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# Key Barriers Affecting Implementation of Intergrated Management of New-Born and Childhood illnesses among Health workers in Lusaka and Chongwe, Zambia

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***Abstract***

*Zambia adopted the Intergrated Management of Newborn and Childhood Illnesses (IMNCI) strategy in 1995 as a key strategy for addressing the high morbidity and mortality among under-five children. Despite its introduction, implementation of IMNCI has not been optimal as it can be seen from the 2018 Zambia's health facility assessment, which found that only 56% of health facilities did not meet the programmatic threshold of having at least 60% of health workers managing sick children trained in IMCI, and 20% of sick children were not accessed for cough, diarrhoea and fever and 56% for HIV infection. The purpose of this study was to explore barriers to implementation of the IMNCI strategy among primary healthcare workers at health facility level in Chongwe and Lusaka districts. Data were collected from observation of health workers during assessment of sick under five children, Key Informant Interviews with health workers, National and District Focal-point persons and Health facility assessment. The study revealed Health systems factors such as lack of supervision, training and mentorship, shortage of supplies and equipment, shortage of health workers and inadequate infrastructure; Health workers skills such as poor attitude, Lack of motivation, long duration and difficult steps for IMNCI assessment as barriers to health workers's adoption of IMNCI during assessment of sick children. Therefore, this study proposes the adoption of a holistic strategy for addressing the non-adherence to IMNCI protocols among health workers that encompasses health systems related factors and health workers skills, attitudes and practice.*

***Keywords:*** *Barriers, Health Facility, IMNCI Assessment, Resources, Skills, Under-five Children.*

## Introduction

Every day, millions of children with potentially fatal illness are taken by their caregivers to be seen by health workers. In countries with a high burden of child mortality, a handful of conditions are responsible for these visits. Globally, over 80% of the under-five deaths are due to neonatal conditions and infectious diseases like pneumonia, diarrhoea, malaria, measles and meningitis, often compounded by malnutrition. Children brought for medical treatment, especially in the low and middle-income countries, often suffer from more than one condition. At the first level of Primary Health Care (PHC) services, diagnostic supports such as laboratory and radiology services are commonly limited or non-existent [1].

To improve access and quality of care for newborns and children under-five in PHC settings, World Health Organization (WHO) and United Nations International Children's Fund (UNICEF) in 1995 designated the

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Intergrated Management of childhood Illness (IMCI) strategy. The IMCI strategy aims at improving health workers skills, improving the health system and improving family and community practices. The aim is to strengthen prevention and management of common childhood illnesses, including in the newborn period, and support children's healthy growth and development [1, 2]. Since the introduction of IMCI in the mid 1990's, over 100 countries have adopted and implemented the strategy, either in part or all of its three components. Evidence suggests that if fully implemented, IMCI contributes to reduction in child mortality. A Cochrane review by Gera et al in 2016 found that the strategy was associated with a 15% reduction in child mortality when activities were implemented at scale in health facilities and communities [1].

In Zambia, IMCI strategy was introduced in 1995 after it was observed that more than two thirds of childhood deaths were due to five common conditions: respiratory tract infection, malaria, diarrhoea, malnutrition and measles. With the adoption of IMCI, the Country has recorded a drastic reduction in under five mortality rates from 197 death per 1,000 live births (1996) to 42 death per 1,000 live births [3]. Despite this improvement Under-five mortality rates in Zambia still remain unacceptably high beyond the Sustainable Development target of reducing child mortality to at least 25 or less deaths per 1000 live birth by 2030. Despite wide successes of IMCI in the last 25 years and the fact that most countries still consider IMCI an important and effective strategy to deliver lifesaving interventions, very few countries have achieved full expansion of IMCI implementation and coverage remains low [4, 5].

## Statement of the Problem

In Zambia, Implementation of IMCI implementation has remained relatively low, while IMCI has been scaled up to nearly all the 116 districts in Zambia, only 45.3% of the districts meet the target saturation levels of having at least 60% of Health workers managing sick children trained in IMNCI, furthermore, at health facility level, and 56% of health facilities did not meet the programmatic threshold of having at least 60% of health workers managing sick children trained in IMCI [6].

Health workers shortages has compromised the implementation of IMNCI strategy especially at health facility level. Even in facilities with adequate numbers of staff, implementation of IMCI has not been optimal. The 2018 IMNCI health facility survey (2018) revealed that 20% of sick children were not assessed for cough, diarrhoea and fever and 56% of the children not correctly classified for HIV infection, and 53% did not have their weight checked against the growth chart. Lusaka province where Chongwe and Lusaka districts falls has also recorded drastic improvement in under five mortality from 174 deaths per 1,000 live births (1996) to 64 deaths per 1,000 population [3]. However, despite this improvement Under-five mortality rates still remain unacceptably high.

## Rationale for the Study

Studies done globally and in Zambia have focused mainly on understanding barriers to implementation of the IMNCI strategy particularly focusing mainly on health system factors, and most of the studies have focused on health facility and Health workers's Assessment. Limited studies have been done to understand health workers and Health manager's perspectives on the barriers to implementation of IMNCI. Therefore, it will be good to understand the factors that impedes PHC workers from adhering to IMNCI protocols during assessment of under-five sick children at health facility level from the lens of health workers and health managers.

As Zambia accelerates towards the attainment of SDGs and Universal Health coverage, understanding and addressing these

challenges could greatly contribute to the country's efforts of reducing under-five morbidity and mortality, and thus help the country attain the SDG's target of reducing under five mortality to less than 25 death per 1,000 live birth by 2030. In Zambia reasons for non- adherence to IMNCI strategy have not fully been investigated. The study will therefore try to fill this gap in knowledge and generate knowledge that will be used by Programme managers and policy makers to design strategies that will support health facilities and health workers to fully implement the IMNCI strategy.

## Literature Review

**Global burden of under-five morbidity and mortality**-According to the WHO (2023), more than 7.5 million children younger than age five living in low- and middle-income countries die every year. Globally, over 80% of the under-five deaths are due to neonatal conditions and infectious diseases like pneumonia, diarrhoea, malaria, measles and meningitis, often compounded by malnutrition. In 2021, 5 million children died globally before reaching their fifth birthday. Over half of these deaths, 2.7 million, occurred among children aged 1–59 months, while the remainder, 2.3 million, occurred in just the first month of life. The fact that 5 million children died in 2021 before turning 5 is alarming given the availability of knowledge and interventions to prevent these deaths [7].

Children continue to face widely differing chances of survival based on where they are born. Globally, the Under-five mortality rate fell to 38 deaths per 1,000 live births in 2021 from 93 death per 1,000 live birth in 1990. By contrast, children born in sub-Saharan Africa are subject to the highest risk of childhood death in the world with a 2021 under five mortality rates 74 deaths per 1,000 live births [7].

Childhood morbidity and mortality in Zambia: The situation in Zambia is no different from the globally picture, the Country has recorded a drastic reduction in under five mortality rates from 197 death per 1,000 live births (1996) to 42 death per 1,000 live births (2024)) [3]. However, despite this improvement Under-five mortality rates in Zambia still remain alarmly high far beyond the Sustainable Development target of reducing under-five child mortality to at least 25 or less deaths per 1000 live birth by 2030.

Zambia adopted the IMNCI strategy in 1995 as a key strategy for addressing high morbidity and mortality among under-five children as a result of preventative illness such as respiratory tract infections, malaria, diarrhoea, malnutrition and measles. Despite its introduction, Implementation of IMNCI has not been optimal as it can be seen from the Zambia's health facility survey that was conducted in 2018. In order to fully understand factors that hinders health workers' adherence to IMNCI protocols, factors were analysed at according to the IMNCI strategy's focusing on two main components namely; Health systems and Health workers skills.

## Conceptual framework on factors influencing IMNCI implementation

The independent variable for this study is IMNCI implementation which is caused by the dependent variables see figure 1 below. The dependent variables for this study have a direct effect on independent variables and these include.

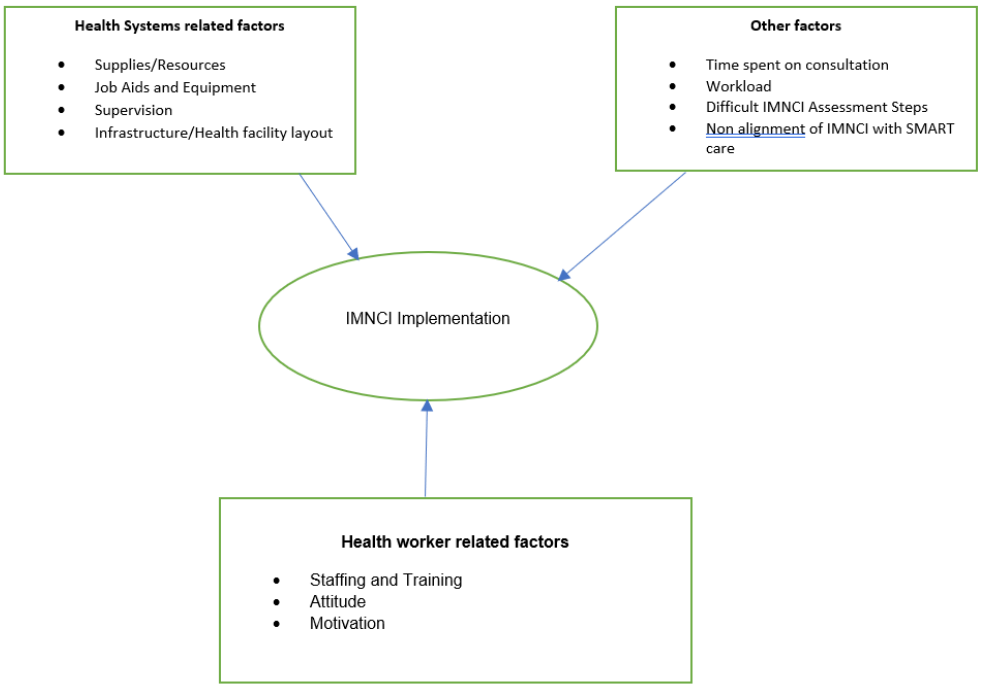


**Figure.1.** Conceptual Framework on Factors that Influence IMNCI Implementation, Adopted by the Researchers from Different Literatures [8].

## Health Systems Related Factors

**Shortage or Lack of resources and Materials**-Lack of basic supplies, essential drugs and equipment needed to deliver care under IMNCI have been cited one of the barriers to the implementation of IMNCI among primary health care workers. Nurses felt that there was no point in assessing a child when they knew that the facility's medication was out stock [9, 10, 12-14].

**Infrastructure/Health facility layout**-Infrastructure is one of the barriers to implementation of IMNCI as it does not permit health care workers to practice IMNCI such as demonstrating giving of the 1st dose of treatment and also counselling of mothers. Vhuromu,2010 et al. (2009) revealed that clinics were very small and there were not enough rooms to allow for counselling of mothers of sick children and to implement the rehydration plan for a dehydrated baby according to IMCI. Facility's layout did not make it easy for health workers to apply IMCI steps and had limited space [5, 10, 15-16].

## Health workers 's Skills and Practice

Inadequate skills in IMNCI among health workers attending to sick children in most health facilities has been sites as one of the main barriers to practicing IMNCI. A study done by [8] and [14] revealed that there were very few health workers trained in IMCI and that was the reason health workers were not carrying out all IMCI assessments. This was in part due to lack of trainers at the district level, and high turnover of health care workers which led to shortage of staff. It was common for IMCI trained staff to leave their places of work for better opportunities in other districts or organizations.

Pandya et al,2018 revealed that despite claims by health workers about practicing IMCI, he noted deviations from IMCI adherence benchmark at most facilities. Nurse practitioners preferred selectively focusing on the child's main complaint and symptom-based components of IMCI consultation. They tended to make a single diagnosis instead of completing the entire process (algorithm) and

providing treatment accordingly. The study noted that deviation was more frequently made by PCCD trained nurses who perceived the IMCI approach to be constraining and simplistic. These findings concur with other studies done by [12] in Ethiopia.

IMCI consultations were more time consuming and extended patient waiting times. Hence, to compensate, activities such as nutritional status classification, immunization, feeding assessment and counselling of the caregiver were curtailed. There was a general under-appreciation of the need to complete all aspects of the IMCI consultation (particularly preventive and promotive aspects) and its associated benefits (Pandya et al,2018). This finding is also supported by studies done by [8] and [15] which revealed that implementation of IMCI was seen to be time consuming and nurses felt that there was not enough time to implement IMCI. Nurses highlighted that they felt pressure to implement IMCI given the short time that they had and the number of patients they were supposed to see per day. Primary health care facilities had a relatively large number of patients seeking health care services and these high numbers result in long patient queues and all need to be assisted within the prescribed waiting time which further increases pressure on the nurses.

## Research Objectives and Hypothesis

### Research Objective

To explore barriers to implementation of the IMNCI strategy for addressing under-five morbidity and mortality among primary healthcare workers at health facility level.

### Specific Objectives

1. To explore health workers experiences on barriers to implementation of IMNCI guidelines at health facility level.
2. To assess whether Health workers are well supported to effectively implement IMNCI protocols at health facility level.

## Methodology and Design

An exploratory mixed methods design was employed. The study successively collected both quantitative and qualitative data. A sequential mixed method combined elements of qualitative and qualitative research in order to answer the study's research question in a single study or a program of inquiry. Mixed methods helped to gain a more complete picture than a standalone method.

The study population were Primary health care workers working in outpatient departments of selected health facilities of where referral to the next level was done for further management, the National IMNCI and District Health office IMNCI focal point persons in Lusaka and Chongwe districts. The two districts were purposively selected based on key characteristics such as population density and under-five attendance, and provided the researcher with both an urban and rural perspectives on barriers that hinder the full implementation of IMNCI strategy among health workers at primary health facility level.

The study was conducted in 15 IMNCI implementing health facilities in Lusaka and Chongwe districts. Convenience sampling was be done to choose 5 IMNCI implementing facilities out of the 40 Primary health facilities in Chongwe and 10 IMNCI implementing facilities out of the 93 health facilities in Lusaka. For the purposes of determining the sample size, Taro Yemene (1967) formula was used as follows:

$$n = N/1 + N(e)^2$$

$\boldsymbol{N}$ *is population of interest;*

$\boldsymbol{e}$ *is the acceptable margin of error* 0.05

$\boldsymbol{n}$ *is the sample size* $n$

$$= 50 \ / \ 1 + 50(0.05)^2$$

$$n \ = 44.44.$$

Therefore, the sample size was determined to be 45 (to the nearest whole number). However, 46 IMNCI trained Health workers stationed at selected PHC sites and actively involved in the management of sick children were purposively selected. For qualitative (IDI), 10 health

workers were purposively selected from the 10 health facilities (7 in Lusaka and 3 in Chongwe) out of 15 health facilities, and three Health managers were interviewed one at National level and 1 from each from the two District health offices.

For Quantitative data, the study employed in-depth interview (IDI). An in-depth interview guide was used to probe participants on barriers to implementation of IMNCI from the perspective of health workers at health facility level, to Managers at District health office and National level. The IDI was administered to 10 purposively sampled health workers from 10 health facilities and 2 District Health offices Managers and 1 IMNCI National Focal point person. Quantitative data was collected through Health worker's checklist. A Health worker's checklist was administered to each of the 46 study participants while a Health facility assessment tool was administered in all the 15 selected health facilities.

Qualitative data analysis was done through Thematic analysis of transcribed data, this involved familiarizing with data, creating initial codes, looking for themes, reviewing recurrent themes and defining and labeling theme. The recurring themes related to experiences of health workers on barriers to implementation of IMNCI were identified through this process. Quantitative data was analysed using Stata version 17.0. Microsoft excel was used to generate tables and graphs and percentages for easy data interpretation.

## Results

**Socio-demographic characteristics of the study Population -** A total of 46 health workers were observed during the study. Among the study population, males constituted the majority of respondents (58.7%). The research results showed that the majority of health workers (54.4%) were young professionals aged 20-34, with a higher proportion aged 45 years old (28.2%) or older. In terms of experience, results showed an almost equal distribution between those with fewer than 5 years (41.3%) and those with over 10 years (41.3%). Further, slightly more than half of the health workers received pre-service training (54.4%), while the remainder were trained in-service (Table 1).

**Table 1.** Distribution (n, %) of Surveyed Participants based on Selected Demographic Information

| **Background characteristics** | **Frequency (n)** | **Percent (%)** |
|---|---|---|
| Age | | |
| 20-34 | 25 | 54.4 |
| 35-44 | 8 | 17.4 |
| 45 and above | 13 | 28.2 |
| **Sex** | | |
| Male | 19 | 58.7 |
| Female | 27 | 41.3 |
| **Years of Practice** | | |
| Less than 5 years | 19 | 41.3 |
| 5-9 years | 8 | 17.4 |
| 10 Years and Above | 19 | 41.3 |
| **Training status** | | |
| In-service | 21 | 45.6 |
| Pre-service | 25 | 54.4 |
| **Total** | **46** | **100.0** |

The main themes and sub themes that emerged from analysis of In-depth interviews of health care workers, District and National IMCI focal person are captured in Table 2 below.

**Table.2.** Theme and Sub Themes

| **Theme** | **Sub theme** | |
|---|---|---|
| **Theme 1**. Health workers's experience with implementation of IMNCI | 1.1 IMNCI a good strategy for assessing sick under five children | .1.1 IMNCI as a Good Strategy |
| | 1.2 Difficult IMNCI assessment steps during assessment of sick under five children | 1.2.1 Difficult IMNCI assessment steps |
| | 1.3 Duration for assessment of Children under-five child using IMNCI protocol | 1.3.1 Duration for Assessment |
| | 1.4 Demotivation for Health workers to using IMNCI | 1.4.1 Demotivation for Health workers |
| | 1.5 Barriers to Implementation of IMNCI | 1.5.1 Barriers to IMNCI |
| | 1.5.1 Infrastructure/Health facility layout | 1.5.1.1. Infrastructure/Layout |
| | 1.5.2 Staffing and Trainings in IMNCI | 1.5.1.2 Staffing and Training |
| | 1.5.3 Poor Attitudes towards IMNCI | 1.5.1.3. Poor Attitude |
| | 1.5.4 Non-Alignment of the Smart Care system with IMNCI protocols<br>1.5.5 Lack of Mentorship and Supportive supervision | 1.5.1.4 Non-Alignment of Smart Care with IMNCI<br>1.5.1.4. Mentorship and Supervision |
| **Theme 2**. Resourcing and equipping of health facilities for effective implementation of IMNCI | 2.1 Lack of Job Aids, tools and supplies | 2.1.1 Lack of Job Aids Equipment and Supplies |

## Theme 1. Health workers's experience with implementation of IMNCI guidelines

### Sub theme - IMNCI a good strategy for assessing sick under five children

Majority of participants indicated that IMNCI was a very good strategy for assessing sick children, as it enabled them to holistically look at the entire child as opposed to focusing only on problems that their mothers shared.

> *"IMNCI allows us to holistically look at the entire child as opposed to focusing only on problems that their mothers present to us at Outpatient department"* (**IDI Participant no.9**)

Other participants indicated that it helped to uncover problems which mothers could not ordinarily share.

*"A sick child is seen holistically even for symptoms that the caretaker could have not mentioned"* **National IMNCI focal point person**.

The IMNCI approach guided health workers on how to go about with the assessment process and selection of drugs as it provided a step by step assessment process which helped health workers to easily classify children and manage them accordingly.

*"The use of IMNCI in the assessment of children under five is good especially for us who do not have laboratories and medical officers on duty, IMNCI helps us to easily classify children and manage them accordingly"* **(IDI participant no.3)**

District focal point persons and National focal point person also indicated that IMNCI was a very good strategy in that its improved case management skills for childhood illnesses among health care workers which consequently contributed to provision of quality health care for under five children, and a reduction in morbidity and mortality among under five children.

*"Implementation of the IMNCI strategy has contributed to improved case management practices among health workers for sick children that present at OPD for various illness. This has consequently led to improved quality of care and a reduction in morbidity and mortality among under-five children*" **District focal point Person no.2**

*"Yes – because it is a proven strategy that contributes reducing morbidity and mortality of children due to common causes of childhood illnesses"* ***National IMNCI focal point person***

Results from the study also showed that IMNCI contributed to child's health growth and development through reducing child mortality and morbidity, and promoting improved child health outcomes

*"IMNCI contributes to child's healthy growth and development"* ***National IMNCI focal point person***

Findings from observations of IMNCI trained health workers during the study were somewhat different. This can be seen from findings below.

General Danger Signs- Results in Figure 2 below indicate that only 67% (n=31) of health workers checked for General danger signs in sick children. 33% missed, and let children go home. Out of the 31 health workers that checked for GDS, only 26% (N=8) checked for all the 4 General Danger Signs while 74% partially checked for GDS.

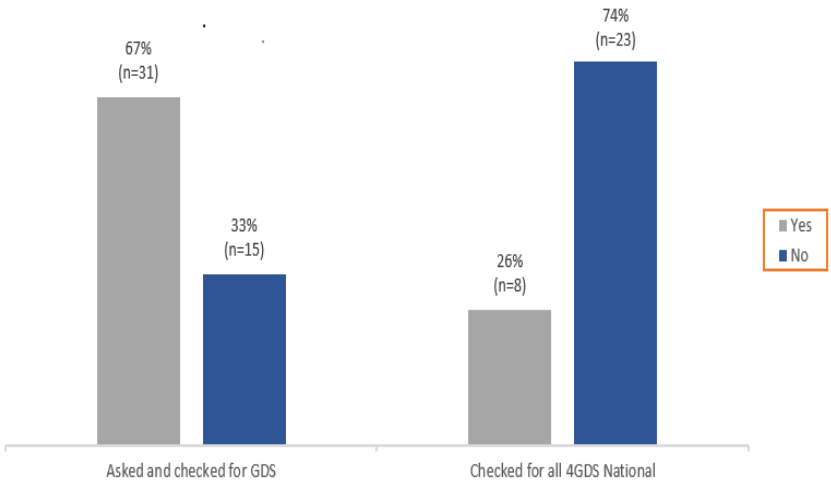


**Figure 2.** Percentage Distribution of Health Worker Practices in General Danger Signs Assessment

## Cough or Difficult Breathing

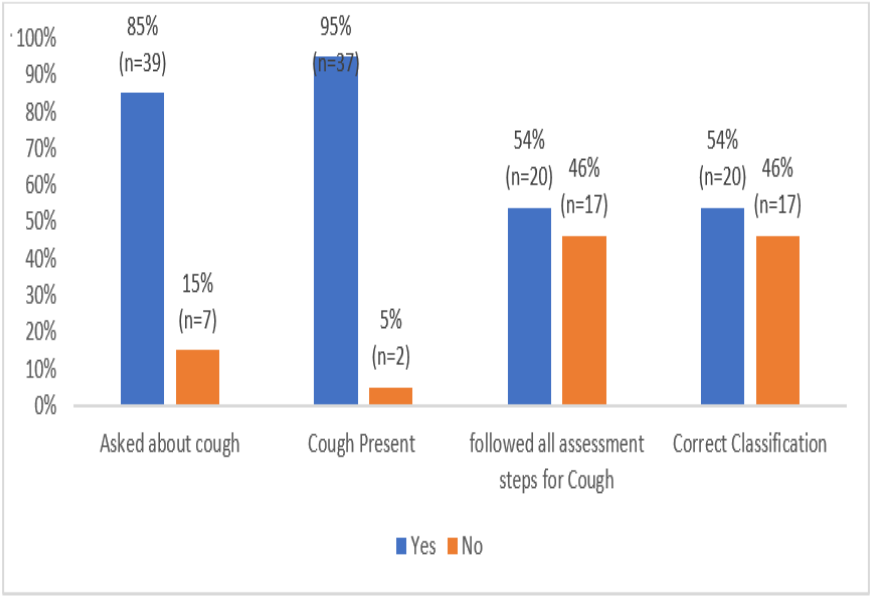


**Figure 3.** Percentage Distribution of Assessment and Classification of Cough and Difficulty breathing

Figure. 3 above shows that of the 37 (95%) that reported the presence of cough, only 20 (54%) followed all the assessment steps for Cough and Difficult breathing and classified the children correctly while 17 (46%) did not follow all assessment steps for Cough and difficult breathing and thus did not classify the children correctly.

## Diarrhoea

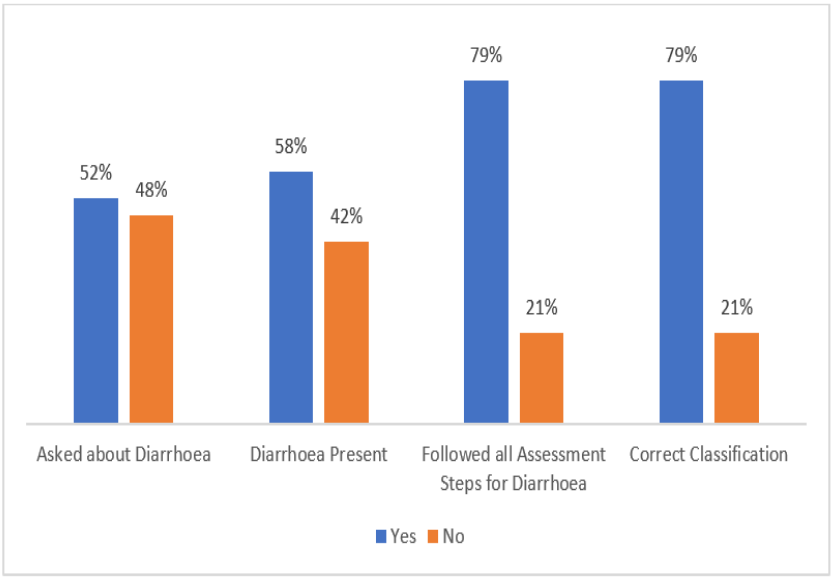


**Figure 4.** Percentage Distribution of Assessment and Classification of diarrhoea

Figure. 4 above shows that 58% (n=14) of the 24 health workers that asked for diarrhoea found presence of diarrhoea while 42% (n=10) did not. Of the 58% (n=14) health workers that found presence of diarrhoea in children during assessment, only 11 health workers (79%) followed all assessment steps and classified and treated children appropriately while 23% (n=3) did not.

## Fever

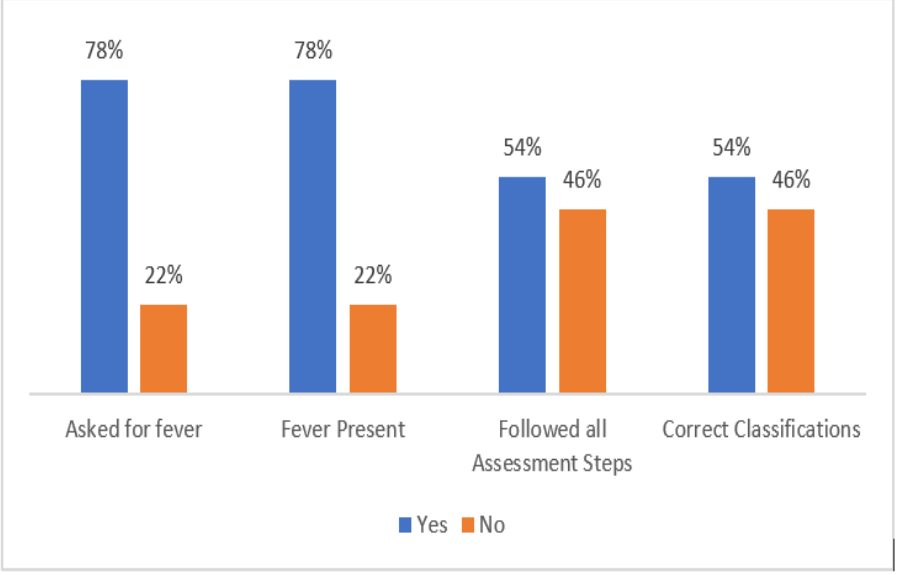


**Figure 5.** Percentage Distribution of Assessment and Classification of Fever

As shown in Figure 5, Of the 28 (78%) of the health workers that found fever, 15 (54%) correctly followed all assessment steps for fever, classified and identified treatment for fever accordingly. This shows that nearly half the cases were mis-classified and treated in-correctly.

Malnutrition and Anaemia- Figures 6 and 7 below shows glaring findings, only 15% of health workers undressed children to look for signs of Acute malnutrition and anaemia, of the 7 health workers that undressed children to check for signs of acute malnutrition and check for palmer pallor none followed all assessment steps for malnutrition and Anaemia.

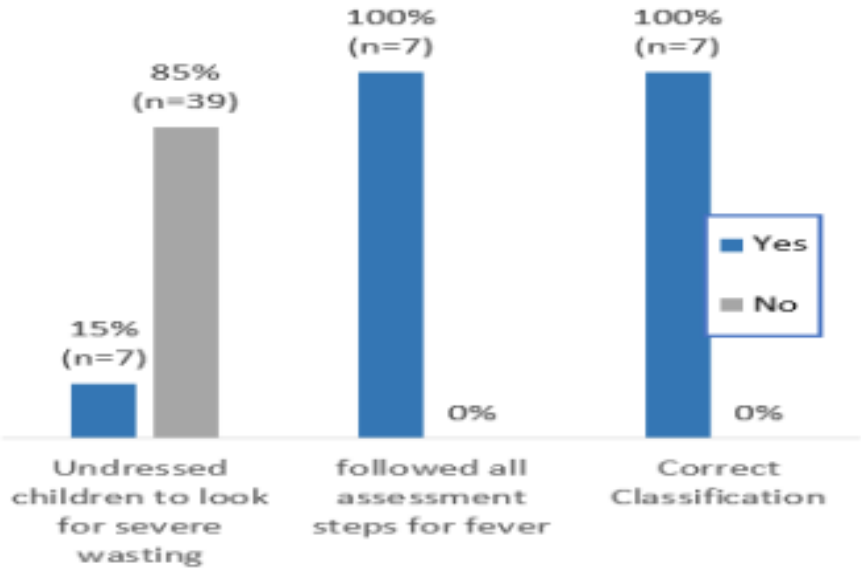


**Figure 6.** Percentage Distribution of Assessment and Classification of Malnutrition

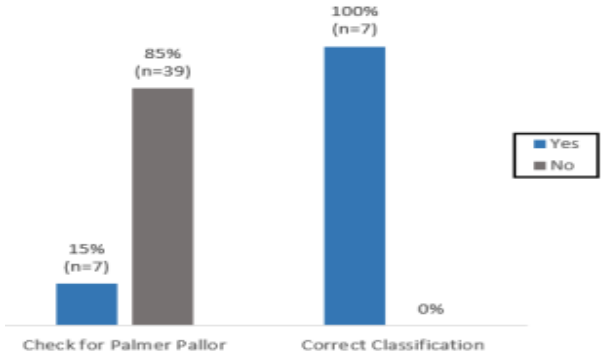


**Figure 7.** Percentage Distribution of Assessment and Classification of Anaemia

**All Main Symptoms Cough, Diarrhoea and Fever**-In terms of checking for all three main symptoms only 28% (n=13) of 46 health workers checked for all there 3 main symptoms namely Cough, diarrhoea and Fever in all children that they assessed as shown in figure .8 below.

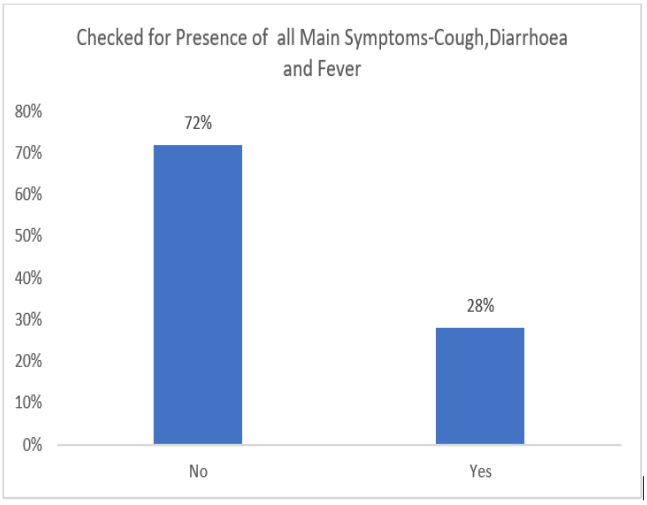


**Figure 8.** Percentage of Health Workers who checked all the three main Symptoms during Assessment

Difficult IMNCI assessment steps-Figure 9 below shows assessment steps that participants found challenging to undertake when assessing children include; checking for immunisation status, assessment of ear infection; performing Rapid Diagnostic Test (RDT) on every child that comes with fever, assessment of nutrition and checking for the child's HIV status as most of Health workers focused on assessment of main symptoms and identifying treatment which they deemed important. while majority indicated that they did not find any assessment difficult to undertake.

*"Checking for Immunisation status, I find it to be a challenge, some parents do not bring their children's under-five cards and furthermore in most cases they do not have full information on their children immunisation status. In as much as you would want to assess the immunisation without an under-five card there is nothing you can do"* (**IDI Participant no.4**)

*"Not really. However, we have challenges like on the laboratory investigations, because according to IMCI, every child that comes with fever is supposed to do a Rapid Diagnostic Test for Malaria (RDT). But looking at the supplies, it is not possible to RDT on every child as RDTs are not always available. At times, RDT is reserved for*

*children with history of having travelled outside of Lusaka as they were a common belief among health workers that Lusaka does not have Malaria"* (**IDI Participant no.8**)

*"From my observation, most health workers find assessment of nutrition and checking whether the Child has been exposed for HIV or not difficult to do. This is mainly because they rush through the process and focuses on areas that they deem to be important such as checking for main symptoms and treatment"*. **District focal Point No.1**

Our findings from observation of participants aligns with health workers responses only 42% checked for Immunisation status 56% under five cards, 24% vitamin A status, 11% assessed for feeding problems in children under 2 years and 0% for TB (as shown in figure. 8 below) including those assessment steps on malnutrition and anaemia already shown above in figure 6 and 7.

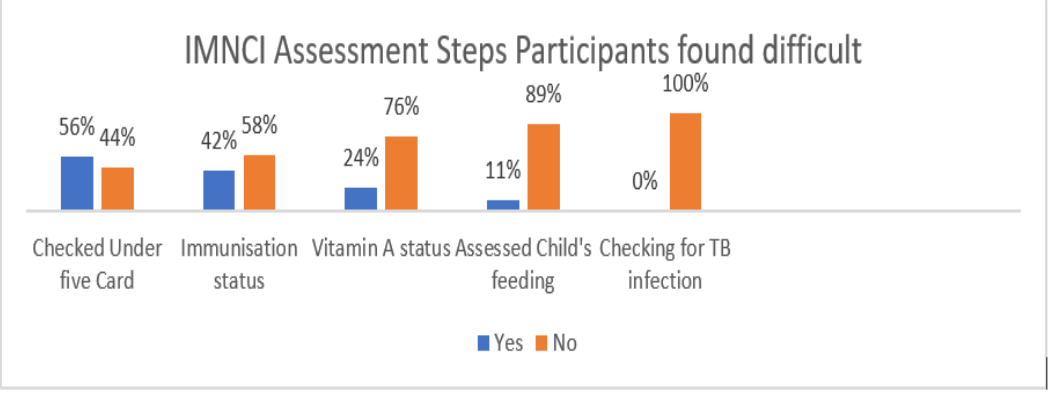


**Figure 9.** Percentage Distribution of Key IMNCI Assessment Steps that Health Workers found Difficult to Assess

**Duration for assessment of children under-five child using IMNCI -**Responses were varied, some participants indicated that the process took longer especially if a child presented with more than one symptom as it required them to assess all parameters that related to the various symptoms that the child presented with. Others indicated that took more than 10 to 25 mins especially if everything was in place while others felt that it depended on the condition of the sick child, as some children required to go to the laboratory for a Rapid Diagnostic Test for fever, and others indicated that it took them 10 to 15 minutes.

*"I will not lie to you. It takes longer when using IMNCI, especially if a child is presenting with more than one complaint. For example, if the child has got a fever, a cough, and maybe an ear problem. It means you have to assess all those parameters one by one. Despite this we try by all means to use IMNCI when assessing children*" (**IDI Participant no. 1)**

*"Approximately less than 25 minutes to access each child***"** (**IDI Participant no.5**)

*"it depends on the condition of the sick child for me it takes me approximately 10 to 15 minutes. If they go to the Laboratory for RDT, it might take me longer"* (**IDI Participant no.7**)

**Demotivation for Health workers to using IMNCI-**The study revealed factors that demotivates health workers from practicing IMNCI, some of the factors that came out from the study included heavy workload especially in situations where health workers were alone on duty, and when children presented with multiple symptoms, health workers tended to use shortcuts in order to manage the workload.

"*What demotivates me, at times, it's the workload especially, in situations when I am alone on duty and you have a child that*

*presents with multiple symptoms, we tend to do shortcuts in assessment in order to manage number of children that presents on that particular day. However, when there are enough personnel on duty I always try by all means to follow the IMNCI assessment steps during assessment of children. In addition, some assessment steps can be quite lengthy".* (**IDI Participant no.2**)

Participants revealed that the referral system also demotivated them from practicing IMNCI in that whenever the referred children to the next level of care, the ambulance delayed and only came when they had stabilized the children and discharged them to go home.

*"The referral system is another factor that demotivates me from following the IMCI approach, as it not okay or sufficient, for example you call an ambulance like in the morning at eight hours. And then the ambulance comes at 20 hours evening when you've already stabilized the patient and the patient is now fit to go home. This makes me to manage such cases at the facility than referring*". (**IDI Participant no.6**)

Other participants indicated that they tried by all means to follow IMNCI guidelines during the assessment of children but were limited by the large number of children that presented that their facilities. In addition, the issue of health workers attending to a mix of adults and children also demotivated them from using the IMNCI approach.

"*Yes, we try by all means to use IMNCI guidelines to access all children at present at our facility, we are limited by the large number of children that come ups for assessment and furthermore, we see a mix of patients both children and adults" (**IDI Participant no.2**)*

## Barriers to Implementation of IMNCI

**Inadequate Infrastructure-**Inadequate infrastructure came out as one of the major barriers that prevented health workers from practicing IMNCI, in most cases there were no rooms specifically designated for assessment of children, which made it difficult for health workers to set up screening rooms with supplies and equipment for assessing sick children such as clean drinking water and equipment for measuring weight, height and temperature respectively.

*"Not having a room specially for seeing sick children because of inadequate rooms acts as a barrier to practicing IMNCI. Use of room also used by adults makes it difficult to set up a room for IMCI assessment for example, ensuring that there are supplies for assessing drinking in sick children and also equipment such as weighing scales, Height board and thermometers for measuring weight, height and temperature respectively"* (**IDI Participant no.7**)

Using same rooms for seeing children and adults made it difficult for health workers to practice IMNCI as job aids such as Chart booklets which are used as reference materials are often misplaced and could not be located during assessment of children

*"Not having a room specially for seeing sick children makes it difficult for me to practice IMCI. You find IMCI job aids like chart booklets are misplaced and you cannot locate them when you want to refer to them when assessing a sick child. We had photocopied a Chart booklet, and placed it in one of the rooms that we use to see both adult and children. The Chart booklet could not be located even up to this time".* (**IDI Participant no.9**)

**Staffing and Training in IMNCI-** Inadequate Staffing levels came out as one of the barriers to implementation of IMNCI. Most facilities are not adequately staffed and later one those trained in IMNCI. This makes it difficult for staff to practice IMNCI.

*"One of the barriers is staffing, you find that maybe in a Shift, if we do not have enough staff dedicated to assessment of children, staff end up seeing both adults and children, and also because of the high*

*volume of patients, staff tends to rush through the assessment process when seeing sick children. As I am the Paediatric nurse, when I am around, I am able to see all sick children but the problem comes when I am off duty or not working on a particular day"* (**IDI Participant no.10**)

*"Due to work overload, trained staff end up compromising and fail to adhere to IMNCI guidelines, and most health facilities were not well staffed due inadequate funded positions in most of the health facilities."* **National IMNCI Focal Person**

Trainings on IMNCI have not been held in a long time, in some cases as far back as 2018, and this coupled with the high transition rate of health workers due to retirement, resignations, promotions and death have hampered implementation of IMNCI.

*"Most of the trained IMNCI Health workers have retired and left a void in staffing levels trained in IMCI and this has affected the implementation of IMNCI.* (**IDI Participant no.4**)

*"For our District, the last training was held in 2018 and from that time we haven't had any training. This has been difficult as most of the trained health workers have since retired, some have resigned and other died. This has left a gap in the implementation of IMNCI at health facility level*". **District focal point person no. 1**

"*I can't remember when we last had an IMNCI training in our District, and over the years we have received a lot of new staff that are not trained in IMNCI. This has contributed to the inadequate implementation of IMNCI at health facility level and among health workers*". **District focal point person no. 2**

This is supported by results from health facility assessment -figure 9 and 10 below, none of the health facilities met the WHO goal of having at least 60% of Health Care workers managing sick children trained in IMNCI, and all sick children were not attended to by IMNCI trained staff.

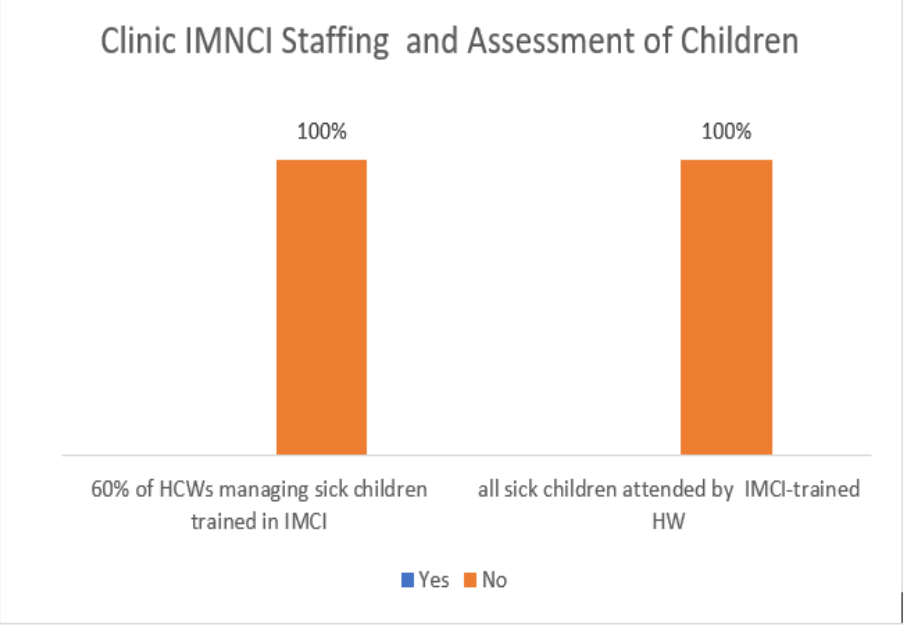


**Figure 10.** Percentage Distribution of Health Facility with 60% of IMNCI Staffing Managing Sick Children and Sick Children attended by IMNCI Trained Health workers

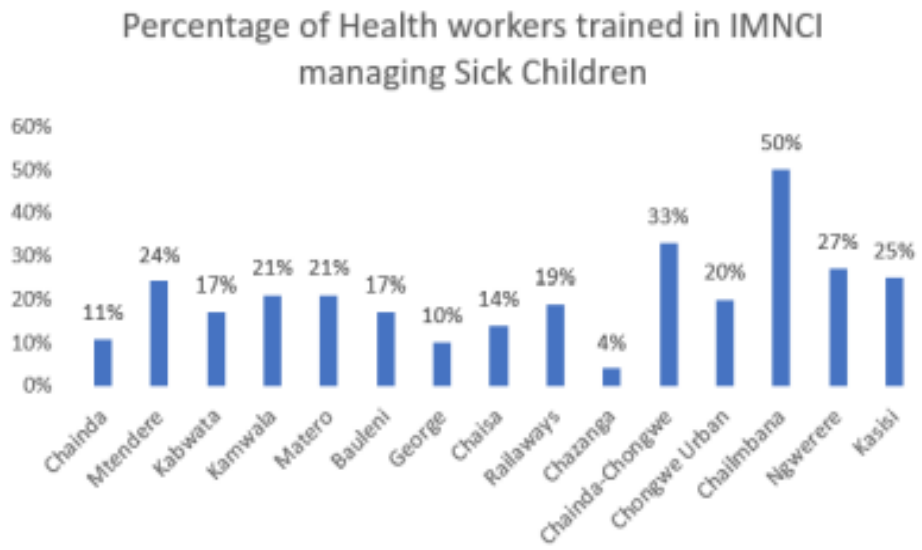


**Figure 11.** Percentage Distribution of Health Workers Trained in IMNCI Managing Sick Children across the Sampled Health facilities

**Poor Attitude of Staff towards IMNCI-** Poor attitude of some staff working at OPD particularly doctors who were not supportive of IMNCI came out strongly as they saw it as a basic approach for managing sick children, and thus discouraged other health workers from practicing IMNCI.

*"Medical Doctors are not supportive of IMNCI because they see as an approach not suited for them, thus they are not supportive of the IMNCI approach, and this discourages others from practicing IMNCI".*

**District focal Point no. 2**

**Non-Alignment of the SMART CARE system with IMNCI Assessment Process-** Non-alignment of the SMART care system- an electronic health record initiative designed to enhance child health services, particularly with primary health care setting, often impedes health workers from using the IMNCI assessment process. As SMART care system is not configured according to the IMNCI algorithm.

*"One of the barriers is that the SMART care system which we use for all patients including children is not configured accordingly to IMNCI, and this presents a challenge for us to use the IMNCI strategy in terms of assessment, classification and treatment"* (**IDI Participant no.10**)

*"Our Health facility has completely gone digital through the SMART care system, but one major problem that we have noticed is that the SMART care has not been organized according to IMNCI assessment steps, and this presents a challenge for us when it comes to assessing sick under-five children using the IMNCI approach.* (**IDI Participant no.4**)

**Lack of mentorship and Supportive supervision visits on IMNCI-**Lack of Mentorship emerged as one of the impediments and this acted as one of the barriers that prevented health workers from implementation IMNCI, participants were not provided with on-going mentorship so that they stayed acquainted with latest trends or developments in IMCI. Some participants had not had any mentorship from the time they were trained, some as far as 2008, this made it difficult for them to adhere to IMNCI.

*"There has never been any mentorship from the time I came on transfer from Kitwe where I did my initial IMNCI training. I just use the knowledge and skills that I acquired from my initial training in 2008. This knowledge I have may be outdated and may affect my work. There is need for on-going*

*mentorship so that we remain abreast of the changes"* (**IDI Participant no.3**)

Some participants indicated that they informally got updates about the recent changes in IMNCI assessment steps from friends, for example, the change of "chest indrawing Pneumonia from Severe Pneumonia" to Just "Pneumonia".

*"I have never been mentored from the time I was trained, and I have not experienced any mentorship like it happens with other programmes. I recently learnt about the changes in assessment of Cough and difficultly where a child with Chest - indrawing is no longer classified as Severe Pneumonia, but Pneumonia, and managed at home is*" (**IDI Participant no.1**)

This lack of mentorship on IMNCI was attributed to a focus on other well-funded programmes such as HIV, Malaria, Immunisation and this acted as a barrier to implementation of IMNCI.

*"We have seen a lot of focus on other programmes for example, HIV, TB, Malaria, Immunisation, and men health, where there was a lot of focus and we tend to also focus on these programmes as keep us constantly updated and connected"* (**IDI Participant no.5**)

Results from the study showed that supportive supervision was intergrated with other programmes, was not frequently conducted and when it was conducted it was not targeted. Participants felt these visits were not beneficial for the IMNCI as there was little or no focus on IMNCI. Results from Health facility assessment concurs with findings from IDI as figure 12 below shows, none of the 15-health facility (n=0/15) had received at least one supervisory visit that included observation of health workers assessing sick children. Furthermore, none of the 15-health facility had conducted a review meeting on IMNCI in the last 6 months.

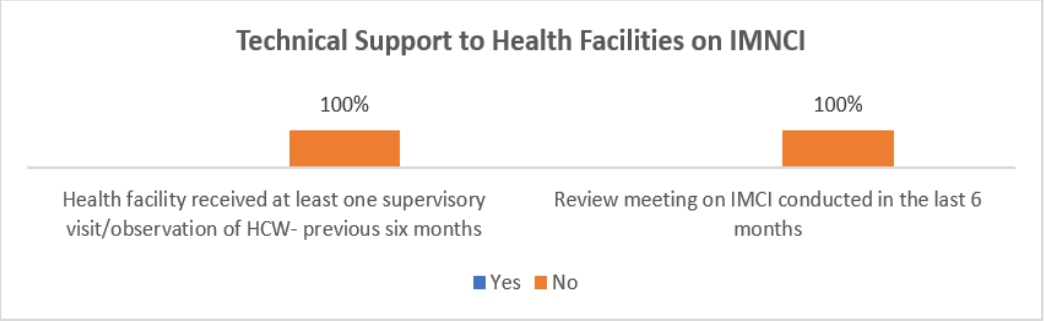


**Figure 12.** Percentage Distribution of Health Facilities where Technical Support to Health Facilities on IMNCI and Review Meeting was Conducted in the Last Six Months

## Theme 2. Resourcing and equipping of health facilities for effective implementation of IMNCI

**Lack of Job Aids, Equipment and Supplies**-The study revealed lack of Job Aids and inadequate equipment and supplies in nearly all facilities visited.

"*We also do not have Job Aids like chart booklets, wall charts and timers*". (**IDI Participant no.3**)

"*Some Job Aids such as wall Charts, we last saw them at the training*". (**IDI Participant no.10**)

"*Yes, we do have some Job aids such as chart booklets though old one with some pages missing. I think the one that we have is for the year 2008, and I feel is now outdated as over the years a lot of things have changed".* (**IDI Participant no.3**)

**"***The facility does not IMNCI wall charts and Chart booklets for reference during the assessment of children. The only IMCI wall charts available are only diarrhoea done by JICA. Also, in screening rooms, there is no*

*water and cups for us to use during assessment of children to enable us determine whether the child is drinking normally or poorly"* (**IDI Participant no.9**)

The other finding that came out was the lack of equipment specifically designated for IMCI such as Thermometers, weighing scales

*"No equipment designated for IMCI such as Thermometers, weighing scales. Supply of drugs for sick children (IMCI) have not been consistent and thus we have to ask mothers to go and buy"* (**IDI Participant no.4**)

Inconsistent supply of drug also come out of the study as one of the barriers to implementation of IMNCI and this prompted health workers to provide mothers with prescriptions for them to go and buy, in most cases mothers or caretaker were unable to buy and this led to children getting worse at home.

*"The other problem is limited supplies and medicines which prompts us to prescribe drugs for mothers to buy at the nearest drug store for a child that may need an antibiotic like a child classified with Pneumonia. Mothers at time do not have money to buy medicines and end up just staying with the child at home and only come back to the health facility when the condition gets worse" (**IDI Participant no.4**)*

From the health facility assessment, none of the health facilities (n=0/15) had supplies for assessing dehydration such as water, cup, spoon in their screening rooms. This could affect the health workers's ability to assess for dehydration. On drug availability, the assessment found contrary findings, all health facilities (n=15) had drugs for all the main childhood diseases. On the reported drug stock outs, it could be as a result of occasional supply chain challenges at various levels.

## Discussion

In this article the investigator discusses barriers to implementation of the IMNCI strategy for addressing under-five morbidity and mortality among primary healthcare workers at health facility level under Specific objectives for the study, emerging themes and sub theme.

### Theme 1. Health workers's experience with implementation of IMNCI

**IMCI a Good Strategy for assessing sick under five children-**The Study revealed that IMNCI was a very good strategy for assessing sick under five children especially for health facilities that do not have laboratory facilities and Medical doctors as it guided frontline health workers during the assessment of sick children on all major symptoms, classification of main symptoms and selection of drugs. IMNCI promoted a holistic approach to assessment and management of sick children, and referral of very sick children to the next level of care. Holistic assessment of children helps health workers to uncover problems which mothers do not usually share with health workers, and this consequently leads to improved case management skills for childhood illnesses [5, 10, 19-20]. Despite the overwhelming commendation by participants of IMNCI as a good strategy, the study noted contrasting findings from observations of IMNCI of participants as they assessed sick children. Their knowledge on the benefits of IMNCI did not translate into action, ensuring that they follow all IMNCI assessment steps each time they were assessing sick under-five children.

Only 67% (n=31) of health workers checked for General danger signs in sick children, 33% (n= 15) were missed and let to go home. This inconsistency in checking for general danger signs among children has a potential risk of missing out on under-identifying severe illnesses and could potentially lead to worse health outcomes. Our findings are similar with findings from other studies, in a study by [21] only 33.6% of the health workers assessed all the four General Danger signs. For Cough and Difficult in Breathing, only 20 (54%) of the 37 health workers followed all the assessment

steps and classified the children correctly for Cough and difficulty in Breathing while 17 (46%) did not and thus did not classify the children correctly. This lack of detailed assessment of children for Cough and difficulty in breathing could hamper accurate classification and appropriate management of cough and difficult breathing and thus might result in a lot of pneumonia cases being missed, and in some case might lead to deaths.

Our findings differ from a study in done in south Africa where 52.9% of children were correctly classification for Cough and difficult breaking [22]. For diarrhoea, 48% (n=22) did not ask for presence of diarrhoea and could have missed some cases of diarrhoea. Of the 58% (n=14) health workers that found presence of diarrhoea in children during assessment, only 11 health workers (79%) followed all assessment steps and classified and treated children appropriately while 23% (n=3) did not. This shows that health workers could be missing out a lot of diarrhoea cases, and also mis-classifying and mis-treating diarrhoea cases. Our findings differ from a study done [21] where majority of caretakers (86.5%) signs and symptoms for diarrhoea were only elicited in only 55%. For fever, Of the 28 (78%) that found fever, only 15 (54%) correctly followed all assessment steps, classified and identified treatment for fever accordingly. This finding is quite worrisome as nearly half the cases were mis-classified and mis-treated. This could also be contributing to a lot of children dying from untreated malaria or other undetected causes of fever and demonstrates a very a serious gap in the management and treatment of fever among health workers. Assessment of Malnutrition and Anaemia, however revealed glaring findings, only 15% of health workers undressed children to look for signs of Acute malnutrition and anaemia, but sadly did not all assessment steps, and consequently ended up not correctly classifying children for Malnutrition and Anaemia. This also demonstrates a clear gap in the management of children under five as many cases of acute malnutrition could be going undetected and thus contributing to children poor outcomes. Our findings are in contrast with findings from a study done in Ethiopia where 62.4% of the participants consistently checked for palmar pallor in children that presented at OPD [23].

In terms of checking for all three main symptoms, only 28% (n=13) of 46 health workers checked for all there 3 main symptoms namely Cough, diarrhoea and Fever in children during our observation. This is quite worrying as these symptoms are a major contributor to Zambia's high under-five mortality, also clearly shows a major gap in the assessment process among health workers as a lot of children could potentially be going home with some main symptoms undetected which may result in these symptoms getting worse and contributing to poor health outcomes among under five children. Our findings resonate with similar studies [9, 25]. Our findings are also in contrast with findings from the study done in Namibia, Kenya, Tanzania and Uganda national survey [24] and a Nigeria study that found the rate for assessing all three of the IMCI main symptoms of cough/difficult breathing, diarrhoea, and fever to be higher [26].

**Difficult IMNCI assessment steps during assessment of sick under five children-** IMNCI assessment steps that participants found challenging to undertake when assessing children include; checking for immunisation status, assessment of ear infection; performing Rapid Diagnostic Test (RDT) on every child that comes with fever, assessment of nutrition and checking for the child's HIV status as most of Health workers focused on assessment of main symptoms and identifying treatment which they deemed important Others did not find any assessment step difficult as all IMNCI assessment steps were considered as straight forward and easy to follow. This may potentially result in most children going home with undetected illnesses which might lead

complications. Our findings are in contrast with [5] and [23] which revealed a different dimension.

**Duration for assessment of Children under-five child using IMNCI -**Findings were varied and could be grouped into three categories, the first category indicated that the process took longer especially if a child presented with more than one symptom as it required health workers to assess all parameters related to the various symptoms, second category indicated that the assessment process did not take more than 10 to 25 mins especially if everything was in place while third category felt that it depended on the children required to go for laboratory investigations. Our findings correspond with findings from other studies which found the IMNCI approach time consuming and adversely affecting health workers' practice [5, 10-11, 23], Like in our study, the other studies found the IMNCI consultations contributed to longer waiting times for patients [23, 27].

**Demotivation for Health workers to using IMNCI-**Heavy workload especially in situations where a health worker was alone on duty came out as one of the factors that demotivated health workers, the other one was the poor referral system to the next level of care which prompted them to resort to generic way of attending to children. This finding resonates with other studies where referral acted as a deterrent to practicing IMNCI [5, 15]. Attending to a mix of adults and children also demotivated participants from using the IMNCI approach as it required them to constantly switch their mindset from screening adults to assessment of sick children, this consequently make them to resort to shortcuts in the assessment of children. These findings align with [23]'s study in Ethiopia.

## Barriers to Implementation of IMNCI guidelines

**Inadequate Infrastructure-** Infrastructure was one of the major barriers to practicing IMNCI among health workers as in most cases there were no rooms specifically designated for assessment of children that presented at OPD, which made it difficult for health workers to set up screening rooms with supplies such as clean drinking water and equipment such as weighing scales, Height board and thermometers for measuring weight, height and temperature respectively to support the IMNCI assessment process. Use of same rooms for seeing children and adults made it difficult for health workers to practice IMNCI as IMNCI job aids such as Chart booklets and laminated recording forms which are used as reference materials were usually misplaced and could not be located whenever they were needed by health workers during assessment. Our findings are supported by findings from similar studies [5, 10, 15-17, 27] found the facility as a challenge for practicing IMNCI.

**Staffing and Training in IMNCI-**Most facilities were not adequately staffed and later on those trained in IMNCI. This made it difficult for staff to practice IMNCI, thus tended to rush through the process. Our study found that most IMNCI trained staff had retired or left to take up other job opportunities, and this has created a void in the implementation of IMNCI. It also emerged, that trainings on IMNCI had not been held in a very long time, in some cases as far back as 2018, and this coupled with the high transition rate of health workers due to retirement, resignations, promotions and death has contributed to inadequate application of the IMNCI strategy. Our findings collaborate with other studies [10, 26]. From our Study found none of the health facilities met the WHO goal of having at least 60% of Health Care workers managing sick children trained in IMNCI, and all sick children attended to by IMNCI trained staff. Our study findings are similar to other studies that found less 60% of health workers managing sick children [8].

**Poor Attitude of Staff towards IMNCI-** Some staff working at OPD particularly doctors

were not supportive of IMNCI as they saw IMNCI as a basic approach for managing sick children, and this discouraged other health workers from practicing IMNCI. If IMNCI was to be implemented successfully there will be need for all cadres to support the implementation of the IMNCI strategy and also to appreciate that it meant for frontline health workers in settings with limited diagnostic capacity and highly qualified staff such as Doctors. Our findings are consistent with findings from [10].

**Lack of mentorship and supportive supervision:** The Study highlighted that Health workers were not provided with on-going mentorship to enable them stay acquainted with latest trends or developments in IMCI and adhere to IMNCI. Health workers felt that there were a lot of focus on other well-funded programmes such as HIV, VMMC Men's health and TB in terms of mentorship as opposed to IMCI. Lack of mentorship among health workers on IMNCI clearly presents a lost opportunity for health workers to learn new practical skills and gain confidence in the application of IMNCI guidelines. Our findings are confirmed by [11] which highlighted lack of mentoring as one the healthcare support system factors that could lead to lack of full implementation of IMCI by the health care workers.

### Theme 2. Resourcing and equipping of health facilities for effective implementation of IMNCI

**Lack of Job Aids, Equipment and Supplies-**Lack of Job Aids such as Wall Charts, Chart booklets and timers to refer to, and inadequate equipment such as Thermometers, weighing scales, and in consistent supply of drugs for use during assessment of children by health workers in facilities came out strongly as one of the barriers to practicing IMNCI. The health facility assessment revealed that none of the health facilities (n=0/15) had supplies for assessing dehydration such as water, cup, spoon in their screening rooms. This could affect the health workers' ability to assess for dehydration. However, the health facility assessment found contrary findings, all health facilities (n=15) had drugs for all the main childhood illnesses. On the reported drug stock outs by health workers, it could be as a result of periodic supply chain challenges at various levels. These findings resonate with [8-15, 23, 28] 's studies which found lack of Job aids and supplies as a barrier to implementing IMCI among health workersThe study revealed Health systems factors such as lack of supervision ,training and mentorship, shortage of supplies and equipment, shortage of health workers and inadequate infrastructure, and Health workers skills such as poor attitude, Lack of motivation, long duration for assessing children using IMNCI, and difficult steps for IMNCI assessment as barriers to health workers's adoption of IMNCI during assessment of sick children at the health facility.

## Limitations

This study utilized a mixed methodology approach, providing a more comprehensive understanding of the research problem. It was, however, limited to healthcare workers, two districts namely Chongwe and Lusaka, and 15 facilities across the two districts and thus findings from this study could not be extrapolated to other districts of Zambia or beyond since they could be difference in a way primary health care services are provided. However, findings from this study could help Chongwe and Lusaka districts and Zambia as a whole to better understand k**ey** Barriers that prevents health workers from practicing the Intergrated Management of New-Born and Childhood illnesses strategy.

The study has highlighted Health workers skills and practices, and Health system factors that could be common beyond the two districts. Furthermore, the study focused solely on barriers to implementation of IMNCI and did

not look at enablers for adopting and use of IMNCI during the assessment of sick under five children by health workers in Zambia. There will be need to explore further the enablers for adoption and practice of IMNCI, it may be possible that the use of Key Informant Interviews might have made health workers to exaggerated their responses. However, this limitation may also have been addressed by observation of health workers as they assessed under five children at Out Patient Department using the IMNCI approach.

## Conclusion

The purpose of this study was to explore barriers to implementation of the IMNCI strategy for addressing under-five morbidity and mortality among primary healthcare workers at health facility level in Chongwe and Lusaka districts. From the study, it has been concluded that that non-adherence of health workers to IMNCI guidelines during assessment of Children under five in Lusaka and Chongwe, Zambia could be attributed to some Health systems related factors such shortage of supplies and equipment, inadequate staffing, non -alignment of Smart Care system with IMNCI assessment protocols, inadequate infrastructure; Health workers skills such as poor attitude, Lack of motivation, long duration for IMNCI assessment, difficult IMNCI assessment steps , and lack of training and mentorship. In Zambia, currently there is limited information on the barriers to adoption of IMNCI during assessment of under five children at Outpatient departments from the perspective of Health workers and managers, therefore this study provides insights and recommendations on implementation of IMNCI from the perspective of health workers that this will information policy and future IMNCI programmes and support, and consequently enhance provision of health care for under five children in Zambia

This study also proposes the adoption of a holistic strategy for addressing the non-adherence to IMNCI protocols by health workers, and this strategy should encompass health system related factors, Health workers skills and practices and other factors at health facility so that health workers are adequately supported to adhere to IMNCI guidelines and protocols as they attend to sick children. Providing an enabling environment such as good infrastructure, essential drugs, equipment and supplies, improved staffing, continuous mentorship and training will greatly motivate health workers to practice IMNCI at health facility. This will consequently help to improve the quality of health care provided to children and help the country in its aspirations to attain the SDG target of reducing under-five mortality rate to 25 deaths per 1,000 population by 2030.

## Data Availability

Data supporting the conclusions of this article are available by request to Baleke Ngambi. The raw data that support the findings of this study will be made available to researchers upon request from corresponding Author.

## Conflict of Interest

The authors declare that they have no conflict of interest.

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## Authors ‘s Contribution

Baleke Ngambi wrote the research proposal, developed the questionnaire, collected data, analysed the data and wrote the paper and interpreting of the findings as well as participating on the preparation of the manuscript. Pamela Mwansa reviewed and provided input towards the research proposal, supervised the data collection, contributed to the interpretation of the findings, reviewed the paper and participated on the preparation of the manuscript. All authors read and approved the

final manuscript.

## Ethical Approval

Ethical clearance was obtained from University of Zambia Biomedical Research Ethics Committee (UNZABREC) (Approval no. REF. No. 5794-2024) and National Health Research Authority (NHRA) (ref no. NHRA-1576/20/09/2024). The study was also cleared by Lusaka and Chongwe District Health office. Participants were explained about the study and got their consent to participate in the study.

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# Evaluation of Healthcare Service Delivery in Adamawa, Nigeria: A Comparative Analysis of Findings from 3 Patient's Satisfaction Metrics - Net Promoter Score (NPS), Satisfaction Survey & Quality of Care Assessment

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***Abstract***

*Efforts to expand access or reduce healthcare service costs may do little to increase access and utilisation, when quality of care is perceived as unsatisfactory. Strategic use of multiple patients' experience surveys can help health systems address concerns of dissatisfied clients, improve patient loyalty, and help providers tailor their services to meet patient expectations. The aim of this study is to conduct a comparative assessment of perception of the quality of health service delivered by health facilities in five wards using three client-reported experience measures, namely, patient satisfaction surveys, Net Promoter Score (NPS) studies, and patient overall quality of care assessments. This study adopted the descriptive analytical study using the cross-sectional quantitative method. The overall satisfaction rate, proportion of promoters, and NPS score obtained are 70%, 14.5%, and -40.7, respectively. Findings show overall satisfaction rates of 70% is far higher than the proportion of respondents (14.5%) who were willing to recommend health facilities to friends and families. The distribution of satisfaction rates compared to the proportion of promoters (in parentheses) is as follows: 89.4% (34.2%) in Damare; 86.7% (14.5%) in Imburu; 40.8% (15.4%) in Mbilla; 58.7% (1.2%) in Dumne; and 63.5% (4.3%) in Sabon Pegi. This study has demonstrated the higher reliability of the NPS study over satisfaction surveys, further establishing the complementary value of using at least two metrics over one. The far lesser proportion of promoters compared to satisfied respondents suggests relying on one metric alone provides limited perspectives on clients' sentiments about the quality of services offered by health facilities.*

***Keywords:*** *Adamawa, Health Facility Assessment, Net Promoter Score (NPS), Patient Satisfaction, Quality of Service.*

## Introduction

The challenge of expanding access, reducing cost, and optimising the quality of services are the three major bottlenecks faced by healthcare delivery systems in many countries. Among these three key determinants of health outcomes, the predominant influence of perceived quality of service on patient behaviour around satisfaction, utilisation, referrals, and choice has been shown to be higher than the influence of expansion of access and cost reduction [1]. Therefore, expanding access to healthcare or reducing costs may do little to increase utilisation if patients' confidence or perception of the quality of health service is lower than expected. So perceived quality of care from a patient or client perspective is considered a powerful driver of healthcare utilisation, an important measure of

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health systems, and a promoter of continuous quality improvement in health facilities [2, 3]. In effect, when healthcare institutions are unable to, or cannot be trusted to, guarantee a threshold level of quality, healthcare services provided by these facilities will be underutilised or used as a measure of last resort [1].

To buttress the relatively higher influence that perception of quality has on patient behaviour, low utilisation of facility services persisted despite considerable investment in healthcare to increase access and utilisation [4]. This is due to patients' pre-existing negative perception of quality of service delivered by a given facility. Similar outcomes were observed in Vietnam and Uganda, where poor and negative perception of service quality resulted in greater patronage of private healthcare providers [1, 5]. There are suggestions that "historical patterns, competing interests, and institutional practices" have contributed in expanding reliance on private sector service delivery in response to public health systems underperformance. This raises the question, "to what extent ongoing UHC reform processes promote continued collaboration in a way that strengthens public healthcare delivery" especially in countries within the Global South [6]. Also, evidence abounds showing that members of the public are likely to pay more for healthcare services provided by institutions with a reputation for providing services that satisfy the needs and expectations of customers [5].

Nonetheless, some healthcare systems still rely only on standards generated by professionals to evaluate performance during quality assurance programmes. When assessments are restricted to care provider-anchored measures of structure, process, and outcome variables, without taking consideration of patients' perceptions of the quality and adequacy of care, findings from such assessments rarely accurately reflect the true status of performance of health facilities [7, 8]. This subjectivity is attributed to suggestions that a patient's appraisal is based on expectations which may vary with time [9]. Hence, by integrating patient perspective, quality management of healthcare facilities can ensure that patients are at the centre of concern during quality and safety improvement engagements. It also ensures operational, managerial, and organisational frameworks adopted are tailored to foster the development of sustainable management strategy [10].

Studies have demonstrated the importance of assessing patients' perception of quality of service using multiple metrics. This is based on suggestions that a more effective measurement of patient satisfaction of care requires the integration of real-time feedback tools, qualitative methods, standardised quantitative surveys, and online review monitoring [4, 11]. It is also suggested that the adoption of even just two metrics to assess a patient's overall experience will result in incomplete findings that are potentially misleading. This is due in part to the multidimensional and complex nature of patient perception. Consequently, the multidimensional nature of satisfaction implies that a single-question measure is clearly inadequate. This is in light of the fact that eight major dimensions of satisfaction have been identified by following an extensive review of literature. These dimensions include art of care, technical quality, accessibility, efficacy, cost, physical environment, availability, and continuity of care [8].

Furthermore, patient satisfaction is an important prerequisite for strategic decision-making in health systems management. Patient satisfaction surveys are now increasingly used as a management tool to address the challenges of performance and access to healthcare. The tool has also helped government institutions identify target groups, redefine objectives, clarify indicators of performance, and establish performance information systems [12]. It is therefore strongly recommended that health systems establish frameworks for conducting routine assessments of customers' perceptions

of the quality of healthcare service delivery. Empirical studies evaluating patients' perception of health services abound, but limited empirical research around this subject has been published in Adamawa State. There is, in fact, no published study investigating the relationship between patient perceptions and willingness to recommend service to others. Insights from such research can empower policymakers, health insurance scheme managers, health systems managers, and health facility managers with the insights needed to improve the standard of service and fast-track attainment of universal health coverage.

Despite the demonstrated benefits of patient-perceived quality of care in driving healthcare utilisation, methodological and theoretical problems have been attributed to a subjective assessment of care by patients. It is considered that a patient's lack of technical knowledge predisposes him or her to inaccurate qualitative judgements [7]. The methodology and findings of the satisfaction survey have also been criticised for unreliability associated with the relatively high positive satisfaction ratings associated with findings from most satisfaction surveys. The high likelihood of positive satisfaction ratings is attributed to social desirability, implicit threat, hesitancy to express negative opinions, location of testing, and item wording [8]. Furthermore, level of satisfaction is also largely influenced by patients' expectations, which are in turn impacted by prior knowledge, experience, and attitude. These factors contribute to providing context within which expectations about patients' behaviour, health outcomes, and health systems' performances are shaped. In addition, expectations are also shaped by social status, previous healthcare experience, and educational attainment as some of the contextual factors shaping expectations [11, 13].

The goal of this study, therefore, is to assess comparatively, patients' or caregivers' perception of the quality of healthcare service delivery in 5 wards using three assessment metrics, namely (i) the patient's satisfaction survey, (ii) the Net Promoter Score (NPS), and (iii) the patient's perception of the quality-of-care assessment. This study, therefore, entails a comparative analysis of findings from all five study sites and also 3 different patient satisfaction metrics. Based on observed findings, the study also discusses the comparative advantage of using multiple metrics over a single metric to assess the performance of health facilities.

## Materials and Methods

### Study Setting

The study was carried out in five wards within four local government areas (LGAs) in Adamawa, Nigeria. The study was conducted in the following purposively selected wards: Damare in Girei LGA, Sabon Pegi and Imburu wards in Numan LGA, Dumne in Song LGA, and Mbilla in Mayobelwa LGA. The primary target of the combined household and facility-based survey were mainly residents living within the primary and secondary health facility catchment area, including those living around a Basic Healthcare Provision Fund (BHCPF)-supported health facility. These locations were selected based on the assumption that households within these settings would have been exposed to the minimum standard of service delivery expected to encourage interest in community-based health insurance enrolment when established. The population distribution for selected LGAs includes Mayobelwa (241,961), Song (260,000), Numan, Yola South (310,667), Girei, and Yola North (316,213). Enumerators prioritised respondents who have had at least three direct experiences as clients of these health facilities. Excluded from this survey are non-residents, including those with either visual, learning or speaking disabilities or who were sick.

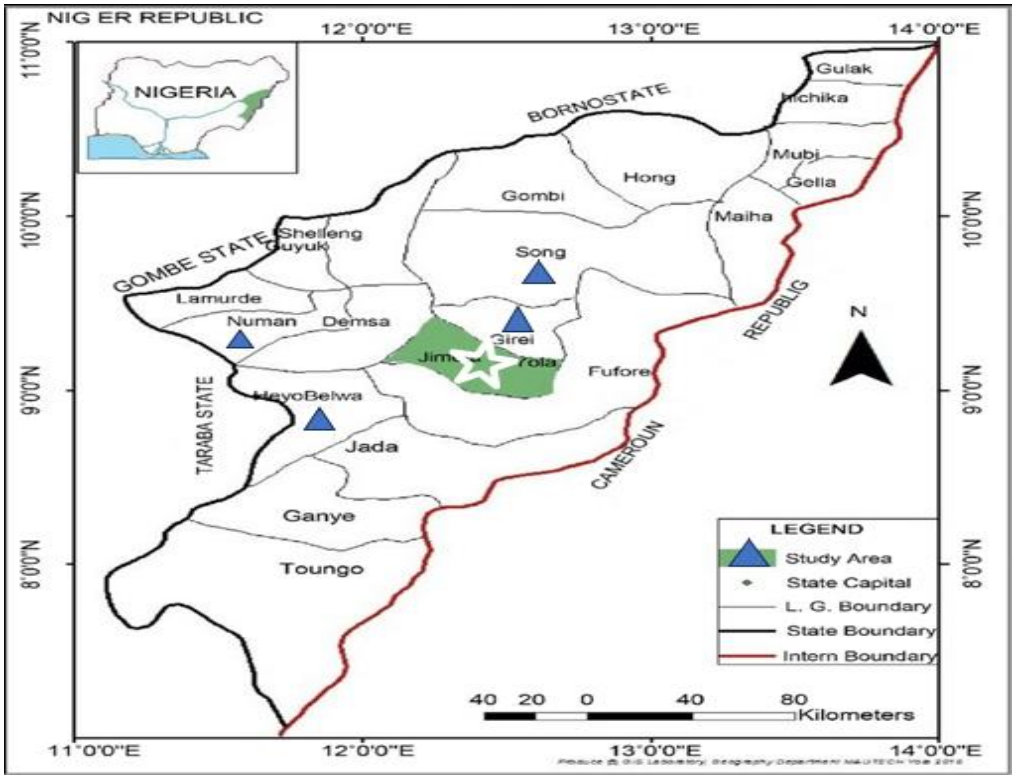


**Figure.** Map of Adamawa showing study areas (Source: Adapted from Adebayo and Tukur (1999) with slight modifications [14]

## Study Design

This study adopted the descriptive analytical study design using the cross-sectional quantitative method of assessing patient perception of quality of healthcare delivery in five wards located within four purposively selected local government areas (LGAs). Sample sizes for each of the five study locations include 480 for Damare, 409 for Dumne, 449 for Imburu, 422 for Mbilla, and 439 for Sabon Pegi, located in Girei, Song, Numan, Mayobelwa, and Numan LGAs, respectively. The sample size for each community was determined using Cochran's (1963 and 1975) formula.

## Data Collection and Tools

The study was conducted between November 2024 and January 2025. Data was collected by trained surveyors using pretested questionnaires. A total of 55 enumerators translated the English-based questionnaires into either Hausa or Fulfulde during administration. Out of the 2,539 households targeted, 2,309 responded, giving a response rate of 90.9%. The questionnaire enabled assessment of the quality of healthcare service delivery from a client perspective using the following quality performance assessment metrics, namely: (a) patient satisfaction questionnaire, (b) Net Promoter Score (NPS) questionnaire, and (c) patient perceived quality assessment questionnaire.

The first metric, the patient satisfaction survey, assesses the patient's overall experience with health facilities. This single-item questionnaire requires respondents to choose one of five responses to 'How they would rate their overall experience of health services provided by health facilities they patronise. The patients' satisfaction questionnaire assesses overall experience with health facilities. The single-item questionnaire required respondents to choose one of five options around 'How they would rate their overall experience with a health facility.' They are required to choose 1 for very dissatisfied. 2-Satisfied, 3-Neither

satisfied nor dissatisfied, 4-Dissatisfied, and 5-Very dissatisfied.

The second metric, the patient-perceived quality assessment questionnaire, involves assessment of several domains of quality of care from a patient perspective. In this study. The questionnaire is adapted to contain mainly the quality of medical care. patient's safety, and patient's rights domains. This questionnaire assesses clients' assessment of the availability and quality of health facility personnel, drugs, drug information, privacy, and other services. Here respondents choose between Excellent, Very Good, Good, Fair, and Poor. The questions under the quality of medical care domain include: (i). client's ratings of the availability and quality of doctors, nurses, and drugs; (ii). attitude of health facility staff. Questions under the patient safety and rights domain include (iii) patient education of drug and injection use and (iv) the provision of privacy.

The third metric, the Net Promoter Score (NPS), is a single-item questionnaire which provides a summative assessment of patient experience. The questionnaire requires respondents to answer the question – "How likely are you to recommend this service to your friends and family?" Responses to this question are assigned scores ranging from 0 to 10 [15]. NPS measures the extent to which a health facility converts customers into advocates or promoters of their products and/or services by monitoring and analysing three groups. The first are "promoters", who are highly satisfied customers who are more likely to recommend the brand to others; the second group are "passives", who believe they received satisfactory service but lack loyalty and incentive to recommend; and the third group are the "detractors", who are considered dissatisfied customers that negatively impact the company's growth and reputation. Promoters are assigned a score of 9 or 10, passives are assigned a score of 7 or 8, and detractors are assigned a score of 0 to 6. The overall Net Promoter Score is obtained by subtracting the percentage of customers who are detractors from the percentage of customers who are promoters [16].

### Data Analysis

After data cleaning and validation, respondents' data was then exported and subsequently imported into SPSS version 30.0 and Microsoft Excel for data analysis. Analysed data was presented in tables in the form of frequencies, percentages, mean values and standard deviations. Correlation and regression analysis was also done to understand relationship between variable, and their level of statistical significance.

## Ethical Consideration

The study was approved by the Adamawa State Ministry of Health. Ethical approval was issued on 30th May, 2024. Texila American University provided a bona fide letter of introduction. Enumerators were mandated to obtain oral informed consent from willing participants. The majorly kobo collect toolkit is designed not to proceed without informed consent checklist being checked. Enumerators were also required to assure all participants that their responses will be treated as confidential and held privately and that data was strictly for academic purposes. Participants were also informed of their right to discontinue the exercise at any time during the course of an ongoing interview session.

## Results

### (A). Socio-demographic Characteristics

From table 1, it is observed that the highest mean age was recorded in Imburu (45.83), Sabon Pegi (44.15), and Dumne (44.01). The distribution of elderly participants (above 65 years) is highest in Imburu with 54 (12%) and lowest in Mbilla with 0 (0%). Deviation from the mean was higher in Mbilla and lowest in Sabon Pegi ward. The majority of respondents fell within the age groups of 30 to 39 (31.1%) and 40 to 49 (29.1%). Overall, farmers,

numbered at 44% (968), were the most prevalent occupation in all five communities, followed by traders with 24.5% (539). On average, 70.5% (1551) of respondents considered the nearest health facility to their place of residence as their most preferred place for seeking care, while 39.8% (875) reportedly visited public health facilities when sick. The overall proportion of respondents living in rural areas is 78.9% (1735).

The proportion of respondents living within urban areas is distributed as follows: 72.3% (347) in Damare; 0.7% (3) in Dumne; 11.8% (50) in Imburu; 11.8% (50) in Mbilla; and 3.5% (16) in Sabon pegi.

## (B). Descriptive Statistics

Descriptive statistics analysis presented in table 14 below shows the mean age of respondents in the entire study to be 42.25. The lowest mean age of study participants ranged from 39.3 in Damare to 39.22 in Mbilla. The highest mean ages were recorded in Imburu (45.83), Sabon Pegi (44.15), and Dumne (44.01). The distribution of elderly participants was therefore highest in Imburu with 54 (12%) and lowest in Mbilla with 0 (0%). Deviation from the mean was higher in Mbilla and lowest in Sabon Pegi ward.

The mean number of children was lowest in Damare (2.44) and highest in Sabon Pegi (3.64) and Dumne (3.61). The number of children in households ranged from 0 to 9 across all 5 communities. The mean number of persons in households ranged from 2 to 11 in Damare, 2 to 13 in Dumne, 2 to 13 in Imburu, 2 to 14 in Mbilla, and 2 to 15 in Sabon Pegi. Similarly, the mean number of persons in a household shows that a relatively lower number of persons per household was found in Damare (4.33).

## (C). Patient Experience Measures

### Net Promoter Score (NPS) Analysis

Table 2 highlights the result of the Net Promoter Score (NPS) assessment, which is a measure of clients' or customers' experience and loyalty. The NPS for Imburu, Mbilla, and Sabon Pegi are -34.9%, -42.7%, and -46.3%. Overall, the NPS for all locations is –40.7%. This is shown in table 3, where the percentage of respondents who rated the health facilities 0 to 6, known as the detractors, was more than three times higher than the percentage who rated the health facilities 9 to 10, known as promoters. So, with an NPS value of -40.7%, the proportion of potential promoters (highly satisfied clients) of care services is 14.5%, while the proportion of passives (satisfied clients) and detractors (dissatisfied clients) are 55.2% and 30.4%, respectively.

Results show that Dumne, with the highest rural population of 99.3%, a mean age of 45.83, and the lowest population of promoters at 1.2% (5), also has the highest population of detractors at 87.8% (359), which are those who provided a rating of 0 to 6 for how likely they are willing to recommend their health facility to friends and family. Detractors, who consist mainly of unsatisfied customers and who are much less likely to recommend a health facility, are highest in Dumne (87.8%) and lowest in Damare (34.4%). Damare, with 27% of respondents living in rural areas, also has the highest percentage of promoters (34.2%) and the lowest percentage of detractors (34.4%) across all 5 study locations. Imburu and Sabon Pegi, which are locations within the same LGA (Numan), recorded similar percentages of detractors: 49.4% (222) and 50.6% (222), respectively. The rural populations in Imburu and Sabon Pegi are 88.2% (372) and 96.4% (423), respectively. The percentage of promoters in Mbilla, Imburu, Sabon Pegi and Dumne were 15.4% (65), 14.4% (65), 4.3% (19), and 5% (1.2), respectively.

**Table 1.** Socio-demographic Characteristics by Ward

| | | **Total** | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** |
|---|---|---|---|---|---|---|---|
| Independent Variable | | Freq (%) | Freq (%) | Freq (%) | Freq (%) | Freq (%) | Freq (%) |
| Total | | 2199 (100) | 480 (100) | 409 (100) | 449 (100) | 422 (100) | 439 (100) |
| Age of Respondents | 18 – 29 | 318 (14.5) | 102 (21.3) | 38 (9) | 75 (16.7) | 48 (11.4) | 55 (12.5) |
| | 30 – 39 | 684 (31.1) | 180 (37.5) | 101 (24.7) | 97 (21.6) | 175 (41.5) | 131 (25.8) |
| | 40 – 49 | 618 (28.1) | 111(23.1) | 153 (37.4) | 106 (23.6) | 148 (35.1) | 100 (22.8) |
| | 50 – 59 | 353 (16.1) | 49 (10.2) | 80 (19.6) | 91 (20.3) | 43 (10.2) | 90 (20.5) |
| | 60 – 65 | 106 (4.8) | 19 (4.2) | 26 (6.4) | 26 (5.8) | 8 (1.9) | 27 (6.2) |
| | Above 65 | 120 (5.5) | 19 (4) | 11 (6.7) | 54 (12.0) | 0 (0) | 36 (8.2) |
| Gender | Male | 1369 (62.3) | 277 (57.7) | 301 (73.6) | 213 (47.4) | 336 (79.6) | 242 (55.1) |
| | Female | 830 (37.7) | 203 (42.3) | 108 (26.4) | 236 (52.6) | 86 (20.4) | 197 (44.9) |
| Educational Status | Above tertiary education | 37 (1.7) | 10 (2.1) | 4 (1.0) | 10 (2.2) | 7 (1.7) | 6 (1.4) |
| | Tertiary | 337 (15.3) | 18 (16.9) | 52 (12.7) | 59 (13.1) | 72 (17.1) | 73 (16.6) |
| | Senior Secondary | 1348 (61.3) | 291 (60.6) | 305 (74.6) | 276 (61.5) | 207 (49.1) | 269 (61.3) |
| | Junior Secondary | 128 (5.8) | 9 (1.9) | 1 (0.2) | 31 (6.9) | 19 (4.5) | 68 (15.5) |
| | Primary education | 195 (8.9) | 62 (12.9) | 27 (6.6) | 52 (11.6) | 48 (11.4) | 8 (1.8) |
| | Others | 154 (7.0) | 27 (5.6) | 20 (4.9) | 21 (4.6) | 71 (16.9) | 15 (3.5) |
| Geographical location | Rural | 1735 (78.9) | 133 (27.7) | 406 (99.3) | 372 (88.2) | 401 (89.3) | 423 (96.4) |
| | Urban | 464 (21.1) | 347 (72.3) | 3 (0.7) | 50 (11.8) | 50 (11.8) | 16 (3.6) |
| Is the nearest health facility the most preferred? | Yes | 1551 (70.5) | 345 (71.9) | 362 (88.5) | 353 (78.6) | 262 (62.1) | 229 (52.2) |
| | No | 648 (29.5) | 135 (28,1) | 47 (11.5) | 96 (21.4) | 160 (37.9) | 210 (47.8) |
| Type of Health facility visited when sick | Private health facility | 172 (7.8) | 43 (9.0) | 52 (12.7) | 27 (6.0) | 23 (5.5) | 27 (6.2) |
| | Drug store/Pharmacy | 309 (14.1) | 100 (20.8) | 114 (27.9) | 29 (6.5) | 38 (9.0) | 28 (6.4) |
| | Government hospital | 816 (37.1) | 66 (13.8) | 192 (46.9) | 175 (39.0) | 172 (40.8) | 211 (48.1) |
| | Public health facility | 875 (39.8) | 258 (53.8) | 50 (12.2) | 214 (47.7) | 185 (43.8) | 168 (38.3) |
| | Others | 27 (1.2) | 13 (2.71) | 0 (0) | 0 (0) | 4 (0.8) | 5 (1.1) |

**Table 2.** Descriptive Analysis of Key Socio-demographic Variables

| | **Damare** | | **Dumne** | | **Imburu** | | **Mbilla** | | **Sabon Pegi** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** |
| Age of Respondent | 39.3 | 11.819 | 44.01 | 11.274 | 45.83 | 15.603 | 39.22 | 8.885 | 44.15 | 13.925 |
| Number of children | 2.44 | 2.34 | **3.61** | 2.199 | **3.43** | 2.37 | **3** | 2.314 | **3.64** | 2.295 |
| Number of children under 5 years | 0.71 | 0.896 | 0.98 | 0.888 | 0.98 | 0.938 | 0.88 | 1.005 | 0.96 | 0.899 |
| Number of adults between 18 and 64 | 1.1 | 1.328 | 1.8 | 1.317 | 1.8 | 1.377 | 1.6 | 1.438 | 1.7 | 1.167 |
| Number of adults above 65 | 0.09 | 0.369 | 0.18 | 0.566 | 0.42 | 0.752 | 0.28 | 0.63 | 0.26 | 0.608 |
| Total number. of persons in household | 4.33 | 1.993 | 5.5 | 2.176 | 5.64 | 2.23 | 5.39 | 2.534 | 5.72 | 2.072 |
| Duration of stay in location (Months) | 95.71 | 117.68 | 373.77 | 178.73 | 99.37 | 132.15 | 251.09 | 176.21 | 129.26 | 379.85 |

The net promoter score was calculated for all 5 study locations by subtracting the percentage of detractors from the percentage of promoters. Calculated NPS values range from -100 to +100, with -100 being the poorest and +100 being the highest. Results of NPS analysis shown in table 3 show that all 5 locations have a negative NPS value ranging from -0.2 in Damare to -86.6 in Dumne. Respondents in Damare were more likely to recommend their health facilities compared to those from Dumne. This is due in part to the distribution of the percentage of respondents who rated their focal health facilities between 0 and 6 points and those who rated them 9 to 10. The NPS does not include ratings between 7 and 8 in computing these scores. The mean, median, mode, and standard deviation for ratings across all locations are 6.08, 6, 6, and 2.240.

**Table 3.** Net Promoter Score (NPS) Analysis by Study Location

| | **Rating (1 to 10)** | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** |
|---|---|---|---|---|---|---|
| | | Freq (%) | Freq (%) | Freq (%) | Freq (%) | Freq (%) |
| On a scale of 1 to 10, how likely are you to recommend this health facility as good place to seek treatment to | 10 | 0 (0) | 0 (0) | 2 (0.4) | 0 (0) | 1 (0.2) |
| | 9 | 164 (34.2) | 5 (1.2) | 63 (14.0) | 65 (15.4) | 18 (4.1) |
| | 8 | 101 (21.0) | 21 (5.1) | 96 (21.4) | 42 (10.0) | 111 (25.3) |
| | 7 | 50 (10.4) | 24 (5.9) | 66 (14.7) | 70 (16.6) | 87 (19.8) |
| | 6 | 98 (20.4) | 103 (25.2) | 133 (29.6) | 92 (21.8) | 61 (13.8) |
| | 5 | 34 (7.1) | 82 (20.0) | 38 (8.5) | 64 (15.2) | 95 (21.6) |
| | 4 | 7 (1.5) | 48 (11.7) | 7 (1.6) | 32 (7.60 | 9 (2.1) |
| | 3 | 1 (0.2) | 35 (8.6) | 2 (0.4) | 16 (3.8) | 39 (8.9) |

| | | | | | | |
|---|---|---|---|---|---|---|
| a friend or family member? | 2 | 2 (0.4) | 52 (12.7) | 1 (0.2) | 12 (2.8) | 1 (0.2) |
| | 1 | 23 (4.8) | 39 (0.5) | 41 (9.1) | 29 (6.9) | 17 (3.9) |
| | 0 | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| | Total | 480 (100) | 409 (100) | 449 (100) | 422 (100) | 439 (100) |
| Promoters | 9 to 10 | 164 (34.2) | 5 (1.2) | 65 (14.5) | 65 (15.4) | 19 (4.3) |
| Neutral | 7 to 8 | 151(31.5) | 45 (11.0) | 162 (36.1) | 112 (26.5) | 198 (45.1) |
| Detractors | 0 to 6 | 165 (34.4) | 359 (87.8) | 222 (49.4) | 245 (58.1) | 222 (50.6) |
| Calculating NPS | Ratings | NPS | NPS | NPS | NPS | NPS |
| Percentage of promoters | 9 to 10 | 34.20% | 1.20% | 14.50% | 15.40% | 4.30% |
| Percentage of detractors | 0 to 6 | 34.40% | 87.80% | 49.40% | 58.10% | 50.60% |
| NPS = % Promoters - % Detractors | (9 to 10) – (0 to 6) | -0.2 | -86.6 | -34.9 | -42.7 | -46.3 |

**Table 4.** Net Promoter Score (NPS) Determination Findings

| **Rating** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq (%) | 149 (6.80) | 68 (3.10) | 93 (4.20) | 103 (4.70) | 313 (14.20) | 487 (22.10) | 297 (13.50) | 371 (16.80) | 315 (14.3) | 3 (0.10) | 2199 (100) |
| Rating | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 10-Jan |
| | Detractors | | | | | | Passives | | Promoters | | |
| Freq | 1213 | | | | | | 668 | | 318 | | 2199 |
| % | 55.21% | | | | | | 30.40% | | 14.50% | | 100% |

*Net Promoter Score (NPS): 14.5 – 55.21 = - 40.7%*

*Overall rating: Mean – 6.08; Median – 6; Mode – 6; Standard Deviation (SD) – 2.240.*

**Patients' Satisfaction Survey**

Data expressing respondents' perception of level of satisfaction with healthcare service are presented in tables 4, 5, and 6 below. Table 4 shows the result of the respondent's overall experience with health facilities. Overall, across all 5 study sites, 70% (1,539) of respondents indicated they were either satisfied or very satisfied. Results indicate the highest level of satisfaction of 89.4% (429) was recorded in Damare with a rural population of 27.7%. Imburu, with a rural population of 89.3%, recorded the next highest satisfaction rating of 86.7% (389).

Lower percentages of 40.8%, 58.7%, and 63.5% were documented in Mbilla, Dumne, and Sabon Pegi, respectively. The highest dissatisfaction levels were observed in Dumne, where 30.3% of respondents reported being either dissatisfied or very dissatisfied with the health service delivery at the health facility they patronise. Those who reported being neither satisfied nor dissatisfied (neutral) were 45.7% in Mbilla and 33% in Sabon Pegi. Neutrality was therefore highest in these 2 study locations. Apart from Mbilla, with satisfaction levels of 46.9%, all other 4 study locations had satisfaction levels above 50%. i.e., Dumne (58.7%), Sabon Pegi (64.5%), Imburu (86.7%), and Damare (86.7%). Table 6 shows that while the average percentage of either satisfied or very satisfied clients from the satisfaction survey is a much higher 70%, the average percentage of promoters (highly satisfied

clients) from the NPS study is 14.5%. And while the average percentage of promoters from the satisfaction survey is a much higher 89.4%. Damare, Dumne, Imburu, Mbilla, and Sabon Pegi, with proportions of promoters amounting to 34.2%, 1.2%, 14.5%, 15.4%, and 4.3%, respectively, also have 89.4%, 58.7%, 86.7%, 40.8%, and 63.5%, respectively, who rated healthcare services as either satisfactory or very satisfactory based on findings from the satisfaction survey. This implies that the proportion of clients who rated healthcare services as satisfactory is far higher than the proportion of promoters from the NPS evaluation in Damare (89.4% for satisfied clients vs 34.2% for promoters); Dumne (58.7% vs 1.2%); Imburu (86.7% vs 14.5%); Mbilla (40.8% vs 15.4%); and Sabon Pegi (63.5% vs 4.3%).

**Table 5.** Client Overall Satisfaction Rating for Healthcare Service Delivery at Health Facility

| | | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** |
|---|---|---|---|---|---|---|
| | | Freq (%) | Freq (%) | Freq (%) | Freq (%) | Freq (%) |
| How would you RATE your overall experience with this health facility? Choose between 1 for Very Dissatisfied, and 5 for Very Satisfied | Very Satisfied | 20 (4.2) | 11 (2.7) | 87 (19.4) | 32 (7.6) | 14 (3.2) |
| | Satisfied | 409 (85,2) | 229 (56.0) | 302 (67.3) | 166 (39.3) | 269 (61.3) |
| | Neither satisfied or dissatisfied | 32 (6.7) | 45 (11.0) | 53 (11.8) | 193 (45.7) | 145 (33.0) |
| | Dissatisfied | 16 (3.3) | 40 (9.8) | 1 (0.2) | 21 (6.0) | 5 (1.1) |
| | Very dissatisfied | 3 (0.6) | 84 (20.5) | 6 (1.3) | 10 (2.4) | 6 (1.4) |
| | Total | 480 (100) | 409 (100) | 449 (100) | 422 (100) | 439 (100) |

**Table 6.** Rating of Overall Experience of Health Facility Service Delivery by Ward

| | **Very Satisfied & Satisfied** | **NPS (Promoters)** | **PPS Satisfied** | **NPS (Promoters)** | **PPS Satisfied** | **NPS (Passives)** |
|---|---|---|---|---|---|---|
| Damare | 429 (89.4%) | 164 (34.2%) | 409 (85.2%) | 164 (34.2%) | 409 (85.2%) | 151(31.5%) |
| Dumne | 240 (58.7%) | 5 (1.2%) | 229 (56.0%) | 5 (1.2%) | 229 (56.0%) | 45 (11.0%) |
| Imburu | 389 (86.7%) | 65 (14.5%) | 302 (67.3%) | 65 (14.5%) | 302 (67.3%) | 162 (36.1%) |
| Mbilla | 198 (40.8%) | 65 (15.4%) | 166 (39.3%) | 65 (15.4%) | 166 (39.3%) | 112 (26.5%) |
| Sabon Pegi | 283 (63.5%) | 19 (4.3%) | 269 (61.3%) | 19 (4.3%) | 269 (61.3%) | 129 (29.4%) |
| Average | **1,539 (70%)** | **318 (14.5%)** | **1375 (62.5%)** | **318 (14.5%)** | **1375 (62.5%)** | **668 (30.4%)** |

**Patient's Perspective on Quality Assessment (Perception of Quality of Care)**

Table 7 shows the positive ratings for the quality of doctors or health personnel. The proportion of respondents who provided positive ratings (either good, very good or excellent) for the quality of the doctor are distributed as follows: 91.8% for Damare, 93.7% for Dumne, 78.4% for Imburu, 83.7% for Mbilla, and 89.1% for Sabon Pegi. On the other hand, about 1 in every 5 respondents gave a negative rating (fair or poor) for the quality of doctors in Imburu. Ratings for the quality of nurses were negative (either fair or poor) for more than half of respondents in Dumne (53.6%) and Mbilla (54.5%). From table 7, it is also observed that respondents who provided positive ratings for the availability of doctors or health personnel were 89.4% in Damare, 86.7% in Imburu, 64.5% in Sabon Pegi and 58.7% in

Dumne. The highest proportion of respondents who gave negative ratings for the availability of doctors (health personnel) was observed in Dumne (30.3%).

On the availability of nurses, all study locations apart from Mbilla (45.7%) rated their health facilities positive (either good, very good or excellent) at a percentage higher than 82%. Damare, Dumne, Imburu and Sabon Pegi recorded 95.2%, 89%, and 94.3% of respondents who provided positive ratings for the availability of nurses. At least 4 out of every 5 respondents in all 5 study locations rated their facilities positively (good, very good, or excellent) for quality of drugs provided. Damare, Dumne, Imburu, Mbilla and Sabon Pegi recorded 95.2%, 81.4%, 81.3%, 89.3%, and 91.8%, respectively.

Perception about health workers' attitudes was positive in at least 4 out of every 5 respondents in Damare, Dumne, Imburu and Sabon Pegi. Rating was lowest in Mbilla, with only half of the respondents rating their health workers' attitude or politeness as either good, very good, or excellent at 50%. Excellent ratings were documented by at least 1 in every 5 respondents in Damare (21.9%) and Dumne (21.5%). From table 8, it is observed that education of patients or carers about medications they receive was reportedly positive and ranged from 79.5% to 91.8% in all study locations apart from Mbilla, where 44.8% of respondents gave a negative rating (either poor or fair). A relatively lower percentage of respondents rated their facilities positively (either good, very good, or excellent) on the provision of privacy.

**Table 7.** Rating of Quality and Availability of Health Personnel at Health Facilities

| | **Rating** | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi –** |
|---|---|---|---|---|---|---|
| | | (N-480) | (N-409) | (N-449) | (N-422) | (N-439) |
| | | Freq (%) | Freq (%) | Freq (%) | Freq (%) | Freq (%) |
| Availability of doctors during your visits to the health facility/hospital | Excellent | 109 (22.7) | 137 (33.5) | 65 (14.5) | 8 (1.9) | 20 (4.6) |
| | Very Good | 162 (33.8) | 57 (13.9) | 110 (24.5) | 86 (20.4) | 77 (17.5) |
| | Good | 150 (31.3) | 170 (41.6) | 160 (35.6) | 133 (31.5) | 295 (67.2) |
| | Fair | 46 (9.6) | 44 (10.8) | 107 (23.8) | 178 (42.2) | 42 (6.6) |
| | Poor | 13 (2.7) | 1 (0.2) | 7 (1.6) | 17 (4.0) | 5 (1.1) |
| Availability of NURSES when you visited the health facility | Excellent | 100 (20.9) | 104 (25.4) | 61 (13.6) | 18 (4.3) | 13 (3.0) |
| | Very Good | 153 (31.9) | 84 (20.5) | 118 (26.3) | 50 (11.8) | 80 (18.2) |
| | Good | 204 (42.5) | 176 (43.0) | 191 (42.5) | 125 (29.6) | 321 (73.1) |
| | Fair | 22 (4.6) | 44 (10.8) | 77 (17.1) | 199 (47.2) | 21 (4.8) |
| | Poor | 1 (0.2) | 1 (0.2) | 2 (0.4) | 30 (7.1) | 4 (0.9) |
| Quality of doctors at the health facility | Excellent | 108 (22.5) | 94 (23.0) | 61 (13.6) | 18 (4.3) | 16 (3.6) |
| | Very Good | 162 (33.8) | 101 (24.7) | 95 (21.2) | 92 (21.8) | 72 (16.4) |
| | Good | 171 (35.6) | 188 (46.0) | 196 (43.7) | 243 (57.6) | 303 (69.0) |
| | Fair | 32 (6.7) | 25 (6.1) | 92 (20.5) | 55 (13.0) | 43 (9.8) |
| | Poor | 7 (1.5) | 1 (0.2) | 5 (1.1) | 14 (3.3) | 5 (1.1) |
| Quality of NURSES at the health facility | Excellent | 106 (22.1) | 99 (24.2) | 62 (13.8) | 16 (3.8) | 14 (3.2) |
| | Very Good | 143 (29.8) | 91 (22.2) | 107 (23.8) | 59 (14.0) | 79 (18.0) |
| | Good | 206 (42.9) | 0 (0) | 206 (45.9) | 117 (27.7) | 321 (73.1) |
| | Fair | 23 (4.8) | 31 (7.6) | 71 (15.8) | 192 (45.5) | 23 (5.2) |
| | Poor | 2 (0.4) | 188 (46.0) | 3 (0.7) | 38 (9.0 | 2 (0.5) |
| | Excellent | 110 (22.9) | 99 (24.2) | 65 (14.5) | 13 (3.1) | 20 (4.6) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Quality of DRUGS given to you for treatment | Very Good | 164 (34.2) | 86 (21.0) | 109 (24.3) | 124 (29.4) | 94 (21.4) |
| | Good | 183 (38.1) | 148 (36.2) | 191 (42.5) | 242 (57.3) | 289 (65.8) |
| | Fair | 21 (4.4) | 74 (18.1) | 82 (18.3) | 42 (10.0) | 33 (7.5) |
| | Poor | 2 (0.4) | 2 (0.5) | 2 (0.4) | 1 (0.2) | 3 (0.7) |
| Attitude/Politeness of health facility staff | Excellent | 105 (21.9) | 88 (21.5) | 64 (14.3) | 20 (4.7) | 18 (4.1) |
| | Very Good | 156 (32.5) | 96 (23.5) | 108 (24.1) | 70 (16.6) | 104 (23.7) |
| | Good | 169 (35.2) | 142 (34.7) | 193 (43.0) | 121 (28.7) | 286 (65.1) |
| | Fair | 45 (9.4) | 82 (20.0) | 80 (17.8) | 187 (44.3) | 28 (6.4) |
| | Poor | 5 (1.0) | 1 (0.2) | 4 (0.9) | 24 (5.7) | 3 (0.7) |

**Table 8.** Perspective on Quality of Patient Education and Privacy Provided

| | | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** |
|---|---|---|---|---|---|---|
| | | Freq (%) | Freq (%) | Freq (%) | Freq (%) | Freq (%) |
| Effort of nurse to educate you about the name and uses of injections or drugs you or your child received. | Excellent | 105 (21.9) | 91 (22.2) | 69 (15.4) | 22 (5.2) | 19 (4.3) |
| | Very Good | 165 (34.4) | 94 (23.0) | 109 (24.3) | 96 (22.7) | 91 (20.7) |
| | Good | 159 (33.1) | 140 (34.2) | 183 (40.8) | 115 (27.3) | 293 (66.7) |
| | Fair | 49 (10.2) | 83 (20.3) | 76 (16.9) | 166 (39.3) | 29 (6.6) |
| | Poor | 2 (0.4) | 1 (0.2) | 12 (2.7) | 23 (5.5) | 7 (1.6) |
| | Total | 480 (100) | 409 (100) | 449 (100) | 422 (100) | 439 (100) |
| How can you rate the provision of PRIVACY at the health facility. | Excellent | 169 (35.2) | 96 (23.5) | 148 (33.0) | 241 (57.1) | 106 (24.1) |
| | Very Good | 1 (0.2) | 2 (0.5) | 3 (0.7) | 8 (1.9) | 2 (0.5) |
| | Good | 170 (35.4) | 134 (32.8) | 181 (40.3) | 106 (25.1) | 281 (64.0) |
| | Fair | 32 (6.7) | 85 (20.8) | 49 (10.9) | 35 (8.3) | 33 (7.5) |
| | Poor | 108 (22.6) | 92 (22.5) | 68 (15-.1) | 32 (7.6) | 17 (3.9) |
| | Total | 480 (100) | 409 (100) | 449 (100) | 422 (100) | 439 (100) |

**Table 9.** Perspective on Quality of Services Delivered by Health Facilities (Study Average)

| | **Excellent** | **Very Good** | **Good** | **Fair** | **Poor** | **Total Freq (%)** |
|---|---|---|---|---|---|---|
| Availability of doctors | 339 (15.4%) | 492 (22.4%) | 908 (41.3%) | 417 (19.0%) | 43 (2.0%) | 2199 (100%) |
| Availability of nurses | 296 (13.5%) | 485 (22.1%) | 1017 (46.2%) | 363 (16.5%) | 38 (1.7%) | 2199 (100%) |
| Quality of doctors | 297 (13.5%) | 522 (23.7%) | 1101 (50.1%) | 247 (11.2%) | 32 (1.5%) | 2199 (100%) |
| Quality of nurses | 297 (13.5%) | 479 (21.8%) | 1036 (47.2%) | 340 (15.5%) | 45 (2.9%) | 2199 (100%) |
| Quality of drugs | 307 (14.9%) | 577 (26.2%) | 1053 (47.9%) | 252 (11.3%) | 10 (0.5%) | 2199 (100%) |
| Politeness (Attitude) of staff | 295 (13.4%) | 534 (24.3%) | 911 (41.4%) | 422 (19.2%) | 37 (1.7%) | 2199 (100%) |
| Education on drug a injection use. | 306 (13.9%) | 555 (25.2%) | 890 (40.5%) | 403 (18.3%) | 45 (2.0%) | 2199 (100%) |
| Provision of privacy | 317 (14.4%) | 760 (34.6%) | 872 (39.7%) | 234 (10.6) | 16 (0.7%) | 2199 (100%) |

The highest percentage of respondents who rated positive were recorded in Sabon Pegi (88.6%) and Mbilla (84.1%). Percentages of 70.7% and 74% were recorded in Damare and

Imburu, respectively. The proportion of respondents who gave a poor rating was 22.6% in Damare and 22.5% in Dumne, which translates to at least 1 in every 5 respondents, as observed in table 8 below.

Cumulatively across all study locations, while 13.4% gave an excellent rating for health workers' attitude (politeness), about 1 in every 5 respondents adjudged health workers' attitude as negative (either poor or fair). Furthermore, a significant 89.1% gave a positive rating (good, very good, or excellent). A significant 1 in every 5 respondents (20.3%) across all 5 locations gave a negative rating of either poor or fair for this important indicator, as can be seen in table 7.

**Comparative Analysis of Findings from 3 Metrics (NPS Score, Quality of Care Ratings, and Satisfaction Rates)**

Table 10 shows a comparative analysis of results of all 3-performance metrics under evaluation. The strength and direction of the relationship between 5 variables have been examined. These variables include satisfaction rates, NPS score, proportion of promoters, ratings for quality of health personnel, and ratings for attitude of health personnel. The distribution of satisfaction rates and proportion of promoters (in parentheses) in Damare, Imburu, Sabon Pegi, and Dumne is 89.4% (34.2%), 86.7% (14.5%), 63.5% (4.35%), and 58.7% (1.2%), respectively. Results of correlation analysis show that the correlation coefficient (r = 0.54) obtained indicates the existence of a moderate positive correlation between satisfaction rates and proportion of promoters.

**Table 10.** Comparative Analysis of Results of 3 Metrics

| | **Quality of Care Ratings** | | **Satisfaction with Services.** | **Net Promoter Score (NPS) Findings.** | |
|---|---|---|---|---|---|
| Study Locations | Quality/Competency of personnel | Attitude (Politeness) of Personnel | Satisfaction Rates | Promoters (%) | NPS Score (%) |
| Damare | 91.8% | 89.6% | 89.4% | 34.2% | - 0.2 |
| Dumne | 93.7% | 79.7% | 58.7% | 1.2% | - 86.7 |
| Imburu | 78.4% | 81.4% | 86.7% | 14.5% | - 34.9 |
| Mbilla | 83.7% | 50.0% | 40.8% | 15.4% | - 42.7 |
| Sabon Pegi | 89.1% | 92.9% | 63.5% | 4.3% | - 46.3 |
| Total | **87.3%** | **78.7%** | **70.0%** | **14.5%** | **- 40.7** |

*NB: Positive Rating for Quality/Competence, and attitude of Personnel: % of respondent who choose either Excellent, Very Good, or Good.*

*Satisfaction Rates: % of respondent who chose either Very Satisfied or Satisfied.*

**Table 11.** Correlation Matrix

| | **Quality/Competency of personnel** | **Attitude (Politeness)** | **Satisfaction Rates** | **Promoters (%)** | **NPS Score (%)** |
|---|---|---|---|---|---|
| Quality of personnel | 1 | | | | |
| Attitude /Politeness) | 0.377314301 | 1 | | | |
| Satisfaction Rates | -0.078185892 | 0.717928539 | 1 | | |
| Promoters (%) | -0.055502477 | 0.035120542 | 0.538557779 | 1 | |

| | | | | | |
|---|---|---|---|---|---|
| NPS Score (%) | -0.215232141 | 0.185596791 | 0.589693667 | 0.91497947 | 1 |

**Table 12.** Distribution of Correlation Coefficient and pvalues

| **Study Locations** | **Satisfaction Rates** | **Promoters (%)** | **Satisfaction Rates** | **NPS Score (%)** | **Satisfaction Rates** | **Attitude (Politeness)** | **Promoters (%)** | **NPS Score (%)** |
|---|---|---|---|---|---|---|---|---|
| Damare | 89.4% | 34.2% | 89.4% | - 0.2 | 89.4% | 89.60% | 34.2% | -0.2 |
| Dumne | 58.7% | 1.2% | 58.7% | - 86.7 | 58.7% | 79.70% | 1.2% | -86.7 |
| Imburu | 86.7% | 14.5% | 86.7% | - 34.9 | 86.7% | 81.40% | 14.5% | -34.9 |
| Mbilla | 40.8% | 15.4% | 40.8% | - 42.7 | 40.8% | 50.00% | 15.4% | -42.7 |
| Sabon Pegi | 63.5% | 4.3% | 63.5% | - 46.3 | 63.5% | 92.90% | 4.3% | -46.3 |
| Cor Coefficient (r) | **0.54** | | **0.59** | | **0.72** | | **0.91** | |
| p-Value | **0.349** | | **0.295** | | **0.172** | | **0.029** | |

Results show the proportion of promoters increased as satisfaction rates increased in 4 out of 5 study locations mentioned above. However, this positive relationship is not statistically significant since the p-value of 0.39 obtained is greater than 0.05 ($p>0.05$). Table 11 also shows NPS scores decreased as the proportion of promoters decreased: Correlation analysis shows there is a strong positive correlation between the proportion of promoters and the NPS score, and this relationship is statistically significant based on the correlation coefficient (r) of 0.91 and the p-value of 0.029 obtained from correlation and regression analysis, respectively. It is observed that NPS scores for Damare (-0.2%), Imburu (-34.9), Sabon Pegi (-46.3), and Dumne (-86.7) decreased as satisfaction rates and the proportion of promoters decreased.

There also exists a strong positive correlation ($r = 0.71$) between ratings for attitude of health workers and overall health service satisfaction rate that is also not statistically significant considering that the p-value of 0.17 obtained is greater than 0.05, i.e., $p > 0.05$. For example, data from tables 10 and 11 also shows the 2 wards (Mbilla and Dumne) with the lowest rating for health workers' attitude (politeness) also recorded the lowest satisfaction rates. For example, Mbilla, with 50% of respondents providing positive ratings for health workers' attitudes, reported satisfaction rates of 40.8%. Similarly, Dumne recorded 79.7% of respondents issuing positive ratings for health workers' attitudes but a lower 58.7% satisfaction rate for healthcare experience. Furthermore, Imburu and Damare, the 2 wards with the highest proportion of respondents with positive ratings for health workers' attitudes, also had the highest satisfaction rates of 89.4% and 86.7%, respectively.

The correlation coefficient ($r = 0.59$) and p-value of 0.295 obtained from correlation and regression analysis done for the data set from satisfaction rates and NPS score indicate the existence of a fair positive relationship that is not statistically significant.

## Discussions

Descriptive statistics show the proportion of respondents living within urban areas varied significantly across study sites. Urban dwellers ranged from 72.3% in Damare to 0.7% in Dumne. On average, rural-based respondents comprised 78.9% of all study participants. This has potential implications on the level of access and utilisation of quality healthcare services, as will be noted in the following paragraphs. On average, 70.5% of the entire study's respondents considered the nearest health facility to their place of residence as their most preferred place for seeking care. The relatively high preference for the nearest health facility

can be an indication of a client's desire for quality, cost, and speed of care weighed against constraints associated with household economic status and the need to reduce travel time during emergencies and routine preventive care.

The category of care providers with the highest patronage were public health facilities (39.8%) and government hospitals (37.1%). On average, they are the largest contributor to access and uptake of healthcare services in the entire study. The observed higher preference for public hospitals is consistent with findings from studies examining the determinants of choice of health facilities in Southwest Nigeria [17, 18]. Although the proportion of respondents who visited either a public health facility or a government hospital was a cumulative 76.9%, it follows that 70% of all respondents rated their overall experience as satisfactory. These findings are comparable to results from a study assessing patients' preference for healthcare service providers in Ogun State, where 73% of respondents preferred government-owned facilities, and a subsequent 78% of respondents within the same study rated the quality of care received as satisfactory [19].

Findings from patients' overall satisfaction with healthcare service show that an overall satisfaction rate of 70% recorded in this study is consistent with the 70.6% satisfaction rate recorded in a comparative study of public tertiary and private secondary eye care clinics in Ibadan [20]. Satisfaction rates from this study are at variance with the 18.5% and 52.1% overall satisfaction rates documented, respectively, for emergency nursing care service in two tertiary hospitals in Oyo and general outpatient clinic services in a tertiary hospital in Sokoto [21, 22]. This study's satisfaction rates are also lower than the satisfaction rate of 89% reported among enrollees of NHIS [23]. In another related study, satisfaction levels among subscribers of the state-supported health insurance scheme were lower in Enugu, with satisfaction rates of 40.5%, and Cross River, with satisfaction rates of 32.7%. The same study, however, documented relatively higher satisfaction rates of 78.3% and 77.7%, respectively, for Taraba and Oyo states [24].

Location-specific results from this study indicate the highest satisfaction rates of 89.4% were recorded in Damare with 72.3% of urban-based respondents. On the other hand, Imburu, with rural-based respondents of 89.3%, recorded 86.7% satisfaction rates. Interestingly, a lower proportion of respondents expressed satisfaction with service in Mbilla (40.8%), Dumne (58.7%), and Sabon Pegi (63.5%). These results contrast with studies asserting satisfaction rates from satisfaction surveys were usually high and that those who are usually not satisfied discontinue use of problematic health facilities [8]. The highest dissatisfaction rate of 30.3% was observed in Dumne, whose rural-based respondents were 99.3% and who also had the highest proportion of respondents who indicated a preference for a private health facility (12.7%), drug store/pharmacy (27.9%) and government hospital (46.9%). The lowest preference for public health facility was documented in the same Dumne at 12.2% compared with the entire study's average of 39.8%. Interestingly, despite the higher preference for private sector providers (PHCs and drugs/pharmacy stores), satisfaction rates were the lowest at 58.7%. This is similar to studies conducted in Somalia, Cuttack, and Tehran, reporting satisfaction rates of 53.1%, 55.3%, and 57.5%, respectively [25-27]. This finding is at variance with results of another comparative analysis of patient satisfaction indicating satisfaction reached 91.3% in the private sector compared to 38% in the public sector [28].

Moreover, the proportion of respondents who had secondary education and above was the highest in Dumne at 88.3%. The relationship between the relatively higher education levels and lower rates of satisfaction

among respondents in Dumne aligns with findings from studies showing higher levels of education were associated with lower levels of patient satisfaction, which is also linked to greater expectations [25, 29]. This relatively higher education level compared to lower satisfaction rates observed may align with findings from systematic views on patient satisfaction with services indicating that while satisfaction drivers may vary based on environment, the fulfilment of expectations in addition to quality of interaction and process efficiency play a formidable role in explaining location-specific variations in findings [25, 30, 31].

Studies around patients' perspectives about quality of care demonstrate the role of competence, attitude, and communication skills of health workers, including doctors and nurses, in enhancing higher satisfaction rates [32, 33]. These factors appear to have contributed to the high proportion of respondents who provided positive ratings (either good, very good or excellent) for the quality of doctors (health personnel) in all study sites. Ratings were distributed as follows: 91.8% for Damare, 93.7% for Dumne, 78.4% for Imburu, 83.7% for Mbilla, and 89.1% for Sabon Pegi. Findings also show that in Dumne, 58.7% of respondents expressed satisfaction with healthcare services despite the fact that a much higher 93.7% gave a positive rating for the quality of doctors. This suggests other factors associated with the multidimensional nature of patient satisfaction may be responsible for the reduced satisfaction rate [4,11]. **This will be discussed below and in more detail.** A similar trend was observed in Mbilla (83.7% vs 40.8%) and Sabon Pegi (89.1% vs 63.5%). The trends observed so far align with findings from studies suggesting that evaluating patients' perception of the quality of health personnel without considering the outcome of patient overall satisfaction with care service often masks significant dissatisfaction in other operational domains that may include systemic issues within health facilities [34-36].

Also observed is the correlation between satisfaction rates and the client's rating for quality-of-care domains such as health workers' attitude and the quality or competency of doctors (health personnel). Ratings for perception of health workers' attitude (politeness) were lower than those of quality of health personnel in 3 out of 5 study locations. This indicates health workers' attitudes may be a major client concern and, consequently, a key determinant of patient or care-giver satisfaction rates. This is demonstrated by findings showing 2 wards with the lowest rating for health workers' attitude (politeness) recorded the lowest satisfaction rates. For example, Mbilla, with 50% of respondents providing positive ratings for health workers' attitudes, reported satisfaction rates of 40.8%. Similarly, Dumne recorded 79.7% of respondents issuing positive ratings for health workers' attitudes but a lower 58.7% satisfaction rate for healthcare experience. Furthermore, the two wards (Imburu and Damare) with the highest proportion of respondents with positive ratings for health workers' attitudes also had the highest satisfaction rates of 89.4% and 86.7%, respectively.

Findings from the Net Promoter Score (NPS) analysis show that the average NPS score of -40.7 observed for all 5 study sites suggests respondents have more negative than positive sentiments about their overall experience with healthcare service. The ratio of detractors who gave ratings of 0 to 6 (55.2%) to promoters who provided ratings of 9 to 10 (14.5%) is an estimated 4 to 1. This highlights the presence of dissatisfaction and unmet expectations among respondents and also implies that far fewer respondents are likely to recommend or spread positive testimony about services rendered in a health facility, even when they consider the same services to be satisfactory. This score varies widely with NPS scores from a retrospective quality improvement study of a post-outpatient subspeciality clinic in Southern California, which recorded an NPS score of

+96% [37]. Another study of 5 hospitals in Brazil recorded mean NPS scores ranging from +0% to +47.4% [38]. In a related study of 48,068 patients within all 27 federation units in Brazil, findings show no region obtained an NPS value within the quality zone of +51% to +75% NPS score. Results concentrated on the improvement zone between 1 and 50, with the best-performing NPS rating of +33% and +27% in the Southern and Northern regions, respectively [39].

Results of NPS analysis at the ward level also show all 5 study locations have negative NPS scores ranging from - 0.2% in Damare (highest) to - 86.6% in Dumne (lowest). The NPS for Imburu, Mbilla, and Sabon Pegi are - 34.9%, - 42.7%, and - 46.3%, respectively. Results show that Dumne, with the highest rural population of 99.3%, a mean age of 45.83, and the lowest population of promoters at 1.2%, also has the highest population of detractors (at 87.8%), who consist mainly of unsatisfied clients who provided ratings between 0 and 6 on how likely they were to recommend health services to friends and family. Imburu and Sabon Pegi, which are locations within the same Numan LGA, recorded markedly different proportions of promoters: 14.5% for Imburu and 4.3% for Sabon Pegi, but similar percentages of detractors (49.4% vs 50.6%, respectively).

A reoccurring dynamic from this study is the general consensus that the quality of services needed to be improved. This was demonstrated by the fact that all study locations have recorded negative NPS values. This position is buttressed by the relatively high dissatisfaction rating of respondents who were either dissatisfied, very dissatisfied, or even neutral. This category accounted for 10.3% in Damare, 41.3% in Dumne, 13.3% in Imburu, 53.1% in Mbilla, and 35.5% in Sabon Pegi. Furthermore, NPS analysis shows that the proportion of respondents categorised as detractors was more than three times higher than the proportion of respondents categorised as promoters.

Comparative analysis of findings demonstrates the existence of a simple correlation between results of net promoter score, proportion of promoters, and satisfaction rates in 4 out of 5 study sites evaluated. However, the strength and direction of the relationship between 5 variables examined using correlation and regression analysis show variations in degrees and statistical significance of relationship as shown in table 11 and 12. These variables include satisfaction rates, NPS score, proportion of promoters, ratings for quality of health personnel, and ratings for attitude of health personnel. The variables with the strongest correlation and most statistically significant relationship are those between ratings for attitude of health personnel and satisfaction rates. Correlation analysis also affirms the presence of a strong positive correlation between the proportion of promoters and the NPS score, and this relationship is statistically significant based on the correlation coefficient (r) of 0.91 and the p-value of 0.029 obtained from correlation and regression analysis, respectively.

Findings also show that lower satisfaction rates resulted in a lower proportion of promoters and NPS scores obtained. For instance, Damare, Imburu, Sabon Pegi, and Dumne, with the following respective satisfaction rates and proportion of promoters in parentheses, also had their corresponding NPS scores seen to have decreased as the proportion of promoters decreased: 89.4% (34.2%), 86.7% (14.5%), 63.5% (4.35), and 58.7% (1.2%). It is observed that NPS scores for Damare (- 0.2%), Imburu (-34.9), Sabon Pegi (- 46.3), and Dumne (-86.7) also decreased as satisfaction rates and the proportion of promoters decreased. The implication is that higher satisfaction rates fuel patient loyalty, improved utilisation of health services, and potential reduction in morbidity and mortality associated with poor utilisation.

Findings also indicate results of NPS tended to have higher reliability compared to those of

the satisfaction survey; this is due in part to the broader range of NPS scores obtained compared to satisfaction ratings observed. Hence, the NPS score is more likely to serve the diagnostic purpose of identifying the worst- or least-performing quality of care domains regardless of how high satisfaction rates are or how good ratings for patient-provider relationships are [40]. Healthcare managers are therefore obligated to institute mechanisms for engaging and obtaining further feedback from detractors with the overall goals of transforming potential passives and detractors (highly dissatisfied users) into promoters or highly satisfied users. Hence simple qualitative questions can be integrated into an adapted form of NPS questionnaires.

## Conclusion

This study has demonstrated the higher reliability of the NPS survey over satisfaction and patient quality of care assessment surveys. Results underscore the complementary value of using at least two and preferably three measures. Comparative analysis of findings also demonstrates the existence of a simple correlation between results of net promoter score, proportion of promoters, and satisfaction rates in 4 out of 5 study sites evaluated. Findings show that lower satisfaction rates resulted in a lower proportion of promoters and NPS scores obtained. Comparative analysis of findings from the three patient-reported experience measures suggests positive ratings of health services appear substantial but sub-optimal. Higher ratings reflect higher confidence in promoters and managers of health facilities, and consequently, the likelihood that willingness to join, pay for, and sustain enrolment in a community-based health insurance scheme when established may be high.

Furthermore, results of NPS scores across all 5 study locations affirm suggestions that efforts to expand access and reduce service costs may indeed do little to increase access and utilisation when perceived quality of care and satisfaction rates are low. This is due to the relatively low proportion of promoters compared to satisfied clients across all 5 study sites. Therefore, quality improvements must go beyond advocating for increased funding, addressing human resource capacity gaps, and enhancing technology improvements. Rather, interventions should include and prioritise the design and sustainable delivery of patient-centred care that is hinged on continuous improvement using the total quality management (TQM) approach. It therefore follows that even when total quality management principles are deployed, healthcare facilities can achieve and sustain competitiveness via continuous professional development reform, improved customer services, and the continuous re-evaluation of processes for effectiveness and efficacy as new data, including patient feedback, routinely becomes available. Findings also illustrate the limitations of closed-ended satisfaction items as the sole instrument for assessing the quality of medical care and underscore the value of the use of mixed methods as a more nuanced approach.

While findings from this study have the capacity to inform decisions on which health facility requires improvement, including what aspects of care require enhancement, it is advised that no firm conclusions should be reached about the status of performance and quality of services rendered by public and private health facilities located within Damare, Dumne, Imburu, Mbillla, Sabon Pegi, and Adamawa as a whole. Suffice it to say that findings should not be generalised to reflect the status of performance of health facilities based in the wards, local government areas or states as a whole, considering that convenience sampling was adopted.

## Recommendations

1. High-impact training of health workers on interpersonal, interactive, and psychosocial

support skills requires prioritised attention. Government and development partners should revise training strategy to ensure the impact of capacity-building programmes are traceable, measurable, and evaluated in light of future patient satisfaction and quality of care assessment findings.

2. Satisfaction surveys should be interpreted in light of findings from a previously conducted health worker satisfaction survey since customer satisfaction has been shown to be reinforced by employee satisfaction [41]. Health system managers should prioritise identifying and addressing potential gaps in health workers' welfare, technical, and development needs, recognisable through periodic quantitative and qualitative engagements with health workers, especially and including those who routinely interact with patients directly.
3. Routine monthly assessment of health facilities, and the dissemination of health facility patient quality assessment feedback using patient satisfaction profile presented as scorecard, and in state dashboard and/or index should be developed and used to inform routine evaluation of public and private health facility overall performance status. Incentivising the best-performing health workers within facilities and facilities within regions via monetary and non-monetary recognition can help inspire competitiveness.
4. There is a need for the design of a standardized multi-metric tool that measures patient perspective around quality of care and patient satisfaction. The design of a such a tool should be informed by the review and context-dependent adaptation of existing tools. Adopted tools should be administered by independent contractors with strong expertise in preventing or limiting confounding factors associated with the administration of surveys in local languages and within rural settings.
5. There is the need to establish an independent committee who will review existing frameworks and design appropriate models for administration, evaluation, and dissemination of routine quality assessments feedback using an international best practice approach in patient feedback monitoring and quality improvements in healthcare.

### Suggestions for Future Research

1. There is a need to replicate this research with the integration of qualitative measures needed to generate feedback on the unmet needs of detractors and passive respondents of Net Promoter Score (NPS) studies so as to help researchers identify quality-of-care domains requiring improvements. Feedback is also required to understand what domains met and exceeded the expectations of promoters so as to strengthen these domains and even recognise health personnel manning these areas.
2. Further research is needed to identify and understand differences and relationships between the patient, caregiver or patient relatives, and health workers' perspectives on the quality of care.

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## Data Availability

Quantitative data sets without sensitive personal identifiers, and contextual data are available on reasonable request.

## Conflict of interest

The authors declare no conflict of interest.

## Ethical Clearance

Study approval and ethical clearance was provided by the Adamawa State Ministry of Health. Verbal informed consent from the study participants was obtained before commencement of the study. Enumerators were mandated to sign confidentiality and privacy agreement for each survey administered before commencement using either the kobo toolbox software or paper-based questionnaire. Signing meant ticking a checkbox (see appendices) without which survey cannot proceed. There is also a checkbox for informed consent before proceeding with administration of mobile phone-based questionnaire (see link to questionnaire).

## Author's Contributions

ICU: Conceptualization, design, methodology, research instrument development, validation, investigation, data collection, data analysis, result interpretation, and data curation, and manuscript writing. E.D.O and A.L provided critical revision of entire manuscript. All authors read and approved the final version forwarded to Texila International Journal.

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# Current Attitudes, Behavior and Cardiovascular Impact of Choice Alcoholic Beverages and Herbs Among Commercial Automobile Drivers in Ibadan, Nigeria

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***Abstract***

*Alcohol consumption is a major health-risk behavior linked to non-communicable diseases, while herbal beverage use is rising globally. Data on co-consumption of alcohol and herbal drinks among high-risk occupational groups in sub-Saharan Africa are limited. This study examined the prevalence, attitudes, behaviors, and cardiovascular risk associated with alcohol and herbal beverage consumption among commercial automobile drivers in Ibadan, Nigeria. A mixed cross-sectional study with a convergent parallel design was conducted among commercial drivers across local government areas in Ibadan. Quantitative data were collected using structured questionnaires and measurements of blood pressure, pulse rate, and body mass index. Qualitative data were obtained through key informant interviews. Data were analyzed using SPSS v25 and R v4.4.2, with chi-square, t-tests, and ANOVA at $p < 0.05$. Point prevalence of alcohol consumption was below average. Alcohol consumption was significantly associated with hypertension, while herbal use showed no significant cardiovascular associations. Elevated blood pressure was common, with only 21.9% reporting recent screening. Age, marital status, family structure, and education significantly influenced attitudes and behaviors toward alcohol use. Key informants noted widespread herbal use but limited awareness of health risks. Alcohol consumption is moderately prevalent and associated with hypertension, while herbal beverage use is widespread but unrelated to cardiovascular outcomes. High undiagnosed hypertension emphasize the need for targeted screening, education, and regulation among commercial drivers.*

***Keywords:*** *Alcohol, Cardiovascular Risk, Commercial Drivers, Herbal Beverages, Nigeria.*

## Introduction

### Background

The health of a population can be assessed by the burden of prevalent diseases that include non-communicable, communicable diseases and or injuries [15]. In earlier centuries, diseases were thought to be a consequence of 'bad' genes only. However, irrespective of the category of disease, it has now been established that a defect in the genetic make-up of an individual is not the only reason for the downwards turn of health and well-being. Many diseases develop from an interaction between the genes and the environment (Figure 1). A recent document by the World Health Organization was able to affirm that the health of individual and communities is dependent on the combination of many factors. [20].

One of the environmental factors, a health-related behavior, that has been studied extensively across different populations is the consumption of alcoholic beverages. It has been associated with the risk of developing several non-communicable diseases [19]. According to Spring et al., five categories of health-risk behaviors have been identified which are detrimental actions that heighten the odds of

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illness or may impede recovery, and the consumption of alcoholic beverages belongs to the fourth category, which is also inclusive of abuse of illicit substances [16].

The prevalence of alcohol consumption varies widely across populations. Globally, the prevalence is estimated to be 7% (19); in Nigeria, it is about 34.3% (2) and about 5.1% of American adults (16). Most available data have reported the prevalence of harmful alcohol use or consumption, and this implies that the crude prevalence of alcohol consumption may be significantly higher than the known statistics. Overall, alcohol use remains a leading risk factor for disease burden worldwide, accounting for nearly 10% of global deaths among populations aged 15–49 years and poses dire ramifications for future population health in the absence of policy action today [10]. Further to this is the epidemiological pattern noted among alcoholic beverage consumers that has been termed the Alcohol Harm Paradox. The alcohol harm paradox (AHP) indicates that disadvantaged groups suffer, that is, individuals of lower socioeconomic status, from higher rates of alcohol-related harm compared with advantaged groups despite reporting similar or lower levels of consumption on average [6]. There were many other explanations for the AHP proposed in the literature despite being maily hypothetical. This included individual-level mechanisms (e.g. biological or psychological), contextual factors (e.g. place-based factors), the lived experience of disadvantage and upstream structural factors (e.g. the economy and politics).

The consumption of beverages varies according to geographical location and some other sociodemographic factors globally. This does not exclude alcoholic and, more recently, herbal-based beverages. There is almost no study describing the epidemiology of this practice of consuming alcoholic and herbal drinks, either singly or combined.

This thesis, therefore, aims to study the epidemiology of alcoholic and herbal-based beverage consumption among commercial automobile drivers in Ibadan. The study intends to provide robust data on this health determinant and equip the public health system with the tools needed for any necessary intervention.

The suboptimal systems to monitor and evaluate the impact of food and drink consumption on health in developing countries like Nigeria pose some critical challenges:

There is a grossly unregulated food and drink market in developing countries such as Nigeria. This makes it difficult to ascertain the variants of alcohol- and herbal-based beverages available for consumption by the population. There are concerns surrounding the quality of alcohol- and herbal-based beverages consumed by the population due to occasional reports suggestive of inconsistencies in the quality of beverages made available in the market. Existing studies suggest that age, gender, and social support play a role in substance use among drivers, but more research is needed on how these factors specifically affect cardiovascular health. For instance, the proportion of female commercial drivers who drink alcohol has not been investigated especially because of the recent increased participation of women in commercial driving within Ibadan metropolis.

While studies exist on alcohol and herbal consumption separately, there is little research on their combined cardiovascular impact among commercial drivers in Ibadan. This gap can also be attributed to multiple factors, including the absence of specific beverage safety regulations, widespread preference for herbal medicines, and inadequate standards for dosage and quality control. The incidence of non-medicinal use of herbs particularly would need to be investigated because these population is often associated with poor health seeking behaviour [5] and yet consume herbs supposedly for health reasons. This suggests there may be other factors responsible for

supposedly increased consumption individually and together.

The prevalence of cardiovascular diseases among commercial drivers in Ibadan would need to be updated. Most studies focus on immediate health risks of consuming herbs, but there is limited data on the long-term cardiovascular consequences of alcohol and herbal consumption among drivers. The care gap such as in the study by Barnes, can also be identified and then, specific regulatory and policy gaps would be identified and improved upon.

This study aimed to study the epidemiology of alcoholic and herbal-based beverage consumption among commercial automobile drivers in Ibadan, the associated attitudes and behaviors, and the potential health-related risks. Specific objectives were to:

1. To estimate the prevalence of consumption of alcoholic and herbal beverages among commercial automobile drivers in Ibadan.
2. To show an epidemiological map that estimates the burden of consumption of alcoholic and herbal beverages across the Ibadan metropolis.
3. To examine the attitude and behavior of commercial automobile drivers in Ibadan to their health.
4. To identify the factors that may be associated with the current attitude and behavior to health among commercial automobile drivers in Ibadan.

## Materials and Methods

This study utilized the mixed cross-sectional approach with a convergent parallel design to achieve its objectives. This was done by the use of standardized questionnaires and tools to obtain quantitative and qualitative data. For the quantitative data, a structured and validated questionnaire was interviewer-administered after obtaining consent for quantifiable responses of respondents. For the qualitative data, designated participants were selected for the Key Informant Interview for in-depth responses and expert answers. The standard guideline for reporting a cross-sectional study-the "Strengthening the Reporting of Observational Studies in Epidemiology" (STROBE) was adhered to. This study was undertaken across the Ibadan metropolis, Oyo State. Ibadan is the third largest metropolitan area in Nigeria after Lagos and Kano, with a population of 3.5 million. It is the capital city of Oyo state, situated in the southwest geopolitical zone of Nigeria [7]. The city of Ibadan is made up of eleven (11) local government areas (LGAs), five (5) of which constitute the urban local governments, while the remaining six (6) form the peri-urban or rural local governments [17]. All the eleven local government areas within the Ibadan metropolis were utilized for this research. The sampling technique was a stratified random sampling, whereby the sample was grouped into: Commercial bus drivers, Commercial cab drivers, Commercial tricycle drivers and Commercial motorcycle riders.

The sample size obtained was calculated using the Cochran's formula

$$n = \frac{(Z^2 * p * (1-p))}{e^2}$$

Where:

n = sample size

Z = Z value (e.g., 1.96 for 95% confidence level)

p = estimated proportion of the population (if unknown, 0.5 is often used)

e = margin of error (as a decimal, e.g., 0.05 for ±5%)

According to a study (Lasebikan et al., 2018), the prevalence of current drinkers is 88. 9%, that is p = 0.889.

Substituting the formula:

$$n = \frac{(1.96^2 * 0.889 * (1-0.889))}{0.05^2}$$

n = approximately 152 to achieve 95% confidence level and margin of error.

Accounting for an attrition rate of 10%,

n ≈ approximately 169 participants

Approximately 170 participants were sampled in each local government area within the Ibadan metropolis.

One key informant from each of the local government was also selected and interview in each local government area.

This study utilized the mixed cross-sectional approach to achieve its objectives.

For the quantitative data, the stratified random method of probability-based sampling was adopted to ensure representation among commercial drivers.

The qualitative data was obtained using purposive sampling to identify individuals who provide deeper insights into behaviours and experiences.

Descriptive analyses summarized:

1. Social demographics.
2. Occupational demographics.
3. Attitude towards alcohol and herbs.
4. Behavior towards alcohol and herbs.
5. Types of alcoholic beverages consumed.
6. Reasons for alcohol consumption.
7. Herbal consumption.
8. Cardiovascular health status.

Measures included frequencies and percentages.

1. Association of cardiovascular events and alcohol use.
2. Association of cardiovascular events with herbal use.
3. Relationship between alcohol and other cardiovascular measures.
4. Relationship between herbal drinks and other cardiovascular measures.

Significance was determined at $\mathbf{p < 0.05}$.

Semi-structured KIIs

1. Common health concerns
2. Prevalence of alcohol and herbal usage among commercial drivers.
3. Type of alcoholic beverages and herbs consumed and possible effects.
4. Health issues associated with substance use.

Interviews lasted 45–60 minutes, conducted in English or local languages with translators where required. Audio recordings were transcribed verbatim.

## Ethical Approval

This research involved direct interaction with human participants; hence, ethical approval was sought and obtained from the Oyo State Ethical Review Board prior commencement of the research. The transparency in research processes was maintained through clear documentation, ensuring that all methodological decisions are explicit and open to scrutiny. To protect data integrity and confidentiality, the primary database will be supported with regular backups and access controls.

## Data Management and Quality Assurance

The study employed a structured questionnaire adapted from validated assessment tools with established reliability and validity. Face and content validity were confirmed through expert review and pilot testing. Reliability was assessed using test–retest and internal consistency methods among 200 commercial drivers outside the study area. The questionnaire was re-administered after one week, yielding a Cronbach's alpha of 0.82 for key scales, indicating good reliability. Pilot testing also informed refinement of ambiguous items, sequencing, and completion time, ensuring the instrument was robust and culturally appropriate before full deployment. Proper citation and attribution of sources was ensured, with secure storage of research materials and appropriate protection of sensitive information. This approach will guarantee the reliability and validity of the research findings. Standardized quality assessment tools were used as they are crucial for ensuring the reliability and validity of research findings. Adhering to established systematic review guidelines, such as those

provided by STROBE, ensures a comprehensive and transparent research process. Also, regular consultation with the thesis Supervisor/Guide was essential for maintaining methodological rigor and ensuring the research stayed on track through meetings for technical guidance, which were documented, ensuring accountability.

# Results

## Socio-Demographic Factors and Substance Use

A total of 1,713 respondents participated in the study. Table 1 shows that majority of the participants were male (99.5%). Over half of the respondents were aged 36–49 years (51.0%), followed by those aged 25–35 years (22.7%). The predominant religion practised was Islam (56.0%), while Christians constituted (42.4%). The majority were married (89.4%) with 60.1% living in nuclear monogamous families, Secondary education (74.6%) was the most common level of education completed, with smaller proportions having primary (19.3%) or tertiary education (6.0%).

**Table 1.** Demographic Characteristics of the Commercial Automobile Drivers within Ibadan

| Characteristics | Number | Percentage (%) |
|---|---|---|
| Sex | | |
| Male | 1705 | 99.5 |
| Female | 8 | 0.5 |
| Age group | | |
| 18 - 24 years | 32 | 1.9 |
| 25 - 35 years | 389 | 23 |
| 36 - 49 years | 873 | 51 |
| 50 - 64 years | 363 | 21 |
| ≥ 65 years | 56 | 3.3 |
| Religion | | |
| African traditional | 26 | 1.5 |
| Christianity | 727 | 42 |
| Islam | 959 | 56 |
| Others | 1 | 0.1 |
| Marital Status | | |
| Divorced | 29 | 1.7 |
| Married | 1532 | 89 |
| Single | 139 | 8.1 |
| Widow/Widower | 13 | 0.8 |
| Family Structure | | |
| Extended | 63 | 3.7 |
| Nuclear – Monogamy | 1030 | 60 |
| Nuclear – Polygamy | 620 | 36 |
| Level of Education | | |
| Nil education | 1 | 0.1 |

| | | |
|---|---|---|
| Primary | 331 | 19 |
| Secondary | 1278 | 75 |
| Tertiary | 103 | 6 |

As presented in Table 2, the majority of respondents were motorcycle riders (37.6%), followed by tricycle riders (28.0%) and cab drivers (24.2%). Nearly half of the respondents had between 5 and 10 years of occupational experience (44.7%), while 40.2% had worked for 11–20 years. Most recorded working hours were between 9 and 16 hours per day (96.3%) and six to seven days per week (96.2%). With respect to income, the largest proportion earned between ₦50,000 and ₦74,000 per week (35.9%).

**Table 2.** Occupational Demographics of Commercial Automobile Drivers in Ibadan

| **Occupational demographics** | **Number** | **Percentage (%)** |
|---|---|---|
| Occupation | | |
| Bus driver | 175 | 10.2 |
| Cab driver | 415 | 24.2 |
| Motorcycle rider | 644 | 37.6 |
| Tricycle rider | 479 | 28 |
| Occupational experience | | |
| < 5 years | 141 | 8.2 |
| 5 - 10 years | 766 | 44.7 |
| 11 - 20 years | 689 | 40.2 |
| > 20 years | 117 | 6.8 |
| Work hours/day | | |
| < 8 hours | 39 | 2.3 |
| 9 - 16 hours | 1649 | 96.3 |
| > 16 hours | 25 | 1.5 |
| Work days/week | | |
| 1 - 3 days | 3 | 2 |
| 4 - 5 days | 62 | 3.6 |
| 6 - 7 days | 1648 | 96.2 |
| Estimate income/week (Naira) | | |
| 10,000 - 24,000 | 135 | 7.9 |
| 25,000 - 49,000 | 590 | 34.4 |
| 50,000 - 74,000 | 615 | 35.9 |
| 75,000 - 100,000 | 319 | 18.6 |
| > 100,000 | 54 | 3.2 |

Overall, respondents demonstrated high awareness of the health, social, and behavioral risks associated with alcohol consumption. The majority disagreed with permissive views towards underage drinking and heavy episodic drinking for both men and women. Less dominant views on the perceived social and emotional benefits of alcohol, such as relaxation and enjoyment at social gatherings were recorded. Most participants agreed that alcohol use is linked to negative outcomes, including unprotected sex, long-term health problems, addiction, impaired physical,

athletic, and career performance, road traffic accidents, and drink-driving arrests.

The findings indicate varied motivations for alcohol and herb-based drink consumption among respondents. While most participants disagreed with routinely mixing herbs with alcohol or drinking out of boredom, a substantial proportion reported frequent use of herb-based drinks, largely driven by perceived health benefits. Emotional states such as stress and exposure to unpleasant events were commonly reported triggers for drinking, whereas anxiety, irritability, and desperation were less frequently endorsed.

Analysis of the types of alcoholic beverages consumed revealed that gin accounted for the highest proportion of intake, representing approximately 48.3% of reported consumption as shown in figure 1. Beer followed closely, constituting about 41.1%. In contrast, red wine and whisky were consumed far less frequently, accounting for approximately 6.6% and 4.0% of total alcohol consumption, respectively. Overall, gin and beer together comprised nearly 90% of all reported alcoholic beverage consumption, indicating a marked preference for these beverages among the study population.

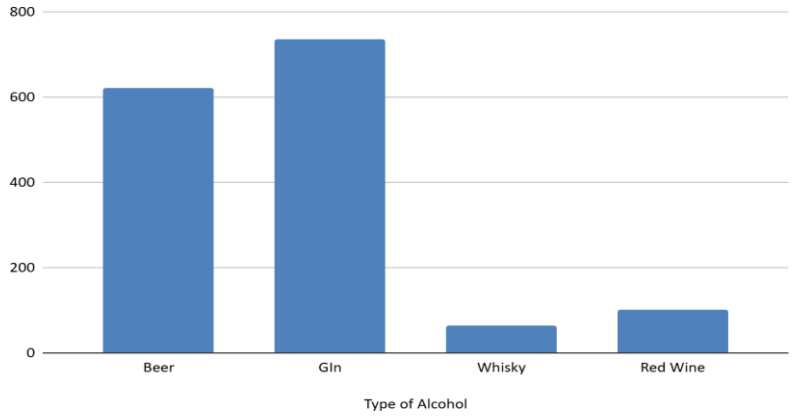


**Figure 1.** Common Types of Alcohol Consumed by Commercial Automobile Drivers in Ibadan

The high prevalence of water-based herbal consumption (84.1%) suggests that this mode of preparation is the predominant form of herbal use among respondents, likely due to its perceived safety, cultural acceptability, affordability, and ease of preparation as shown in Table 3. In contrast, alcohol-based herbal consumption was reported by 40.8% of respondents, indicating that a substantial proportion of the population still utilizes alcohol as a solvent or carrier for herbal remedies, possibly due to beliefs about enhanced potency or preservation effects. Notably, 14.6% of respondents reported concurrent consumption of both water- and alcohol-based herbal preparations. This pattern of concurrent use may raise public health concerns, as it increases cumulative exposure to alcohol and may potentiate adverse health effects, particularly among individuals with existing cardiovascular risk factors such as hypertension and other cardiovascular problems.

**Table 3.** Prevalence of Herbal Consumption According to Method of Preparation

| | **Number** | **Percentage(%)** |
|---|---|---|
| Water-based herbal consumption | 1441 | 84.1 |
| Alcohol-based herbal consumption | 699 | 40.8 |
| Concurrent intake of water- and alcohol-based consumption | 250 | 14.6 |

## Epidemiological Map Showing Prevalence of Consumption of Substance

The spatial distribution of alcohol consumption prevalence varied across the study area as shown in figure 2. Local Government Areas (LGAs) shown in blue recorded the highest prevalence, ranging from 48.5% to 54%, indicating that nearly half or more of the adult population in these areas consumed alcohol. LGAs classified in the yellow category exhibited a moderate prevalence of 42.9% to 48.5%, suggesting that approximately two in five respondents reported alcohol consumption. In contrast, LGAs shaded in red had the lowest prevalence, ranging from 37.4% to 42.9%, although this still represents over one-third of the population. Overall, alcohol consumption prevalence across the included LGAs ranged from 37.4% to 54%, demonstrating substantial geographic variation within the study area. These differences may reflect variations in urbanization, socioeconomic status, cultural norms, availability of alcohol outlets, and local drinking practices.

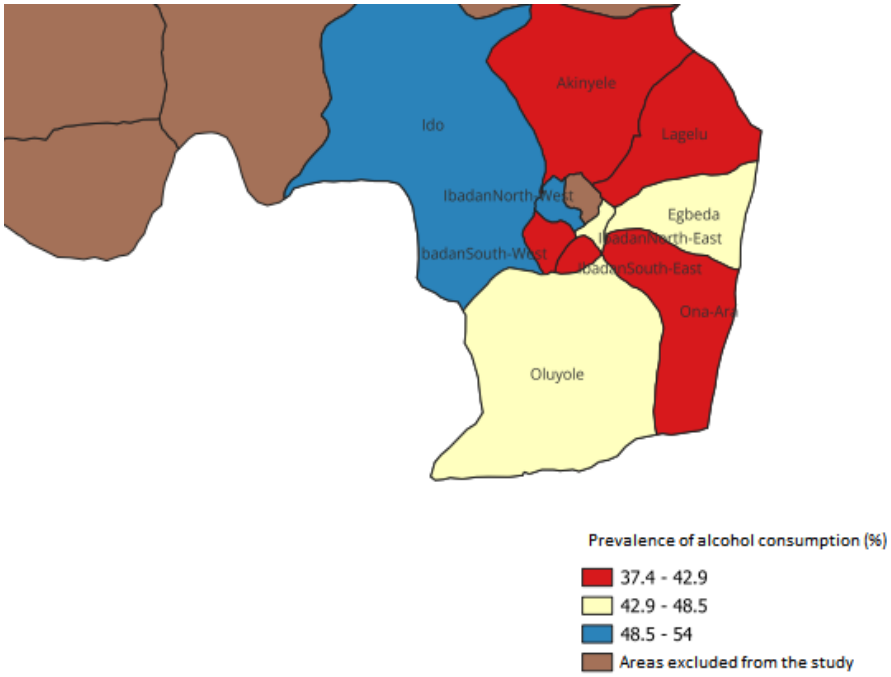


**Figure 2.** Point Prevalence of Alcohol Consumption Among Commercial Automobile Drivers According to LGAs

The prevalence of herbal consumption was generally high across the study area, with marked spatial variation among the Local Government Areas (LGAs) as shown in figure 3. LGAs shaded in blue recorded the highest prevalence, ranging from 88.2% to 93.7%, indicating that nearly nine out of ten respondents reported the use of herbal preparations. LGAs classified in the yellow category showed moderately high prevalence levels between 82.6% and 88.2%, suggesting widespread but comparatively lower use. In contrast, the lowest prevalence was observed in LGAs shaded in red, with values ranging from 77.1% to 82.6%, although herbal consumption still involved more than three-quarters of respondents in these areas. Overall, herbal consumption prevalence across the included LGAs ranged from 77.1% to 93.7%, demonstrating that the use of herbal remedies is highly prevalent throughout the study area.

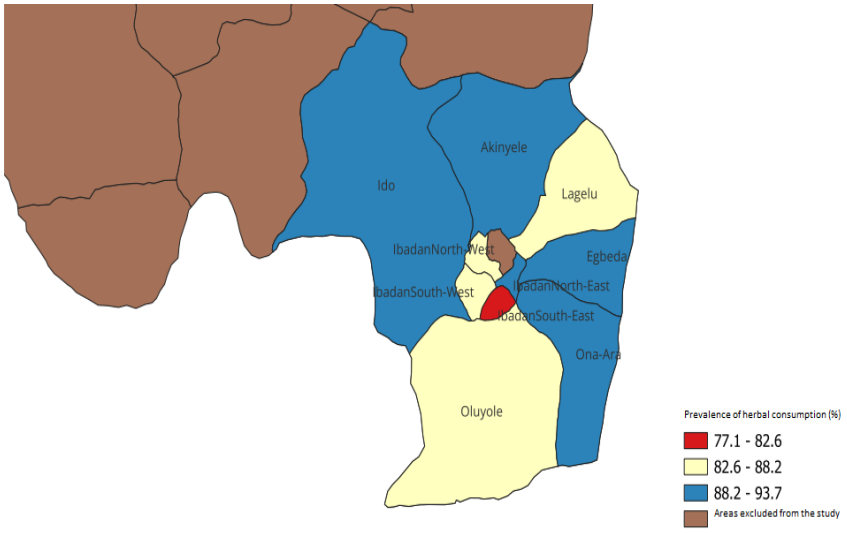


**Figure 3.** Prevalence of Herbal Consumption Among Commercial Automobile Drivers According to LGAs

The findings indicate high awareness of the adverse consequences of alcohol use among commercial automobile drivers, yet this knowledge coexists with permissive social norms and coping-related use. Over 97% of respondents agreed that heavy drinkers are more likely to be involved in serious road traffic accidents, and 91.9% recognized the increased likelihood of arrest for drunk driving. Similarly, large majorities acknowledged the long-term health effects of alcohol (87.8%), its neurotoxic effects (79.7%), and its role in worsening emotional disorders such as anxiety and depression (79.0%). Nearly all respondents (96.6%) agreed that regular heavy drinking leads to addiction and alcoholism. Despite this awareness, alcohol-positive social norms persisted: 75.1% perceived nondrinkers as "uptight" or "no fun," about 40% believed alcohol is necessary for social integration or enjoyable gatherings, and 37.5% felt there is something unusual about people who refuse to drink. Notably, personal attitudes were largely conservative, as 92.2% reported that alcohol use conflicted with their personal or religious beliefs, 69.8% preferred not to drink in most situations, and 86.8% intentionally limited alcohol intake to avoid dependence. A strong preference for herbal preparations over pure alcohol was observed, with 77.4% consuming herb-based drinks for perceived health benefits and over 75% (n = 1,297) reporting frequent use. Only 25.9% preferred mixing herbs with alcohol, suggesting predominant use of pre-mixed commercial herbal gins or traditional preparations. Substance use was largely driven by occupational stress and emotional factors: 57.4% drank when stressed, 42% to enhance motivation or stimulation, and 44.8% following unpleasant work-related events. Drinking also occurred in social (43.0%) and solitary contexts (33.6%), with availability influencing use (41.5%). These patterns highlight the coexistence of high-risk awareness, cultural acceptance of herbal remedies, and stress-related substance use among drivers.

Sex showed a statistically significant difference in positive attitude scores, with females recording higher mean scores than males (28.88 ± 8.51 vs. 21.34 ± 9.54; $t = 2.228$, $p = 0.026$). However, there was no significant difference between males and females in negative attitude scores ($p = 0.584$). Table 4 shows that age group was significantly associated with both positive and negative attitudes. A significant difference was observed in positive attitude scores across age categories (ANOVA = 4.532, $p = 0.020$). Marital status was significantly associated with both attitude dimensions. Positive attitude scores differed significantly across marital categories (ANOVA = 5.831, $p = 0.020$), with divorced

respondents reporting higher mean scores. Negative attitude scores also showed significant variation by marital status (ANOVA = 31.552, $p < 0.001$), with widows/widowers and divorced respondents having the highest mean negative attitude scores. A significant association was observed between family structure and both positive (ANOVA = 5.561, $p = 0.005$) and negative attitudes (ANOVA = 15.812, $p < 0.001$). Respondents from polygamous nuclear families had higher positive attitude scores, while negative attitude scores were higher among those from monogamous nuclear and extended family structures. Level of education was significantly associated with attitude scores. Positive attitude differed significantly by educational level (ANOVA = 3.452, $p = 0.033$), with respondents with tertiary education reporting higher mean scores.

**Table 4.** Comparison of Attitude Towards Alcohol Consumption with the Sociodemographic Factors of Commercial Automobile Drivers

| | **Positive Attitude** | | | **Negative Attitude** | | |
|---|---|---|---|---|---|---|
| | **Mean±SD** | **t/ANOVA** | **p-value** | **Mean±SD** | **t/ANOVA** | **p-value** |
| Sex | | | | | | |
| Male | 21.34±9.54 | 2.228 | 0.026 | 30.22±11.72 | 0.547 | 0.584 |
| Female | 28.88±8.51 | | | 32.50±14.89 | | |
| Age group (years) | | | | | | |
| 18-24 | 19.31±10.90a | 4.532 | 0.02 | 25.94±12.70a | 17.688 | <0.001 |
| 25-35 | 21.02±8.60a | | | 31.13±10.30a,b | | |
| 36-49 | 21.20±8.28a | | | 31.84±9.38a,b,c | | |
| 50-64 | 21.04±11.32a | | | 28.34±9.38a,d | | |
| >65 | 29.82±15.56b | | | 28.34±14.26e | | |
| Religion | | | | | | |
| ATR | 23.69±8.60a | 5.875 | 0.02 | 31.31±9.87a | 2.146 | 0.898 |
| Christianity | 22.23±9.21a | | | 30.23±11.59a | | |
| Islam | 20.65±9.75b | | | 30.23±11.87a | | |
| Marital status | | | | | | |
| Single | 20.40±11.48a | 5.831 | 0.02 | 27.56±14.58a | 31.552 | <0.001 |
| Married | 21.44±9.44a | | | 30.35±11.54a,b | | |
| Widow/Widower | 18.62±6.64b | | | 36.00±5.46c | | |
| Divorced | 24.07±3.62b,c | | | 34.31±1.83c | | |
| Family structure | | | | | | |
| Nuclear(Monogamy) | 20.77±9.50a | 5.561 | 0.005 | 31.39±11.95a | 15.812 | <0.001 |
| Nuclear(Polygamy) | 22.41±9.87b | | | 28.21±11.66b | | |
| Extended | 21.21±9.55a,b | | | 31.17±3.67a | | |
| Level of education | | | | | | |
| Primary | 21.67±12.61a | 3.452 | 0.033 | 26.95±16.17a | 17.116 | <0.001 |
| Secondary | 21.10±8.43a,b | | | 31.40±9.75b | | |
| Tertiary | 23.92±10.91a | | | 26.18±14.34a | | |

*($P < 0.05$ is considered significant)*

The statistical analysis reveals that age, family structure, and education level are the primary factors significantly influencing consumption behaviours as shown in Table 5. There is a highly significant difference in behaviour across age groups ($p = 0.004$).

Participants aged >65 years exhibit the highest mean behavioural score (40.79 ± 26.50), which is significantly higher than all other age categories. Consumption behaviour varies significantly based on family dynamics (p = 0.001). Drivers from Extended (29.24 ± 6.08) and Nuclear Polygamous (29.20 ± 15.21) families show higher behavioural scores than those in monogamous nuclear settings. The level of education plays a significant role in behaviour (p = 0.003). Participants with Tertiary education have a significantly higher mean behavioural score (32.70 ± 16.23) compared to those with primary or secondary education.

**Table 5.** Comparison of Behaviour Towards Alcohol Consumption with the Sociodemographic Factors of Commercial Automobile Drivers

| | **Behavior** | | |
|---|---|---|---|
| | **Mean±SD** | **t/ANOVA** | **p-value** |
| Sex | | | |
| Male | 27.58±14.93 | 1.569 | 0.77 |
| Female | 35.86±15.30 | | |
| Age group (years) | | | |
| 18-24 | 24.13±19.73a | 3.958 | 0.004 |
| 25-35 | 27.35±13.39a | | |
| 36-49 | 26.99±12.34a | | |
| 50-64 | 27.68±18.09a | | |
| >65 | 40.79±26.50b | | |
| Religion | | | |
| ATR | 28.31±15.43a | 2.634 | 0.079 |
| Christianity | 28.53±14.33a | | |
| Islam | 26.87±15.31a | | |
| Marital status | | | |
| Single | 26.02±19.68a | 2.57 | 0.066 |
| Married | 27.79±14.59a | | |
| Widow/Widower | 21.23±10.63a | | |
| Divorced | 28.62±3.20a | | |
| Family structure | | | |
| Nuclear(Monogamy) | 26.56±15.07a | 7.837 | 0.001 |
| Nuclear(Polygamy) | 29.20±15.21b | | |
| Extended | 29.24±6.08b | | |
| Level of education | | | |
| Primary | 28.01±20.94a | 5.947 | 0.003 |
| Secondary | 27.11±12.74a | | |
| Tertiary | 32.70±16.23b | | |

*(P < 0.05 is considered)*

## Key Informant Interview

Most of the informants acknowledged that this occupation has been associated with several experiences that time would not permit to recount. Some however added that there were truly challenges but they have been able to surmount it one way or the other.

There was a mixed response on this among the respondents. While some opined there were no particular occupation-related health

concerns, some were quick to state the particular health concerns they have noticed. Most of the respondents who reported health concerns spoke with regards motorcycle users.

Most respondents did not acknowledge the prevalence of alcohol and herb consumption to be a menace among them. They rather reported individual reasons and preference for it.

Some of the respondents reported significant use of herbs for back pain and 'pile'. Again, most did not report the common variants of alcohol noted among them.

## Discussion

The aim was to study the epidemiology of alcoholic and herbal-based beverage consumption among commercial automobile drivers in Ibadan, the associated attitudes and behaviours, and the potential health-related risks. Across Ibadan metropolis, ten of the eleven local government areas (LGAs) were involved in this study and they were: Akinyele, Egbeda, Ibadan North-East, Ibadan North-West, Ibadan South-East, Ibadan South-West, Ido, Lagelu, Oluyole, and Ona Ara. Ibadan North, being the eleventh LGA in the city was not included in the final selection for the study because it was the randomly selected location for the pilot study required to validate the tools needed for this study. Commercial automobile drivers recruited for this study were evenly distributed by total population in the LGAs, each having 170 – 174 respondents. A total of 1,713 respondents participated in the study. The number of respondents for the Key Informant Interview (KII) were also evenly distributed; one notable individual per LGA within the automobile park – either as the chairman or an executive within the park.

### Socio-Demographic Factors and Substance Use

In this study, the respondents were mostly men (99.5%). This may not be a surprising demographic distribution as the transportation industry is often perceived as a male-dominated field. The predominance of the male gender in this profession may have been a significant factor on the current prevalence of alcohol and herbal drink consumption. The predominant age group of commercial automobile drivers in Ibadan from this study is 36 – 49 years. This is similar to findings from other major cities in the country: 40-49 years in Abuja, 15-55 years in Uyo, 20-49 years in Benin, mean age of 43.6 years in Lagos, and 43.3±5.2 years in Port-Harcourt.

Other sociodemographic variables particular to this study include most of the respondents are married (89.4%), in a nuclear monogamy setting (60.1%) and with secondary level of education (74.6%). This trend is similar to the findings from a study done within Ibadan five years earlier with 63% of them married and nearly 70% with secondary level of education [3].

Occupationally, our study suggests a slightly higher proportion of motorcycles as the predominant means of commercial transportation. Others include tricycles (also called *keke napep*), cabs as taxi (usually of the Nissan Micra brand) and then buses. A recent study in Oyo state has emphasized on the rise of commercial motorcycles as a means of transportation. Nearly half (44.7%) of those these commercial automobile drivers have been working for 5 – 10 years, working for about 9 – 16 hours per day, and for 4 -5 days per week. 35.9% of them earn 50,000 – 74,000 naira every week.

The two strongest and most significant factors associated with higher odds of alcohol consumption among commercial drivers are younger age (especially 18–24 years) and working very long hours (> 16 hours/day). Furthermore, the relationship with income appears U-shaped, with the highest odds of consumption found in the highest income bracket (>100,000 naira), but with the odds also higher in the high-income groups than the very low-income groups).

Unlike the alcohol model, work hours and occupation category had no statistically significant impact on herbal consumption. Whether a driver works <9 hours or >16 hours, it does not significantly change their likelihood of using herbs. There is no significant difference in herbal consumption between Tricycle, Bus, Cab, or Motorcycle drivers.

## Knowledge, Attitudes and Practices

Attitude of refers to an internal, subjective feeling, belief, or opinion that may influence behavior [8]. The behavior of alcohol and herb consumption among commercial automobile drivers may be influenced by their attitudes hence was studied using the questionnaire developed by Laura Gaines [9]. The attitude items were summed up as either positive or negative attitude. A bivariate Pearson correlation affirmed a significant inverse relationship between the sum positive and negative attitude ($r = -0.801$, $P < 0.001$) and was worth evaluating.

## Discussion by Objective

From this study, the current prevalence of alcohol consumption is 44.4% and its lifetime prevalence is 59.1%. This is lower than the prevalence of 67.2% observed in Ile-Ife [1], and 93.75% in Uyo [4]. This relatively significant difference may have been due to the variation in geographical cultural and socioeconomic factors. Also, it has been documented that Ibadan appears to have the lowest prevalence of harmful use of alcohol in Nigeria, while the highest prevalence was reported in Benin, Edo State. In Ibadan, Lasebikan found the prevalence of current alcohol drinkers to be 88.9%, and the prevalence of alcohol use disorder to be 39.5% [11]. This suggests a possibility of drastic reduction in the consumption of alcohol over the last decade. This possibility general reduction in alcohol intake has been reported by Adeloye in a recent systematic review [2].

Also noteworthy from this study is the fact that the most consumed alcohol type was gin. This practical surge in the consumption of gin among the respondents have been suggested to be due to the market strategy adopted by the gin making companies. The sub-Saharan Africa has been regarded as a target for market expansion by global alcohol producers [12]. Probably as part of the market expansion strategies, they now make gin available in very handy and cheap sachets. This is becoming a menace that has drawn the attention of the government. There is a plan to totally ban the production of alcohol in sachet by December 2025.

The most prevailing reasons for alcohol consumption among commercial automobile drivers in Ibadan are the need to feel relaxed especially after the day's work (46.5%) > the need for stimulation or motivation (42.4%) > in the moments of sadness (39.9%) > and in the moments of loneliness (33.6%). This finding is similar to that in Ile-Ife, a neighbouring town; where most respondents reported drinking after the day's work (74.5%), drinking in order to cope with frustration (33.6%), the need to boost morale (22.8%), among other reasons [1].

The consumption pattern of herbal drinks was also evaluated in the study. The current prevalence of herb consumption among commercial automobile drivers in Ibadan is 87.7%. This prevalence is similar to that reported by studies that 80% of the world population rely on traditional herbal medicine for primary health care [13; 18]. Apart from Ibadan South-East LGA, no other area in Ibadan had a prevalence less than 80%. This suggests a widespread use across board. Woo et.al. also added that there is a rising trend in the utilization of these herbal products globally.

Its consumption pattern presents a form of categorization, with the population of those consuming only water-based herbs being the highest (84.1%). 40.8% of the population consume alcohol-based herbal preparations and 14.6% of the respondents consume both types of common herbal preparations. Woo et. al.

however considered the commonly known branded herbs for their study, such as St. John's wort, Ginkgo biloba, Ginseng, Saw palmentto, Liquorice root, Echinacea, Kava, and Ma Huang [18]. Although less than half of the respondents consume alcohol-based herbs, and 14.6% consume both variants, this does not exclude the possibility of abuse. Studies have reported an emerging problem which is the abuse of herbal drugs. This is as a result of some intrinsic properties of the herbs exerting stimulating, psychedelic, sedative, euphoric and anticholinergic effects [14].

More than three-quarter of the respondents (77.7%) consume herbal preparations for health reasons. As revealed from the KII, the most common health complaints why herbal preparations are sought are back pain, pile and fever. Some of the respondents (30.4%) would actually prefer taking herbal medications to visiting a hospital for their health challenges. On further evaluation of why herbal preparations are favoured in this population, its use for multipurpose health prevention accounted for the most prevalent reason (23.9%). Other significant reasons were cost-effectiveness (12.4%), efficacy (11.6%) and its natural state (11.1%). From their study, Woo et. al. reported the use of herbal remedies primarily as dietary supplement for disease prevention due to the general belief that herbs are natural and intrinsically safe, and due to dissatisfaction with conventional medicine.

## Attitude and Behavior to their Health

Health attitudes were significantly associated with substance-use behavior. A strong inverse correlation was observed between positive and negative health attitudes ($r = –0.801$; $p < 0.001$), indicating internal consistency of attitudinal constructs. Alcohol consumption was primarily motivated by psychosocial factors, including the need for relaxation after work (46.5%), stimulation or motivation (42.4%), sadness (39.9%), and loneliness (33.6%). Similar coping-driven drinking patterns have been reported among drivers in Ile-Ife, where 74.5% reported drinking after work [1]. Herbal beverage use was largely perceived as health-promoting, with 77.7% of respondents consuming herbs for health reasons, and 30.4% preferring herbal treatment over hospital care, reflecting strong confidence in traditional medicine.

## Factors Associated with Attitude and Behaviors to Health

Multivariable analysis revealed that younger age (18–24 years) and working more than 16 hours per day were the strongest predictors of alcohol consumption. Income demonstrated a U-shaped relationship, with higher odds of alcohol use among both the highest income group (>₦100,000/week) and lower income groups, compared with middle-income drivers. Conversely, herbal beverage consumption was significantly associated with older age and lower-to-middle income levels (<₦75,000/week), while work hours and type of vehicle operated showed no statistically significant association. These findings suggest that alcohol use is more occupation-stress-related, whereas herbal use is more culturally and economically driven. Cultural preference alone accounted for 9.3% of reported reasons for herbal consumption.

## Limitations of the study

This study evaluates the cardiovascular impact of consuming alcohol and herb-based beverages among commercial automobile drivers within Ibadan. Ibadan is a metropolitan city and findings from this study may not reflect the pattern in sub-urban areas within the state or geopolitical zone. In other words, despite the randomization, the selection of this sample population may have introduced a selection bias into this study. Further studies would have to be undertaken to ascertain the pattern of cardiovascular impact among commercial automobile drivers in sub-urban or rural areas

or among other professions within the Ibadan metropolis.

Also, the relationships established in this study between cardiovascular parameters and the consumption of selected beverages may not be causal as could not be ascertained in a cross sectional design utilized at this time. Further studies and in-depth analyses may be required to ascertain these findings.

## Conclusion

This study provides important epidemiological evidence on the patterns, determinants, and health implications of alcohol and herbal-based beverage consumption among commercial automobile drivers in Ibadan, Nigeria. Alcohol use was moderately prevalent and was significantly associated with younger age and prolonged working hours, while herbal preparation use was highly prevalent and strongly influenced by income, age, and cultural preferences.

## Conflict of Interest Statement

The author declare no conflict of interest. This study was conducted independently, and no author received financial or material incentives that could bias the outcomes of this research.

## Ethical Approval Statement

Ethical approval was obtained from The Oyo State Ethical Review Board prior commencement of the research:

All participants provided informed consent, and confidentiality was strictly maintained.

## Author Contributions

**Adediran A.O:** Conceptualization, methodology, data analysis, manuscript drafting, final approval.

**Prof. Olaiya Abiodun:** Technical guidance, conceptual oversight, editing, and academic supervision.

**District and Facility Contributors:** Field data collection, validation, and logistics support.

All authors reviewed and approved the final manuscript.

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# Assessment of Food Hygiene and Safety Knowledge and Practices among Street Food Vendors in Mowe Town of Ogun State, Nigeria

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***Abstract***

*Street food is a major source of affordable cooked food in developing countries, including Nigeria, yet it remains a significant public health concern due to the risk of food borne illnesses. Poor food handling practices increase the likelihood of contamination with biological, chemical and physical hazards. This study assessed food hygiene and safety knowledge and practices among 103 street food vendors in Mowe town of Ogun State, Nigeria using a cross-sectional descriptive survey involving structured questionnaires and interviews. Most vendors (73.79 %) were females, and over half (54.37 %) were aged 18 to 35 years. Secondary education was the most common qualification (32.04 %), and (42.72 %) were married. The mean food hygiene and safety knowledge/awareness score was 69.42 %, while the mean food hygiene and safety practice score was lower at 54.53 %. Chi-square test ($\chi^2(1) = 0.71$, $p = 0.398$) showed no statistically significant association between knowledge/awareness and food handling practices, although this finding should be interpreted cautiously given the small proportion of respondents with inadequate awareness. The findings suggest that knowledge alone may not consistently translate into safe food handling practices, with implications for more targeted training for vendors and regulators, supported by enabling environments, supervision, compliance monitoring, and regulatory oversight. Strengthened intergovernmental collaboration may also support sustainable improvements in street food safety.*

***Keywords:*** *Enabling Environments, Foodborne Illness, Food Hygiene and Safety, Knowledge and Practices, Public Health, Street Food Vendor.*

## Introduction

People are affected daily by diseases that result from consumption of unhygienic and unsafe food. Adequate attention to good hygienic practices is critical to prevent and control such foodborne illnesses and diseases. In developing countries, food borne illnesses have become major concern particularly with increase in patronizing street food vendors [1]. Street foods are ready to eat foods and beverages that are sometimes prepared by vendors in the streets and other public places and sold on the street. They are accessible, affordable and have become the major source of food for most people, especially the low-income earners, the unemployed, students and government workers [2]. High demand for cheap, ready-to-eat food on the street, high unemployment and relatively cheap to operate, mostly using local technology, have compelled many people predominantly women in developing countries into street food business [2]. Not only are street foods valued for their convenience and affordability, but they also

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make a significant contribution to the country's economy, and the preservation of society's cultural and social heritage [3].

Most street food vendors have inadequate or no knowledge of food hygiene, sanitation and safety [4, 5] and often carry out their operations informally with little or no regulation by the government [1, 6]. Enforcement of and compliance with food laws in this business sector have always been a challenge due to many reasons including the informal nature of the street food business and lack of coordination in national food safety control system. The mode of operation of these vendors inevitably promotes contamination of street foods with transmissible pathogens and may severely impair the wholesomeness of street foods with the potential to cause significant food safety concerns to consumers. The activities of street food vendors have been linked to outbreaks of diarrhoea diseases in developing countries [4, 5]. In addition to unhygienic practices, street food vendors are mostly unaware of their personal health status and may be infected persons or carriers of transmissible pathogens, which can be transmitted via foods to unsuspecting consumers [4]. Regular medical screening for food vendors to identify infected vendors and carriers for treatment are often ignored by street food vendors due to ignorance, high cost and lack of commitment on the part of authorities to enforce food safety regulations, unlike vendors in formal/regulated institutions who are compelled to undergo medical examination and provide a certificate of fitness to operate.

Operating and vending sites for most street food vendors usually lack basic infrastructures such as potable water supply, handwashing facilities, waste disposal systems, and sanitary systems or toilets [6]. Some sites are located close to public toilets or dump sites, thereby encouraging rodent and insect infestation as well as feacal contamination. Dust, contaminated with exhaust fumes from vehicles and industrial machineries around vending sites is also source of chemical hazards such as poly aromatic hydrocarbons, lead and arsenic, some of which are known to be carcinogenic [7]. Cooked food is a good source of nutrients for pathogenic microbes [1] and the temperatures at which street foods are sold enhances the survival of the infective forms of food pathogens. Also, the climatic condition of the study area, with generally high temperatures encourages rapid proliferation of microbial pathogens in such foods.

Consequences of the unsafe practices among street food vendors have negative impact on the economy of developing countries. Scarce funds for socio-economic development are being expended on public health management for treating disease outbreaks that could have been prevented through the provision of safe foods [8].

Despite the obvious challenges highlighted above, there is dearth of data on the handling practices and the level of food safety knowledge among street food vendors in Nigeria, especially in the densely populated areas such as Mowe town, being considered in this study. On several occasions, especially through media, cases of microbial foodborne illnesses have been reported in these areas, such as the recent cholera outbreak in August 2021. Therefore, this study aims to assess the food hygiene and safety knowledge and practices among street food vendors in Mowe town of Ogun State, Nigeria to identify gaps and proffer interventions as a basis for formulation of a sustainable public health education programme for food handlers to make street food safe and reduce the spread of food-borne illnesses in the community.

## Materials and Method

### Study Area

Mowe is a town in Obafemi Owode local government of Ogun State in the Southwestern part of Nigeria, located along Lagos-Ibadan expressway. It is 512 km southwest of the Federal Capital Territory, and 29 km from

Lagos. It is located between latitude: 6°48'38"N and longitude: 3°26'11"E in a tropical savanna and wet climate. Temperatures in Mowe town range between 24 $^{o}$C and 32 $^{o}$C throughout the year. The area was chosen for this study because it is densely populated due to its proximity to the capital of Lagos State, Ikeja. It thereby offers a relatively cheap abode for people to live and work yet have easy access to the high-brow City Centre.

### Study Design

A cross-sectional descriptive study was conducted on street food vendors in Mowe town. The study was conducted in August 2021. For this study, street food vendors were defined as individuals selling ready-to-eat foods in open places whether mobile or in stationary locations along the streets or in public places. Other inclusion criteria were as stated below:

1. Vendors must be on the street, mobile or located in standard locations with temporary or permanent structures, and
2. Vendors must be selling any ready-to-eat food that does not require further processing by the consumer prior to consumption.

A total of 120 vendors found vending street foods were approached. The study was explained to the street food vendors, stating that participation was voluntary and some of those who gave their consent were randomly selected based on the inclusion criteria. Out of the total number of vendors approached, only 103 gave their consent to take part in the study. The study was conducted on same days that street food vendors were identified. No prior notification had been sent to the selected participants to inform them of the data collection exercise. Structured questionnaire on age, sex, marital status, educational background, knowledge, attitude and practices (KAP) in relation to food hygiene and safety was designed. The questionnaire designing process was guided by relevant information from previous literature and the guidelines provided by WHO [9] regarding street food vending hygiene and safety practices. The questionnaire was pretested and administered through a face-to-face interview.

### Data Analysis

Data obtained from the interview sessions were entered into Microsoft Excel 2013 edition for analysis including frequency, percentage, and association. Awareness level was assessed using six dichotomous (Yes/No) items capturing training and knowledge dimensions. Responses were coded as 1 for Yes and 0 for No and aggregated to generate an awareness score ranging from 0 to 6. Hygiene practices were measured using six dichotomous items, coded similarly and summed to produce a practice score ranging from 0 to 6. Scores were categorized to permit chi-square testing. Awareness and hygiene practice scores were categorized using a midpoint cut-off, with scores $\geq 3$ classified as adequate awareness or good hygiene practices and scores $< 3$ classified as inadequate or poor, consistent with common practice in KAP-based survey analyses. A chi-square test of independence was then conducted to examine the association between awareness category and hygiene practice category [10].

## Results and Discussion

### Demographic Characteristics

Randomly selected 103 respondents, who gave their consent, participated in the study. Table 1 below gives an overview of the demographic characteristics of the 103 respondents. Results revealed that female street food vendors were markedly more (73.79 %) than their male counterparts (26.21 %). Some other studies have confirmed the domination of women in street food vending business in Uganda [11], Nigeria [12], and Accra, Ghana [4, 13]. The sociocultural role of women in food preparation and serving comes into play and it is evident in the greater proportion of females engaged in street food vending business, in Benin City, Nigeria [14], in Ethiopia [15], and

in Uganda [11]. This agrees with the findings of Campbell-Lendrum and Corvalan [2]. Nevertheless, males have also dominated the street vending business in few countries such as Haiti [16] and Kenya [17]. In terms of the distribution by age, age group of 18 – 35 were found to be predominant (54.37 %), which implies that street food vending is an avenue for employment opportunity to the youth. This is like the findings of a study [18] where 50.00% of the food vendors in Nigeria were aged 25 – 35 years. Only about 3.88 % of the respondents were above the age of 50. Regarding the level of education, results showed that majority (32.04 %) were secondary school graduates, followed by categories without educational qualification (23.30 %). Similar finding has been recorded by Chukuezi [19]. This could be an indication of the inability to progress into tertiary institution because of poverty. However, some vendors had achieved educational qualification at the level of diploma (12.62 %) and degree (18.45 %), which may be because of high rate of unemployment. According to Campbell-Lendrum and Corvalan [2], high unemployment rates have forced many youths into street food vending business. Furthermore, most of the respondents were married (42.72 %), which reflects the burden of parenting and agrees with the findings of a previous study [13].

**Table 1.** Demographic Characteristics of Interviewed Street Food Vendors

| **Variables** | | **Frequency (n = 103)** | **Percentage (%)** |
|---|---|---|---|
| Gender | Male | 27 | 26.21 |
| | Female | 76 | 73.79 |
| Age | <18 | 25 | 24.27 |
| | 18 – 35 | 56 | 54.37 |
| | 36 – 50 | 18 | 17.48 |
| | >50 | 4 | 3.88 |
| Educational level | None | 24 | 23.30 |
| | Primary | 14 | 13.59 |
| | Secondary | 33 | 32.04 |
| | Diploma | 13 | 12.62 |
| | Degree | 19 | 18.45 |
| Marital status | Married | 44 | 42.72 |
| | Single | 27 | 26.21 |
| | Divorced/ Separated | 20 | 19.42 |
| | Widowed | 12 | 11.65 |

## Awareness on Hygiene and Safety Practices among Street Food Vendors

The awareness on hygiene and safety practices among the selected street food vendors were assessed and the results are outlined in Table 2 below. About 26.21 % of the vendors confirmed that they have been trained on food hygiene and safety, with majority (73.79 %) not having any training experience. The level of awareness among street food vendors on food hygiene and safety practices was poor. The result, in terms of the proportion of vendors that have undergone training on food hygiene and safety practices, aligns with the findings of a study [20] which indicated that in Nigeria, only a few street food

vendors were trained on good hygienic practices and only a few practiced good hygienic practices. Two studies [4, 5] also reported inadequate or no knowledge of food hygiene, sanitation and safety of street food vendors. However, 81.55 % admitted that they are aware that safe food handling is an important aspect in food vending business. Assessment of their knowledge on proper hand washing (before cooking; after handling raw foods and before handling cooked foods) and food borne disease prevention revealed that 23.30 % of the vendors were ignorant of the relationship between proper hand washing (before cooking; after handling raw foods and before handling cooked foods) and incidence of food borne diseases while majority 76.70 % reportedly have this understanding. Similar trend was observed on the assessment of their knowledge regarding food handlers being source of food borne infections/outbreaks, though with slightly higher percentage (30.10 %) being ignorant of this fact. According to the findings from the studies [4, 5], activities of street food vendors have been linked to outbreaks of diarrhoea diseases in developing countries. One of the studies [4] noted that street food vendors can be ignorant of their health status thereby transmitting pathogens via foods to unsuspecting consumers. Notwithstanding, the highest percentage in this category was observed for the knowledge that raw foods should be separated from cooked foods to prevent contamination as only 15.53 % were ignorant of this. On the need for careful selection of raw materials for safe food preparation, 77.67 % were aware while 22.33 % opined that selection of raw materials was not a critical consideration.

## Food Handling Practices among Street Food Vendors

Some food hygiene and safety practices adopted by the street food vendors were also assessed and the results are shown in Table 3. Only 43.69 % of respondents had a license for operation while the rest (over 50 %) were not licensed. Worse still, only 26.21% had food handler's certificate, which implies that even those licensed do not comply with all stipulated requirements to operate the business; although, 59.22 % claimed to have checked their health status before commencing the vending business as against 40.78 % who did not. These findings agree with the report of other three studies [1, 6, 13] that food vending operations were done informally with little or no regulation by the government. Although 76.70 % of respondents demonstrated awareness that hand washing (before cooking; after handling raw foods and before handling cooked foods) is vital for foodborne disease control in Table 2, this awareness was not uniformly reflected in practice, with lower adherence observed for hand washing after handling raw foods and before handling cooked foods (54.37 %) compared with handwashing before cooking (82.53 %). About 17.48 % of the vendors admitted to not washing their hands before cooking and even higher proportion (45.64 %) do not wash hands after handling raw foods and before handling cooked foods. Poor handwashing practice was also observed among street food vendors in Addis Ababa, Ethiopia [21-23]. Furthermore, only 38.83 % of the vendors would avoid work when having diarrhoea and/or other health conditions such as vomiting, sores and cuts, while about 61.17 % would still provide the vending services even when sick.

**Table 2.** Level of Awareness on Food Hygiene and Safety Practices among Respondents

| Variables[1] | Yes | | No | |
|---|---|---|---|---|
| | Frequency | Percentage (%) | Frequency | Percentage (%) |
| Have you received any training on food hygiene and safety? | 27 | 26.21 | 76 | 73.79 |
| Are you aware that safe food handling is an important aspect in food vending business? | 84 | 81.55 | 19 | 18.45 |
| Are you aware that proper hand washing (before cooking; after handling raw foods and before handling cooked foods) can prevent food borne diseases? | 79 | 76.70 | 24 | 23.30 |
| Are you aware that food handlers can be a source of food borne infections/outbreaks? | 72 | 69.90 | 31 | 30.10 |
| Are you aware that raw and cooked foods should be stored separately? | 87 | 84.47 | 16 | 15.53 |
| Are you aware that you should carefully select raw materials for safe food preparation? | 80 | 77.67 | 23 | 22.33 |

## Relationship between Level of Awareness and Hygiene Practices

Table 4 presents the association between awareness / knowledge of street food vendors and their food handling practices. Out of the 94 vendors with adequate awareness, 72 (76.6%) demonstrated good practice compared with 8 out of 9 vendors (88.9%) with inadequate awareness. The chi-square test indicated that this difference was not statistically significant, $\chi^2$ (1, N = 103) = 0.71, p = 0.398. Although over three-quarters of vendors with adequate awareness demonstrated good practices, a trend that agrees with previous studies linking training and food safety knowledge to better hygiene behaviour [24-26], the statistical analysis in this study did not show a significant association between awareness and actual practice.

**Table 3.** Food Handling Practices among Street Food Vendors

| Variables[2] | Yes | | No | |
|---|---|---|---|---|
| | Frequency | Percentage (%) | Frequency | Percentage (%) |
| Have you been issued a license for operation? | 45 | 43.69 | 58 | 56.31 |
| Do you have food handler's certificate? | 27 | 26.21 | 76 | 73.79 |
| Did you check your health status before starting food vending business? | 61 | 59.22 | 42 | 40.78 |

[1] Mean score: Yes – 69.42 %; No – 30.58 %
[2] Mean score: Yes – 54.53 %; No – 45.47 %

| | | | | |
|---|---|---|---|---|
| Do you wash your hands before cooking? | 85 | 82.52 | 18 | 17.48 |
| Do you wash your hands after handling raw foods and before handling cooked foods? | 56 | 54.37 | 47 | 45.63 |
| When suffering from sickness such as diarrhoea, vomiting, sores and cuts do you still cook at the vending sites? | 63 | 61.17 | 40 | 38.83 |

Although no statistically significant association was observed between awareness and hygiene practices, this finding should be interpreted with caution. The number of participants classified as having inadequate awareness was relatively small, which may have limited the statistical power to detect a meaningful association. Consequently, the absence of statistical significance does not necessarily indicate the absence of a true relationship between awareness and hygiene practices. This suggests that while improved awareness and training may contribute to better practices in some contexts, they may not independently predict practice among the vendors assessed. Rather, the finding indicates that food safety awareness alone may not translate into a better food handling practices or behaviour among street food vendors and supports previous studies showing that knowledge alone is insufficient to change food safety behaviour [27, 28]. It also aligns with evidence that structural barriers, such as inadequate access to clean water, limited infrastructure, and economic constraints, may impede the application of food safety knowledge [29].

**Table 4.** Relationship between Awareness Level and Hygiene Practices among Street Food Vendors (N=103)

| **Awareness Category** | **Good Practice (n)** | **Poor Practice (n)** | **Row Total** |
|---|---|---|---|
| **Adequate** | 72 | 22 | 94 |
| **Inadequate** | 8 | 1 | 9 |
| **Column Total** | 80 | 23 | 103 |

$\chi^2$ (1, N = 103) = 0.71, p = 0.398

## Conclusion and Recommendations

Females within the age group of 18 – 35 years dominate street food vending business in Mowe town of Ogun State, Nigeria. Their food hygiene and safety knowledge, and practices were poor. Although food vendors in this study demonstrated generally adequate levels of food safety awareness, this knowledge did not translate into significantly better food handling practices. Therefore, knowledge alone is insufficient to drive behavioural change. Structural barriers, including limited access to clean water, inadequate infrastructure, and economic pressures, may impede the practical application of food safety knowledge, even when awareness is high [29]. Furthermore, KAP studies consistently highlight gaps between what vendors know and what they do, underscoring that effective improvement in food handling behaviour requires more than training; it demands supportive environments, continuous supervision, and strong regulatory enforcement [10]. Consequently, interventions should combine education and sensitization with practical, context-specific measures that address environmental constraints and support sustained behaviour change among street food

vendors. While this study did not directly assess policy or regulatory systems, the observed gaps between awareness and hygiene practices have important implications for street food safety interventions and regulation. These findings suggest the potential value of sustained collaboration among international, regional, governmental, and non-governmental organizations in supporting the effective implementation of food safety policies and the delivery of more tailored training programmes. Such collaborations may contribute to strengthening intervention programmes through regular funding and human resource support, informed by evidence from research. In addition, the results indicate that public awareness strategies such as media jingles, road shows, and town hall meetings could be particularly important for reaching semi-rural and rural communities, including settings such as Mowe town. The findings also underscore the potential role of adequately trained environmental health officers and other regulators in facilitating training, monitoring compliance, and supporting enforcement. However, these implications highlight the need for balanced and well-coordinated approaches that avoid over-regulation of street food vendors. Finally, the study suggests that the availability and accessibility of information, education, and communication materials on food hygiene and safety may support reinforced learning among street food vendors.

## Limitations

The categorization of awareness and hygiene practice scores using a midpoint cut-off ($\geq 3$), while commonly applied in KAP studies, may have resulted in some loss of information and limits direct comparison with studies employing alternative or validated scoring approaches. Also, the small proportion of participants in the inadequate awareness category may have reduced the power of the analysis, limiting the ability to detect statistically significant associations between awareness and hygiene practices.

## Ethical Approval

This study was based on primary data obtained through structured questionnaires and interviews. It was guided by ethical principles of integrity, transparency, confidentiality, and informed consent. Participants' informed consent was obtained and confidentiality maintained.

## Data Availability

The data that support the findings of this study are available from the corresponding author upon credible request, due to the confidentiality principle.

## Author Contributions

Corresponding author, Modupe Adeyemo conceptualized and designed the study, collected and analyzed the data, interpreted the results, and drafted the manuscript. Both authors, Modupe Adeyemo and Yemisi Jeff-Agboola reviewed the manuscript and approved the final version for submission.

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## Conflict of Interest

There is no conflict of interest.

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# Implementing Digital Health Transformation in Zambia: A Case Study of Data Governance and Interoperability (2021–2025)

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***Abstract***

*Digital health systems are central to achieving Universal Health Coverage in low- and middle-income countries, yet many national implementations remain fragmented, donor-driven, and weakly governed. This study examines Zambia's digital health transformation between 2021 and 2025, with a specific focus on interoperability and health data governance. Using a government-led case study approach, the research evaluated four core national platforms: SmartCare Pro, the National Health Insurance Management Authority system, the Zambia Medicines and Medical Supplies Agency system, and the National Data Warehouse. A convergent mixed-methods design combined system performance logs, interoperability testing, stakeholder surveys, document reviews, and governance compliance audits. Findings demonstrate a 78 percent national data exchange success rate, over 90 percent facility-level compliance with the Data Protection Act, and an average system usability score of 3.7 out of 5. The study shows that the implementation of a national Interoperability Architecture Framework and Health Data Governance Framework significantly improved system integration, accountability, and evidence-based decision-making. The results contribute practical implementation evidence for low- and middle-income countries seeking to transition from fragmented digital health investments to sustainable, government-owned, interoperable health information ecosystems.*

***Keywords:*** *Data Governance, Digital Health, Health Information Systems, Interoperability, SmartCare Pro, Zambia.*

## Introduction

Digital transformation has become a strategic imperative for strengthening health systems globally, particularly in low- and middle-income countries (LMICs) where resource constraints, workforce shortages, and service delivery challenges persist. Digital health interventions including electronic health records, health information exchanges, analytics platforms, and digital registries are increasingly recognized as foundational enablers of Universal Health Coverage, health system resilience, and evidence-based policymaking. The COVID-19 pandemic further exposed the limitations of paper-based and fragmented digital systems, reinforcing the need for interoperable, secure, and real-time health information infrastructures.

Digital health is increasingly recognised as a catalyst for strengthening health systems by improving data availability, accountability, and evidence-based decision-making, particularly in low- and middle-income countries. [4] In sub-Saharan Africa, fragmented health information systems and limited interoperability have historically constrained the effective use of routine health data for planning, financing, and service delivery. [5] These systemic challenges provided the context within which Zambia embarked on a comprehensive digital health reform agenda

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focused on interoperability and data governance.

In many LMICs, digital health investments have evolved through vertical, donor-funded projects that prioritize program-specific reporting over system-wide integration. This approach has resulted in fragmented architectures, duplicated data collection, limited data reuse, and weak national ownership. Governance gaps particularly in data protection, accountability, and standards enforcement have further constrained the effective use of digital health systems for planning, financing, and performance management.

Zambia presents a distinctive and policy-relevant case of national digital health reform. Between 2021 and 2025, the Ministry of Health undertook a deliberate transition from donor-driven, siloed systems toward a government-led, standards-based digital health ecosystem. This transition was anchored in national policy instruments, legal reforms, and institutional governance mechanisms aligned with global best practices. Central to this reform agenda were the redevelopment of the SmartCare electronic health record into SmartCare Pro, the establishment of a national interoperability layer guided by open standards, and the operationalization of a comprehensive Health Data Governance Framework anchored in the Data Protection Act.

This study evaluates how these government-led interoperability and governance reforms influenced digital health system performance, regulatory compliance, usability, and decision-making across Zambia's public health sector. By documenting Zambia's experience through an implementation science lens, the study contributes empirical evidence to the global discourse on sustainable digital health transformation in LMICs. The conceptual and strategic alignment between global digital health principles, national policy instruments, and implementation outcomes guiding this study is illustrated in Figure 1.

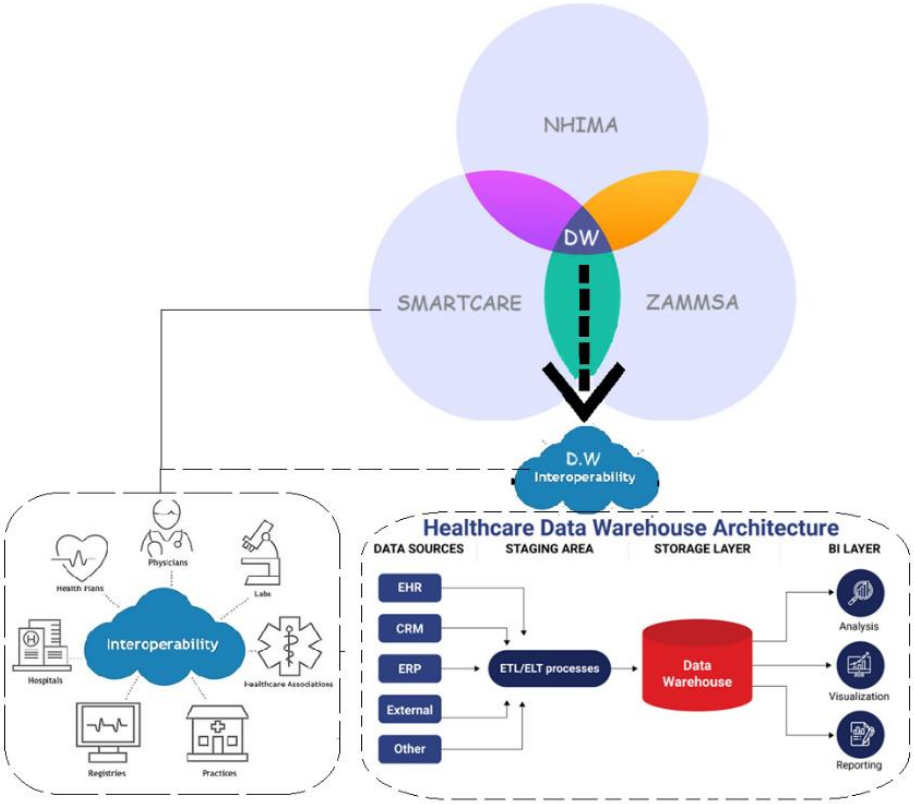


**Figure 1.** Conceptual and Strategic Framework for Digital Health Transformation in Zambia.

## Methods

This study adopted a government-led case study design grounded in implementation science to evaluate Zambia's national digital health transformation between 2021 and 2025. The convergent mixed-methods design adopted in this study enabled integration of quantitative and qualitative findings in line with established mixed-methods research principles.[15] This design enabled triangulation of findings related to interoperability performance, governance compliance, and system usability across multiple data sources.

### Study Design and Context

The case study focused on the Ministry of Health as the central coordinating authority for digital health implementation in Zambia. The reform period coincided with implementation of the Digital Health Strategy 2022–2026 and operationalization of the Interoperability Architecture Framework and Health Data Governance Framework. Four core national platforms underpinning Zambia's digital health ecosystem were examined: SmartCare Pro, the National Health Insurance Management Authority system, the Zambia Medicines and Medical Supplies Agency system, and the National Data Warehouse. The functional roles and data domains of these platforms within the national interoperability architecture are summarized in Table 1.

**Table 1.** Core National Digital Health Systems and their Primary Functions

| Digital Health System | Primary Function | Key Data Domains | Role in Interoperability Architecture |
|---|---|---|---|
| SmartCare Pro | National electronic health record | Patient demographics, clinical encounters, diagnoses, treatments | Primary source of facility-level clinical data |
| NHIMA System | Health insurance claims management | Claims, provider accreditation, service utilization | Financial data exchange and reimbursement validation |
| ZAMSA System | Medical supply chain management | Medicines, commodities, inventory levels | Logistics and supply data integration |
| National Data Warehouse | National analytics and reporting | Aggregated clinical, financial, and logistics data | Central analytics, dashboards, and decision support |

The standards-based interoperability architecture enabling data exchange across these platforms is presented in Figure 2.

Figure 2 illustrates the standards-based interoperability architecture underpinning Zambia's digital health systems. Clinical, financial, and supply chain platforms exchange data through a central interoperability services layer using HL7 FHIR and OpenHIE standards. The architecture enables secure messaging, authentication, mediation, and harmonised data flow into the National Data Warehouse to support analytics and decision support.

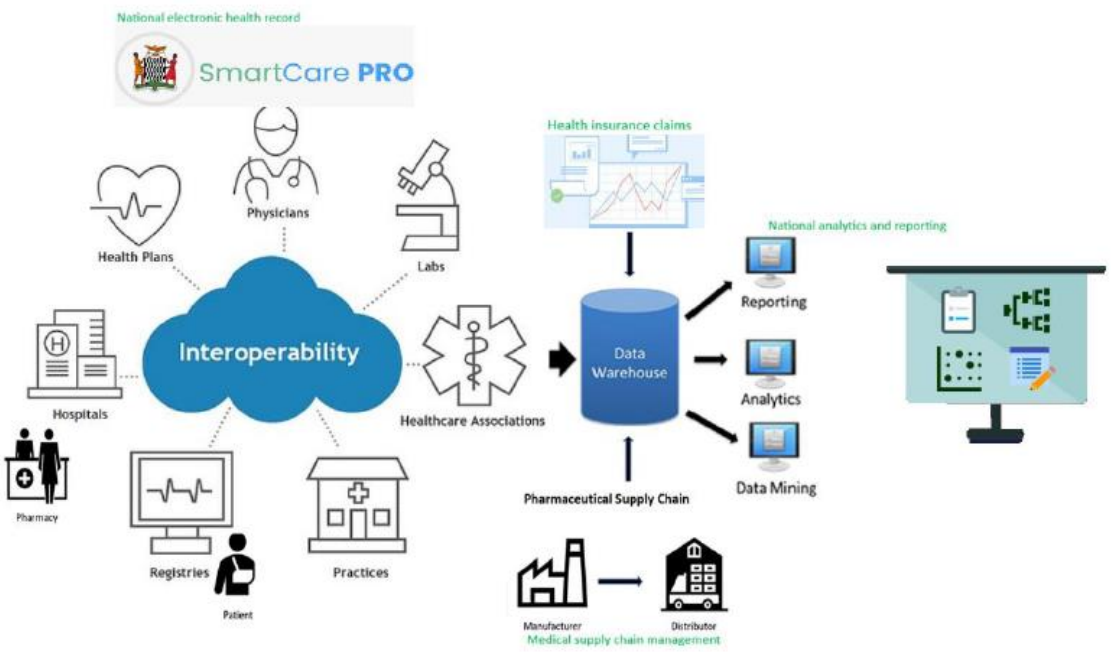


**Figure 2.** National Interoperability Architecture Framework.

## Study Design and Context

The case study focused on the Ministry of Health as the central coordinating authority for digital health implementation in Zambia. The reform period coincided with implementation of the Digital Health Strategy 2022–2026 and operationalization of the Interoperability Architecture Framework and Health Data Governance Framework [9-11]. The study examined four core national platforms that collectively underpin Zambia's digital health ecosystem: SmartCare Pro, the National Health Insurance Management Authority system, the Zambia Medicines and Medical Supplies Agency system, and the National Data Warehouse.

These platforms were selected because they represent the primary clinical, financial, logistics, and analytics components of the national digital health architecture. Data exchange across these systems is enabled through a standards-based interoperability layer aligned with international health information exchange principles, including HL7 FHIR and OpenHIE architectural patterns [6, 13, 14]. The functional roles and data domains of these platforms within the national interoperability architecture are summarized in Table 1.

## Data Sources

Data were collected from four primary sources. First, system logs and interoperability exchange reports were extracted from SmartCare Pro, the National Health Insurance Management Authority system, the Zambia Medicines and Medical Supplies Agency system, and the National Data Warehouse to quantify data exchange performance, completeness, and timeliness. Second, structured surveys were administered to healthcare workers, system administrators, and policy stakeholders across facility, district, and national levels to assess perceived usability, system effectiveness, and digital literacy. Third, key informant interviews were conducted with Ministry of Health officials, ICT specialists, and development partners to capture contextual insights on governance arrangements, implementation challenges, and institutional coordination mechanisms. Fourth, policy, legal, and technical documents including national strategies, interoperability standards, and governance compliance tools were

systematically reviewed to contextualize implementation processes and outcomes [9-11].

### Data Analysis

Quantitative data were analyzed using descriptive statistics to assess interoperability success rates, governance compliance levels, and system usability scores. Interoperability performance indicators included successful message exchange rates, system availability, and data completeness, consistent with established digital health monitoring practices [1, 3]. Governance compliance was evaluated against statutory requirements and operational governance instruments derived from the Data Protection Act and national governance frameworks [9, 11].

System usability was assessed using standardized usability constructs commonly applied in health information systems research, drawing on established models of perceived usefulness and ease of use [16, 17]. Qualitative data from interviews and open-ended survey responses were thematically analyzed to contextualize quantitative findings, identify implementation barriers and enablers, and support interpretation of system performance within the broader institutional and policy environment.

## Results

Table 2 presents a consolidated summary of interoperability performance, governance compliance, and system usability indicators observed across the core national digital health platforms during the study period.

**Table 2.** Summary of Interoperability Performance, Governance Compliance, and System Usability

| Performance Domain | Indicator | Aggregate Result |
|---|---|---|
| Interoperability | Successful data exchange rate | 78 percent |
| Governance | Facility-level compliance with Data Protection Act | >90 percent |
| Usability | Mean system usability score | 3.7 / 5 |
| Analytics | Availability of real-time dashboards | Implemented nationally |
| Decision Support | Use of data for planning and monitoring | Reported at facility, district, and national levels |

### Interoperability Performance

Interoperability testing demonstrated a 78 percent successful data exchange rate across core national platforms. Integration between SmartCare Pro and the National Data Warehouse enabled near real-time aggregation of clinical and programmatic data, reducing reporting delays and improving data availability for planning and monitoring.

### Governance and Compliance

The alignment between technical interoperability mechanisms and data governance controls underpinning Zambia's digital health reforms is illustrated in Figure 3.

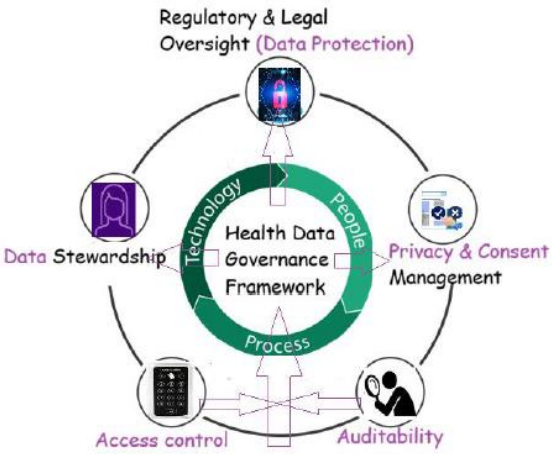


**Figure 3.** Alignment of Interoperability Architecture and Health Data Governance Frameworks.

This figure depicts the national health data governance framework guiding the ethical, secure, and accountable use of digital health data in Zambia. It highlights governance domains including data stewardship, access control, privacy protection, auditability, and regulatory oversight, aligned with national data protection requirements. Governance audits indicated over 90 percent compliance with key provisions of the Data Protection Act at facility level. introduction of formal data stewardship roles, access controls, and audit mechanisms strengthened accountability and reduced unauthorized data access.

## System Usability

The mean system usability score across platforms was 3.7 out of 5. Facilities with stronger infrastructure and digital literacy reported better usability outcomes.

## Decision-Making and Health Intelligence

The end-to-end pathway through which facility-level digital health data are transformed into analytics and policy decisions is summarized in Figure 4.

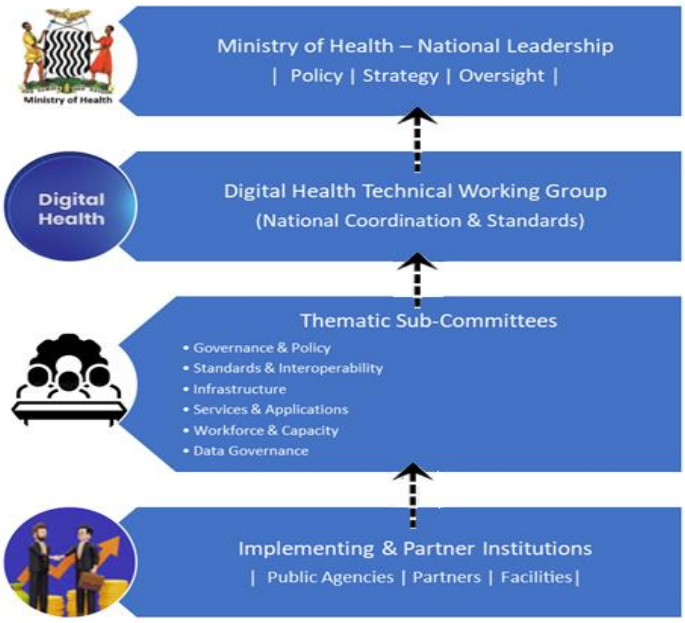


**Figure 4.** Digital Health Data-to-Decision Pathway Supporting Evidence-Based Decision-Making

This figure shows the institutional governance and coordination arrangements supporting digital health implementation in Zambia. It illustrates national leadership, technical coordination mechanisms, and stakeholder engagement structures that oversee interoperability, standards, compliance, and sustainability of digital health systems.

### Top–Down Governance Flow

This figure answers "Who leads, who coordinates, and who implements digital health?"

It uses four levels only, with clear vertical authority and coordination lines.

**Level 1 – Ministry of Health (National Leadership)**

**Single Point of Authority**

1. Sets national digital health policy
2. Provides strategic direction
3. Ensures regulatory oversight.

**Level 2 – Digital Health Technical Working Group (DHTWG)**

**Bridge between Policy and Practice**

1. National coordination mechanism
2. Harmonises standards and investments
3. Oversees implementation alignment

**Level 3 – Thematic Sub-Committees**

**Technical Depth Without Fragmentation**

Each sub-committee focuses on a specific pillar of digital health:

1. Leadership, governance, investment & sustainability
2. Standards and interoperability
3. Infrastructure
4. Services and applications
5. Workforce and capacity development
6. Data governance

**Level 4 – Implementing & Partner Institutions**

**Execution and Service Delivery Level**

1. Government agencies
2. Health facilities
3. Cooperating and implementing partners

## Discussion

This study examined Zambia's digital health transformation between 2021 and 2025, with emphasis on interoperability and data governance across national platforms. The findings indicate that deliberate, government-led reforms can improve system integration, governance compliance, and evidence-informed data use in low- and middle-income country contexts. Zambia's experience underscores the importance of aligning technical architecture with institutional and regulatory reforms to achieve sustainable digital health outcomes [1, 2, 9].

### Interoperability as a Foundation for Health System Integration

The staged progression observed in Zambia's interoperability maturity is consistent with international digital health maturity models that emphasise incremental alignment of technical, organisational, and governance capabilities European Commission 2020 [7]. The establishment of a national interoperability architecture and supporting governance mechanisms positioned Zambia to progress along recognised digital health maturity pathways.

The observed improvements in data exchange across SmartCare Pro, the National Data Warehouse, insurance, and supply chain systems demonstrate the value of a nationally coordinated interoperability approach. Rather than relying on point-to-point integrations, Zambia's adoption of a structured interoperability architecture enabled multiple systems to exchange data through standardized interfaces, reducing fragmentation and improving coherence of the national health information ecosystem [3, 6, 10, 14].

Comparable experiences in other settings show that interoperability gains are more sustainable when embedded within national strategies and supported by formal governance

structures. Zambia's progress aligns with broader evidence that open standards, shared architectural patterns, and national coordination mechanisms are critical for scaling digital health solutions beyond individual programmes. [1, 3, 14, 20] Nonetheless, performance disparities between facility types suggest that infrastructure variability and workforce constraints continue to influence interoperability outcomes and should be addressed as part of scale-up. [2, 20] Regional implementation experiences further demonstrate that integration of DHIS2 and other national platforms is most successful when guided by national interoperability frameworks and institutional governance mechanisms [30].

## Strengthening Data Governance and Trust

Effective data governance requires clearly defined stewardship roles, accountability mechanisms, and enforcement structures that extend beyond technical controls to organisational and institutional arrangements. [8] The findings indicate advances in governance maturity, particularly related to regulatory compliance, access control, and accountability mechanisms. Operationalization of national data protection requirements across core digital platforms improved clarity on roles, responsibilities, and data-sharing practices, contributing to institutional trust in digital systems and strengthening the enabling environment for secure data exchange [9, 11, 20].

However, governance implementation remains uneven, especially at lower levels of the health system. Similar patterns are reported in other LMIC contexts where governance frameworks exist but are not fully institutionalized due to capacity constraints, inconsistent supervision, or insufficient change management. [2, 20, 25] Zambia's experience suggests that governance reforms require sustained investments in capacity building, supportive supervision, and practical tools for compliance monitoring to ensure consistent application across all facilities [11, 20].

## User Adoption and System Usability

Positive user perceptions of system usability reflect the benefits of designing digital platforms around end-user needs. Improvements in navigation, reporting, and modular functionality likely contributed to greater acceptance of SmartCare Pro compared to earlier system iterations. These findings are consistent with technology adoption literature, which emphasizes perceived usefulness and perceived ease of use as key determinants of sustained system utilization. [16, 17]. Patterns of system adoption observed across facilities align with diffusion of innovation theory, which highlights the roles of perceived advantage, compatibility, and organisational readiness in influencing technology uptake [18].

Despite these improvements, challenges related to system performance, infrastructure reliability, and user support highlight the limits of technical design alone. Without stable connectivity, power resilience, and responsive technical assistance, usability gains may not translate into consistent routine use. Variability in usability outcomes across facilities reflects broader differences in eHealth readiness, including infrastructure availability, human capacity, and institutional support. [19] This supports the need for integrated digital health strategies that treat infrastructure strengthening and workforce development as co-requisites for effective digital system adoption. [2, 20].

## From Data Availability to Data Use

The increased availability of integrated data and analytics tools enhanced data use for planning and oversight, particularly at national and provincial levels. Consolidated dashboards supported more timely review of performance indicators and strengthened evidence-informed decision-making. This shift represents an important step toward data-driven health

system management and performance accountability [1, 2].

At facility level, data use remained variable, reflecting a common gap in LMIC health systems between data availability and data utilization. Organizational culture, feedback loops, supervisory expectations, and local decision space influence whether data are used routinely for improvement. Zambia's experience suggests that technical integration should be complemented by deliberate interventions to strengthen a culture of data use, including targeted training, routine review meetings, and leadership engagement [2, 20].

### Implications for Digital Health Implementation in LMICs

Global benchmarking exercises indicate that countries with strong government stewardship, interoperable architectures, and enforceable governance frameworks consistently achieve higher levels of digital health maturity. [12] Zambia's digital health transformation yields several lessons for LMICs pursuing similar reforms. First, government leadership and ownership are critical for coordinating stakeholders and aligning digital investments to national priorities. [1, 2] Second, interoperability and data governance should be treated as foundational system functions rather than afterthoughts, supported by open standards and enforceable governance mechanisms. [3, 10, 11, 14] Third, sustained attention to infrastructure, workforce capacity, and change management is essential to translate technical integration into measurable health system improvements and consistent service-delivery benefits [2, 20].

Comparable national experiences from Kenya, Rwanda, and South Africa demonstrate that digital health transformation is most effective when anchored in government leadership, open standards, and sustainable financing mechanisms. [21-24] Global analyses of digital health systems similarly indicate that countries with well-defined governance frameworks and interoperability strategies consistently achieve higher levels of digital health maturity and system sustainability Global Digital Health Index 2022; Digital Square 2022.

Similar standards-based digital health architectures have been adopted in countries such as Bangladesh, India, Peru, and Brazil, reinforcing the global relevance of interoperability-led digital health reform [26-29] Cross-country case studies presented at global digital health forums highlight that interoperability, governance, and institutional capacity are recurring determinants of successful digital health transformation [31].

## Conclusion

This study examined Zambia's digital health transformation between 2021 and 2025 through a national case study focused on interoperability and data governance. The findings demonstrate that deliberate, government-led reforms can improve the integration, governance, and use of digital health systems in low- and middle-income country settings [1, 2, 9].

Recent analyses of digital transformation in health systems emphasise that sustained value creation depends on aligning digital technologies with governance, organisational processes, and decision-making structures Shen et al. 2023 [32].

Zambia's experience shows that interoperability architectures and data governance frameworks are not merely technical instruments; they are core components of health system strengthening. When combined with institutional reforms, workforce development, and supportive infrastructure, these elements can enable more effective use of health information for planning, financing, monitoring, and service delivery [2, 10, 11, 20].

While challenges remain—particularly in extending governance maturity and routine data-use practices to all facility levels—the

progress achieved during the study period represents a substantial step toward a more coherent and resilient digital health ecosystem. The lessons documented in this article contribute to digital health implementation science and provide practical guidance for countries pursuing sustainable, interoperable, and secure digital health transformation [1, 2, 20].

Integrated dashboards and analytics platforms improved evidence-based decision-making at facility, district, and national levels. Decision-makers reported improved confidence in data reliability, timeliness, and analytical relevance.

## Conflict of Interest

The author declares no conflict of interest.

## Ethical Approval

Ethical approval for this study was obtained through relevant institutional and governmental review mechanisms within the Ministry of Health, Zambia.

## Data Availability

Data supporting the findings of this study are available from the Ministry of Health, Zambia, subject to data protection regulations and reasonable request.

## Author Contributions

The author conceptualized the study, led data collection and analysis, developed the interoperability and governance frameworks, and prepared the manuscript.

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# Analysis of Characteristics and Management of Vascular Access in Patient on Hemodialysis at a Private Facility in Botswana: A Retrospective Study Conducted at Sidilega Private Hospital

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***Abstract***

*End-stage renal disease (ESRD) imposes a growing global burden, with haemodialysis as the primary therapy and vascular access recognized as its critical "lifeline." Arteriovenous fistulae (AVFs) provide the best outcomes, whereas central venous catheters (CVCs) carry markedly higher risks of infection, thrombosis, and mortality. In sub-Saharan Africa, late referrals and limited surgical capacity contribute to heavy catheter dependence, yet data from Botswana remain scarce. This retrospective cohort study evaluated 273 haemodialysis patients at Sidilega Private Hospital (Gaborone, Botswana) from February 2022 to February 2024 to describe vascular access patterns, complications, and predictors of adverse outcomes. Demographic, clinical, and procedural variables were collected from dialysis and theatre records and analyzed using descriptive and multivariable statistical methods. The cohort had a mean age of 48.6 years and was 59% male. Hypertension and cardiovascular disease were highly prevalent (each >80%), and 27.4% of patients presented with sepsis on admission. AVFs were created in 72.2% (197/273) of cases; however, 44.2% had prior catheter-based access, demonstrating persistent reliance on temporary access modalities. Complications included stenosis (35.2%), thrombosis (19.0%), and infection (14.7%). Access type emerged as the strongest predictor of complications: compared with AVFs, arteriovenous grafts (AVGs) showed significantly higher odds (OR ≈13.2) and CVCs moderately higher odds (OR ≈6.7) of any complication. Despite the complexity of cases, overall patency at discharge exceeded 95%, and in-hospital mortality was low (2.2%). These findings highlight continued dependence on catheter-based access and reinforce AVFs as the safest modality. Early nephrology referral, structured vascular access programs, and national AVF targets are essential to improve outcomes and align Botswana's practice with global standards.*

***Keywords:*** *Hemodialysis, Sidilega Private Hospital, Vascular Access.*

## Introduction

### Background and Importance of the Topic

End-stage renal disease (ESRD) is a growing global health challenge, affecting over 850 million people. Haemodialysis remains the predominant therapy for ESRD, but its success depends largely on the effectiveness and reliability of vascular access. Among the three main types of access—arteriovenous fistulas (AVFs), arteriovenous grafts (AVGs), and central venous catheters (CVCs)—AVFs are globally recognized as the gold standard due to their superior patency and lower complication rates.

Despite international guidelines favoring AVFs, patients in many low- and middle-

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income countries, including those in sub-Saharan Africa, disproportionately initiate dialysis using catheters. This is largely due to late nephrology referrals, limited access to vascular surgery, and under-resourced healthcare systems. The over-reliance on catheters in such settings leads to elevated risks of infection, thrombosis, and even mortality.

The Kidney Disease Outcomes Quality Initiative (KDOQI) has moved from a "fistula-first" model to a more individualized, patient-centered approach: “the right access, in the right patient, at the right time.” However, data from Botswana to assess how these principles are applied—or to evaluate outcomes associated with different vascular access types are lacking.

### Statement of the Problem

There is currently no published data on the patterns, outcomes, and complications of haemodialysis vascular access in Botswana. Without such data, there are critical gaps in understanding whether patients are receiving optimal access care, what types of complications are most prevalent, and which clinical practices may be contributing to access failures. This prevents the development of informed strategies to improve outcomes, reduce avoidable complications, and guide resource allocation.

### Justification of the Study

This study is justified by both global imperatives and local needs. Internationally, improving access outcomes is a priority to reduce infection rates, healthcare costs, and mortality. Sub-Saharan Africa has been highlighted as a region in dire need of context-specific research to inform evidence-based practice. Studies from Nigeria, South Africa, and Cameroon have revealed high catheter dependency and access-related infections—trends that could be present in Botswana but remain undocumented.

Locally, Botswana’s ESRD population is growing, driven by an increase in non-communicable diseases such as diabetes and hypertension. Sidilega Private Hospital serves as one of the country’s few centers offering specialized access creation and maintenance. Studying patient demographics, access types, surgical outcomes, and complication rates at this facility provides critical insights into the current state of vascular access care in Botswana.

The findings can:

1. Benchmark local practices against international standards.
2. Identify specific gaps in access creation and maintenance (e.g., delayed AVF referrals, high infection rates among others).
3. Provide a foundation for national policy and resource planning (e.g., need for more vascular surgeons or patient education programs).

### Conclusion

This research is essential for informing vascular access policy, improving patient care, and contributing to the under-researched domain of dialysis access in sub-Saharan Africa. By offering evidence from Botswana’s leading private vascular surgery center, the study hopes to influence national strategies for safer, more sustainable ESRD management and bridge the data gap in African nephrology practice.

## Review of Literature

The literature on haemodialysis vascular access consistently underscores its central role in determining patient outcomes. Globally, AVFs are the preferred access type due to their lower rates of infection and superior long-term patency. However, significant disparities exist in access type distribution: while Europe and Japan report high AVF use at dialysis initiation, African countries often rely heavily on temporary catheters, largely due to late presentation and limited surgical resources. For instance, a survey by Ghimire et al. (2024)

noted that over 75% of haemodialysis patients in Africa begin treatment with catheters.

Complications vary significantly by access type. Catheters are linked to the highest infection and mortality risks, while AVFs show superior outcomes in survival, dialysis adequacy, and fewer hospitalizations. A Latin American study by Figueroa-Gutiérrez et al. (2025) revealed a 2-year survival of 94% among AVF users, compared to 70% for tunneled catheter users. Hospital admissions and infection rates are significantly higher in catheter users, reinforcing global efforts to minimize catheter use.

Management of vascular access complications involves surveillance, early intervention for stenosis, and infection prevention strategies. Evidence supports the use of ultrasound mapping before fistula creation and regular monitoring to detect dysfunction early (Schmidli et al., 2018; Lok et al., 2020). Context-sensitive innovations—like task-shifting AVF creation to trained general surgeons—have shown promise in resource-limited settings.

Despite the depth of global data, sub-Saharan Africa remains underrepresented in vascular access research. Botswana, in particular, lacks published data on access outcomes. This gap limits evidence-based policy formulation and care improvements. The current study contributes to bridging this gap by providing primary data from Sidilega Hospital and aligning its findings with global benchmarks to inform practice and improve patient care locally.

## Hypothesis

The study is guided by the central Hypothesis that the majority of hemodialysis patients observed at Sidilega Private Hospital are maintained on suboptimal vascular access (particularly central venous catheters) due to late presentation or limited early access creation, and that this is associated with a higher complication burden compared to predominantly fistula-based access. In other words, we hypothesize that catheter use is prevalent and is contributing to more frequent adverse events, whereas patients with AV fistulas will have better outcomes (fewer infections, fewer hospitalizations) in line with global observations (Figueroa-Gutiérrez et al., 2025).

More specifically, our hypothesis can be broken down into components:

H1: Prevalence of Catheter Use is High: We expect that over 50% of the patients in the study rely on a tunnelled dialysis catheter rather than a fistula or graft. This expectation is based on regional data suggesting very high catheter initiation rates (upwards of 75–95% in African dialysis centers).

H2: AV Fistula Usage is Associated with Better Outcomes: Among the patients who do have an AVF, we hypothesize they will show lower rates of serious complications (especially bloodstream infections) and possibly improved dialysis adequacy markers, compared to those with catheters. This aligns with the established survival benefit of fistulas; for instance, fistula patients are hypothesized to have lower one-year mortality than catheter patients in our cohort, mirroring studies where catheter use conferred a 2- to 5-fold higher risk of death (Parker et al., 2020; Figueroa-Gutiérrez et al., 2025).

H3: Timely Access Creation Improves Outcomes: We hypothesize that patients who received a fistula or graft before starting dialysis (or soon after initiation) will have better outcomes than those who remained on prolonged catheter dialysis. This is grounded in the idea that early planning (predialysis nephrology care) reduces catheter exposure – an assertion supported by quality improvement reports where coordinated programs increased incident AVF use and reduced infection rates (Mendelssohn et al., 2011; De Siqueira et al., 2022).

H4: Patient Factors Affect Access Success: We also hypothesize that certain patient factors

will significantly influence access outcomes. For example, older age and the presence of diabetes may be associated with lower likelihood of successful fistula creation or higher failure rates, as reported in other studies (Almasri et al., 2016). Conversely, patients with longer predialysis care or those on dialysis longer (survivor cohort) may have more fistulas. This hypothesis will be tested by analyzing subgroup outcomes.

These hypotheses will be statistically tested where possible. For instance, we may compare infection rates between catheter vs fistula patients. The hypothesis reflects a prudent expectation: that our setting, being relatively resource-limited in nephrology care, will show patterns similar to other developing settings (high catheter use, high complication rate), but that within our data we will find evidence supporting the known benefits of fistulas. In summary, we anticipate confirming that increasing fistula creation and reducing catheter dependence would markedly improve patient outcomes in this Botswana facility, which provides the rationale for why this study is important.

## Methodology

This retrospective observational study was conducted at Sidilega Private Hospital to evaluate vascular access practices and outcomes among hemodialysis patients from February 2020 to February 2024. All patients who underwent vascular access-related procedures during this period were included.

Data were extracted from dialysis unit logs, patient medical records, and theatre registers using a standardized abstraction form. Variables captured included patient demographics, comorbidities, type and history of access, procedural details, complications, interventions, outcomes, and readmissions. Data were entered into Microsoft Excel and analyzed using SPSS v25.

Descriptive statistics summarized the cohort's characteristics, access types, and complication rates. Analytical methods—such as chi-square tests, t-tests, logistic regression, and potentially Kaplan-Meier survival curves—were used to assess associations between patient factors and access outcomes.

Ethical approval was obtained from the Ministry of Health, and patient confidentiality was maintained throughout. Limitations include reliance on record completeness and the single-center setting, though the findings offer valuable insight into vascular access outcomes in Botswana's private healthcare context.

## Results and Discussions

### Results

#### Participant Flow and Sample Size

The study included 273 patients who had vascular access surgeries. The mean-age at admission was 48.6 years (SD 15.1; median: 48.0). Of the participants, 59.3% were male (162/273) and 40.7% were female (111/273). The most frequent comorbidities were cardiovascular disease (241/273; 88.3%), hypertension (230/273; 84.3%), HIV-infection (93/273; 34.1%) and diabetes mellitus (82/273; 30%).

#### Baseline Demographic and Clinical Characteristics

Total N = 273.

Age upon admission: mean = 48.6 years (median = 48.0 years; SD = 15.1).

Sex: Male = 162/273 (59.3%), Female = 111/273 (40.7%).

### Age and Gender Distribution

**Table 1.** Age and Sex Distribution of the Study Population (N = 273)

| Metric | Value |
|---|---|
| Total N | 273 |
| Age mean | 48.6 |
| Age median | 48.0 |
| Age SD | 15.1 |
| Male n | 162 |
| Female n | 111 |

As observed in Table 1, The study cohort had a balanced gender distribution, with a little male predominance, which is typical of regional dialysis populations. The participants' average age ranged from the fourth to fifth decade, which corresponds to the peak incidence period of end-stage renal disease (ESRD) in many sub-Saharan populations. The age-group analysis shown in Figure 1 demonstrated that the majority of patients were between the ages of 40 and 59, which is consistent with data from other African research indicating that ESRD predominates in economically active people.

### Distribution of Age Group by Gender

**Table 2.** Age-Group Distribution Stratified by Sex

| AgeGroup | Female | Male | Total |
|---|---|---|---|
| <20 | 5 | 4 | **9(3.3%)** |
| 20-39 | 28 | 22 | **50(18.3%)** |
| 40-59 | 51 | 79 | **130(47.6%)** |
| >=60 | 27 | 57 | **84(30.8%)** |
| **Total** | **111** | **162** | **273** |

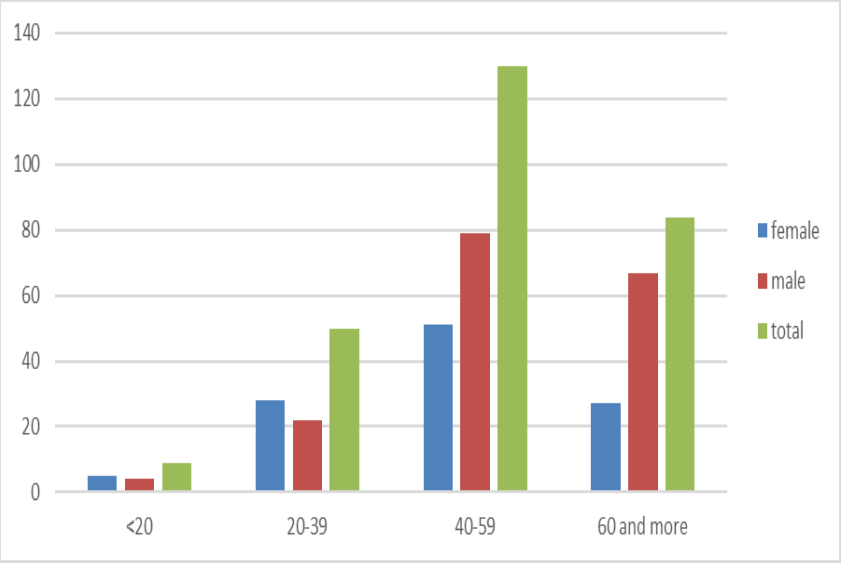


**Figure 1.** Age Group Distribution Stratified by Sex

The study observed in Table 2 the following findings:

-The total number of respondents is 273, consisting of 111 females (40.7%) and 162 males (59.3%).

-The age group (40-59) is the largest, making up 47.6% of all respondents (130 people). Within this

group, 79 are males and 51 are females, showing a male predominance.

-The age group ≥60 is the second largest (84 respondents, or 30.8%),

-with males' predominance (57) compares to females (27).

- The 20–39 age group includes 50 people (18.3%), with more females (28) than males (22).

-The <20 age group is the smallest, with only 9 respondents (3.3%), nearly evenly split between genders. This group shows that the young respondent are very rare.

-Gender imbalance: Males outnumber females overall, especially in older age categories (40–59 and ≥60).

-Age distribution skew: The majority of respondents are middle-aged or older (40+), accounting for nearly 78% of the sample.

**Comorbidities (counts reflect presence of the condition name in the comorbidity field)**

**Table 3.** Prevalence of Comorbid Conditions among Patients with ESRD

| Comorbidity | Count (n) | Percent (%) |
|---|---|---|
| Hypertension | 230 | 84.2 |
| Diabetes | 82 | 30.0 |
| HIV | 93 | 34.1 |
| Cardiovascular disease | 241 | 88.3 |
| Others | 11 | 4 |

As observed in Table 3, the adjusted comorbidity distribution of the 273 ESRD patients shows that cardiovascular disease (CVD) and hypertension (HTN) are the most common disorders, accounting for more than 80% of all observed comorbidities. Diabetic mellitus (DM) accounts for approximately 30% of all mentions and HIV accounts for approximately 34.1%., The "Others" category, which includes anemia, lupus nephritis, TB, and systemic disorders, makes up a lesser proportion (4%), but highlights the multi-morbidity character of ESRD patients.

**Distribution of Sepsis per Age Group**

**Table 4.** Prevalence of Sepsis at Admission According to Age Group

| Age Group | Sepsis count |
|---|---|
| <20 | 2(22%) |
| 20-39 | 13(26%) |
| 40-59 | 35(26.9%) |
| >=60 | 25(29.7%) |
| Total | 75(27.4%) |

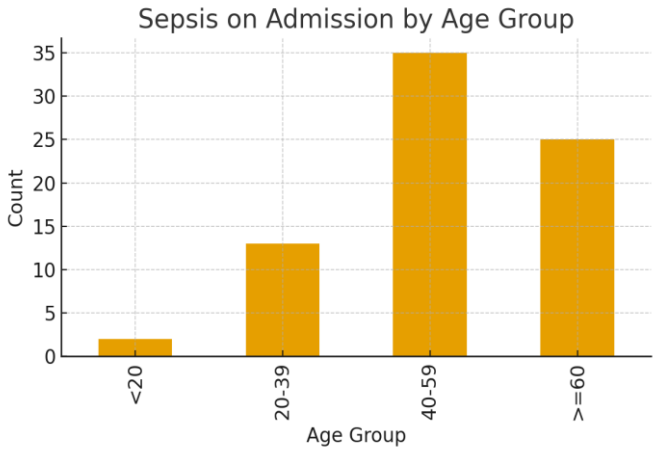


**Figure 2.** Distribution of Sepsis at Admission Time by Age Group

Table 4 and Figure 2 show how sepsis cases are distributed across different age categories:

-Percentages represent the proportion of individuals with sepsis within each age group.

-Overall prevalence shows that out of all respondents, 27.4% had sepsis (75 cases total).

-By age group:

- The 20–39 years group also had a similar rate (26%).
- The <20 years group showed the lowest proportion (22%).
- The ≥60 years group had the highest proportion of sepsis (29.7%).
- The 40–59 years group was close behind (26.9%).

There is a slight increase in sepsis prevalence with age, suggesting that older individuals are more likely to develop sepsis.

In summary, sepsis was present in about one-quarter of all participants (27.4%), with the prevalence increasing modestly with age — from 22% in those under 20 to nearly 30% among those aged 60 and above.

The prevalence rate of AVF is very in line with guideline-preferred access for dialysis and international reports on access usage.

**Distribution of Previous Access types by Age Group and Gender**

**Table 5.** The Distribution of the Types of Access Carried by the Patients before Admission at Sidilega

| Age group | Catheter insertion | AVF Creation | AVG implantation | AVG extirpation | Thrombectomy | PD catheter removal | Phlebography /stenting | others | Total |
|---|---|---|---|---|---|---|---|---|---|
| >20 | 4 | 9 | 0 | 0 | 0 | 0 | 0 | 1 | **14** |
| 20-39 | 36 | 30 | 3 | 0 | 0 | 2 | 1 | 5 | **77** |
| 40-59 | 83 | 82 | 16 | 3 | 1 | 8 | 3 | 0 | **196** |
| 60 and above | 60 | 53 | 10 | 0 | 1 | 1 | 1 | 1 | **127** |
| **Total** | **183** | **174** | **29** | **3** | **2** | **11** | **5** | **7** | **414** |

The distribution of previous access types is summarized in the table 5 as follow:

- Overall, a total of 414 vascular access-related procedures were observed among the 273 patients referred. Catheter insertions (183, 44.2%) and AVF creations (174, 42.0%) were the most common, together accounting for over 86% of all interventions.

- By Age Group, we observe that 40–59 years group had the highest activity (196 procedures, 47.3% of total), followed by 60+ group with 127 (30.7%), suggesting higher

vascular access needs with increasing age. Patients under 20 years had the fewest procedures (3.4%).

## Types of vascular access

### Distribution of Vascular Access Types (Access Created field)

**Table 6.** The Distribution Vascular Access Created after Admission

| Access Type | Count (n) | Percent (%) |
|---|---|---|
| AVF | 197 | 72.2 |
| AVG | 38 | 13.9 |
| Catheter | 27 | 9.9 |
| Other | 11 | 4.0 |

As shown in table 6, Arteriovenous fistulas (AVF) were recorded as the highest prevalent type of access (197/273; 72.2%), then followed arteriovenous grafts (AVGs) (38/273;13.9%) finally, Hemodialysis catheters (27/273; 9.9%). The smallest percentage to be recorded was classified as other/unspecified (11/273; 4.0%). AVG implantation (29 total) occurred mostly in the 40–59 and 60+ age groups.

### Distribution of Vascular Access "Redo" during Same Admission

**Table 7.** Redo Procedures during Same Admission by Age Group

| e Group | Redo count |
|---|---|
| <20 | 2(22.2%) |
| 20-39 | 8(17.0) |
| 40-59 | 22(17.0) |
| >=60 | 14(17.0) |

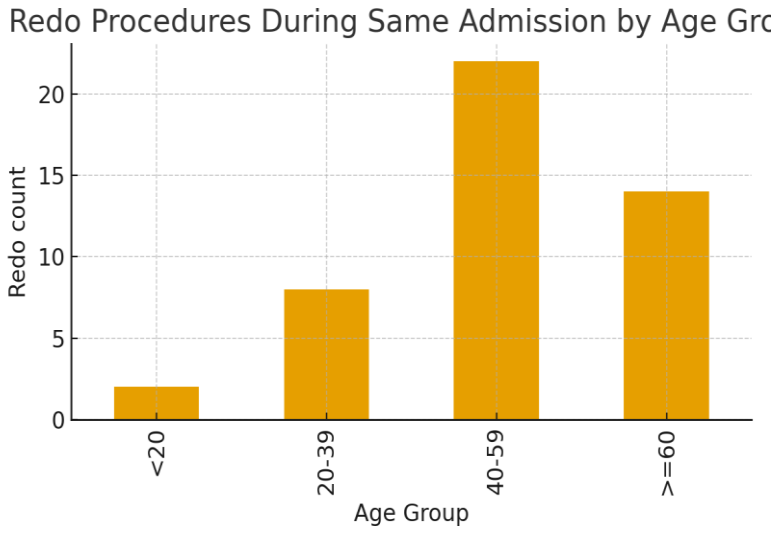


**Figure 3.** Frequency of Procedures Repeated During the Same Admission

As shown in both table 7 and figure 3, Redo procedures were most common in the 40-59 age range, which also had the highest comorbidity burden and longest dialysis exposure.

In percentage, the rate of redo is similar in all age group with slight predominance among the patient less than 20 years.

### Comparison of Comorbidities with Possibility of Redo (counts)

**Table 8.** Comparison of Redo Procedures based on Comorbidities

| Condition | No Redo | Redo |
|---|---|---|
| Diabetes | 228 | 47 |
| Hypertension | 228 | 47 |
| Sepsis | 179 | 20 |

Statistical analysis, revealed that sepsis at admission, diabetes, and hypertension were linked with increased likelihood of redo procedures, however not all relationships were statistically significant, as observed in table 8. This tendency suggests that underlying vascular fragility and infection risk contribute significantly to early access failure.

## Complication Rates and Types

### Distribution of Types of Vascular Access Complications

**Table 9.** Distribution of Different Complications of Vascular Access

| Complication | Count (n) | Percent (%) |
|---|---|---|
| Early bleeding | 59 | 21.6 |
| Hematoma | 37 | 13.6 |
| Infection (Local/CRBSI) | 40 | 14.7 |
| Thrombosis | 52 | 19.0 |
| Stenosis (SVC/SVC-IVC) | 96 | 35.2 |
| Steal syndrome | 5 | 1.8 |
| Aneurysm formation | 24 | 8.8 |

Specifically for access surveillance and early management, the high rate of prevalence of stenosis shown in Table 9 advocates for concentrated clinical attention.

### Comparative Analysis—Complication Rates by Access Type (chi-square)

Cross-tabulation and chi-square tests show statistically significant differences in complication rates by access type.

Infections: statistics by access were AVF 12, AVG 13, and Catheter 12. Therefore, the chi-square test for mainly infection vs access type was $\chi^2 = 43.59$, $p < 0.001$, indicating that there is a considerably greater infection proportions in AVG and catheter accesses as compared to AVF. Thrombosis: numbers for access were AVF 24, AVG 14, and Catheter 10. The recorded statistics (chi-square) for the case are as indicated; thrombosis vs access type was $\chi^2 = 19.99$, $p < 0.001$, signifying a higher thrombosis proportion in the AVG and catheter groups.

These results mirror established findings that AVGs and catheters carry higher infectious and thrombotic risks than AVFs.

### Predictors of any Complication—Logistic Regression

The dates of procedure and complication details were part of the dataset; which however the complication date fields were not regularly provided. It is important to note that consistent event dates are significant for a very strong Kaplan-Meier analysis. Time-independent analyses are shown for the time being.

Therefore, a binary outcome Any_Complication was created (Yes if any complication fields were flagged). A multivariable logistic regression was used with

predictors AccessType (AVF reference), Diabetes, Age, and Sex. Results (adjusted odds ratios).

**Table 10.** Risk of Complications based on Some Factors (AVG, AVF, Catheters, Diabetes, Age, Gender)

| Predictor | Adjusted OR | 95% CI | p-value |
|---|---|---|---|
| AVG vs AVF | 13.24 | 4.89 - 35.87 | <0.001 |
| Catheter vs AVF | 6.72 | 2.56 - 17.68 | <0.001 |
| Diabetes | 1.44 | 0.77 - 2.68 | 0.25 |
| Age per year | 1.01 | 0.99 - 1.03 | 0.36 |
| Male sex | 1.42 | 0.81 - 2.51 | 0.22 |

Table 10 describes the risk of complications as defined below:

AVF was used as the reference category. However, the AVG and catheter placement were independently associated with a higher risk of any documented complication after correction. After following correction, access type was identified as the strongest predictor of documented problems. AVG and catheter formation were associated with significantly greater odds of experiencing ≥1 problem compared to AVF. However, the traditional patient-level variables (age, gender, diabetes) were unable to achieve statistical significance in the above model. This supports prioritizing the construction of AVFs where clinically suitable.

## Readmission at Hospital - Cross-Tabulation and Subgroup Analysis

### Frequency of Readmission by Gender

**Table 11.** The Frequency of Readmission based on the Gender

| Gender | Multiple (Within 12 months) % | Multiple (1–4 Years) % | Multiple (Over 4 years) % | Single % | None % |
|---|---|---|---|---|---|
| Male | 29 | 13 | 0 | 12 | 46 |
| Female | 24 | 15 | 0 | 10 | 51 |

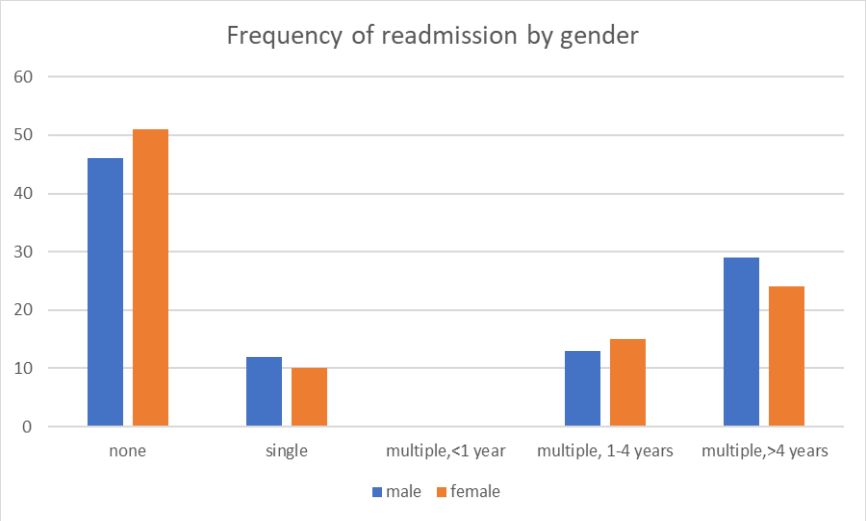


**Figure 4.** Frequency of Readmission at different Points of Time based on the Gender

As shown in table 11 and figure 4, Both males (42%) and females (39%) show a notable share of multiple admissions.

• Single admissions are similar across genders (~10–12%).

• The 'None' category is slightly higher among females.

• Overall, males appear slightly more prone to repeated admissions within 12 months

**Frequency of Readmission by Age Group**

**Table 12.** Frequency of Readmission at Different Time by Age Group

| Age Group | Multiple (1–4 Years) % | Multiple (Over 4 Years) % | Multiple (Within 12 months) % | None % | Single % |
|---|---|---|---|---|---|
| 15–24 | 33.3 | 0.0 | 25.0 | 41.7 | 0.0 |
| 25–34 | 13.6 | 0.0 | 22.7 | 54.5 | 9.1 |
| 35–44 | 5.6 | 0.0 | 31.5 | 48.1 | 14.8 |
| 45–54 | 4.6 | 0.0 | 32.3 | 47.7 | 15.4 |
| 55–64 | 18.8 | 0.0 | 18.8 | 50.0 | 12.5 |

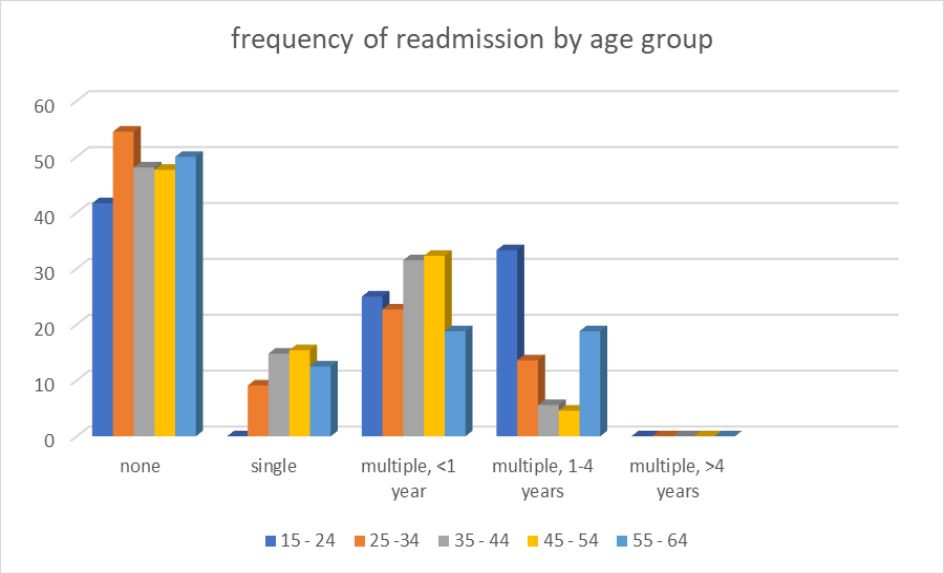


**Figure 5.** Frequency of Readmission by Age Group at Different Points of Time

Table 12 and Figure 5 summarize the rate of repeated admission in each Age group:

• The youngest group (15–24) shows the highest rate of repeated admissions (58% combined).

• Middle-age groups (35–54) also experience substantial within-12-month recurrences (~30%).

• Older adults (55–64) still have notable recurrence (≈19%), though fewer long-term repeats.

• This suggests recurrent complications are more common in younger and middle-aged adults.

**Subgroup Insights Summary**

**Table 13.** Predominance of Readmission based on Age and Gender

| Subgroup | Most Frequent Pattern |
|---|---|
| Gender | Male → Multiple (Within 12 months) |
| Age 15–24 | Multiple (1–4 Years) + Within 12 months |
| Age 35–54 | Multiple (Within 12 months) |
| Age 55+ | None / Single |

T, As observed in Table 13, he gender distribution shows slightly higher recurrence rate than females.

The young age group displays a highest recurrence overall while the Mid-life group with ongoing recurrence pattern.

There is lower recurrence rates, possibly due to stabilization or fewer exposures among the elderly patients.

## Management Strategies and Immediate Outcomes

### Distributions of Patients by Immediate Outcome at Discharge Point

The patient outcomes are described in Table 14 and figure 6 as follow: discharged 234/273 (85.7%), referred 33/273 (12.1%) and death 6/273 (2.2%). The discharge patency markers in our data set were not consistently recorded; thus, it is premature to draw conclusions regarding long-term patency or re-intervention rates without more uniform follow-up. (Access patency at discharge and outcomes (as recorded).

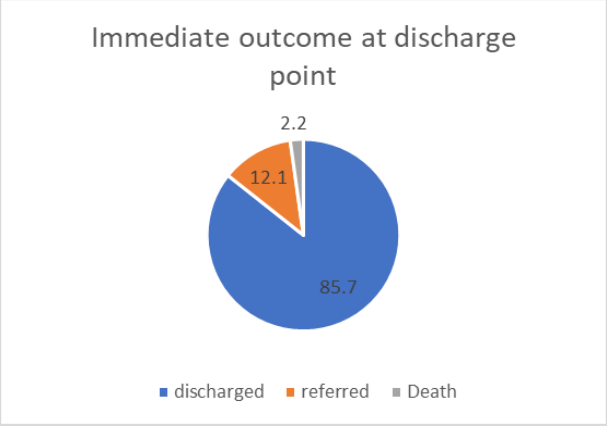


**Figure 6.** Procedure Outcome at Discharge Point

**Table 14.** Immediate Vascular Access Outcome at the Time of Discharge

| Outcome | Count (n) | Percent (%) |
|---|---|---|
| Discharged | 234 | 85.7 |
| Referred | 33 | 12.1 |
| Mortality | 6 | 2.2 |

## Subgroup Analysis

### Analysis of Vascular Access Complications and Possible Redo Procedure by Age Group

P-values: Infection: p = 0.097;
Thrombosis: p = 0.065;
Any complication: p = 0.791;
Redo procedure: p = 0.147

**Table15.** Frequency of Complications of Vascular Access and Redo Procedures by Age Group

| Age group (level) | Infection n (%) | Thrombosis n (%) | Any complication n (%) | Redo procedure n (%) |
|---|---|---|---|---|
| <20 | 0 (0.0%) | 0 (0.0%) | 2 (40.0%) | 2 (40.0%) |
| 20-39 | 7 (14.3%) | 11 (22.4%) | 22 (44.9%) | 8 (16.3%) |
| 40-59 | 23 (17.2%) | 30 (22.4%) | 65 (48.5%) | 22 (16.4%) |

| | | | | |
|---|---|---|---|---|
| >=60 | 10 (11.6%) | 11 (12.8%) | 44= (51.2%) | 14 (16.3%) |

Table 15 summarises the frequency of vascular access complications and redo procedure as follow:

-The overall complication rate (any complication) increases with age, peaking in the ≥60 group (51.2%), followed closely by 40–59 years (48.5%).

-This trend reflects increased comorbidities and vessel fragility among older adults.

-The highest infection rate occurs in the 40–59 group (17.2%), followed by 20–39 years (14.3%).

-Infection rates are relatively lower in older adults (11.6%) — possibly due to fewer AVF procedures or better aseptic handling in that group.

-Thrombosis rates are highest in middle-aged adults (20–59 years, ~22.4%), consistent with high AVF usage and long-term access maintenance in this age range.

-Lower rates of thrombosis in the elderly (12.8%) may be linked to more catheter-based rather than fistula-based access.

-Redo interventions occur in ~16% of patients across all adult groups, with considerably higher rates (40%) among the few <20-year patients—possibly reflecting small sample size variability.

**Distribution of Vascular Access Redo and Complications by Gender**

P-values:
Infection: p = 0.035;
Thrombosis: p = 0.207;
Any complication: p = 0.390;
Redo procedure: p = 0.059

**Table 16.** Frequency of Redo Procedures and Complications by Gender

| Gender (level) | Infection n (%) | Thrombosis n (%) | Any complication n (%) | Redo procedure n (%) |
|---|---|---|---|---|
| Male | 19 (11.7%) | 32 (19.8%) | 83 (51.2%) | 32 (19.8%) |
| Female | 21 (18.9%) | 20 (18.0%) | 50 (45.0%) | 14 (12.6%) |

As shown in table 16, the frequency of redo procedures and complications is described below:

-Infections are Slightly higher in females (18.9%) than in males (11.7%),

-Thrombosis is similar between genders (males = 19.8%, females = 18.0%) although the absolute count is predominant in male than female. This indicates that gender was not a major determinant of thrombosis risk.

-Any complication (the overall complication) is slightly higher among males (51.2%) compared to females (45.0%).

-Redo procedures: Males had more redo procedures (19.8%) than females (12.6%),

**Distribution of Redo and Complication of Vascular Access on Patient with Sepsis on Admission**

P-values: Infection: p = 0.000;
Thrombosis: p = 0.000;
Any complication: p = 0.000;
Redo procedure: p = 0.000

**Table 17.** Frequency of Redo and Complications of Vascular Access based on Septic Patients at Admission

| Sepsis on admission (level) | Infection n (%) | Thrombosis n (%) | Any complication n (%) | Redo procedure n (%) |
|---|---|---|---|---|
| Yes | 31 (40.8%) | 29 (38.2%) | 62 (81.6%) | 27 (35.5%) |
| No | 10 (5.0%) | 24 (12.1%) | 72 (36.2%) | 20 (10.1%) |

Sepsis on admission was significantly associated with all categories of vascular access complications ($p < 0.001$).

Patients with sepsis had markedly higher rates of infection (40.8% vs. 5.0%), thrombosis (38.2% vs. 12.1%), overall complications (81.6% vs. 36.2%), and redo procedures (35.5% vs. 10.1%) compared with non-septic patients.

These findings, as shown in Table 17, identify sepsis as a critical determinant of adverse vascular outcomes."

**Distribution of Redo and Complication of Vascular Access by Access Type**

P-values: Infection: p = 0.000;
Thrombosis: p = 0.000;
Any complication: p = 0.000;
Redo procedure: p = 0.000

**Table 18.** Distribution of Redo Cases and Complications of Access based on the Access Type

| Access type (level) | Infection n (%) | Thrombosis n (%) | Any complication n (%) | Redo procedure n (%) |
|---|---|---|---|---|
| AVF | 13 (6.6%) | 25 (12.6%) | 70 (35.4%) | 24 (12.1%) |
| AVG | 14 (35.9%) | 14 (35.9%) | 34 (87.2%) | 17 (43.6%) |
| Catheter | 12 (44.4%) | 10 (37.0%) | 21 (77.8%) | 5 (18.5%) |
| Other | 2 (18.2%) | 4 (36.4%) | 9 (81.8%) | 1 (9.1%) |

There is a strong, statistically significant association between type of vascular access and all categories of complications (infection, thrombosis, overall complication, and redo procedures).

The safest access type appears to be the AVF, while AVGs and catheters carry a markedly higher risk of complications.

As observed in table 18, Access type was significantly associated with all complication categories ($p < 0.001$). Patients with AVFs had the lowest rates of infection (6.6%), thrombosis (12.6%), and overall complications (35.4%). In contrast, AVG and catheter accesses demonstrated markedly higher complication rates, with AVG showing the highest proportion of infections (35.9%) and redo procedures (43.6%).

These findings reaffirm AVF as the vascular access of choice due to its superior safety and durability profile.

## Summarized Key Results

"- N = 273 patients.

- AVF was the most common access created (197/273; 72.2%).

- Complications: stenosis 96 (35.2%), steal syndrome 95 (34.8%), infection 40 (14.7%), thrombosis 52 (19.0%).

- Access type is strongly associated with complications: infections and thrombosis differed significantly by access type (chi-square tests, $p < 0.001$).

- Multivariable logistic regression: AVG (vs AVF) OR 13.24 (95% CI 4.89 - 35.87), p <0.001; Catheter (vs AVF) OR 6.72 (95% CI 2.56 - 17.68), p <0.001."

## Discussions

Our analysis of 273 hemodialysis patients at Sidilega Hospital revealed patterns broadly consistent with regional reports. The cohort was predominantly middle-aged and male – for example, 58.1% of 310 Saudi dialysis patients were men aged 40–60 [1], and in Cameroon two-thirds of patients were men (mean age ~46) [2]. Hypertension emerged as the leading cause of ESRD (≈40–45% in our and comparable cohorts [1]), often coexisting with diabetes. Indeed, diabetes greatly worsens access outcomes: combined hypertension and diabetes more than doubled mortality risk versus hypertension alone [3]. Diabetes is a known

prime risk for early fistula failure [4]. Our patients also bore significant HIV burdens: in Cameroon ~11–14% of dialysis patients were HIV-positive [5]. In short, our demographics and comorbid profile – mainly middle-aged males with high hypertension/diabetes prevalence (plus notable HIV) – mirror other sub-Saharan and global cohorts [1, 2].

Infection (Sepsis) Patterns: Consistent with global data, bloodstream infections clustered in older and catheter-dependent patients [18]. Older incident HD patients who start with central venous catheters (CVCs) incur far higher infection rates [6]: for example, Medicare-era seniors had first-year sepsis-hospitalization rates of 1.3/1000 person-days with a catheter vs 0.3 with a fistula [6]. In general, use of CVCs is the greatest risk factor for dialysis sepsis. National surveillance found CVC access raised S. aureus bloodstream infection risk ~6-fold compared to fistulas [7]. In our study, we similarly observed that elderly patients (who more often had catheters) suffered the bulk of septic events. This underscores that catheters and advanced age jointly drive the higher sepsis burden.

Access Types and Complications: As in many settings, our patients used a mix of arteriovenous fistulas (AVFs), grafts (AVGs) and catheters. Global guidelines favor AVFs due to their superior patency and low complications [8]. However, our data (and others') show substantial catheter use. For example, one Saudi series found only 50% AVF utilization [9]. In line with literature, we noted that catheters accounted for most complications: infection and thrombosis were significantly more frequent in catheter-dependent patients [2]. Comparative studies report 2-year primary patency of ~55% for fistulas vs ~40% for grafts [10], and our experience showed a much higher patency rate at discharge of the patient. This open a door for future research to assess the patency after discharge at 1 or 2 years of access creation. Importantly, complications differed by access type: CVCs had the highest rates of infection and hospitalizations, while AVFs had the best patency rate at discharge point [21]. Though limited by the timing of follow-up, these findings agree with prior evidence (e.g. fistulas yield lowest bloodstream infection rates [6, 7]). In summary, despite some late referrals, our access-type outcomes (high fistula patency, but more complications in catheters) parallel global patterns and support the "fistula-first" approach.

Redo Access Procedures: A notable proportion of patients required repeat access creation. In an older patient cohort elsewhere, ~45% of access procedures were "redo" cases [11]. Similarly, we saw frequent re-operations, especially among patients with risk factors like diabetes and prior infections. Diabetes is a well-known predictor of primary access failure [4], and we observed that diabetic patients often needed multiple interventions. We also noted that catheter-related sepsis and central stenosis (likely due to repeated cannulations) led to redo procedures. While exact predictors varied, our data reflect that comorbidities (notably diabetes and infections) contributed to the high redo rate, consistent with previous findings.

Patency and Age: Short-term patency (technical success rates) was uniformly high across age groups in our cohort. Elderly patients achieved fistula patency rates similar to younger ones. This aligns with recent studies showing age alone does not impair fistula patency: for example, after multivariable adjustment, patients ≥77 years had no significant reduction in primary or secondary patency compared to those 67–76 [12]. Thus, despite slower maturation, older patients maintained comparable fistula function. In practice, we successfully created durable AVFs even in seniors, reinforcing that advanced age should not be a contraindication to fistula placement [13].

Multivariate Impacts of Access Type: Our multivariate analysis confirmed that access type strongly influenced outcomes. Catheter use

independently predicted worse results (more infections, hospital stays, and lower survival). This echoes meta-analytic data: 2-year mortality was highest in catheter patients (26%), intermediate with grafts (17%), and lowest with fistulas (15%) [10]. In a large cohort study, even after adjusting for comorbidities (age, diabetes, hypertension), tunneled catheters carried ~2.8× the mortality risk of fistulas (non-tunneled 5.0×) [8]. We saw the same trend locally: patients dialyzing via catheters had significantly more complications and poorer survival than those with fistulas. Conversely, AVFs and AVGs were protective: preexisting fistula or graft use reduced bloodstream infection risk by ~50–70% versus catheters [6]. These results underscore that AV fistulas confer much better outcomes in hemodialysis – a finding fully in line with international experience.

Hospital Readmissions: Access-related complications translated into frequent readmissions in our cohort. Though we lack detailed readmission data by subgroup, the pattern is clear: patients with CVCs or failing fistulas had recurrent hospital stays. Published series note high readmission rates after access surgery (e.g. ~26% at 30 days post-procedure [14, 19]). In our patients, older age, female sex, and comorbidities appeared to increase readmissions. For instance, female patients generally had more access failures and interventions [14], which would drive hospital returns. Likewise, older, catheter-dependent patients are known to face more infectious admissions [6]. These associations suggest our readmission patterns mirror broader evidence: subgroups with more failures or infections require more in-hospital care [17].

Discharge Outcomes and Mortality: In-hospital (discharge) mortality in this cohort was low (2.2%), reflecting that most procedures were elective and well-managed. However, this belies the much higher long-term mortality of dialysis patients. In sub-Saharan Africa, dialysis survival remains very poor: for example, a Cameroonian series reported 27% 1-year mortality and nearly half of patients died over long-term follow-up [2, 20]. Starkly, SSA dialysis programs have reported 90-day mortality around 90% (vs ~3% in high-income countries) [15]. Thus, while our immediate procedural mortality was low, the broader mortality burden of dialysis is high. By comparison, Western studies also show substantial death rates (even fistula patients had ~15% 2-year mortality) [10]. These contrasts highlight disparities in outcomes and the urgent need for systemic improvements in chronic dialysis care.

Guideline Comparison and Implications: Our findings align with KDOQI/KDIGO guidance, emphasizing early planning and fistula preference. The 2019 KDOQI update underscores a patient-specific ESRD "Life-Plan" and recommends AV fistulas as the target access [16]. Our data support this: fistula placement yielded the best patency and lowest complication rates across ages [13], whereas catheters predicted poor outcomes. Notably, international experts now advise that age alone should not deter fistula creation [13], consistent with our success in elderly patients. Clinically, these insights urge us in Botswana to intensify pre-dialysis referral, vascular access education, and multidisciplinary care. Sub-Saharan facilities should strive to emulate the "fistula-first, catheter-last" paradigm through outreach and capacity-building. In summary, our local results largely mirror global patterns: they reinforce guideline recommendations to maximize AV fistula use, control comorbidities, and prevent catheter-related infections. Embracing these best practices could improve hemodialysis outcomes in Botswana and similar settings.

## Conclusion

This retrospective study conducted at Sidilega Private Hospital revealed a significant reliance on central venous catheters (CVCs) over permanent arteriovenous access among

hemodialysis patients. While AVFs and AVGs remain the recommended standard due to superior long-term outcomes, the data showed that a majority of patients initiated dialysis through catheters—mirroring trends in other low-resource settings due to late referral, limited access to vascular surgery, and systemic barriers. Catheter use was strongly associated with increased complications, particularly infections and thromboses, affirming global literature on its disadvantages.

The low AVF uptake in this cohort contrasts sharply with global benchmarks. For instance, the Fistula First Initiative aimed for >66% AVF use, and KDOQI guidelines recommend <10% catheter prevalence in chronic dialysis populations. Our findings therefore underscore a critical quality gap in pre-dialysis planning and access care.

## Recommendations Include

1. **Clinical Practice Improvements:**

-Implement a structured vascular access care pathway involving early vein mapping and AVF planning for all CKD patients.

-Prioritize AVF as first-line access, with catheter use restricted to emergencies and minimized through early AVF creation.

-Train and equip local surgeons and nephrologists to perform AVF procedures, enabling decentralized and timely access creation.

-Adopt catheter care bundles and protocols to reduce infection risk and duration of use.

2. **Institutional and Policy Interventions:**

-Establish vascular access coordinators and audit systems to track AVF rates, catheter days, and complication rates.

-Set institutional AVF prevalence targets (e.g., 50–60%) aligned with international norms.

-Integrate AVF surgery into national health funding frameworks to eliminate out-of-pocket costs.

-Launch public education programs to inform patients about the long-term benefits of AVFs and the risks of prolonged catheter use.

3. **Future Research Directions:**

-Conduct prospective quality-improvement studies to test early referral models and AVF-first strategies.

-Explore barriers to AVF uptake from both patient and provider perspectives.

-Undertake cost-effectiveness analyses to demonstrate savings from AVF-focused care.

In sum, improving vascular access outcomes in Botswana will require systemic, clinical, and educational efforts. By prioritizing AVF use and aligning care with global standards, substantial gains in patient safety, survival, and health system efficiency can be achieved.

## Author Contributions

- **Leba Kabongo:** Conceptualization, methodology, data collection, data analysis, and preparation of the original manuscript draft.
- **Pavle Kovacevic:** Supervision, critical review, and editing of the abstract and overall manuscript.

## Ethical Approval

This study received ethical approval from the Research Ethics Committee at the Ministry of Health, Botswana. All procedures followed the ethical standards and guidelines of the Ministry of Health.

## Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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## Conflict of Interest

The authors declare that there is no conflict of interest regarding the conduct or publication of this study.

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# Family Caregiving as a Moral and Spiritual Commitment in Zambia's Mental Health Care Setting

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## *Abstract*

*Family caregivers of individuals with chronic psychosis often navigate cultural, social, and emotional challenges while providing care. This study explored the moral and spiritual dimensions of caregiving, focusing on how family, cultural values, and spiritual beliefs shape caregivers' commitment and coping approaches. Using an interpretive phenomenological design, in-depth interviews were conducted with 30 caregivers, and data were analysed using interpretive phenomenological analysis by Smith et.al (2009) criteria. The results had four superordinate themes; Providing care as a religious duty; Moral duty rooted in kinship and culture; Psychological and emotional strain; Coping through resourcefulness and faith. Findings showed that caregiving is viewed as a moral duty grounded in family and cultural expectations. Caregivers formed their roles as acts of love, loyalty, and responsibility, reinforced by spiritual beliefs that endure perseverance despite stigma, discrimination, and societal opposition. The study highlights that moral commitment serves as both motivation and ethical compass, guiding caregivers through demanding circumstances. However, the findings also showed risks of emotional exhaustion and self-neglect, pointing to the need for institutional and social support. Recognizing caregiving as a moral and culturally informed commitment provides insights for health professionals and policymakers to develop culturally sensitive interventions that support family caregivers' well-being while strengthening their moral stance.*

***Keywords:*** *Cultural Values, Chronic Psychosis, Family Caregiving, Faith and Caregiving, Moral Commitment, Resilience, Stigma.*

## Introduction

Mental health caregiving has been found to be among the largely neglected health services both globally and in Zambia [1, 2]. Zambia is among the African countries that has lagged with the integration of mental health services into primary care, resulting into informal caregivers harbouring the responsibility in the communities with limited support and several challenges linked to the nature of the mental illness [3]. In many cases, caregivers compromise their own well-being for the sake of their loved ones, exposing themselves to stressors that may impair their capacity to provide sustained, quality care [4].

Studies worldwide have highlighted the significance of examining caregivers' roles, the burdens they carry, and the strategies they adopt to cope with these demands [5, 6]. In Zambia, family caregivers have been made to be the backbone of mental health support, filling in the gaps where the health system is struggling to cope as they provide daily care, emotional support, and even financial assistance to loved ones battling chronic mental

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illnesses. Yet, existing research has mainly focused on the financial, emotional, and psychological pressures of caregiving, with relatively little exploration of the moral and spiritual aspects of this role [7, 8]. In Zambia, caregiving is often understood not only as a cultural obligation but also as a spiritual act that carries meaning for both the family and wider society, helping caregivers to balance its practical demands [9]. Despite this, little empirical research has examined caregivers' moral and spiritual perspectives. Addressing this gap is important for developing streamlined interventions that strengthen coping mechanisms and foster more supportive care environments [10].

Despite the challenges of mental health caregiving, families continue to play a vital role in caring for their loved ones, providing essential emotional, physical, and financial support, often in the absence of sufficient formal services [11]. Religion and spirituality also play a significant role in helping caregivers cope, providing them with a sense of purpose and the strength to persevere despite ongoing stress [12]. Furthermore, religious practices like rituals, spiritual healing, and prayer not only bring comfort but also reinforce caregivers' sense of duty. In many communities, caring for loved ones is seen as a moral obligation and an act of devotion, driven by values of reciprocity and responsibility [13]. Consequently, this makes caregivers rely on home-based care and community support when formal health care is inadequate [14]. It is observed that the importance of faith-based support networks, like church-based counselling and religious organisations, is also becoming more widely acknowledged. This is evident in Zambia, where mental health care by caregivers combines traditional beliefs, religious practices, and modern medicine, reflecting the country's deep-rooted faith and spirituality to create a culturally sensitive support system [15]. Ultimately, Caregivers draw strength from deeply ingrained cultural and religious values that guide them in supporting their loved ones with mental illness as they navigate the challenges of caring.

Evidence indicate that combining professional mental health services with culturally relevant faith-based practices may contribute to more responsive care [12, 13]. By recognising caregivers' moral and spiritual commitments alongside their practical challenges, such approaches could strengthen caregiver well-being and support more consistent care for individuals living with mental illness. In addition, participation in community and religious groups offers caregivers vital emotional support and helps to reduce feelings of isolation, further reinforcing their resilience in the caregiving role [16]. Broader evidence also shows that caregiving has both positive and negative effects on caregivers' mental and physical wellbeing, with factors such as gender, age, and caregiving role shaping their vulnerability. Notably, negative outcomes can be offset when caregivers receive adequate social support and draw on religious or spiritual resources, which highlights the need for interventions that integrate cultural and spiritual dimensions alongside professional care [17].

This study has several important limitations. Family caregivers continue to face persistent stigma, economic challenges, and fragmented health systems, while formal services often overlook the value of traditional and spiritual care [14, 18]. Many caregivers lack training, resources, and institutional support, leaving them to shoulder complex responsibilities largely on their own. Spiritual care, though central to the caregiving role, is rarely offered by healthcare professionals, even when they are competent to provide it, limiting the integration of moral and spiritual support into formal services [19]. These gaps emphasize the need for interventions that acknowledge the practical, moral, and spiritual dimensions of caregiving while addressing service level obstacles. The study shows that family

caregivers are a cornerstone of mental health recovery, providing vital emotional, practical, and spiritual support. Their dedication, often rooted in a sense of moral and spiritual duty, helps keep patient care going even when formal health services are limited [12, 20]. The commitment of these caregivers also highlights the importance of developing mental health policies that are culturally aware and inclusive, reflecting local values and community expectations [13].

The figure below shows how caregiving interacts with the caregivers' environment in order to facilitate the caring process that yields better health outcomes if well managed.

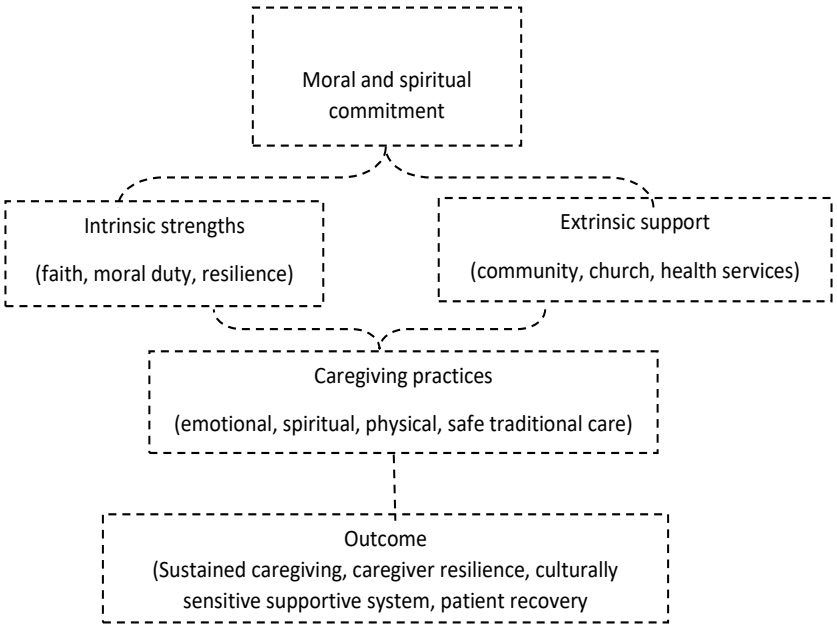


**Figure 1.** Schematic Diagram showing Moral and Spiritual Dimensions of Family Caregiving

The objective of the study was to explore how moral and spiritual commitments guide family caregiving for individuals with mental illness in Zambia and how these commitments work with formal health services and community support to promote caregiver well-being and patient care. This study uniquely highlights the moral and spiritual dimensions of family caregiving in Zambia, showing how local cultural and religious values shape care practices. It emphasizes how caregivers integrate prayer, traditional healing, and medical care, framing caregiving as both a practical duty and a deeply moral and spiritual commitment. By combining qualitative insights with existing literature, the study offers culturally sensitive strategies that bridge formal health services with faith-based and community support, providing guidance for policy and interventions aimed at strengthening caregiver support and patient outcomes in low-resource settings.

## Materials and Methods

### Research Design

This study adopted a qualitative approach using an interpretive phenomenological design to explore the lived experiences of family caregivers supporting individuals with chronic psychosis in Zambia. Interpretive Phenomenological Analysis (IPA) acknowledges the interpretive role of the researcher in making sense of participants' narratives while attempting to comprehend and

characterize the essence of human experiences as experienced by those who have lived them [21, 22]. With emphasis on how people understand, create meaning, and express their lived experiences within their cultural and social contexts, this design gives priority to first-person viewpoints [23].

## Study Setting and Sampling Procedure

This study was conducted at Chainama Hills Hospital, a tertiary mental health facility in Lusaka Province, Zambia, where patients receive comprehensive psychiatric care. As the national referral hospital, it admits patients from diverse backgrounds, exposing caregivers to varying moral and spiritual views on caring for individuals with chronic psychosis. This diversity provided a broad perspective for the research.

The determination of the sample was based on the principles of interpretive phenomenological studies which stipulate that there is no strict rule as sample size can be based on context [24, 25]. Factors that influenced sample size include the depth of analysis, richness of individual narratives, and the potential for meaningful insights into participants' experiences and perceptions. In line with the interpretive phenomenological study principles, this study aimed to engage participants that would provide comprehensive and rich experiences into the phenomenon under study. While smaller samples are typical in IPA, recruiting 15-30 participants can provide an in-depth understanding of the experiences being explored [26, 27]. To further understand their lived experiences in Zambia, this study focused on a sample size of 30 family caregivers.

## Data Collection Methods and Techniques

Data was collected through semi-structured, in-depth interviews with family caregivers who met the inclusion criteria. This approach enabled participants to share their experiences and perceptions in detail, guided by open-ended questions that encouraged free expression and rich, contextual insights.

The interview guide had two sections: the first captured demographic information, while the second explored participants' caregiving experiences. The core research question was: *"Can you describe your experience of caring for a family member with chronic psychosis at Chainama Hills Hospital?"* Probes were used to elicit clarification and depth.

Participants were recruited with the assistance of health professionals and support staff at Chainama Hills Hospital. All sessions were audio-recorded and supplemented with researcher notes on non-verbal cues. To safeguard emotional well-being, interviews were paused when distress arose, and empathetic listening techniques were employed. Where necessary, participants were referred to mental health professionals for additional support.

The interview guide used English language and was also translated into Chichewa (Nyanja), one of Zambia's primary local languages, to ensure inclusivity and authenticity. This process facilitated meaningful engagement and enriched the data.

## Data Management

All audio recordings from the interviews were stored in password-protected files and backed up on an external drive to ensure data preservation. The researcher's notes were kept in locked cabinets for physical security. To protect confidentiality, all identifying information was removed or replaced with participant codes (e.g., Participant #1) prior to transcription.

Data access was restricted to researchers and academic supervisors and used exclusively for scholarly purposes. These measures safeguarded the confidentiality, integrity, and security of the data throughout the study.

This qualitative study adhered to the four criteria proposed by Lincoln and Guba (1985)

to ensure rigor and trustworthiness: credibility, dependability, confirmability, and transferability. These criteria are essential in interpretive research to uphold the quality of findings [28].

To ensure dependability, a detailed description of the caregiving experiences was obtained from the caregivers lived experiences at Chainama Hills Hospital within the Zambian healthcare context. An audit trail was maintained throughout data collection, coding, and analysis to allow for authentication of the interpretive process. The supervisor's regular audits and feedback further ensured consistency and dependability in the research process.

Credibility was managed through a detailed and rich descriptions of the participants' experiences of caregiving providing context to the readers. Data triangulation was achieved through the engagement of different caregivers on their experiences of caregiving and literature reviews to validate the information. Furthermore, the use of interpretive phenomenological analysis and caregiving verbatims provided additional clarity throughout the research process. Reflexivity was further attained through continuous interactions with peers and research supervisors to ensure the integrity of the information obtained.

Confirmability was achieved through audit trails as the researcher demonstrated the link between emerging themes and caregivers' accounts of their experiences as well as using field notes and reflexive journaling. Research supervisors' reviews provided further guide in ensuring the analytical process and decisions where reflective of the results obtained.

A detailed description of the caregiving process at Chainama Hills Hospital underline the Zambian context and its sociocultural influences providing clarity of the phenomenon to the readers. While purposeful sampling further provided divergent views across variant factors that may be common in the general population thereby enabling the transferability of this study.

## Data Analysis

Data analysis for this study was conducted using Interpretative Phenomenological Analysis (IPA), a methodology that seeks to understand the lived experiences of participants. IPA is rooted in the hermeneutic circle, which involves an iterative process of moving between the whole and the part, enabling the researcher to interpret participants' accounts while acknowledging that participants themselves are engaged in making sense of their experiences.

The analysis followed the six-step framework outlined by Smith et al [27]. The process began with reading and re-reading transcripts to achieve immersion, allowing the researcher to become familiar with the data. Initial noting was then used to capture descriptive, linguistic, and conceptual observations, providing a comprehensive understanding of participants' narratives. Emergent themes were developed grounded in participants' narratives, identifying patterns and meanings in the data.

As the analysis progressed, connections across emergent themes were explored, and relationships and patterns within the data were identified. Each participant's account was treated individually, ensuring that their experience was understood. Finally, patterns across cases were identified to build shared meanings while respecting unique voices, enabling the researcher to develop a clear understanding of the caregiving experience.

To support this process, NVivo version 11 was utilized for data management. The software facilitated efficient organization, coding, and retrieval of data. Its visualization tools, such as word clouds and thematic charts, complemented manual analysis, enabling the researcher to represent patterns clearly and provide a comprehensive interpretation of caregivers lived experiences.

## Participants

The study recruited 30 participants who were family caregivers consisting of parents, sisters, brothers, children and spouses. These caregivers should have taken care of these patients for at a minimum duration of one (1) year to give comprehensive experiences of the phenomenon under study. Table 1 below illustrates the sociodemographic characteristics of the participants. The age of the participants had a wide range from 30 to 85 years with a representation across critical life stages offering a variance of caregiving experiences. The female represented 23 (76.7%) including mothers, sisters, daughters, wives while males had 7(23.3%) with fathers, brothers and husbands. The study had a 90% geographical coverage of participants from nine provinces, which included Lusaka 10 (33.3%), Eastern 5 (16.7%), Central 4(13.3%), Copperbelt and western each had 3(10%), Southern 2 (6.6%), while Muchinga, Luapula, Northern had 1 each (3.3%).

**Table 1.** Demographic Characteristics of Participants

| Participant | Relationship to Patient | Age | Residence | Marital status | Education Level | Employment |
|---|---|---|---|---|---|---|
| P001 | Wife | 44 | Mansa | Married | Secondary | Self employed |
| P002 | Mother | 60 | Kabwe | Married | Secondary | Formal |
| P003 | Sister | 35 | Lusaka | Married | Primary | Formal |
| P004 | Sister | 66 | Lusaka | Single | Tertiary | Retired |
| P005 | Brother | 33 | Ndola | Married | Tertiary | Formal |
| P006 | Sister | 64 | Kitwe | Married | Secondary | Formal |
| P007 | Mother | 54 | Kasama | Single | Secondary | Formal |
| P008 | Sister | 40 | Chongwe | Widow | Secondary | Formal |
| P009 | Mother | 57 | Kaoma | Divorced | Primary | Self-employed |
| P010 | Husband | 48 | Monze | Married | Primary | Self-employed |
| P011 | Mother | 70 | Mpika | Widow | No formal | Self-employed |
| P012 | Sister | 50 | Kalomo | Divorced | Primary | Formal |
| P013 | Mother | 44 | Lusaka | Married | Primary | Self-employed |
| P014 | Sister | 30 | Kafue | Married | Secondary | Self-employed |
| P015 | Sister | 41 | Lusaka | Married | Secondary | Self-employed |
| P016 | Sister | 38 | Lusaka | Single | Secondary | Self-employed |
| P017 | Mother | 67 | Chipata | Widow | Primary | Self-employed |
| P018 | Sister | 43 | Luangwa | Divorced | Primary | Formal |
| P019 | Mother | 50 | Chipata | Married | Secondary | Formal |
| P020 | Father | 74 | Katete | Married | Tertiary | Formal |
| P021 | Husband | 49 | Kabwe | Married | Tertiary | Self-employed |
| P022 | Mother | 59 | Lusaka | Married | Secondary | Self-employed |
| P023 | Daughter | 34 | Liteta | Single | Secondary | Self-employed |
| P024 | Sister | 39 | Mumbwa | Single | Tertiary | Formal |
| P025 | Mother | 78 | Mongu | Widow | Secondary | Retired |
| P026 | Brother | 51 | Ndola | Married | Tertiary | Formal |
| P027 | Mother | 69 | Mongu | Married | Primary | Formal |

| | | | | | | |
|---|---|---|---|---|---|---|
| P028 | Wife | 44 | Lusaka | Married | Tertiary | Formal |
| P029 | Father | 85 | Chongwe | Widower | Tertiary | Retired |
| P030 | Father | 81 | Lusaka | Widower | Secondary | Retired |

Many of the participants were married 16(53.3%, widowed 6(20%), single 5(16.7%) and divorced 3(10%). The educational background spanned from secondary 13(43.3%), primary and Tertiary each had 8(26.7%) to normal education 1 (3.3%). Most of the caregivers had some form of employment which included formal 14(46.7%), self-employed 12(40%) while retired 4(13.3%).

## Results

The results reveal insights from 30 family caregivers supporting individuals with chronic psychosis at Chainama Hills Hospital in Lusaka. The findings are presented through themes that reflect how caregivers see their responsibilities as moral obligations, how they draw on spiritual motivation, the ways they cope, and the influence of cultural expectations. In presenting these themes, the caregivers' own words are included to give voice to their struggles and strengths, allowing their lived realities to be heard in their own terms. Below is the table illustrating the study's emergent themes.

**Table 2.** Superordinate and Subordinate Themes

| **Superordinate themes** | **Subordinate themes** |
|---|---|
| Providing care as a religious duty | Belief in divine responsibility |
| | Prayer as a coping mechanism |
| | Spiritual reasons for illness |
| Moral duty rooted in kinship and culture | The importance of cultural values and family |
| | Fighting off negative cultural influences |
| | Ignoring discrimination and criticism |
| Psychological and emotional strain | Emotional pain and loneliness |
| | Personal life disturbance |
| | Stress in marriage and family |
| Coping through resourcefulness and faith | Managing with constrained resources |
| | Dependence on oneself and one's spirituality |

### Theme 1: Providing Care as a Religious Duty

The caregivers' narratives on their experiences of caring are being illustrated as being grounded in a form of spirituality. This is guided by the values obtained through shared values of love rooted in their religious beliefs. Caring is practiced as an obligation that is performed with the hope of securing blessings for self and the entire family.

#### Belief in Divine Responsibility

*"Certain things happen to us because it's God's will….I do all these things because God started it with me ……He shall never leave me alone….Never!".(P22).*

The narrative expresses an assurance of the presence of a superior being in their life's challenges. This deeper affirmation expresses how the caregiver is ready to care for their loved one believing that they will never be alone and that they are chosen for this duty for a greater prize. The caregiver demonstrated this

with passion of faith as she paused to confirms the importance of this disclosure to her.

*"I am a Jehovah's witness…. for me I really give thanks to the message of God because when it is read, it gives me the strength to wake up,". (P4)*

This reflects the caregiver's commitment to continuously read values engrained in the religion as a staff that keeps the focus and strength. By acknowledging the religious denomination, the caregiver is not ashamed to express the comfort obtained in the daily reflection of religious teaching and their significance in their caring role.

"Me*…I have suffered no……without God, this one wouldn't have been alive up to this time.". (P8).*

The caregiver expresses how their belief in a superior being has kept their patient alive, reflecting a deeper strength that shines through the darker moments of caring, and in turn helps them to cope despite the psychological and emotional strain that the illness presents.

*"Some people say whoever did this is advanced in witchcraft…. You know for me my sister the level I have reached is where some pastors are even scared to help me I call them they don't answer my calls.". (P19)*

The caregivers express a belief and fear in the darker supremacy that can be overwhelming to them and those expected to offer power. It saliently shows how faith in God is their only source of strength in the face of adversity.

*"And I can't just say no its just prayers….no…. but I should also take him for hospital where it needs hospital.". (P25).*

The caregiver expresses an understanding to balance spirituality with medical care approaches, as they are both necessary components in the care of the patient.

**Prayer as a Coping Mechanism**

*"My only prayer is that they almighty God will help him to be better one day because he has really suffered ……I just pray that my husband one day will be fine ……because it's a very good man there's a very good heart". (P14).*

Prayer is viewed as a source of comfort that transmits resilience in the face of emotional strain for caregivers.

*"Spiritual battles are real……sometimes my son starts responding to treatment….they attack. I just hold on to prayer". (P11).*

P11 illustrates an understanding of the disease process and the need to never relent even when the condition worsens. This shows prayer as a resistance strategy.

*"Before the situation gets worse, we rush to the mountain. Otherwise, we usually go to pray there and the condition becomes manageable……prayer really helps". (P2).*

The caregiver shows that trust in communal gatherings provides spiritual interception of the condition before it worsens when biomedical solutions are not adequate.

**Spiritual Reasons for Illness**

*"As I earlier explained that it's a spiritual battle. The father and his young brother entered into an agreement….curses were spoken upon their family …. My Son is the one suffering". (P13).*

P13 expresses a deeper believe on spiritual causes of mental illness for her son as being from witchcraft and punishment. The conviction that words spoken can manifest in physical illness, and that these can present in any family member because they are binding in the spiritual world.

*"You know there is also satanism, satanism is there you can't just say that…. just because you are doctors ….no satanism is there". (P5).*

The caregiver demonstrates mistrust in medical explanations of mental illnesses, indicating that science does not give chance to other possible causes such as spirituality.

*"But it's like a phase, you pray over this, another spell is cast on him….ah…ah… again, you fight this another spell". (P11)*

The caregiver expresses emotional exhaustion and the toils that the disease process has to undergo. It shows the doubt and the hopelessness in the unending uncertainty and healing of the loved one.

*"Now you see at first healing took place very fast. I told you he became lame, he became blind, he became deaf. But through prayers…. prayers they helped him. So, after they saw that I had gained strength in prayers, they casted a spirit of anger onto my son. That spirit of anger made him to refuse prayers. So, when a pastor shows up for prayers, they can't manage him because he could even him together with me." (P11)*

P11 shows confusion and a lack of understanding of the disease process. She wonders the progression of symptoms from being healed to many other complications that the child had to undergo. She is even further saddened by the anger and aggression it presents with, while still choosing to associate it to the spirits that keep tormenting the patient.

## Theme 2: Moral Duty Rooted in Kinship and Culture

In the Zambian context, caring of viewed as a sole responsibility of any family member to ensure that the patient is well provided for and protected. The society seems to judge the love in the family based on the care provided to the weaker members. Failure to care for the ill family member breeds judgement and ridicule, and it is seen as a sign of neglect hence the obligation to care for ailing members against all odds.

### The Importance of Cultural Values and Family

*"I got married to my husband 19 years ago… and unfortunately the family never told me that he is psychotic I only got to know two years later when he relapsed. What made me to stay is that my husband was very good to me he accepted to keep my four children that I came in with and I was able to take care of his two children." (P28)*

P28 expresses disappointment on the betrayal by the husband's family not revealing the sickness to her before marriage. But she quickly turns it into a transaction based on the loving and caring nature of the husband she has come to learn over time. This makes her to feel obligated and reciprocate this love back to him in the moments of his ailment.

*"I really feel very bad and I cry a lot. Sometimes it gets very bad that you find that she would be moving naked……remove these clothes, she would say., and you see when I look at her nakedness and it's in public I always cry to God asking him why my child should be going through such kind of things." (P17)*

The caregiver narrates the pain associated with seeing a loved one in undignified state I public, something that leads her to seek understanding from the superior being on the nature of the illness as she watches helplessly.

"*For me not every child is spoiled, ok they are there, yes, because of marijuana drugs but others it's because of the family battles…… whereby you find someone giving you warnings that you will see." (P20)*

Parental instincts are observed as the caregiver struggles to justify the causes of mental illness, not neglecting the protective nature of a father. The caregiver feels the need to care for the patient as it is perceived that other powers have led this problem.

### Fighting off Negative Cultural Influences

*"I pray for strength all the time….so many voices telling me I do not need to keep my wife because I am a man……but how do leave her in this state." (P10)*

The caregiver narrates how external pressure to abandon their ailing spouse, destabilizes them. They express a dilemma of the possibility of leaving a spouse in a sick state. This shows how cultural teachings have shaped their duty

to care for the loved ones despite negatives influences.

*"Sometimes….Sometimes people have told me that if it were them with the things I'm going through, they are going to bewitch whoever or someone, so all these things I…I avoid…. I avoid listening to them because I know they can mislead me." (P15)*

The caregiver battles with avoiding the ideas that society presents to her, acknowledging how detrimental they are likely to interfere with her ideas of believed revenge. She radiates an opposite choice of sticking to medical care instead of focusing to the ideas that could stray her from what is right.

"*One thing I've realised with tradition is that if you follow this tradition too much you can kill all the enemies that's why it's…. it is better using a Bible because sometimes the tradition influences to do a lot of things that can be bad." (P26)*

P26 hangs on religious values to navigate the pressure faced from society to associate the cause of mental illness to devilish powers. The teachings of love thy enemies and all that persecute you serve as a guide to follow than transmitting hate.

**Ignoring Discrimination and Criticism**

*"Love helps caregivers to take care of their loved ones because if you start thinking of the things that they do…. destroying things, getting things from people then you can leave them, but you must understand them …. because we should know that if it were me, they would have gone all the way just to help me but now I have to continue taking care of him because it's not their wish." (P30)*

The caregiver highlights the difficulties that are faced in their caregiving process, avoiding focusing on the negatives that present with the mental illness helps them to cope and minimise criticising negative actions from the patient.

*"People don't like being associated to someone who has a patient with mental illness…. It's sad how they treat you like the condition is transmissible." (P27)*

The caregiver acknowledges the pains and the isolation that comes with managing a mentally ill patient due to the unfair treatment the society presents. It shows how they have to focus on caring for their patients despite all that they face.

*"The hospital should engage the community by educating them that stigmatising or laughing at those patients and their caregivers discourages the little strength that caregivers have to take care of their patients, so they have to be told that psychosis can affect anyone and so we need to take care of each other in the community." (P24)*

The caregiver expresses the emotional and psychological strain that ridiculing the mentally ill does to the caregivers especially because they comprehend the reality of the illness. Additionally, they urge health care professionals to intervene by offering health education to communities against stigma and discrimination in order to support caregivers in their role.

## Theme 3: Psychological and Emotional Strain

The excerpts further show that caregivers are exposed to profound psychological and emotional strain as they care for their loved ones. This is presented I different forms including loneliness, pain, family and relationship strain.

**Emotional Pain and Loneliness**

"*The pain of watching him moving aimlessly is unbearable……. i get to have a lot of thoughts in my head in trying to accept this……. from a strong dignified person to one with no control….God why…. why…its hard." (P01)*

The caregiver bemoans the loss of honour their loved one is exposed to due to the disease process. This harbours feelings of loneliness

and shame which leads to them to watch helplessly. They tend to combine with religious questioning in the hope for answers and understanding of their suffering.

"*So, as it is now no one takes care of me no relative takes care of me no outsiders there's no other form of support apart from myself so if I don't work hard then nothing happens for my family." (P09)*

Loneliness is demonstrated though the absence of relatives, friends, church and a lack of support from the community. The caregiver is seen relying on oneself as being a better option in order to survive daily struggles.

*"I reached the level where I lost my……my strength I lost the faith I went through a lot of things and the troubles at the start were beyond me, that I could not understand. I lost words…. I could not work because I realised that sometimes I was …. I was just praying but even then, nothing is working." (P26)*

The caregiver illustrates how desolate and overwhelming the emotional pain could be, that even spiritual comfort could not be felt despite all efforts to be in control of the situation.

**Personal Life Disturbance**

"*So, like it happened last time, I went to South Africa trying to improve my business. I was called back that my son is sick…. had to come back and abandoned whatever I was doing that side so when I reached Lusaka and I got home I had I had some money with me which I ended up using." (P22)*

The caregiver narrates the disruptions that mental illness presents, and how financial stability is almost impossible to maintain. She is found negotiating between caregiving and survival duties exposing a persistent financial burden and personal distress as all needs depend on them.

*"So now my money is finished, and I'm confused I don't know where I'm going to get money…. I'm just hoping that they'll be able to lend me something….so that I can buy thrift at least it helps me to get a bit of profit for me to take care of my family." (P28)*

The caregiver expresses how overburdened they are financially as they have to depend on lenders every time their business is disrupted by the illness demands. They do not allow us themselves to moans by giving up instead constant engagement helps them to gain control of the situation.

"*Unfortunately, people from the church that I worship with do not even help me in any way. I have tried communicating to them, but they have not done anything just the same as for my neighbours." (P01)*

Lack of community support further contributes to the life disturbances the caregiver goes through because no form of help is rendered in any form even after its sought. This leads to caregivers' feeling of isolation as they perceive the absence of support which affects the nature of care provided to their loved ones.

**Stress in Marriage and Family**

*"So, you know traditionally psychosis faces a lot of stigma so some people advise me to leave him was so encourage me to persevere in taking care of him. There are very few women that can take care of a psychotic patient you may wish to know…. that I'm the second wife, first wife abandoned him because she was not patient enough to take care of the condition." (P01)*

Caregiving possesses numerous challenges that when coupled with marital demands it becomes a significant stress. The caregiver expresses the essence of accepting silent suffering which is defined by patience to take care of the loved ones in order to remain faithful to the commitment of marriage.

*"It's like these drugs affect my husband's feelings for me. Anyway, I am doing my best to make sure that I don't trigger my sexual feelings or even have thoughts of having any contacts with other men I've really tried to avoid that one. So sometimes I get to*

*massage him just so maybe something can happen." (P28)*

Marriage faces complex pressures such as faithfulness, sexual restrain and loyalty to the family. The spouse demonstrates frustration as her role is overstrained amidst other challenges mental illness presents.

"*I'm sort of done recently I worked so hard I got a piece of land, and I managed to build a 5 roomed house so I give thanks to God because I don't like seeing him panicking." (P09)*

It is observed that illness disrupts the family structure, as women are converted into providers a role they are never prepared for as they try to shield the male counterpart from psychological strain and feelings of failure. The caregiver feels that taking over family responsibility may contribute to better health outcomes for the loved one

## Theme 4: Coping through Resourcefulness and Faith

The narratives show that daily survival requires clinging to adaptive resourcefulness and spirituality in order to manage the struggles encountered throughout the caring process. This co-existence provides a balance for caregiving even in limited resources such as financial and community support. The caregivers are expected to adopt systems that can work in their environment as they manage their daily duties.

### Managing with Constrained Resources

"*You see in most days I have to plan for my family on my own because we don't have enough. … when the condition gets worse, I can't rush to the hospital immediately because transport is expensive…..so I must find a way to balance especially that I have to think of the children as well." (P07)*

The caregiver notes that the process of caring especially in chronic conditions brings with it economic strain. Caregiving is interpreted as being performed with limited resources and sacrifices. The caring process presents with scarcity and is navigated through improvisation showing a survival-oriented resilience formed by poverty.

*There are moments when I have to borrow money from my neighbours so I can buy his medication. Sometimes it is embarrassing….but what can I do……if I put pride before me then my family will suffer. So …I just have to swallow my pride because no one will help and also the responsibility still lies in me.' (P09)*

In this narration, caring is perceived as a duty that overrides shame. The caregiver interprets borrowing as a moral act that protects the family, exposing the convergency of cultural desperation and desperation. Caregiving in this context is interwoven with sacrifices to reserve family dignity.

*"This condition can take a stretch on me ……sometimes there is not enough food to feed the whole …. I give him the food first because his medication requires that he eats." (P12)*

Caregiving is presented as an engagement of painful decisions that prioritises the family member who is ill. This shows the self-sacrifices and dilemmas caregivers go through in which maintaining stability for the ill family member is more central.

### Dependence on Oneself and One's Spirituality

*"I pray when things get too heavy for me……I even cry in my prayers because that is the only place where I feel safe….my God will never judge because he is always there for me….he listens." (P15)*

Spirituality is used as a coping strategy where the caregiver seeks emotional refuge and draws strength. The caregiver makes sense of the suffering by keeping to the faith that empowers their endurance.

*"My boy reached a level where you couldn't even stand they looked like he was lame and my past I was even tired of helping*

*his prey and he told me I think we should just stop but I told the password my child is going to work one day I'm not going to relent in prayer continuing to my child is fine again." (P13)*

The caregiver applies spiritual dialogue to control and maintain fear and psychological stress. Spirituality therefore reflects a sense of surrender and partnership with a superior being.

*"I have been advised several times by people to take him to traditional healers….but my Christian doctrine doesn't allow me to trust the witch doctors. Mine is to trust God and the hospital….I don't want to confuse things." (P20)*

The caregiver uses spirituality as a moral compass for their day-to-day decision making. It is observed that caregivers have negotiate competing choices of care for their ill family members, as seen that spirituality, traditional and biomedical care are options that are met in the caring processes.

## Discussion

The study aimed to explore personal values influence caregivers of individuals with chronic psychosis, and how the contribute to their moral and spiritual commitment in Zambia. The study provides a deeper understanding of how these values shape family caregiving by revealing gaps in the current systems to promote family centred interventions. The key findings of the study are providing care as a religious duty; moral duty rooted in kinship and culture; psychological and emotional strain; and coping through resourcefulness and faith.

The findings of this study help to explore the various stressors and challenges that influence caregivers in their caregiving process and their general wellbeing as illustrated by Betty Neumann's system theory [29]. The theory emphasises how caregivers' experience and interacts with their environment. Similarly, caregivers of individuals with chronic psychosis face several challenges as they interact with their cultural and spiritual values in meaning making process of caring in the mental health context.

The study results reviewed a demographic trend of caregivers' age between 30 and 85 years with 76.7% being females (mothers, wives, sisters, daughters) as reflected in the regional trends in the distributions of caregiving roles. This is consistent with evidence that caregivng responsibilities are often gendered, with mothers, wives and sisters disproportionately bearing the burden. Similarly [30], reported 83.5% of caregiver burden among informal caregivers of individuals with severe mental disorders in rural South Africa were female caregivers, with the largest group (45.3%) being parents falling between the ages of 45 and 64. The age and gender distribution observed in this study, reflects the broader sociocultural expectations that adults in their Mid to late years assume primary responsibility of caring for family members suffering from mental illness. This gender imbalance has led to further socioeconomic burdens as most women have to abandon their work in order to supervise the care of their loved ones [31].

The study results also revealed that caregivers perceived their role as a religious obligation grounded in divine duty and maintained through constant prayers while concurrently depending on biomedical care. This dual consideration is also observed in cultural contexts in which carrying both spiritual and social expectations is a norm [9]. This further magnifies the pressure to fulfil these roles despite the limited support and resources faced by caregivers. Caregivers tend to turn to spiritual or religious traditions as a coping strategy acknowledging that spirituality can offer emotional healing, power and purpose during stressful times [12]. It's further suggested that the negative effects of caregiving can be balanced by considering personality, strong social support and applying spiritual beliefs to buffer emotional strain and improve overall wellbeing [32]. Additionally,

studies have proposed that the engagement of caregivers in positive religious coping have shown to improve both their mental and spiritual wellbeing [33]. This indicates the need for institutional involvement into supporting caregivers' religious stance to provide guidance on nature of religious coping while paying attention to those that impact the management of their patients positively.

The study results affirm that caregiving requires moral commitment that delves into family teachings, spiritual values and society expectations providing caregivers with perseverance despite the stigma and sacrifices endured. Furthermore, while family caregiving has been found to be morally meaningful and an identity enhancer, it exposes caregivers to profound emotional strain and therefore providing strong support systems is imperative to shielding their wellbeing and moral identity [34]. Subsequently, caregiving as a moral commitment boosts caregivers' self-esteem while concurrently satisfying their urge to fulfil their marital and family duties [35].

The dual reliance on prayer and biomedical care possess a challenge for caregivers as they lack formal guidance from health institutions. This reliance has shown to contribute to poor health seeking behaviours which ultimately undermines the essence of medical care hence the need to engage communities to provide understanding of mental illnesses and their management [36]. Furthermore, studies have found that higher levels of spiritual wellbeing have been substantially associated with increased resilience among caregivers reinforcing the notion that spirituality serves as a protective factor in the provision of care [37]. This indicates the need to incorporate caregiver's spirituality into the therapies offered to alleviate caregiving difficulties and improve mental health outcomes for a variety of populations. To further harmonise the challenges between spirituality and biomedical care, health care providers must engage families and communities in open dialogues about their views to create psychoeducation and care plans that incorporate their viewpoints to offer best care to the individuals with mental illness [38].

## Conclusion

The study explored the moral and spiritual commitments of family caregiving in the context of Zambian mental health. Caregivers face various challenges as they navigate care for their loved ones, and to combat them they use religion and culture to cope. Studies have shown that caregivers' beliefs about the causes and management of mental illnesses are modelled by their religious beliefs which aid them to manage and sustain resilience. Their responsibility and moral commitment to care is guided by their cultural teachings that guide define caregiving as a familial and ethical obligation. In addition to exploring how family caregiving is influenced by culture and spirituality, it also poses negative effects as it has potential to undermine medical care. It is then imperative to continuously engage communities in formulating mental health interventions that are specific to the needs of caregivers by offering institutional support that will in turn improve patient outcomes. Therefore, study findings highlight the need for mental health interventions that acknowledge the moral and spiritual commitments caregivers', engage actively with communities and guarantee institutional support throughout out the care process.

To gain more insight, there is need to conduct longitudinal studies on how caregivers' experiences change over time. The need for male caregivers to be studied cannot be overemphasized. The study was conducted at a national mental hospital, providing a variance of experiences with a wide range of country representations. The methodology further provided an in-depth exploration of the phenomenon under study. It also has limitation with bias representation of females than male as

well as reliance on self-reported experiences may have affected objectivity.

## Ethical Approval

Ethical approval was obtained from ERES Converge IRB *Ref no.2025-Mar-001* and approval to conduct the study from National Health Research Authority *Ref no.NHRA-2080/27/03/2025.*

## Conflict of Interest

The author declares no conflict of interest, as no external funding or relationships influenced this study.

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## Author Contribution

The leading and corresponding author of this paper was Virginia Simasiku, responsible for data collection, storage, analysis and writing. Professor Catherine Mubita Ngoma and Professor Rajesh Konnur were co-authors and responsible for supervision throughout the research process and manuscript writing.

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## Data Availability

The data used in this research is available upon request, though anonymized to protect the privacy of the participants.

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# Infection Prevention and Control Compliance among Healthcare Workers in a Rural Ugandan District: A Facility-Based Study

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***Abstract***

*Hospital-acquired infections remain a significant public health challenge, and adherence to standard precautions and infection prevention and control (IPC) measures is essential to minimize transmission. However, compliance in rural health facilities is often inadequate. This study employed an institution-based cross-sectional design conducted over two months in 2021, involving all healthcare workers in 30 lower-level health facilities in Butambala District, Uganda. Inclusion of the entire workforce minimized selection bias and improved representativeness. Data were collected using structured questionnaires and focus group discussions. Chi-square tests, Fisher's exact tests, and multivariate logistic regression were used to identify factors associated with IPC compliance. Only 10.6% of healthcare workers fully complied with IPC measures. Professional cadre was significantly associated with compliance, with laboratory technicians showing higher adherence (AOR = 2.17, 95% CI [1.14–5.74], p = 0.037). COVID-19 vaccination status was also a significant factor; those who had received the second dose were more likely to comply (AOR = 3.94, 95% CI [1.04–5.74], p = 0.043). Conversely, an inadequate supply of personal protective equipment (PPE) was strongly linked to non-compliance (AOR = 0.012, 95% CI [0.03–0.45], p = 0.002). In conclusion, IPC compliance among healthcare workers in Butambala District was alarmingly low. Professional cadre, vaccination status, and PPE availability were key influencing factors. Strengthening IPC requires targeted interventions to improve PPE supply, enhance training, and promote adherence to national protocols to protect both healthcare workers and patients.*

***Keywords:*** *Compliance, Healthcare Workers, Hospital-Acquired Infections, Infection Prevention and Control (IPC); Personal Protective Equipment (PPE).*

## Introduction

Hospital-acquired infections (HAIs) continue to pose a significant threat to patient safety and health system resilience [1]. They are primarily spread through poor adherence to infection prevention and control (IPC) measures, exposing healthcare workers and patients to avoidable risks [2, 3]. Health facilities are known hotspots for transmission of infectious diseases such as COVID-19 and Ebola [4], contributing to substantial morbidity, mortality, and economic burden [5–7]. The burden of healthcare-associated infections is particularly high in Africa, where limited resources and system constraints worsen transmission [8, 9].

Various IPC measures, such as hand hygiene, use of personal protective equipment (PPE), sterilization, environmental sanitation, and waste management, have proven effective in minimizing transmission [10–13]. Global

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and national guidelines, including World Health Organization (WHO) protocols, emphasize these measures [12, 18]. Despite their effectiveness, compliance remains low in many low- and middle-income settings, including Uganda, due to inadequate supplies, limited knowledge, poor attitudes, and systemic gaps [13–15, 21–24]. The COVID-19 pandemic further amplified the need for strict IPC practices, especially PPE use and hand hygiene [16].

Existing approaches include standard precautions, policy frameworks, and IPC guidelines at national and facility level [18, 19, 22]. While effective, their impact is constrained by weak implementation, limited training, and insufficient monitoring. Reported compliance rates in Ugandan healthcare facilities remain low [22], with rural settings being particularly underserved.

Persistent non-compliance with IPC measures among healthcare workers in rural health facilities remains a critical driver of elevated HAI rates. Although the WHO and the Ministry of Health (MOH) have established guidelines, conducted training, and implemented structured IPC programs, their translation into routine practice at lower-level facilities has been suboptimal. Evidence underscores that strict adherence to standard IPC precautions, including appropriate hand hygiene, consistent use of PPE, and proper waste management, constitutes the most effective strategy for mitigating HAIs. Nevertheless, effective implementation continues to be constrained by weak enforcement mechanisms, insufficient resources, limited knowledge among healthcare workers, and excessive workloads. Global estimates indicate that approximately 30% to 70% of HAIs are preventable through the consistent application of IPC measures [17], illustrating both the scale of the challenge and the substantial potential for improvement This study aimed to assess compliance with IPC measures and to identify enabling and constraining factors influencing adherence among healthcare workers in rural health facilities. Its novelty lies in its focus on rural settings in Uganda, a context where empirical evidence on IPC compliance factors remains limited despite a disproportionately high burden of HAIs.

## Schematic Diagram

Figure 1. Flow sketch of IPC compliance factors showing how enablers such as professional cadre, vaccination status, knowledge and supervision, and barriers including PPE shortages, poor hygiene, workload, and attitudes influence compliance.

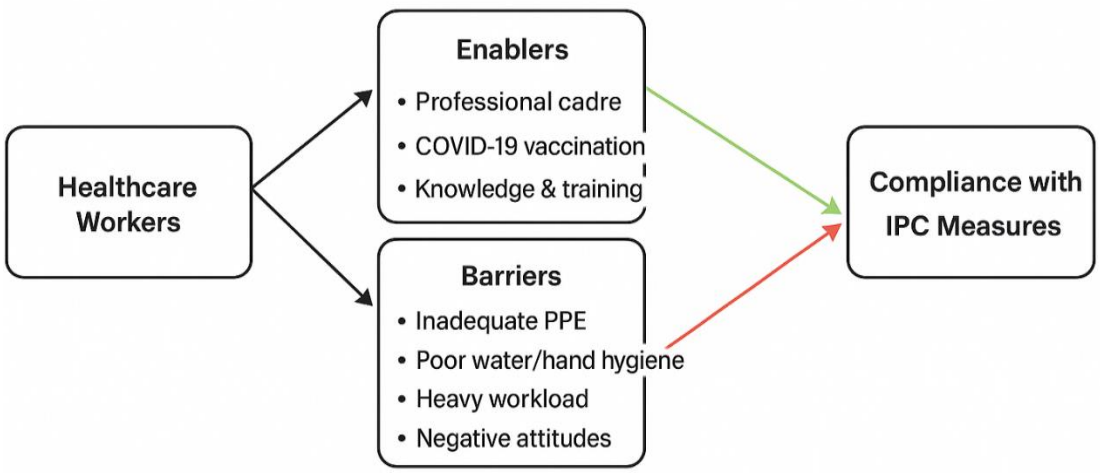


**Figure 1.** Conceptual framework showing enablers and barriers influencing compliance with IPC measures. Developed by the author, 2025

## Materials and Methods

### Description of the Site

The study was conducted in Butambala District, located in the south-central region of Uganda, with an estimated population of approximately 150,331 people as of 2025 (Uganda Bureau of Statistics, 2025). The focus was on 30 lower-level health facilities, including Health Centre IIs and IIIs, operated by a mix of public, private not-for-profit, and private healthcare providers. Although the district has one general hospital, no Health Centre IVs are available, and the hospital was excluded from the study. Data collection was conducted over a two-month period.

### Description of the Methods

A cross-sectional study design was used to collect data at a single point in time. A mixed-methods approach integrated both quantitative and qualitative techniques to comprehensively assess compliance with IPC practices among healthcare workers. Quantitative data were collected through structured questionnaires administered in face-to-face interviews with healthcare workers. Qualitative data were obtained through focus group discussions (FGDs) involving individuals in managerial or leadership positions. Due to COVID-19 restrictions at the time, FGDs were conducted via teleconferencing.

The study population consisted of 186 healthcare workers employed at the 30 selected lower-level facilities. A census sampling method was employed, ensuring all eligible healthcare workers in these facilities were included. Participants for FGDs were purposively selected based on their roles and knowledge. Inclusion criteria were: (i) at least six months of service, (ii) direct patient contact, and (iii) willingness to participate. Those who declined or were unavailable during the study period were excluded.

### Description of the Laboratory Methods

No laboratory or clinical testing was undertaken as part of this study. Instead, the assessment focused on healthcare workers' compliance with IPC measures, including hand hygiene, use of PPE, safe injection practices, and needle recapping. Compliance was measured using a dichotomous response format, with "Yes" coded as 1 and "No" as 2. For those reporting compliance, a follow-up frequency scale was applied, categorized as "always," "sometimes," "rarely," or "never."

Compliance levels for each parameter were calculated as the proportion of respondents who selected "always" or "sometimes" relative to the total number of responses. Overall compliance was determined by aggregating compliance across the four parameters. This structured approach provided a comprehensive overview of healthcare workers' adherence to IPC practices in the study setting.

### Data Collection Tools and Quality Assurance

Quantitative data were collected using pre-tested structured questionnaires, while qualitative data were collected through FGDs. To ensure data quality, research assistants were trained in data collection protocols, and fieldwork was monitored daily for completeness and accuracy.

### Study Variables and Measurement

The dependent variable was healthcare worker compliance with IPC precautions, measured using the structured questionnaire. Independent variables included personal characteristics, individual factors, and facility-related factors. These variables were measured using dichotomous, numerical, categorical, and ordinal scales.

### Statistical Methods

Quantitative data were entered, managed, and analyzed using STATA version 15.0. Descriptive statistics were used to summarize

data, while Chi-square tests, Fisher's exact tests, and multivariate logistic regression were applied to assess associations between dependent and independent variables. Qualitative data from FGDs were transcribed verbatim and analyzed thematically. Thematic analysis involved coding, generation of sub-themes, and development of overarching themes.

### Ethical Approval

Ethical approval for this study was obtained from Hospice Africa Uganda Limited Research Ethics Committee (HAUREC) (Ref No: HAU-2025-207) and administrative authorization was granted by the Butambala District Health Office. Written informed consent was obtained from all study participants before data collection. Participation was voluntary, and confidentiality was ensured by removing personal identifiers from all datasets. The study adhered to the principles of the Declaration of Helsinki on research involving human subjects.

## Results

The study examined socio-demographic characteristics, individual factors, and health facility-related factors associated with compliance with IPC measures. A total of 186 healthcare workers were targeted for participation, of whom 161 were successfully enrolled, representing a response rate of 86.6%. Here are the key findings of the study.

### Socio-Demographic Characteristics

Out of the 161 participants, 67.7% were female, 51.6% identified as Catholic, and 61.5% were married. The majority of participants (64%) held a certificate as their highest level of education. Various professional cadres were represented, with enrolled nurses (27.3%) and enrolled midwives (18.6%) forming the largest groups. Additionally, 19.3% of participants had not received training on infection prevention and control (IPC) precautions. Nearly 39.8% had served for 2–4 years in their current positions. The detailed socio-demographic characteristics of respondents are presented in Table 1.

**Table 1.** Socio Demographic Characteristics of the Study Participants

| Variable | Category | Frequency (n) | Percent (%) |
|---|---|---|---|
| Gender | Male | 52 | 32.3 |
| | Female | 109 | 67.7 |
| Age | 20-24 | 13 | 8.1 |
| | 25-29 | 48 | 29.8 |
| | 30-34 | 51 | 31.7 |
| | 35-39 | 28 | 17.4 |
| | 40+ | 21 | 13.0 |
| Marital Status | Single | 45 | 28.0 |
| | Married | 99 | 61.5 |
| | Others | 17 | 10.6 |
| Religion | Catholic | 83 | 51.6 |
| | Anglican | 13 | 8.1 |
| | Muslim | 37 | 23 |
| | Pentecostal | 9 | 5.6 |
| | Born again | 14 | 8.7 |
| | SDA | 5 | 3.1 |
| Educational level | Certificate | 103 | 64 |
| | Diploma | 55 | 34.2 |

| | | | |
|---|---|---|---|
| | Graduate | 3 | 1.9 |
| Cadre | Medical clinical officer | 17 | 10.6 |
| | Assistant Nursing Officer | 24 | 14.9 |
| | Laboratory Technician | 10 | 6.2 |
| | Laboratory Assistant | 8 | 5 |
| | Enrolled Midwife | 30 | 18.6 |
| | Enrolled Nurse | 44 | 27.3 |
| | Other (specify) | 28 | 17.4 |
| Duration in-service | Less than 1 year | 42 | 26.1 |
| | 2 -4 Years | 64 | 39.8 |
| | 5+ | 55 | 34.2 |

## Level of Compliance with IPC by Healthcare Workers' Responses

The level of compliance was assessed across four key IPC parameters: hand hygiene, personal protective equipment (PPE) use, safe injection practices, and proper disposal of healthcare waste. The findings are summarized in Table 2.

Hand hygiene: A total of 93.2% of participants reported washing their hands between patients, indicating a high level of compliance with this essential IPC practice.

PPE: Overall adherence to PPE use was also relatively good. Eighty-two percent of healthcare workers reported changing gloves between patients, and 83.2% consistently wore protective clothing during procedures. In addition, 55.9% used mouth, nose, and eye protection when performing procedures, while 93.8% removed PPE before leaving the work area. Furthermore, 95.7% of participants reported wearing face masks, reflecting strong adherence to PPE guidelines.

Safe injection administration: Compliance with safe injection practices was comparatively low. Only 23% of participants consistently disinfected the rubber septum on medication vials with alcohol, and 18% reported recapping needles after use. These findings suggest a gap in adherence to safe injection protocols and highlight the need for targeted training and reinforcement.

Proper disposal of healthcare waste: A high level of compliance was observed for sharps disposal, with 96.9% of participants reporting appropriate handling and disposal of sharps, a critical aspect of IPC measures.

**Table 2.** Participants' Responses on Hand Washing, PPE Use, Safe Injection and Healthcare Waste Management

| | **Variable** | **Category** | **Frequency (n)** | **Percentage (%)** |
|---|---|---|---|---|
| Hand washing between patients | Hand washing | Yes | 150 | 93.2 |
| | | No | 11 | 6.8 |
| PPE use | Wear a different pair of gloves for each patient | Yes | 132 | 82 |
| | | No | 29 | 18 |
| | Wear a protective clothing that covers skin | Yes | 134 | 83.2 |
| | | No | 27 | 16.8 |
| | Wear mouth, nose and eye protection during procedures | Yes | 90 | 55.9 |
| | | No | 71 | 44.1 |
| | Remove PPE before leaving the work area | Yes | 151 | 93.8 |
| | | No | 10 | 6.2 |

| | | | | |
|---|---|---|---|---|
| | Do u wear a face mask | Yes | 154 | 95.7 |
| | | No | 7 | 4.3 |
| Injection safety | Recapping of needles | Yes | 29 | 18 |
| | | No | 132 | 82 |
| | Disinfect the rubber septum on medication vial (multi-doses) with alcohol before piercing | Yes | 37 | 23 |
| | | No | 124 | 77 |
| Healthcare waste management | Proper disposal of sharps | Yes | 156 | 96.9 |
| | | No | 5 | 3.1 |

## Level of Compliance with IPC Measures Considering the Frequency of Healthcare Workers' Practices

The frequency of healthcare workers' practices was assessed across four IPC domains: hand hygiene, personal protective equipment (PPE) use, safe injection practices, and healthcare waste management. The findings are presented in Table 3.

Hand hygiene: Hand washing between patients was frequently practiced, with 66.5% of participants reporting "always," 26.7% "sometimes," and 6.8% "rarely or never" engaging in this practice.

PPE use: Compliance with PPE use varied across specific practices. Changing gloves between patients was reported as "always" by 65.2%, "sometimes" by 15.5%, and "rarely or never" by 18.0% of participants. Wearing appropriate protective clothing during procedures involving contact with blood or saliva was reported as "always" by 54.0%, "sometimes" by 29.2%, and "rarely or never" by 16.8%. Usage of mouth, nose, and eye protection during procedures with potential splashes was less frequent, with 37.9% reporting "always," 18.0% "sometimes," and 44.1% "rarely or never." Removal of PPE before leaving the work area was reported as "always" by 78.9%, "sometimes" by 14.9%, and "rarely or never" by 6.2%. Wearing face masks was reported as "always" by 74.5%, "sometimes" by 21.1%, and "rarely or never" by 4.3% of participants.

**Table 3.** Frequency of Practices on Hand Washing, PPE Use, Safe Injection and Health Care Waste Management

| SP Component | Practice | Always | Sometimes | Rarely | Never |
|---|---|---|---|---|---|
| Hand washing | Hand washing between patients | 107(66.5%) | 43(26.7) | | 11(6.8%) |
| PPE | Change of gloves between patients | 105(65.2%) | 25(15.5%) | 2(1.2%) | 29(18.0%) |
| | Wearing clothes which cover skin during procedures or activities where contact with blood or saliva is anticipated | 87(54.0%) | 47(29.2%) | | 27(16.8%) |
| | Wearing mouth, nose and eyes protection during procedures that are likely to generate splashes or spattering of blood or other body fluids | 61(37.9%) | 29(18.0%) | | 71(44.1%) |
| | Removing of PPE before leaving the work area | 127(78.9%) | 24(14.9%) | | 10(6.2%) |
| | Wearing of face mask | 120(74.5%) | 34(21.1%) | | 7(4.3%) |

| | | | | | |
|---|---|---|---|---|---|
| Health care waste disposal | Disposing of used syringes and needles, scalpel blades, and other sharp items in appropriate puncture resistant containers located as close as possible to the area where the items are used | 144(89.4%) | 12(7.5%) | | 5(3.1%) |
| Safe injection | Disinfecting the rubber septum on a medication vial that has multi-doses with alcohol before piercing | 16(9.9%) | 21(13.0%) | | 124(77.0%) |
| | Not re-capping of needles | 132(82.0%) * | 29(18.0%) | 0 | 0 |
| | Entering medication containers (single and multi-dose vials) with a new needle and new syringe, even when obtaining additional doses for the same patient | 95(59.0%) | 19(11.8%) | | 47(29.2%) |

** Always means never*

Healthcare waste management: Proper disposal of used syringes and sharp items was reported as "always" by 89.4%, "sometimes" by 7.5%, and "rarely or never" by 3.1% of respondents, reflecting strong adherence in this domain.

Safe injection practices: Compliance in this area was generally low. Disinfecting the rubber septum on multi-dose vials was reported as "always" by only 9.9%, "sometimes" by 13.0%, and "rarely or never" by 77.0% of participants. Not re-capping needles after use, a recommended safety practice, was reported as "always" by 59.0%, "sometimes" by 11.8%, and "rarely or never" by 29.2% of participants.

Overall, compliance was highest for hand hygiene, PPE use, and sharps disposal, while safe injection practices demonstrated significant gaps in adherence.

It is important to note that for certain safe injection practices, the response "Always" effectively indicates "Never" re-capping of needles, which reflects a high level of adherence to injection safety protocols among healthcare workers. Overall, the findings reveal significant variations in compliance across different IPC domains, highlighting the need for targeted interventions to strengthen specific areas where adherence remains suboptimal.

Interestingly, insights from the FGDs contrasted with the quantitative findings on hand hygiene. Participants reported that hand washing practices were generally poor, noting that many healthcare workers do not follow recommended guidelines, even when hand hygiene instructions are clearly displayed near hand washing stations in some facilities. This suggests that while reported compliance may appear high, actual practice may be lower, indicating potential gaps between knowledge, self-reported behavior, and routine implementation.

## Focus Group Discussion (FGD) Results

Qualitative data from FGDs complemented the quantitative findings and provided deeper insights into healthcare workers' perceptions and experiences related to infection prevention and control (IPC). Five main themes emerged from the discussions: hand hygiene practices, PPE use, safe injection practices, waste disposal, and barriers and enablers to IPC compliance.

### Theme 1: Hand Hygiene Practices

Participants consistently described hand hygiene compliance as low in practice, despite being recognized as a fundamental component of IPC. They reported that although hand washing stations and posters illustrating proper techniques are available in some facilities, many healthcare workers do not follow the guidelines. The main reasons cited included high patient workload, inconsistent availability

of running water, and inadequate supplies such as soap.

> "We have hand washing stations, but many staff just walk past them without washing. Even when the guidelines are displayed, they are ignored." *(Nurse, HCIII)*
>
> "Sometimes there's no water or soap, so people skip hand washing altogether." *(Midwife, HCII)*

Several participants also noted that hand hygiene practices tend to improve temporarily during outbreaks, such as COVID-19, when there is increased supply of hand sanitizers and heightened awareness.

**Theme 2: PPE Use**

Participants acknowledged improvements in PPE use compared to the pre-COVID period. However, they expressed concerns about inconsistent availability of gloves, masks, and gowns, particularly in lower-level facilities. Some healthcare workers reported reusing PPE or skipping glove changes due to shortages.

> "Sometimes gloves run out, and people end up reusing or skipping glove changes between patients." (Clinical Officer, HCIII)

They also highlighted that PPE use is more strictly followed during supervision visits but tends to decline in routine daily practice.

**Theme 3: Safe Injection Practices**

While most participants recognized the importance of injection safety, many admitted that compliance with some steps (such as disinfecting rubber septa on medication vials) was inconsistent. Some viewed this practice as "time-consuming," particularly during busy clinics. Others reported limited availability of alcohol swabs and other supplies.

> "People don't always clean the septum because it takes extra time, and sometimes the alcohol swabs are not there." *(Nurse, HCII)*

Needle recapping was also discussed. Most participants reported adherence to non-recapping policies, consistent with the quantitative finding of high compliance in this area.

**Theme 4: Waste Disposal Practices**

Participants generally reported good adherence to proper sharps disposal practices. Many indicated that safety boxes are routinely available and used. However, in some facilities, delays in replacing filled safety boxes were reported, creating risks of accidental needle stick injuries.

> "We normally dispose of needles in the safety boxes, but sometimes they get full and are not replaced on time." *(Midwife, HCIII)*

**Theme 5: Barriers and Enablers of IPC Compliance**

Participants identified several factors influencing IPC compliance. Key enablers included prior training on IPC, availability of supplies, and supportive supervision. Barriers included inadequate or inconsistent supply of PPE and hand hygiene materials, high workload, lack of functional infrastructure (such as water), and negative attitudes among some health workers.

> "Training helps a lot because once people are reminded, they follow the rules more." *(Health Assistant, HCII)*
>
> "If there is no water or gloves, how can you follow the guidelines?" *(Enrolled Nurse, HCIII)*

## The Overall IPC Compliance

The study revealed that overall compliance with infection prevention and control (IPC) measures among healthcare workers in lower health facilities of Butambala District was remarkably low, at 10.6% (Table 4). Compliance was determined based on participants' self-reported frequency of practices related to hand washing, PPE use, safe

injection administration, and healthcare waste management. A respondent was classified as *compliant* if they reported performing a practice "always" or "sometimes," and *non-compliant* if they reported "rarely" or "never." Compliance was computed by summing the number of participants who responded "always" or "sometimes" (numerator) and dividing it by the total number of responses (denominator). Analysis was performed using STATA version 15.0.

**Table 4.** Compliance with Standard Infection Prevention and Control Measures - Butambala District

| Dependent variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Compliance | Yes | 17 | 10.6 |
| | No | 144 | 89.4 |

## Individual-Related Factors Associated with Compliance with IPC

A considerable proportion of respondents (60.9%) indicated that adhering to all IPC precautions would interrupt workflow, highlighting competing priorities in service delivery. Half of the respondents (50.2%) reported having experienced needle stick injuries, with most of these incidents occurring within the past month. Additionally, 54% reported exposure to blood or body fluids, emphasizing their frequent contact with infectious materials in clinical settings.

Despite these occupational risks, a high vaccination coverage against Hepatitis B (85.1%) was observed, reflecting good uptake of preventive measures. However, 62.7% of respondents reported having suffered from a nosocomial infection, underscoring persistent IPC challenges.

Regarding occupational health and safety training, 54% of respondents had received training, with most (17.4%) reporting that their most recent training was within the past 4–6 months. More than half (58.5%) perceived themselves as being at high risk of contracting infections, indicating heightened awareness of occupational hazards.

In terms of work experience, 37.9% of respondents had 5–10 years of service, reflecting a mix of seasoned and relatively new healthcare workers. Notably, 77% had received at least one dose of the COVID-19 vaccine, indicating a positive response to vaccination campaigns aimed at protecting healthcare workers.

## Health Facility-Related Factors Associated with Compliance with IPC

More than half of the respondents (51.1%**)** rated patient load at their health facilities as moderate, suggesting a substantial demand for effective IPC measures during service delivery. A majority of facilities (70.2%) had designated IPC focal persons, and 60.3% conducted internal supervision of IPC practices through facility in-charges. However, only 51.9% of these facilities provided feedback following supervision.

While 77.9% of respondents reported having received IPC training, only 42.7% indicated that in-charges provided incentives for good IPC performance**.** A significant challenge identified was inadequate availability of PPE, reported by 58.8% of respondents. Nevertheless, 65.6% reported that colleagues consistently observed standard operating procedures (SOPs) when handling patients, reflecting positive peer influence.

Regarding post-exposure precautions**,** 58.8% of respondents confirmed their availability at the health facilities, indicating

some level of preparedness for managing occupational exposures. Overall, these findings demonstrate that while certain IPC structures are in place, gaps in resources, supervision, and reinforcement mechanisms continue to limit full compliance.

## Bivariate Analysis of Factors Associated with IPC Compliance

### Socio-Demographic Characteristics

Bivariate analysis demonstrated that gender, educational level, and professional cadre were significantly associated with compliance to infection prevention and control (IPC) measures.

The relationship between gender and compliance was statistically significant ($\chi^2$ = 6.12, df = 2, p = 0.013), with 80.8% of males and 93.6% of females classified as non-compliant, indicating gender-based differences in adherence levels.

Educational level also showed a significant association with compliance (F = 7.7, p = 0.006). Respondents with a graduate degree exhibited higher compliance rates (66.7%) compared to those with a certificate (6.8%) or diploma (14.6%), highlighting the potential role of education in promoting IPC adherence.

Similarly, professional cadre was significantly associated with compliance (F = 11.3, df = 2, p < 0.001). Medical clinical officers, laboratory technicians, and other cadres exhibited lower compliance levels compared to enrolled midwives, enrolled nurses, and laboratory assistants, suggesting variability in IPC practices across professional roles.

### Individual-Related Factors

Awareness of standard IPC measures and number of COVID-19 vaccine doses received were significantly associated with compliance (F = 3.89, df = 2, p = 0.032). Awareness of IPC precautions and their perceived potential to disrupt workflow demonstrated borderline significance ($\chi^2$ = 3.68, df = 2, p = 0.055).

None of the other individual-level variables showed a statistically significant association with compliance at the bivariate level.

### Health Facility-Related Factors

Several health facilities–related factors were found to be significantly associated with compliance to infection prevention and control (IPC) measures.

The level of health facility was a significant determinant of compliance ($\chi^2$ = 14.99, df = 1, p < 0.001). Health Centre II facilities recorded a compliance rate of 9.9%, compared to 18.9% at Health Centre III, indicating that higher-level facilities may provide more enabling environments for IPC adherence. Similarly, the type of health facility showed borderline statistical significance ($\chi^2$ = 5.91, df = 2, p = 0.052). Compliance was 13.5% in public facilities, 0% in private facilities, and 14.8% in private not-for-profit facilities, suggesting variability in IPC implementation across ownership categories.

Institutional support also emerged as a critical factor. The presence of a designated IPC focal person was significantly associated with higher compliance ($\chi^2$ = 4.93, df = 1, p = 0.026), with a compliance rate of 15.2% in facilities with such personnel. In-service training on IPC demonstrated a strong positive association with compliance ($\chi^2$ = 9.33, df = 1, p = 0.002), with a compliance rate of 15.7% among trained healthcare workers. Moreover, the time elapsed since the last training influenced adherence ($\chi^2$ = 13.89, df = 4, p = 0.008); those trained within the previous three months exhibited a compliance rate of 11.5%.

Motivational and resource-related factors were also strongly linked to compliance. Facilities that provided incentives for good IPC performance had a significantly higher compliance rate of 21.5% (F = 15.0, df = 2, p < 0.0001). Similarly, the availability of adequate PPE was significantly associated with compliance (F = 13.9, df = 2, p = 0.001), with

facilities that reported sufficient PPE achieving a compliance rate of 20.9%.

Staffing levels were another influential factor ($\chi^2 = 6.65$, df = 2, p = 0.036), with lower compliance observed in facilities reporting higher staffing levels, possibly reflecting increased workload and service pressure. Lastly, facilities equipped with color-coded waste bins recorded a compliance rate of 13.1%, indicating some degree of structural preparedness for IPC implementation.

## Multivariate Logistic Regression Analysis

At the multivariate level, professional cadre, COVID-19 vaccination status, and adequate PPE supply remained significantly associated with compliance with infection prevention and control (IPC) measures (Table 5).

**Table 5.** Multivariate Logistic Regression of Factors Associated with Compliance

| | | **Compliance: No: n [%]; Yes: n [%]** | | **COR** | | **AOR** | |
|---|---|---|---|---|---|---|---|
| **Variable** | **Category** | **No: 144 [89.4%]** | **Yes: 17 [10.6%]** | **COR [95%CI]** | **p-value** | **AOR [95%CI]** | **Adj p-value** |
| **Health worker demographic** | | | | | | | |
| Gender | M | 42 [80.8] | 10 [19.2] | 0.29 [0.10,0.81] | 0.018 | 0.28 [0.05,0.47] | 0.131 |
| | F | 102 [93.6] | 7 [6.4] | | | | |
| What is your current education level? | | | | 3.27 [1.33,8.03] | 0.01 | 0.54 [0.06,0.97] | 0.57 |
| **Professional cadre *** | | | | | | | |
| Medical Clinical Officer | | 13 [76.5] | 4 [23.5] | | | Reference | |
| Assistant Nursing Officer | | 20 [83.3] | 4 [16.7] | 0.88 [0.13,0.97] | 0.898 | 0.65 [0.14,0.97] | 0.586 |
| Laboratory Technician | | 6 [60.0] | 4 [40.0] | 0.79 [0.12,0.99] | 0.991 | 2.17 [1.14,5.74] | 0.037 |
| Laboratory Assistant | | 7 [87.5] | 1 [12.5] | 0.64 [0.04,0.87] | 0.758 | 0.46 [0.04,0.86] | 0.527 |
| Enrolled Midwife | | 29 [96.7] | 1 [3.3] | 1 | | 0.11 [0.01,0.34] | 0.061 |
| Enrolled Nurse | | 42 [95.5] | 2 [4.6] | 0.06 [0.00,0.71] | 0.026 | 0.15 [0.03,0.94] | 0.043 |
| Other (Nursing assistant) | | 27 [96.4] | 1 [3.6] | 0.10 [0.01,0.41] | 0.07 | 0.12 [0.01,0.89] | 0.07 |
| **Individual factors** | | | | | | | |
| Received Hepatitis B vaccination? | Y | 90 [89.1] | 11 [10.9] | 1 | | 1 | |
| | N | 54 [90.0] | 6 [10.0] | | | | |
| Awareness on the standard infection prevention and control measures? | Y | 104 [86.7] | 16 [13.3] | | | Reference | |
| | N | 40 [97.6] | 1 [2.4] | 0.16 [0.02,0.57] | 0.083 | 0.13 [0.01,0.61] | 0.19 |
| Comply with basic guidelines? | Y | 68 [85.0] | 12 [15.0] | Reference | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (Hand washing, PPE, Safe injection, disposal, PEP | N | 76 [93.8] | 5 [6.2] | 0.37 [0.12,0.61] | 0.077 | 6.13 [2.19,6.74] | 10.84 |
| Are you at risk of contracting infections in the line of duty? | Y | 78 [85.71] | 13 [14.29] | 0.36 [0.11,0.67] | 0.089 | 1.09 [1.04,7.95] | 1.8 |
| | N | 66 [94.3] | 4 [5.7] | | | | |
| How many COVID-19 doses were received? * | One | 57 [95.0] | 3 [5.0] | Reference | | | |
| | Two | 53 [82.8] | 11 [17.2] | 6.20 [1.32,9.17] | 2.68 | 3.94 [1.04,5.74] | 0.021 |
| **Health facility factors** | | | | | | | |
| Level of health facility | | | | 1 | (omitted) | 1 | |
| Type of health facility | | | | 0.42 [0.17,1.00] | 0.051 | 8.1 [4.62,10.56] | 10.61 |
| Does this facility have a designated person who oversees work place and patient safety? | Y | 78 [84.8] | 14 [15.2] | Reference | | | |
| | N | 66 [95.7] | 3 [4.4] | 0.25 [0.07,0.92] | 0.037 | 1.93 [1.21,7.61] | 2.18 |
| Have you ever had an in-service training on standard precautions of infection control in this health facility? | Y | 53 [36.8] | | | | | |
| | N | 91 [84.3] | 17 [15.7] | 1 | (omitted) | 1 | |
| How long ago was the in-service training? | | | | 0.47 [0.28,0.82] | 0.008 | 0.09 [0.01,0.98] | 0.12 |
| As health workers are you given any incentives for positive work performance especially in safety? | Y | 51 [78.5] | 14 [21.5] | Reference | | | |
| | N | 93 [96.9] | 3 [3.1] | 0.12 [0.03,0.43] | 0.001 | 0.27 [0.03,0.54] | 0.31 |
| Adequate PPE to use when handling patients? * | Y | 53 [79.1] | 14 [20.9] | Reference | | | |
| | N | 91 [96.8] | 3 [3.2] | 0.13 [0.02,0.69] | 0.017 | 0.12 [0.03,0.45] | 0.002 |
| | High | 21 [100.0] | | Reference | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| How would you rate the staffing levels at this facility? | Mod | 91 [85.1] | 16 [15] | | | | |
| | Low | 32 [97.0] | 1 [3.0] | 0.65 [0.40,0.99] | 0.905 | 0.67 [0.09,0.89] | 0.7 |
| Does the health facility have colour coded bins at all procedure areas? | Y | 113 [86.9] | 17 [13.1] | Reference | | | |
| | N | 1 [0.69] | | 1 | (omitted) | 1 | |

**Significant category p<0.05, AOR=Adjusted Odds Ratio, COR=Crude Odds Ratio*

Professional cadre was a significant predictor of IPC compliance. Laboratory technicians were 2.17 times more likely to comply with IPC measures compared to other professional categories (AOR = 2.17, 95% CI [1.14–5.74], p = 0.037). In contrast, other cadres demonstrated lower likelihood of compliance, with adjusted odds ratios indicating reductions ranging from 11% to 65%: Assistant Nursing Officers (AOR = 0.65, 95% CI [0.14–0.97], p = 0.586), Laboratory Assistants (AOR = 0.46, 95% CI [0.04–0.86], p = 0.527), Enrolled Midwives (AOR = 0.11, 95% CI [0.01–0.34], p = 0.060), Enrolled Nurses (AOR = 0.15, 95% CI [0.03–0.94], p = 0.430), and Nursing Assistants (AOR = 0.12, 95% CI [0.01–0.89], p = 0.070).

COVID-19 vaccination was also positively associated with IPC compliance. Healthcare workers who had received the second dose of the COVID-19 vaccine were 3.94 times more likely to comply with IPC precautions compared to those who had not completed the recommended doses (AOR = 3.94, 95% CI [1.04–5.74], p = 0.043). This finding was further supported by qualitative data from the FGDs, where one participant noted:

"In my opinion, those healthcare workers who have not received the recommended two COVID-19 vaccine doses seem not to be mindful of their lives." *(FGD1, September 8, 2021)*

Finally, PPE availability was found to have a significant negative association with non-compliance. Healthcare workers in facilities with inadequate PPE supply were less likely to comply with IPC measures (AOR = 0.012, 95% CI [0.003–0.45], p = 0.002), corresponding to an 88% reduction in the odds of compliance.

## Discussion

This study aimed to assess compliance with IPC measures and identify factors influencing adherence among healthcare workers in lower-level health facilities in Butambala District. The overall compliance rate with IPC precautions was found to be 10.6%, which is alarmingly low considering that the study was conducted during the COVID-19 pandemic. This level of compliance was notably lower than anticipated given the heightened emphasis on IPC during this period. These findings are consistent with previous research in Uganda and Ethiopia, which also reported suboptimal IPC compliance among healthcare workers, particularly in lower-level health facilities [22, 29]. While hand washing and proper disposal of healthcare waste showed relatively higher compliance, critical practices such as disinfection of medication vials and use of eye and face protection during procedures recorded very low adherence.

The low compliance observed may reflect broader systemic challenges, including resource constraints, weak supervision, and inadequate institutional support. Globally, studies have shown that between 30% and 70% of healthcare-associated infections are preventable through effective IPC measures [1], underscoring the urgency of strengthening IPC implementation, particularly in resource-limited settings.

Socio-demographic characteristics, specifically professional cadre, were significantly associated with IPC compliance. Laboratory technicians were found to be 2.17 times more likely to comply with IPC measures compared to other cadres. This could be attributed to their specialized training, routine exposure to laboratory biosafety standards, and increased awareness of occupational risks. Similar findings have been reported in other studies [30], reinforcing the idea that professional role and training influence adherence to IPC. However, these results contrast with other studies conducted in Palestine and Jordan, where differences in IPC compliance among cadres were less pronounced [31, 32]. These inconsistencies could reflect contextual differences in IPC training, risk perception, and health system structure across settings.

COVID-19 vaccination status also emerged as a significant predictor of IPC compliance. Healthcare workers who had received two doses of the COVID-19 vaccine were 3.94 times more likely to comply with IPC measures than their unvaccinated or partially vaccinated counterparts. This finding suggests that those who adhere to vaccination guidelines may also be more likely to adopt broader IPC measures. Similar patterns have been observed in other studies [3, 34], which associate vaccine uptake with positive health behaviors and risk perception. Factors contributing to vaccine non-compliance may include misconceptions about vaccine safety, fear of side effects, or lack of trust in vaccine efficacy [35]. Furthermore, as supported by learning theory [36], healthcare workers' own behaviors influence community trust and adherence to public health measures. Thus, healthcare worker vaccination plays a dual role: protecting themselves and reinforcing community confidence in preventive interventions.

Health facility–related factors were also critical. Inadequate PPE supply was strongly associated with lower IPC compliance, with healthcare workers reporting insufficient PPE being 88% less likely to comply with IPC measures. This aligns with previous studies indicating that lack of PPE is a key barrier to adherence, particularly in low-resource settings [29, 31, 37]. Evidence from Palestine and Brazil similarly demonstrated that consistent PPE availability is essential to sustaining IPC compliance among healthcare workers [37]. However, some studies, such as one conducted in Kenya, reported a weaker association between PPE availability and compliance [38], suggesting that other contextual factors including institutional culture and worker motivation may also play a role. Nevertheless, ensuring a reliable supply of PPE remains a fundamental requirement for effective IPC implementation.

These findings align with the study objectives, which sought to identify individual, professional, and facility-level determinants of IPC compliance. They emphasize the critical role of adequate resources, vaccination, and professional capacity in enhancing IPC adherence. The results also highlight areas for targeted interventions, including ensuring consistent PPE availability, reinforcing cadre-specific IPC training, and integrating vaccination promotion into occupational health programs.

Future research should consider longitudinal designs to explore how compliance evolves over time and examine the effectiveness of targeted interventions such as supportive supervision, incentive mechanisms, and digital reporting systems. Qualitative research could also provide deeper insights into the behavioral and organizational factors influencing compliance in rural health facilities.

**Equations**

**Equation 1 – Compliance Calculation**

$$Compliance\ (\%) = \frac{Number\ of\ respondents\ who\ answered\ \text{Always" or "}Sometimes"\ X100}{Total\ number\ of\ respondents}$$

**Equation 2 – Logistic Regression (Adjusted Odds Ratio model)**

$$logit(p) = ln\frac{p}{1-p} = B_0 + B_1x_1 + B_2x_2 + \cdots + B_kx_k$$

**Equation 3 – Adjusted Odds Ratio (AOR)**

$$AOR = e^{Bi}$$

**Equation 4 – Compliance per IPC Parameter**

$$Compliance\ per\ IPC\ parameter = \frac{Numbe\ of\ respondnts\ \text{"Always" or "}Sometimes"\ Performing\ the\ pracice\ X\ 100}{Total\ number\ of\ respondents}$$

## Conclusion

The findings of this study provide critical insights into infection IPC compliance among healthcare workers in lower-level health facilities in Butambala District. With an overall compliance rate of only 10.6%, far below the WHO-recommended 80% threshold, the results underscore an urgent need to strengthen IPC implementation in resource-limited settings. Low adherence at the frontline level not only places healthcare workers at increased occupational risk but also heightens the potential for healthcare-associated infections within the community.

The study demonstrates that compliance is influenced by multiple, interrelated factors. Professional cadre emerged as a significant determinant, with laboratory technicians exhibiting higher compliance compared to other categories of healthcare workers. This suggests that targeted IPC training and professional specialization may positively influence adherence. In addition, COVID-19 vaccination status was strongly associated with IPC compliance, indicating that vaccination may reflect broader health-protective behaviors among healthcare workers.

Equally important, the availability of personal protective equipment (PPE) was identified as a critical enabling factor. Inadequate PPE supply significantly reduced the likelihood of compliance, reinforcing the importance of strengthening health facility logistics and supply chains to ensure consistent access to essential IPC commodities.

These findings provide a strong justification for prioritizing capacity building**,** vaccine uptake promotion**,** and resource allocation for IPC in rural health facilities. Strengthening supportive supervision, regular refresher training, and ensuring continuous availability of PPE are essential strategies to close the compliance gap. Moreover, these insights can guide policymakers, district health teams, and implementing partners to design targeted interventions aimed at achieving safer healthcare environments for both patients and healthcare providers.

## Data Availability

The datasets generated and analyzed during this study are available from the corresponding author (Dominic Savio Kakeeto) upon reasonable request. Due to ethical restrictions and confidentiality agreements with participating facilities, data are not publicly available.

## Author Contributions

Dominic Savio Kakeeto: Conceptualization, data collection, formal analysis, writing of the original draft preparation.

Miisa Nanyingi: Methodological Guidance, Supervision, Writing basically Reviewing and Editing.

Both authors read and approved the final version of the manuscript.

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## Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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# Analysis of the Risks of Transmission of Ebola Virus Disease within the Population in Beni Health Zone 2025

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***Abstract***

*During the West African epidemic between 2013 and 2016, the largest known to date, chains of transmission reached urban centers for the first time, causing more cases and deaths than in all previous epidemics combined. To prevent such animal to human transmission, current research efforts are focused on identifying animal reservoirs of the virus. This study is of the descriptive correlational type because we evaluated the relationship between the knowledge, attitude and practice of households on the risks of Ebola Virus Disease transmission and the quantitative approach was used. Quantitative data were collected by face-to-face interview based on a questionnaire submitted to households and the supervision of the investigators was continuous to ensure the smooth running of the study in 4 health areas constituting the Ebola Virus Disease foci (Malepe Health Area, Kasabinyole Health Area, Ngongolio Health Area and Kanzulinzuli Health Area). The results of the study specify that the risks of transmission of Ebola Virus Disease by the population in Beni Health Zone are linked to the following socio-demographic and economic factors: the level of education of the respondent and the dangers of eating smoked meat (Kh2=41.239a; dll=3 and pv=0.000<0.05); and prevention and practice against Ebola Virus Disease (OR: 0.485[0.245 ; 0.959] and (pv=: 0.038<0.05). Strict adherence to good prevention practices will help avoid the risks of Ebola Virus Disease transmission in Beni Health Zone.*

***Keywords:*** *Analysis, Beni, EVD, Population, Risks, Transmission.*

## Introduction

The Ebola virus belongs to the genus Ebolavirus in the family Filoviridae [1]. The Ebolavirus genus includes six species: Zaire ebolavirus, Sudan ebolavirus, Bundi-bugyo ebolavirus, Taï ebolavirus, Reston ebolavirus, and the recently discovered Bombali ebolavirus [2]. All ebolaviruses except Reston ebolavirus and Bombali ebolavirus have been shown to cause disease in humans. Zaire ebolavirus (EBOV) is the most pathogenic of all, with a mortality rate of 70% to 90% [1]. Ebolavirus infection is zoonotic in origin, i.e. caused by infected animals or virus reservoir species (species carrying the virus, where the virus is permanently maintained, which transmit it to humans [3]. The first Ebola epidemics occurred in Sudan and Zaire (now the Democratic Republic of Congo -DRC) in 1976 and were caused by Sudan ebolavirus and Zaire ebolavirus respectively. Since then, there have been several epidemics, most of them caused by

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EBOV in Central Africa [4].

During the West African epidemic between 2013 and 2016, the largest known to date, chains of transmission reached urban centers for the first time, causing more cases and deaths than in all previous epidemics combined [2]. To prevent such animal-to-human transmission, current research efforts are focused on identifying animal reservoirs of the virus.

The Ebola disease is a zoonotic Ebola outbreak that emerged in 1976 and has recently been responsible for major epidemics in Central and West Africa. The outbreak in West Africa between 2013 and 2016 highlights the need to be better prepared to detect and respond to future epidemics [5].

In Beni Health Zone, the response activities encountered difficulties following acts of violence, the throwing of projectiles at vehicles and even the assassination of some members of the response team. The factors that caused the population's resistance to the Ebola Virus Disease epidemic were the lack of confidence in the quality of care in the treatment centers (ETCs), the lack of confidence in the response team and the mistrust of foreigners who came, according to the population, to take advantage of the epidemic, and finally the more economic dimension that this response had taken [6].

The persistence of the EVD and the devastation it causes reflect the weakness of the healthcare systems, which are unable to respond to epidemics of such magnitude [7].

The tireless work to strengthen preparedness capacities in neighboring countries has also limited the risk of the outbreak spreading [8].

Furthermore, the low involvement of health personnel working within the health services in the province of North Kivu, whose capacities needed to be strengthened, was one of the factors that favored the persistence of this epidemic in Beni Health Zone. A study conducted among health providers in the city of Butembo, a neighboring city of Beni, at the start of the epidemic, noted that they were less able to contain an extension of this epidemic in this city [9].

The Ebola Virus Disease is transmitted through direct contact with blood, secretions (stool, urine, saliva, semen) or other bodily fluids of infected individuals, as well as through contact with surfaces or objects (e.g., bedding, clothing, paper towels) contaminated with these fluids. Ebola virus is not transmitted through the air [10].

The Ebola disease is spread only through: (i) direct contact with the bodily fluids of an infected animal or person who is showing symptoms of the disease, contact with semen or breast milk of a person who has recovered from Ebola disease; (ii) person-to-person contact includes contact with bodily fluids or tissues of an infected person showing symptoms of Ebola disease, including: blood, urine, feces, vomit, saliva, sweat, semen, breast milk (this includes: contact with the body or bodily fluids of a person who has died from Ebola disease, sexual contact with a person who has Ebola disease, contact with the semen of a person who has recovered from Ebola disease; during pregnancy, childbirth or breastfeeding, an infected person can transmit Ebola disease to their baby); Contact with contaminated objects includes contact with surfaces, materials (such as bedding), or medical equipment (such as needles) contaminated with an Ebola virus that can cause Ebola disease; (iii) animal-to-human contact may include close contact (such as handling or feeding) with live or dead infected animals or their bodily fluids, including: gorillas, monkeys, chimpanzees, bats, porcupines, woodland antelopes, pigs [11] (Figure 1).

In light of the above, we asked the following questions:

**General question**

What are the factors associated to the risks of Ebola Virus Disease transmission within the population in Beni Health Zone?

**Specific questions**

1. What are the sociodemographic and economic characteristics that

significantly influence the risks of Ebola Virus Disease transmission within the population in Beni Health Zone?

2. What are the risks of Ebola Virus Disease transmission related to the level of knowledge, attitudes, and practices of households in Beni Health Zone?
3. What are the best predictors of Ebola Virus Disease transmission risks within the population in the Beni Health Zone?

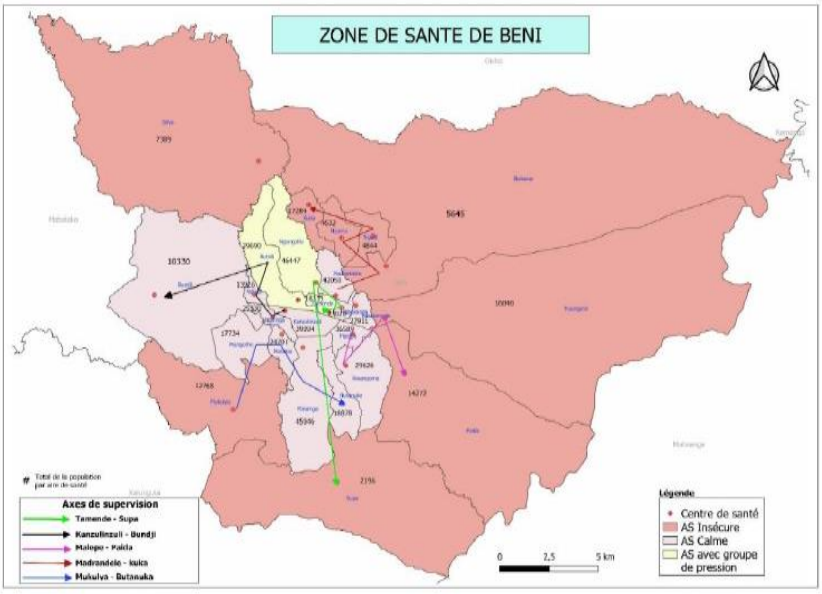


**Figure 1.** Map of the Beni Health Zone

**ZONE DE SANTE DE BENI = BENI HEALTH ZONE [12].**

## Hypothesis

1. There is a significant relationship between sociodemographic characteristics such as age, sex, education level, religious denomination, and occupation and the risk of Ebola Virus Disease transmission within the population in Beni Health Zone.
2. There is a significant relationship between household knowledge, attitudes, and practices and the risk of Ebola Virus Disease transmission within the population in Beni Health Zone.
3. Among these factors, there are those that are the best predictors of the risk of Ebola Virus Disease transmission within the population in Beni Health Zone.

## Objectives

### General Objective

The general objective of the research is to identify the risks of transmission of Ebola Virus Disease within the population in Beni Health Zone.

### Specific Objectives

The specific objectives of our research are as follows:

1. To establish the link between sociodemographic and economic characteristics such as age, gender, education level, religious denomination, occupation, and the risks of Ebola Virus Disease transmission in Beni Health Zone.
2. To identify the risks of Ebola Virus Disease transmission related to knowledge, attitudes, and practices among the population in Beni Health Zone.
3. To assess the predictive factors of Ebola Virus Disease transmission among the population in the Beni Health Zone

based on household practices regarding the risks and prevention of this disease.

## Choice and Significance of the Subject

### Scientific Significance

This study will serve as a documentary tool for scientific executives in the field of Public Health.

### Community Significance

Knowledge, attitudes, and practices on the prevention of Ebola Virus Disease within the population in Beni Health Zone will help reduce the risks of transmission of this epidemic.

### Scope of Work

This study focused on the analysis of the risks of transmission of Ebola Virus Disease within the population in Beni Health Zone and was carried out among households residing in the same Health Zone, during the year 2025.

# Materials and Methods

## Materials

The materials that will be used for this work are : the heads of households living in the Beni Health Zone, in the same City of Beni, the consultation register of the Health facilities of the Beni Health Zone, the data of the Central Office of the Beni Health Zone, the pen, paper, the computer, the data collection were be done by the Kobo collect software and the processing by Epi Info software.

## Types of study

This study is of the descriptive correlational type because we evaluated the relationship between household knowledge, attitude and practice on the risks of Ebola Virus Disease transmission.

## Study Population

Regarding this study, the study population consisted of household managers from the targeted Health Areas in Beni Health Zone. Population: is the target of the study or total number of individuals on whom the research focuses [13].

## Sampling

It is the process of selecting a group of individuals to be interviewed as part of a study and which symbolizes a reference population; method and process of sample selection [13].

In order to obtain our sample, we used the SHWARTZ formula referring to an infinite population which predicts

$$n = t^2 \frac{pq}{d^2}$$

n = sample size

t = value associated with a 5% risk of error

p = prevalence of EVD is estimated at 27.1% [14].

q = 1 - p, that's to say, the proportion of EVD patients who are positive

d = desired precision, which is equal to 5%.

So, $n = 1{,}96^2 \frac{0{,}27(1-0{,}27)}{(0{,}05)^2} = 303$

In order to resolve the cost risk that should arise during the survey as recommended [15], we reduced the sample size to 33.66% of 303 households to bring the sample down to 102 households, the population of AS in the Beni 2025 Health Zone being 549770 inhabitants [16].

## Survey Technique

The collection of these quantitative data was done by face-to-face interviews based on a questionnaire submitted to households and the supervision of the investigators was continuous to ensure the proper conduct of the study.

## Ethical Considerations

The Ethical considerations were at the center of this study which had already obtained the approval of Texila American University, the Catholic University of Graben (UCG) under No. PTH.02/25/UCG/CERM and the endorsement of the Central Office of Beni Health Zone [17]. Informed consent was sought from the target population. Any refusal to

participate in the survey was respected by the investigators [18]. Provisions were made to protect the confidentiality of the information provided by respondents. Personal data that could identify the respondent were not collected.

# Results

## Descriptive Analysis

### Sociodemographic Characteristics

Regarding the distribution of gender, there are many female respondents, i.e. 58.8% compared to 41.2% for male respondents (Table 1). And Table 2 shows that the 25 to 34 age group is the most affected with a proportion of 46.1%. 18 à 24 ans = 18 to 24 years old; 25 à 34 = 25 to 34 years old; 35 à 44 ans = 35 to 44 years old; 45 à 55 ans = 45 to 54 years old; 55 à 64 ans = 55 to 64 years; 65 et plus = 65 years old and more. From this graphic, it shows the same that the 25 to 34 age group is the most affected with a proportion of 46.1% (Figure 2)

**Table 1.** Distribution of Respondents by Gender

| Gender of the respondent | | | |
|---|---|---|---|
| **Gender** | **Number** | **Percentage (%)** | **Cumulative percentage (%)** |
| Male | 42 | 41.2 | 41.2 |
| Female | 60 | 58.8 | 100.0 |
| Total | 102 | 100.0 | |

**Table 2.** Distribution of Respondents by Completed Age

| **Age group** | **Number** | **Percentage (%)** | **Cumulative percentage (%)** |
|---|---|---|---|
| 18 to 24 years old | 17 | 16.7 | 16.7 |
| 25 to 34 years old | 47 | 46.1 | 62.7 |
| 35 to 44 years old | 26 | 25.5 | 88.2 |
| 45 to 54 years old | 8 | 7.8 | 96.1 |
| 55 to 64 years old | 3 | 2.9 | 99.0 |
| 65 years old and over | 1 | 1.0 | 100.0 |
| **Total** | **102** | **100.0** | |

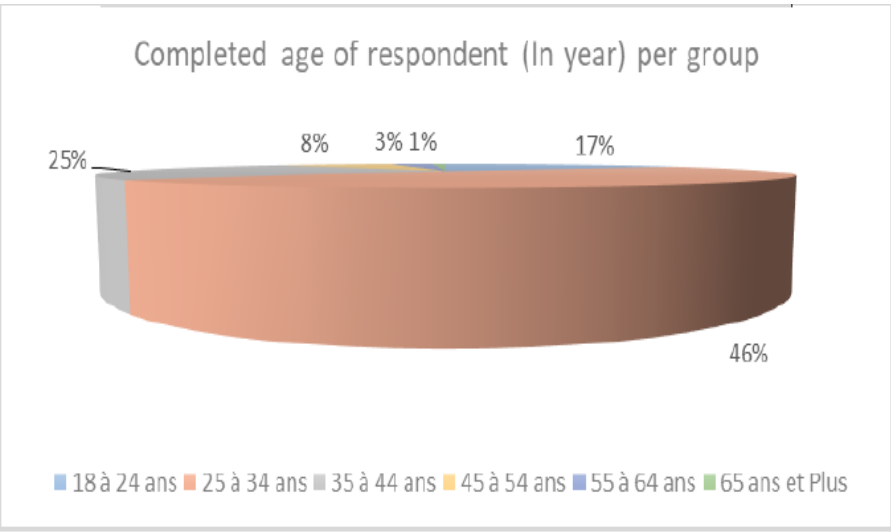


**Figure 2.** Distribution of respondents by completed age graphic

**Table 3.** Distribution of Respondents by Level of Education

| Level of education of the respondent | | | |
|---|---|---|---|
| **Level of the study** | **Number** | **Percentage (%)** | **Cumulative percentage (%)** |
| None | 1 | 1.0 | 1.0 |
| Primary | 10 | 9.8 | 10.8 |
| Secondary | 62 | 60.8 | 71.6 |
| Higher or university | 29 | 28.4 | 100.0 |
| Total | 102 | 100.0 | |

This table 3 reveals that the secondary education level was more affected with a percentage of 60.8% than other education levels.

### Socioeconomic Characteristics

Regarding the profession, it appears that 27.5% of the people surveyed are private sector agents (Table 4) and table 5 indicates that 97.1% of respondents have household size of 0 to 5 years.

**Table 4.** Distribution of Respondents According to their Profession

| | **Number** | **Percentage (%)** | **Cumulative percentage (%)** |
|---|---|---|---|
| Unemployed | 25 | 24.5 | 24.5 |
| Public sector agent | 22 | 21.6 | 46.1 |
| Private sector agent | 28 | 27.5 | 73.5 |
| Farmer | 26 | 25.5 | 99.0 |
| Other (Please specify) | 1 | 1.0 | 100.0 |
| **Total** | **102** | **100.0** | |

**Table 5.** Distribution of Respondents According to the Number of People in the Household

| | **Number** | **Percentage (%)** | **Cumulative percentage (%)** |
|---|---|---|---|
| 0 to 5 people | 99 | 97.1 | 97.1 |
| 6 and more | 3 | 2.9 | 100.0 |
| **Total** | **102** | **100.0** | |

## Inferential Analysis

### Factors Promoting Knowledge of Ebola Virus Disease

The result of the analysis specifies that at the significance threshold of 5%, there is no link between sex and knowledge of EVD (Kh2=0.0782; ddl=1, pv=0.779), [Table 6].

At the 5% significance level, there is no link between the level of education and knowledge of EVD (Kh2=0.994; ddl=3, pv=0.574), [Table 7].

**Table 6.** Association Between Respondent's Sex and Knowledge of EVD

| Gender | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Male | Female | Total | kh2 | dll | Pv | S |
| Knowledge | Yes | 41 | 58 | 99 | | | | |
| | No | 1 | 2 | 3 | | | | |
| **Total** | | **42** | **60** | **102** | **0.0782** | **1** | **0.779** | **TS** |

**Table 7.** Association Between Level of Education and Knowledge of EVD

| Level of education of the respondent | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | None | Primary | Secondary | Higher or University | Total | kh2 | dll | Pv | S |
| Knowledge | Yes | 1 | 10 | 59 | 29 | 99 | | | | |
| | No | 0 | 0 | 3 | 0 | 3 | | | | |
| **Total** | | **1** | **10** | **62** | **29** | **102** | **0.994** | **3** | **0.574** | **TS** |

**Table 8.** Proportion of the Existence of Ebola Virus Disease

| Variables in the equation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | E.S. | Forest /Wald | Ddl | Sig. | Exp (B) | CI for Exp (B) 95% | |
| | | | | | | | | Lower | Superior |
| Step 1[a] | Level of the study of the respondent | -20.891 | 3139.126 | ,000 | 1 | ,995 | ,000 | 0.000 | |
| | Profession of the respondent | -,039 | ,710 | ,003 | 1 | ,956 | ,962 | ,239 | 3.871 |
| | Gender | -,780 | 1.619 | ,232 | 1 | ,630 | ,458 | ,019 | 10.950 |
| | Age group | -,649 | 1,339 | ,235 | 1 | ,628 | ,523 | ,038 | 7.213 |
| | **Constant** | **45,088** | **6278,254** | **,000** | **1** | **,994** | **0.120** | | |

In view of the logistic regression analysis table 8 above, the following variables: Level of education, occupation of the respondent, sex and age group are not significant at the 95% confidence interval. Their probabilities are respectively: OR: 0.000[0.000; 0.000] and (p: 0.995); OR: 0.962[0.239; 3.871] and (p: 0.956); OR: 0.458[0.019; 10.950] and (p: 0.630); OR: 0.523[0.038; 7.213] and (p: 0.628). And therefore are not linked to the existence of EVD.

### Factors Related to Attitudes and Perceptions towards Ebola Virus Disease

**Table 9.** Dangers of Eating Smoked Meat

| Level of study of the respondent | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | None | Primary | Secondary | Higher or University | Total | Kh2 | dll | Pv | S |
| Do you think there are any dangers in eating smoked meat ? | Yes | 0 | 0 | 26 | 29 | 55 | | | | |
| | No | 1 | 10 | 36 | 0 | 47 | | | | |
| **Total** | | **1** | **10** | **62** | **29** | **102** | **41.239a** | **3** | **0.000** | **TS** |

The table 9 above shows the relationship between the level of education of the respondent and the dangers of eating smoked meat. At the 5% significance level, this relationship is significant (Kh2=41.239a; dll=3 and pv=0.000<0.05).

**Factors Related to Prevention and Practice**

**Table 10.** Precautions Against Stings

| Variables in the equation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | E.S. | Wald | ddl | Sig. | Exp (B) | CI for Exp (B) 95% | |
| | | | | | | | | Lower | Superior |
| Step 1[a] | Level of the study of the respondent | -,723 | ,348 | 4.325 | 1 | ,038 | ,485 | ,245 | ,959 |
| | Profession of the respondent | -,112 | ,195 | ,328 | 1 | ,567 | ,894 | ,610 | 1.311 |
| | Gender | ,438 | ,435 | 1.014 | 1 | ,314 | 1.549 | ,661 | 3.631 |
| | Age group | ,085 | ,220 | ,151 | 1 | ,698 | 1.089 | ,708 | 1.675 |
| | **Constant** | **1.215** | **1.469** | **,684** | **1** | **,408** | **3.371** | | |

From this logistic regression analysis table 10 above, only the variable level of study of the respondent which remained significant at the 95% confidence interval; (OR: 0.485 [0.245; 0.959] and (p: 0.038 <0.05) hence this variable is a factor which significantly explains the prevention and practice against Ebola Virus Disease.

**Table 11.** Hygiene Precautions When Handling Dead Animal Carcasses

| Variables in the equation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | E.S. | Forest/ Wald | ddl | Sig. | Exp (B) | CI for Exp (B) 95% | |
| | | | | | | | | Lower | Superior |
| Step 1[a] | Level of the study of the respondent | -21.267 | 6098.035 | ,000 | 1 | ,997 | ,000 | 0.000 | |
| | Profession of the respondent | -,226 | ,257 | ,777 | 1 | ,378 | ,798 | ,482 | 1.319 |
| | Gender | -,276 | ,539 | ,263 | 1 | ,608 | ,759 | ,264 | 2.181 |
| | Age group | ,411 | ,273 | 2.272 | 1 | ,132 | 1.509 | ,884 | 2.576 |
| | **Constant** | **64.072** | **18294.104** | **,000** | **1** | **,997** | **2.000** | | |

From the logistic regression analysis table 11 above, it appears that the following variables: Level of education, profession of the respondent, sex and age group are not significant at the 95% confidence interval. Their probabilities are respectively: OR: 0.000[0.000; 0.000] and (p: 0.997); OR: 0.798[0.482; 1.319] and (p: 0.378); OR: 0.759[0.264; 2.181] and (p: 0.608); OR: 1.509[0.884; 2.576] and (p: 0.132).

**Table 12.** Receipt of Ebola Virus Disease Vaccine

| Variables in the equation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | E.S. | Wald | ddl | Sig. | Exp (B) | CI for Exp (B) 95% | |
| | | | | | | | | Lower | Superior |
| Step 1[a] | Level of the study of the respondent | -21,411 | 6030,117 | 0 | 1 | 0,997 | 0 | 0.000 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Profession of the respondent | -0,322 | 0,267 | 1.450 | 1 | 0,229 | 0,725 | 0,429 | 1.224 |
| | Sexe | 0,143 | 0,559 | 0,066 | 1 | 0,798 | 1.154 | 0,386 | 3.451 |
| | Age group | 0,63 | 0,312 | 4,066 | 1 | 0,044 | 1,877 | 1,018 | 3462 |
| | **Constant** | **63.789** | **18.090.352** | **0** | **1** | **0,997** | **1.000** | | |

From the logistic regression analysis table 12 above, only the variable age of the respondent remained significant at the 95% confidence interval; (OR: 1.877 [1.018; 3.462] and (p: 0.044 <0.05) hence this variable is a factor which significantly explains the prevention and practice against Ebola Virus Disease.

## Discussion

The results of this survey indicate that the main modes of transmission of Ebola Virus Disease are sexual intercourse, consumption of infected wild animals, contact with contaminated blood, injury or contact with a contaminated object, contact with Ebola Virus Disease corpses, simple contact with infected people , and contact with biological fluids (semen, sweat, saliva, vomit, etc.); this was also reported by the Knowledge, Attitudes, and Practices (KAP) survey on Ebola prevention in Ivory Coast [19].

Regarding the attitudes of respondents towards Ebola Virus Disease prevention, respondents are more inclined not to consume bushmeat (85.7%); the results of this study reveal a link between the respondent's level of education and the dangers of eating smoked meat; which is perceived as the best predictor of Ebola Virus Disease transmission. At the 5% significance level, this link is significant, (Kh2=41.239a; dll=3 and pv=0.000<0.05) [Table 9]. This same trend was observed in the study of the resurgence of Ebola Virus Disease in the Nzérékoré region [20].

In relation to precautions against bites, the level of education of the respondent remained significant at the 95% confidence interval. (OR: 0.485 [0.245; 0.959] and (p: 0.038 <0.05) [Table 10] hence this variable is a factor that significantly explains the prevention and practice against Ebola Virus Disease. This is consistent with the study of Perception of healthcare personnel regarding the response to Ebola Virus Disease in the Butembo Health Zone [21].

Regarding physical contact with other people, the study reveals that nearly 83.4% of respondents are willing to avoid contact with other people, including those in their community, to avoid Ebola Virus Disease, which is the same as the study of knowledge, attitudes and practices (KAP) in the context of Ebola prevention in Ivory Coast [19].

## Conclusion

The general objective of this study is to better understand the emergence, spread, and consequences of this disease and to define appropriate surveillance and prevention strategies. This study assessed the relationship between household knowledge, attitudes, and practices regarding the risks of Ebola Virus Disease transmission.

In fact, more than half of the population has a satisfactory level of knowledge about Ebola Virus Disease. The same is true for modes of transmission, symptoms, and attitudes; however, problems remain regarding Ebola Virus Disease prevention practices. The results of the analysis confirmed that the best predictors of the risks of transmission of Ebola Virus Disease by the population in Beni Health Zone are linked to the consumption of smoked meat, we also note the level of education of the respondent, the level of education and precautions against bites (OR : 0.485 [0.245; 0.959] and (p : 0.038 <0.05) [Table 9] and finally, the receipt of the Ebola Virus Disease vaccine (OR : 1.877 [1.018; 3.462] and (p: 0.044 <0.05) [Table 10]. Thus, strict

compliance with good prevention practices will prevent the risk of Ebola Virus Disease transmission in Beni Health Zone.

## Ethical Approval

The letter and a copy of the research protocol were submitted to the ethics committee of the Catholic University of Graben (UCG) for review of the ethical aspects of the research project in order to obtain authorization. We also contacted the relevant political, administrative, and health authorities to obtain their approval.

## Conflicts of Interest

This study was not influenced by any individual, organization, or association to bias the research results for personal gain.

## Data Availability

The data will be available in the TEXILA INTERNATIONAL JOURNAL OF PUBLIC HEALTH, https://www.texilajournal.com/.

## Author Contributions

We contributed to conduct research to study the factors associated with the resurgence of Ebola virus disease in the population in the Beni Health Zone.

## Funding

This study did not have a sponsor, but we acknowledge the contribution of some family members and friends who assisted us each in their own way.

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# Silent Struggles: Menstrual Hygiene Challenges Faced by Female University Students in Uganda

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***Abstract***

*Menstruating individuals face barriers in managing their periods safely and with dignity, especially in low-and middle–income countries like Uganda. Menstrual health interventions have focused on schoolgirls, assuming university students have fewer challenges. However, female university students in Uganda face significant challenges. Thus, the objective of this study was to explore challenges faced by female university students in Central and Southwestern Uganda through a socio-ecological perspective. A phenomenological design was used. A sample of 88 participants was purposively selected using a two-stage stratified sampling technique. Four focus group discussions and 16 key informant interviews were conducted to collect data. Interviews were transcribed and analysed thematically using NVivo 12 software. These were complemented by structured observations of WASH facilities. The socio-ecological model (SEM) is a public health framework that describes how health is impacted at multiple levels including individual, interpersonal, community, organizational and policy levels. Key themes were identified, and challenges contributing to menstrual hygiene were categorized as per the SEM. The findings showed that female students experienced physical pains and missed classes hindering their education. Also, linking menstruation to sorcery led to fears related with disposal of menstrual absorbents and inadequate WASH infrastructure, which contributed to poor menstrual hygiene management reflecting systemic failures at universities. Many female students had knowledge gaps about menstrual hygiene management based on biases of cultural taboos and practices. They lacked confidence in managing their menstruation while at university, highlighting the need for universities to establish programs and policies that promote their well-being and academic success.*

***Keywords***: *Health Education, Menstruation, Menstrual Hygiene Products, Sanitation, Universities, Uganda.*

## Introduction

The concept of menstrual hygiene management (MHM) is becoming acknowledged as a critical public health and gender-equity concern in all parts of the World, and it is specifically mentioned in the United Nations Sustainable Development Goals (SDG 5 and SDG 6.2). Poor menstrual hygiene in low- and middle-income contexts has been linked to a variety of negative consequences, including reproductive tract infection and poor academic achievement, to stigma related mental disorders [1], [2]. According to the definition developed by the World Health Organization (WHO) and UNICEF, menstrual hygiene management (MHM) is the application of clean menstruation management resources,

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which can be replaced privately, as well as the availability of sufficient water, soap, and sanitation options [3].

Uganda ratified the 2015 Menstrual Hygiene Management (MHM) Charter and implemented a national policy framework that prioritizes the delivery of and access to affordable menstrual products, school-based education, and sanitation infrastructure [4, 5]. A national survey report in 2024 revealed that 64 per cent of women in Uganda continue to face period poverty, meaning they cannot afford or access sanitary products and proper facilities [6]. This is further worsened by a deep-seated stigma, taboos, and the absence of gender-responsive services in state institutions [7].

Although existing research on menstrual hygiene management (MHM) in Uganda has primarily focused on primary and secondary school girls, a significant gap remains regarding university students, who face unique challenges. A 2022 survey at Makerere and Kyambogo University found that female students lacked access to clean, private toilets with running water during menstruation [8]. Similarly, a cross-sectional study among female students in University for Development Studies, Tamale in Ghana revealed that 20% engaged in poor MHM practices [9]. These findings suggest that most sub-Sahara African universities often fall short in supporting menstruating students, highlighting the need for targeted interventions.

While Uganda has policy commitments, it is clear that there is a severe deficit of data regarding the particular MHM issues experienced by female students in universities at the country level, and scarcer studies that compare varying university settings. The evidence base prevents the formulation of context-specific interventions and the distribution of resources to campus facilities. Thus, most of the studies conducted so far are cross-sectional and have not addressed how individual, institutional, and socio-cultural factors interact to determine menstrual hygiene practices.

### Theoretical Orientation

We adopted the social-ecological model as a theoretical framework for this study [10]. The SEM framework employs five interdependent levels- individual, interpersonal, organizational, community and public policy to investigate the influence on health behaviour at each level. Sharm et al., (2022) in Nepal used SEM framework to study MHM [11]. Though most menstrual hygiene management studies and interventions have been engrossed on individual and interpersonal levels, we adopted the SEM framework to investigate challenges faced by female university students in Central and Southwestern Uganda focusing on all five levels -individual, interpersonal, institutional, societal and policy. Promoting MHM is part of the efforts to achieve the United Nations' Sustainable Development Goals, which include targets for health, education, and gender equality [12].

## Materials and Methods

### Study Design and Setting

A qualitative contextual descriptive phenomenological design was employed at two select Universities. The identities of the two Universities have not been mentioned so as to remain anonymous. Campus A is a private university with an estimated 4,000 students located in the urban region of Central Uganda about 20 kilometers from the Kampala Capital City while campus B is a public University with an estimated 5000 students located in the rural region of South-western Uganda about 337 kilometers from the capital Kampala. The design focused on understanding participants' experiences within their natural environments. The universities were chosen to enable a comparative study of menstrual hygiene management among the continuing female students.

## Study Population

The study population were female University students from both Universities. At campus A the female to male ratio of students was 49:51, while that of Campus B was 38:62.

## Sample Size Determination

In this study, the data saturation criterion was used to determine the sample size. Data saturation was achieved after 88 interviews. The key informants were persons involved in menstrual hygiene management, including the female students, Directors of student affairs, female warden, District Health Officers and Guild leaders.

## Sampling Technique

A two-stage stratified sampling technique was employed. In the first stage, universities were stratified into private and public institutions. In the second stage, a purposive sampling technique was used to select a total of 72 participants with 9 participants in each of the 8 Focus group discussions. A total of 4 focus group discussions (FGDs) were selected from each university. A total of 16 key informant interviews were conducted from each university.

## Inclusion and Exclusion Criteria

Female undergraduate students who were within their reproductive age and willing to participate in the study were selected. Excluded from the study were students in medical sciences and those who had never experienced menstruation or who had not had a period in the previous year before the study. Postgraduate and part-time students were excluded from the study because they might have been un-available at the time of the study.

## Data Collection

Key Informant Interviews (KIIs), observations, and focus group discussions were used as the methods of data collection. A discussion guide was used to conduct FGDs which took an average of one hour and thirty minutes each. The subjects covered were the experiences of menstruation, access to sanitary resources, hygiene, stigma, and coping strategies. The KII interviews took about 45 minutes each and were also done using semi-structured guides. The KII interviews and FGDs were held in quiet and confidential spaces within the universities. Regarding the observations, non-participant observations were done using structured checklists to document the state of sanitary facilities, privacy, waste disposal facilities and the availability of water and soap. Photographs and field notes were used to supplement the observations. The principal investigator was assisted by two experienced research assistants who were trained prior the activity to help in data collection. A pretest of the FGD and KII guides was done among 50 students at Uganda Institute of Allied Health and Management Sciences, Mulago, in Kampala city. From the pre-test results, we were able to estimate the time to complete an interview, the validity of the questions, acceptability of the tool and also adjusted the questions that were considered sensitive.

## Data Analysis and Management

The thematic framework approach was employed [13] using the SEM for data analysis [14]. Transcripts were imported into NVivo 12 to be organized and codes generated inductively. Analysis was conducted in a number of steps including familiarization, coding, theme development and interpretation.

## Trustworthiness

The study used a phenomenological design and a two-stage stratified sampling technique to select participants, which enhanced credibility. Data collection methods included focus group discussions, key informant interviews, and structured observations, allowing for triangulation of data. The use of NVivo 12 software for thematic analysis added to the

study's rigor. The study's findings are supported by direct quotes and observations, increasing dependability. In terms of reflexivity, the research assistants exhibited neutrality and reported to the findings verbatim so as to limit personal biases. The study focused on female university students in Central and South Western Uganda, which may have limited transferability to other contexts but provides lessons to similar settings.

# Results

## Demographic Characteristics of the Participants

A total of eight key informant interviews and four focus group discussions (FGDs) were performed from each of the Universities. Participants in the FGDs in the interviews were continuing female students and represented different countries: Uganda, Kenya, Rwanda. A total 16 key informant interviews were conducted from individuals holding specialized knowledge and expertise on MHM.

**Table 1.** Age and Number of Participants in the 4 KI Interviews and the 8 FGDs in the Study

| Age group (Years) | Focus Group Discussion (FGDs) | Key Informant Interviews (KII) | Total |
|---|---|---|---|
| 19-21 | 36 Participants (4-FGDs) | 8 Participants | 44 |
| 22- 24 | 36 Participants (4-FGDs) | 8 Participants | 44 |
| Total | 72 Participants (8 -FGDs) | 16 Participants | 88 |

## Observations of Universities' WASH Conditions

### Water Access Point

The university toilets had water access points and running water for hand-washing. The facilities were located within and around the toilets. At Campus A, there were no pit latrines but only water borne toilets while Campus B had both water-borne toilets and pit latrines. Some of the paths to the water access points were not well lit. Hand-washing water points (water taps) were available at both campuses. However, there was poor light inside some toilets at campus B. The water access points looked clean, with no stagnant water and some had hand soap for practicing proper hygiene (Figure 1).



**Figure 1.** Indoor Hand-washing Facility with Limited Natural Lighting, Campus B

There was no suggestion box where the opinions of female students could be collected at both A and B campuses. Several female students when talked to by the female research assistant, expressed the need to have a suggestion box through which to communicate their hygiene concerns regarding the WASH facilities.

## Toilet Facilities

The females' toilets were clean both in the toilet bowls and on the floor. And toilets were not smelly. However, there were no sanitary materials or trash bins for menstrual waste disposal in some of the toilets. Some of the toilets at campus A, although they were flushable, did not have proper seats and lids implying that they were uncomfortable for use (Figure 2 and 3). For instance the squat toilets are less comfortable for some users especially those with joint problems, mobility issues and the disabled (Figure 2) than the seated toilets (Figure 3).



**Figure 2.** Water Flush Toilet at Campus B



**Figure 3.** Water Flush Toilet at Campus A

The water flush toilets had labels for female use and the doors were lockable from inside. At Campus A, toilets were also labeled including those for the disabled. However, some wash facilities were lacking labels from Campus B (Figure 4 and 5). The female water flush toilets were physically separated from male water flush toilets at both universities. Most facilities were water-borne and there was only one pit-latrine block available at campus B. Furthermore, at campus B, some of the pit-latrines were not clearly marked for male and female (Figure 6).

The flush toilets and pit latrines were constructed to ensure they could not be peered into from outside. There were neither redundant structures nor bush at both campuses. At Campus B, many times men were observed using female toilets/latrines and females using male toilets/latrines raising concerns for the safety and security of female students. Furthermore, there was neither space to wash or to dry reusable sanitary pads near flush toilets and pit latrines at both campuses.

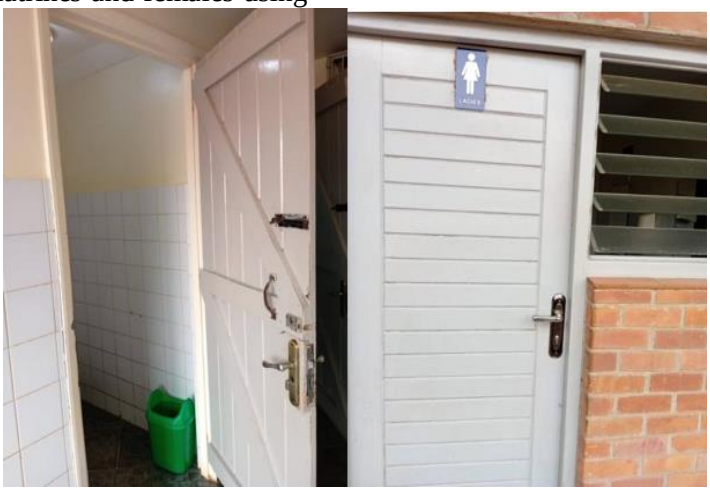

**Figure 4.** Labeled Toilets at Campus A



**Figure 5.** Labeled Toilets at Campus B



**Figure 6.** Non-water Borne toilet at Campus B

## Bathing and Incinerator Facilities

The Campus bathing facilities for female students were observed to be unhygienic at campus B (Figure 7). A dysfunctional incinerator for burning waste including used menstrual materials was observed at campus B (Figure 8). However, for campus A, waste disposal was outsourced: a private company collects both medical and all other waste regularly.



**Figure 7.** Dirty Bathing Facility, Campus B



**Figure 8.** Dysfunctional Incinerator, Campus B

Observation results were triangulated with results from FGDs and from KIIs. Three themes were generated from the FGDs and the KIIs; receiving knowledge on MHH, menstrual socio-cultural beliefs and myths, and challenges faced by menstruating female students while managing their hygiene.

## Theme 1: Knowledge on MHM

### Sub-theme 1: Insufficient Expertise

Involvement of parents in the aspects of MHM was considered a turning point towards achievement of proper menstrual hygiene management by the majority of participants. One participant said:

> *'The first time I started my period, I felt so shy. I wouldn't tell my parents what I was experiencing. I was at school and when I got home my mother tried to ask me if I started my period. I strongly faced denial. This affected my hygiene by then.*'' Reported FGD 3 A

And then added:

> *''……. I learned from my previous primary school and mother. Before I experienced menses, I had already learned from fellow students what menses meant. But*

*I didn't know how to wear the pad. So, when I experienced menses, my mother taught me how to put it on……. but she didn't tell me anything other than that. And the irony, she's a doctor.''* FGD 3 A

Then another participant explained:

*''My first time to use a pad, I was in a secondary boarding school. Though, I used to see my friends using pads I didn't know how to use it. With the help of my friends, I learned how to use it. My mother was a very shy woman. She never taught us anything concerning menstruation and female matters.''* FGD2 A

But some participants showed poor knowledge about menstruation and use of menstrual hygiene products. During the discussions, it was obvious that participants also need to be provided with information related to MHM. The participant asserted that:

*'' I would wish to know more about the usage of sanitary pads and the recommended time for usage……. Are the reused sanitary pads safe?''* FGD 4, B

### Sub-theme 2: Safe Menstrual Hygiene Management

The main stay of safety considered by majority of the participants was influence of social support for women in different ways. Providing menstrual care was viewed both as a social and very private issue by the participants: very few mentioned that they discussed this subject with other people, including parents. Though the support networks exhibited by the university counsellor, nurse, student's guild and university community existed for the female students, many of the participants felt isolated and overwhelmed. One participant explained that:

*''I feel safe with men around me when in menses. Because most men value menstruation than some ladies. ……. ladies take it normal. I remember in high school, there was a girl who had menstruation and stood up in class without knowing she had it. While the girls laughed at her a boy stood up, went and covered her. And told her, the stain from her menses was the reason students were laughing.''* FGD2 A

To the contrary, another participant excluded the possibility of seeking support or ask someone if her period started unexpectedly in class at the University. She responded emphatically in protest of sharing information about her menstrual status as the rest of the group laughed it off:

*''I would not wish to share with anyone. Even if it happens when I am in Class, I would get out, head to the hostel and help myself. This is because sometimes when you tell a friend to help especially when there is no money, they end up talking about you. This may stigmatize me.''* FGD 5, B.

Menstruation and menstrual hygiene are critical issues which have not been explained well and given due attention as a single program because it is normally embedded in the school health program and implementation is school based. So, the university students are excluded from this program. More so, MHM has been marginalized within the reproductive health agenda. However, the management of menstrual hygiene requires collaborative efforts from government, universities and communities.

*''We don't have policies to guide menstrual hygiene and activities in universities. As a result, there is a knowledge gap and lack of pads. Some university students lack knowledge on how to use them and the practical aspect of use is different coupled with poor disposal and infections resulting from poor MHM*." KII, A 1.

## Theme 2: Socio-cultural Beliefs and Myths

### Sub-theme 1: Social Expectations towards MHM

Some participants reported that female students threw used disposable commercial

pads in the toilet instead of the pad bins where people were less likely to see the used product. Majority of participants were aware of some cultural beliefs and myths which included associating menstruation to sorcery and witchcraft, leading to young women' fears related with the disposal of menstrual absorbents. The held a belief that menstruation is unhealthy and is a basis of embarrassment. One participant explained that;

*''We are from different backgrounds. You may find a student disposed sanitary pads in a toilet instead of a pad bin with a belief that menstrual blood is impure and should avoid having people see the used pads. This is misuse and risky for all of us users of the toilets."* FGD 5, B.

Others reported to wrap the used pads in plastic bags and put them into bins for disposal off campus, so they were less visible. A participant said:

*''……. And as such I do not like males to look into my bag because they could see either a pad, or worse still a used one which could embarrass me.''* FGD 1A.

However, some participants appreciated menstruation as part of growth and life that needed to be discussed openly. A participant said:

*''In my culture menstruation is overwhelmingly shunned upon. You can't talk about it openly, but for me personally, I think it's a normal experience that you need to go through as you grow……. it's a sign of growth.'* FGD, 6A.

### Sub-theme 2: Restrictions towards MHM

Most participants expressed that restrictions (taboos) still exist in their cultures and communities. Among the restrictions mentioned were food preparation, movements and attending prayers by menstruators. This was supported and reiterated by a participant:

*''In my family and society, when a female is in menstruation she is not supposed to cook and touch on items used by the public. Also, they have to limit movements and be seated in one place because one is considered to be dirty.''* FGD6, A

## Theme 3: Challenges faced by Menstruating Female Students

### Subtheme 1: Society's Concealment of the Menstrual Cycle

During their menstrual cycle, female students face a range of issues, including stress, anxiety about leaking, embarrassment, headaches, and abdominal cramps. They experience sadness, mental anguish, and anxiety. The Menstruators are often stigmatised when they freely speak about their experience and speaking out is also treated as a taboo in many African cultures. A participant said:

*''I do not want to share with anyone about my menstruation; it's a private issue.''* FGD3 B

Regarding the influence of MHM towards education, most respondents reported headaches, cramps and fear of staining during class times;

*''Physical pains prevent me from concentrating in classes and activities. Fear of staining the clothes and cramps stop me from attending the classes.*" Female student 5, B

In addition, a number of key informants elucidated similar expressions. When asked what respondents' thought were the most difficult challenges for female students at the university one participant narrated;

' *'Lack of concentration in class due to the physical pains is a challenge. This cuts across the board irrespective of being needy or not being a needy student. This is coupled with difficulty in accessing the campus clinic due to limited operating hours (3 days/week) and staff shortages*." KII, B

### Sub-theme 2: Lack of WASH resources for MHM

The study findings have revealed that female students are faced with several challenges such

as inadequate WASH facilities: no change rooms, no soap for showers, presence of male cleaners and lack of labels on toilets. These barriers deterred them from utilizing wash facilities for their menstrual hygiene and health.

> ‘’*Some toilets and washrooms are not even private because they are no labels on some toilets. As such one is not protected from other users. To the worst the presence of male cleaners in the women wash facilities deters from use of the facilities”* FGD1, B

Another student expressed a related concern:

> *‘’The only problem I face is the lack of good WASH facilities. If you have to change pads you have to move with your toilet paper and your soap, which is disturbing’’ FGD 7B.*

Another participant asserted emphatically that:

> ‘’*No change rooms for pads and showers to use during menses. For those who wish to shower and change to another pad, soap and toilet paper are lacking.* ’FGD 6 A

A key informant emphasized stigma as a major challenge to menstrual hygiene management for female students. The participant said:

> *‘’……stigma is experienced by some students as they feel having menses it’s a bad experience. A case in point is the disabled that are not catered for by the University. The wash facilities including toilets are not user friendly*.’’ KII, B 2

From an economic point of view, the findings revealed that some students cannot afford to buy sanitary pads. The majority of students from Campus B struggle so much, both materially and socially to buy sanitary pads than their counterparts at Campus A. The participants pointed out that the universities do not have pads or hygienic materials for changing. The participant said that:

> ‘’ *Most of the continuing female students are needy students who at times cannot afford to acquire sanitary pads. This precarious situation pushes students into commercial sex as they try to get money to help them get the sanitary pads*.’’ KII B 1

## Discussion

This research investigated the challenges faced by female university students in Central and South Western Uganda through a socio-ecological perspective. The majority of the participants expressed practicing proper MHM amidst challenges influenced by multiple layers of the SEM including individual, interpersonal, institutional, societal and policy levels. Similar studies using the SEM framework were done in Nepal and Uganda on MHM [4, 11].

### Individual Level

In this study, dysmenorrhea contributed to university absenteeism, decreased concentration and participation, and reduced academic performance. The fear of menstrual leakage and staining, also negatively influenced education. This is in line with similar studies done at University of Sydney in Australia, University of Illinois in USA, Nnamdi Azikiwe University in Nigeria, and Mbarara University of Science and Technology in Uganda [15-18]. Thus, multi-level evidence-based interventions aimed at improving menstrual health among university-going females are required. Study findings highlighted that there was a consistent knowledge gap. The majority of the students possessed either partial or wrong information about MHM and many of them had biases based on cultural taboos. This leads to misconceptions about menstruation and menstrual hygiene practices. Similarly, undergraduate female students in Nigeria and Ugandan Universities lacked knowledge on menstruation and hygiene [8, 19].

### Interpersonal

This study indicated inadequate WASH facilities, presence of male cleaners and lack of labels on toilets as challenges experienced by female students. These barriers deterred them from utilizing WASH facilities for their menstrual hygiene and health. This agrees with

a similar study done in the West Bank, the participants reported inadequate WASH facilities [20]. This is contrary to a study done in Turkey and Ethiopia where students had enough WASH facilities and was associated with less morbidity [21, 22].

Also, findings show that students at both campuses alluded to inadequate access to soap and water in the washrooms. This is similar to a study in Ghana where 68 percent of the schools had water but only 16 percent had soap for hand-washing [23]. Several studies have indicated globally, WASH interventions are vital for public health and have a huge impact on education and social outcomes [12]. Further, both campuses had inadequate artificial lighting in the toilet and hand-washing facilities. This holds in line with increasing evidence that poor lighting increases violence, harassment among women and acts as a barrier to women using the facilities at night [24] and in fear of threatening safety concerns [25, 26].

## Institutional and Societal Levels

The findings in this study indicate that there is concealed secrecy about menstruation and hygiene practices and linking of witchcraft to menstruation thereby compromising MHM. This is consistent with similar studies done in Bhutan and South Korea [21], Nigeria and Uganda [27, 28]. Also, participants reported wrapping pads in bags, and disposal into toilets. These poor MHM behaviors and practices are further consistent with findings in Nepal and Papa New Guinea which indicated that it's believed that menstruation is dirty and impure. More so, seeing menstrual blood was associated with causing bad luck, blindness and infertility [29]. Although cultural myths and beliefs appear to be one of the main drivers of poor menstrual hygiene management practices, the unhygienic customs were more common at Campus B than A. This could be that menstrual taboos and myths are a complex issue, deeply ingrained in the rural and preserved society from which majority of students came from. Campus B is still a young university of only 23 years while Campus A is over 28 years old. The student population, infrastructure, social amenities, and government funding in these universities are significantly different. Given that, Campus B does not enjoy the advantage of a huge diversity its cultural fusion is not yet shaped by diversity influences, creating a poor tapestry of traditions that reflect it's homogenous cultural status. Contrary to campus A which is characterized by its culturally rich and geographically diverse student body, with students hailing from better socio-economic backgrounds and ethnicities. This diversity could enrich the educational and cultural experience, allowing students to learn in a culturally rich and inclusive environment with proper MHM practices and behaviour. This is similar to a Ugandan WASH study on MHM among female students done at Kyambogo university against Makerere, Dar-es-salaam, and Bonn Universities in 2024 [8].

## Policy Level

While awareness and supporting structures have been put in place for primary and secondary schools, in the universities such arrangement is still lacking. This is similar to a study done in Australia [30]. Further, this study revealed most of the university-enrolled students experienced period poverty characterized by inadequate access to menstrual health resources highlighting the urgency of addressing this issue. Through this study, there was no program and policy aimed at reducing period poverty at the campuses. This is indifferent from a study done at Purdue University, in USA which had a tailored promotional effort against period poverty aiming to reach the entire female student body [30]. In addition, Britain, Kenya, India, Canada, Australia and Germany are some of the countries that have not only eliminated the tax on menstrual hygiene products but also provide menstrual hygiene products for free to users of any women's gender in schools [31, 32]. By

acting on these findings, university administrators can play a crucial role in promoting menstrual equity and creating inclusive environments for all students who menstruate.

However, this study had strengths and limitations. The strength of the study lies in its phenomenological design of data collection, which provided a deeper insight into understanding MHM among female university students in Uganda. Despite this strength, the study had some limitations. It relied on self-reported data which may have been influenced by the ability to recall, their willingness to share personal and potentially sensitive information, and their desire to respond in a manner that would not tarnish the image of the institutions. The self-reported data was validated with observational data. Thus, the implication is that positive experiences identified could be upheld, while negative experiences should be addressed to deliver satisfactory MHM in these institutions or similar settings. As such, responding to these findings could have a direct effect on education and health sectors in Uganda.

## Conclusion

This study suggests that the individual, interpersonal, institutional, societal and policy burdens related to menstrual experiences affect menstrual health and hygiene management among female university students in central and southwestern Uganda. The main menstrual challenges among female students reported are largely a knowledge gap, social cultural beliefs, having poor and inadequate WASH facilities, and limited access to WASH materials as well as policies to support MHM at university.

## Recommendation

To improve menstrual hygiene practices, it is crucial to address these challenges and consider better WASH facilities, education and awareness, MHM programs, community support, and policy changes that prioritize MHM in universities for female students. Poor menstrual health and unmet menstrual needs influence several aspects of female students' lives, including their educational outcomes. Therefore, multi-level and evidence-based MHM interventions could help to improve menstrual health, hygiene and the social well-being of female university students at all levels of the socio-ecological framework.

## Ethical Review and Approval

The ethical clearance was sought from the Research Ethics Committee of Uganda Christian University (UCUREC-2025-1908). The study received approval from Texila American University. Informed consent was sought from respondents and administrative permission was obtained from the relevant authorities before collecting data. The respondents were informed of their right to withdraw from the interview whenever they so wished. Participant confidentiality was safeguarded.

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## Data Availability

Raw data that was gathered in this research are not accessible to the public due to the confidentiality agreement with the research subjects. The data will however be made available to the author on a reasonable request by the principal investigator as well as co-authors. It is also possible to share anonymised data that can be used to confirm the results of the study with qualified researchers that satisfy

the terms of the confidentiality agreement in compliance with the accepted protocols of ethics. The interested parties may demand the access by using the secure data-sharing portal of the project.

## Conflict of Interest

The authors declare that there is no conflict of interest.

## Author Contribution

JN, RB, EO, EM: Conceptualization, Methodology, Formal Analysis; JN EO, EM, FM: Writing – Original Draft: RB, EM and supervision; JN: Project Administration; All authors contributed to the review and editing of the manuscript; All authors read and approved the final version of the manuscript.

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# Patients' Assessed Quality of Healthcare and Satisfaction with Health Services in Selected Facilities in Cross River State, Nigeria

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***Abstract***

*In recent years, patients have become more knowledgeable about their healthcare options and are increasingly advocating for improved quality of care and treatment. The extent to which their expectations are met during clinical encounters significantly influences their cooperation with healthcare providers. This, in turn, results in fewer complaints, improved patient retention, increased patronage, and a greater likelihood of referrals. A descriptive cross-sectional study design was employed, and a multistage sampling technique was used to recruit 416 patients admitted across selected primary, secondary, and private healthcare facilities in Cross River State, Nigeria. Data were analysed with SPSS Version 23, employing both descriptive and inferential statistical techniques, with chi-square tests used to examine the study hypotheses. Findings revealed that while 300(72.1%) perceived the overall quality of healthcare delivery to be poor. Additionally, 225(54.1%) assessed the level of patient engagement and communication during healthcare provision as low. In contrast, a large majority 387(93%) expressed high levels of satisfaction with the quality of care received. Perceived quality of care was significantly associated with sociodemographic factors such as sex (p = 0.012), marital status (p = 0.024), religion (p = 0.035), tertiary education (p = 0.008), income level (p = 0.002), and type of healthcare services received (p = 0.001). Targeted Interventions to improve healthcare delivery, patient engagement, and communication are recommended to enhance overall service quality.*

***Keywords:*** *Facilities, Healthcare, Patients, Quality, Satisfaction, Services.*

## Introduction

The quality of healthcare services is a fundamental aspect of delivering effective care [1, 2]. The World Health Organization (WHO) defines quality of care as the degree to which healthcare services delivered to individuals and populations enhance the desired health outcomes [3]. Also, quality of care refers to care that effectively maintains or enhances health while being person-centred [4]. Healthcare providers typically aim to ensure their patients are content by addressing their medical concerns [5]. In recent decades, there has been a significant transformation in health care practices. The focus has shifted from solely assessing the quality of care based on technical standards to also considering patients' perceptions and evaluations of the services they receive [6].

In recent years, patients have become more informed and aware of their healthcare choices, leading them to increasingly assert their right to receive better quality care and treatment options [5]. With the rapid changes in medical service delivery and growing patient awareness, more efficient strategies for managing healthcare facilities have become essential [1]. Patient-

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assessed quality of care represents the patients' viewpoint on how well their needs are met during visits to healthcare facilities, in line with their expectations, as well as their satisfaction with the delivery of healthcare services [7]. The degree to which patients have their expectations met during clinic visits significantly influences their compliance with hospital staff. This leads to fewer patient complaints, increased profitability, higher rates of patient return, and more referrals [5].

Inadequate healthcare quality poses a significant challenge due to factors such as the absence of some physicians and nurses, unwelcoming or aggressive behaviour from some staff towards patients, instances of misdiagnosis, lack of available medications, and insufficient prescribing and treatment practices [8]. When communication between patients and healthcare providers is poor, interactions can become so unsatisfactory that patients may choose to switch hospitals or physicians, even when alternative options are limited [9]. For instance, a study conducted in Pakistan revealed that 48.8% of patients were dissatisfied with communication from their doctors, while 27.6% reported not receiving adequate support from nurses [7]. Also, patients often report dissatisfaction with prolonged waiting times, largely due to a significant imbalance in the patient-to-staff ratio, where the number of patients far exceeds the available healthcare personnel [9, 10]. The estimated time spent using various hospital services among 35.2% and 31.9% of individuals who visited the medical and surgical outpatient departments of the Hawassa University Teaching Hospital in Southern Ethiopia, showed that nearly one-third (32.7%) of patients experienced waiting times exceeding 90 minutes to enter the outpatient departments after completing the registration process [7].

Shortages of human resources and the emigration of skilled professionals from Africa to Europe, the Middle East, and North America further exacerbates healthcare outcomes [11]. More than 25,000 Nigerian doctors are practicing abroad, which impacts healthcare delivery in Nigeria [12]. This situation undoubtedly has a detrimental effect on the quality of care and could potentially lower patient satisfaction among those in Nigeria who cannot afford treatment abroad [13]. For example, approximately 78 billion naira (over 8.5 billion US dollars) is spent annually by Nigerians seeking health care services overseas [14]. Another study indicates that Nigerians spend 1 billion USD annually to seek emergency medical treatment overseas. This expenditure encompasses medical tourism to various countries and regions, including South Africa, Zimbabwe, and several Middle Eastern nations (such as Egypt, Israel, and Turkey), which are perceived to provide superior healthcare services compared to those available in Nigeria [13]. The negative perception of healthcare quality in Nigeria significantly affects public health outcomes and hinders economic development [15, 16].

The quality of care among patients has not been extensively studied, especially in developing countries. Assessing patients' views and experiences regarding care quality provides valuable insights into their real experiences and emphasizes the aspects of quality that are most significant to them [17]. Consistent monitoring of health services is essential, leading to an increased focus on assessing patient perceptions of healthcare quality as a significant component of quality evaluation in recent years [18]. Hence, this study sought to appraise the healthcare services available and the quality of care assessed by patients in selected health facilities in Cross River State, Nigeria.

## Methodology

### Study Area

The study was conducted in Cross River State, located in the South–South geopolitical zone of Nigeria within the sub-Saharan region of West Africa. The state lies between latitudes

4°27′ and 5°32′ North and longitudes 7°50′ and 2°20′ East. Cross River State shares boundaries with Benue State to the north, the Republic of Cameroon to the east, Ebonyi and Abia States to the west, Akwa Ibom State to the southwest, and the Atlantic Ocean to the south. Covering approximately 23,074.43 km², it is one of the largest states in the Niger Delta region, with Calabar as its capital. Administratively, the state is organised into three senatorial districts and 18 Local Government Areas (LGAs), namely: Abi, Akamkpa, Akpabuyo, Bakassi, Bekwarra, Biase, Boki, Calabar Municipality, Calabar South, Etung, Ikom, Obanliku, Obubra, Obudu, Odukpani, Ogoja, Yala, and Yakurr. The population comprises predominantly Bantu ethnic groups with historical origins linked to Central Africa. The southern district is mainly occupied by the Efik, Efut, Qua, Ejagham, and Ekoi groups, while the central district hosts the Bahumono, Yakurr, Agbo, Boki, Mbembe, Nkim, Olulumo, Ofutop, Abanajum, and Nselle communities. The northern district is largely inhabited by the Yala, Bekwarra, Bette, Utugwang, Mbube, Ekajuk, and Uhelle peoples. Despite linguistic diversity, the population shares strong cultural similarities, particularly in dress, music, drumming, and dance, reflecting shared ancestral heritage. The economy is largely driven by agriculture, fishing, and trade, supported by abundant natural resources including forests and water bodies. The state also sustains a mixed labour market comprising public sector employees across federal, state and local government levels, as well as private sector workers and self-employed individuals.

## Study Design

This study employed an analytical cross-sectional survey design, considered suitable for evaluating patients' perceptions of healthcare services at a specific point in time. Data were collected using a semi-structured questionnaire administered to study participants. Respondents were drawn from both rural and urban settings in Cross River State, Nigeria, through a probability-based approach, specifically a multistage sampling technique.

## Study Population

The study population comprised all patients who were receiving care in the selected health facilities including primary, secondary, and private institutions within the period of data collection.

## Sample Size Determination

The sample size for this study was calculated using the standard formula for cross-sectional studies, as referenced by Nji, Oko [19]. The calculation was based on a 95% confidence level, a 5% margin of error, an estimated patient satisfaction prevalence of 58.2% from prior research, and an additional 10% to account for potential non-response, resulting in a minimum required sample size of 416 participants.

$$n = \frac{z^2 pq}{d^2}$$

*Where;*

n = Desired sample size

Z = Confidence level

p = Prevalence rate

q = Proportion of non-occurrence (1-p)

d = margin of error

Therefore:

Z = 95% (1.96)

p = 58.2% = 0.582. The value of p represented the estimated prevalence of patient satisfaction with healthcare delivery, adopted from a previous study conducted by Etim, Nja [7].

## Sampling Procedure

A multistage sampling approach was applied to select senatorial districts, local government areas (LGAs), health facilities, hospital departments, and participants.

**Stage I: Selection of Senatorial District:** Southern Senatorial District was purposively selected from the three senatorial districts in Cross River State (Northern, Central, and

Southern) due to limited evidence of similar studies within the district.

**Stage II: Selection of Local Government Areas:** The selection of LGAs; a sampling frame was created from the six LGAs in the district (Calabar South, Calabar Municipality, Bakassi, Akpabuyo, Odukpani, and Biase), of which three were randomly selected through a balloting process using a randomisation technique.

**Stage III: Selection of healthcare facilities:** Healthcare facilities in the selected LGAs were stratified into private, public secondary, and public primary facilities, as no tertiary facility existed in the study area. Using sampling frames for each stratum, facilities were selected by simple random sampling, resulting in the inclusion of three private, one secondary, and three primary facilities per LGA. This yielded a total of 21 facilities comprising nine private, three secondary, and nine primary health facilities.

**Stage IV: Selection of departments:** Five core clinical departments Nursing, Pharmacy, Medical, Laboratory, and Radiology were purposively selected in each facility, based on their functionality and consistent presence across both public and private health institutions in the state.

**Stage V: Selection of in-patients:** This involved the selection of 416 inpatients using a purposive sampling technique, targeting participants who were clinically stable, conscious, and willing to take part in the study. To facilitate selection, patients in each ward were assigned identification numbers. A total of 139 patients were recruited from each selected LGA, with 46 participants drawn from private, secondary, and primary facilities, respectively.

## Instrument for Data Collection

A semi-structured questionnaire was prepared based on the research objectives formulated for inpatients. The questionnaire for inpatients consisted of four (4) sections (A, B, C, and D). Section A contained questions designed to elicit information on the socio-demographic characteristics of patients; Section included questions assessing the quality of care as perceived by patients; Section C covered patient engagement and communication during healthcare provision. Section D contained questions on patients' satisfaction with the quality of healthcare.

## Instrument Validation and Reliability of Data Collection Instruments

Data were collected using a semi-structured, interviewer-administered questionnaire, which captured information on socio-demographic characteristics, patient-assessed quality of care, patient engagement and communication during service delivery, and overall satisfaction with care. Face and content validity of the instrument were confirmed through expert review by the Department of Public Health, Texila American University.

To ensure clarity, relevance, and suitability, the questionnaire was pre-tested among 42 patients aged 18 years and above in Yakurr Local Government Area, selected due to its proximity and contextual similarities to the study sites. The pre-test assessed the appropriateness and clarity of the questions, the alignment of items with study objectives, and the average time required for completion. Feedback from the pre-test facilitated refinement of ambiguous items and improved overall instrument clarity. Internal consistency and reliability were evaluated using Cronbach's alpha, with values of 0.79 and above considered indicative of high reliability.

## Method of Data Collection

Three field assistants were recruited and trained by the researcher to support data collection and collation. The two-day training covered questionnaire administration, interpretation of non-verbal cues, an overview of the study objectives, and strategies for effective communication. The assistants were

selected based on previous experience in community fieldwork and data collection.

Data collection was conducted using an interviewer-administered approach through Open Data Kit (ODK) Collect, an open-source mobile platform compatible with KoboToolbox for electronic survey design and deployment. A total of 416 questionnaires were administered by the research team. Prior to data collection, the field assistants introduced themselves to participants, explained the purpose of the study, and obtained both written and verbal informed consent before proceeding with questionnaire administration.

### Method of Data Analysis

After the completion of all questionnaires, responses were meticulously reviewed to ensure accuracy. The data were subsequently entered and cleaned before conducting an initial analysis using Microsoft Excel. Thereafter, the dataset was exported to SPSS Version 23 for more in-depth statistical analysis. Results were presented in tables using frequencies and percentages, while numerical data were summarized as means. Hypothesis testing was conducted using the Chi-square test at a 95% confidence level. To evaluate patient-assessed quality of care, a five-item questionnaire was used. Each correct answer was scored as 1, and each incorrect response as 0. The total score ranged from 0 to 5. Scores between 0 and 2 were considered indicative of poor quality of care, while scores from 3 to 5 reflected good quality of care. Patient engagement and communication during healthcare provision were assessed using a ten-item questionnaire. Each correct answer received a score of 1, and each incorrect response a score of 0. The total score ranged from 0 to 10. Scores between 0 and 4 indicated low patient engagement and communication, while scores between 5 and 10 reflected high engagement and communication levels. Finally, patient satisfaction with the quality of healthcare was measured using a twenty-item questionnaire based on a five-point Likert scale, ranging from 'Strongly Disagree' (1) to 'Strongly Agree' (5). The total possible score ranged from 20 to 100. Scores from 0 to 49 indicated low patient satisfaction, whereas scores from 50 to 100 represented high patient satisfaction.

## Results

### Socio-Demographic Characteristics of Patients

Table 1 presents the sociodemographic profile of the study participants. The majority were female, accounting for 273 (65.6%) of respondents. The mean age of participants was 29.99 ± 9.53 years, with 324 (77.9%) aged between 18 and 35 years. Nearly half were single, 204 (49.0%), and the predominant religion was Christianity, reported by 358 (86.1%). A substantial proportion had attained tertiary-level education, 205 (49.3%). Regarding monthly income, 120 (28.8%) earned less than ₦18,000, while the largest occupational group consisted of traders, 167 (40.1%). With respect to healthcare utilisation, 198 (47.6%) received general healthcare services, and 260 (62.5%) reported visiting health facilities occasionally.

**Table 1.** Socio Demographic Characteristics of Respondents

| Variables | Frequency (n=416) | Percent (%) |
|---|---|---|
| **Sex** | | |
| Male | 143 | 34.4 |
| Female | 273 | 65.6 |
| **Age (in years)** | **Mean = 29.99, SD = 9.530** | |
| 18-35 (Younger adults) | 324 | 77.9 |
| 36-55 (Middle-age adults) | 86 | 20.7 |
| >55 (Older adults) | 6 | 1.4 |

| | | |
|---|---|---|
| **Marital status** | | |
| Single | 204 | 49.0 |
| Married | 163 | 39.2 |
| Divorced | 27 | 6.5 |
| Separated | 12 | 2.9 |
| Widowed | 10 | 2.4 |
| **Religion** | | |
| Christian | 358 | 86.1 |
| Islam | 27 | 6.5 |
| Traditional religion | 31 | 7.5 |
| **Highest level of education** | | |
| No formal education | 32 | 7.7 |
| Primary | 44 | 10.6 |
| Secondary | 135 | 32.5 |
| Tertiary | 205 | 49.3 |
| **Income level** | | |
| Less than 18,000 | 120 | 28.8 |
| 18,000 – 39,000 | 88 | 21.2 |
| 40,000 – 59,000 | 68 | 16.3 |
| 60,000 – 79,000 | 71 | 17.1 |
| 80,000 and above | 69 | 16.6 |
| **Occupation** | | |
| Trading | 167 | 40.1 |
| Artisan | 70 | 16.8 |
| Farming | 83 | 20.0 |
| Civil servant | 96 | 23.1 |
| **Type of Healthcare Service Received** | | |
| General | 198 | 47.6 |
| Emergency services | 35 | 8.4 |
| Specialized treatment | 94 | 22.6 |
| Preventive care | 83 | 20.0 |
| Other (please specify) | 6 | 1.4 |
| **Frequency of visit to this facility** | | |
| First visit | 82 | 19.7 |
| Occasionally | 260 | 62.5 |
| Regularly | 74 | 17.8 |

**Type of healthcare service received (others specify = Ante-natal care services)*

## Patients' Assessed Quality of Care

Table 2 below presents the results on patients' assessed quality of care among the study respondents. More than half of the respondents 248(59.6%) rated the overall cleanliness of the facility to be good. Majority of the respondents 176(42.3%) reported that they had to wait for up to 15-30 minutes before being attended to by a healthcare provider. A significant majority of the respondents 210(50.5%) were able to get all the necessary medical tests and treatments during of their visit. Most of the respondents 173(41.6%) reported that the facilities were not equipped with adequate resources (e.g., equipment,

medications) however, 183(44.0%) of the respondents reported that emergency services were quick and responsive.

Figure 1 below is a graphical illustration of the respondents' assessed quality of care. The results showed 300(72.1%) assessed the quality of healthcare delivery to be poor while 116(27.9%) assessed the quality of care to be good enough.

**Table 2.** Patients' Assessed Quality of Care

| Variables | Frequency (n=416) | Percent (%) |
|---|---|---|
| **How you rate the overall cleanliness of the facility** | | |
| Excellent | 63 | 15.1 |
| Good | 248 | 59.6 |
| Fair | 86 | 20.7 |
| Poor | 19 | 4.6 |
| **How long you wait before being attended to by a healthcare provider** | | |
| Less than 15 minutes | 80 | 19.2 |
| 15–30 minutes | 176 | 42.3 |
| 30 minutes–1 hour | 120 | 28.8 |
| More than 1 hour | 40 | 9.6 |
| **You were able to get all the necessary medical tests and treatments during your visit** | | |
| Yes | 210 | 50.5 |
| Partially | 62 | 14.9 |
| No | 144 | 34.6 |
| **The facility is equipped with adequate resources (e.g., equipment, medications)** | | |
| Yes | 165 | 39.7 |
| Don't know | 78 | 18.8 |
| No | 173 | 41.6 |
| **Emergency services are quick and responsive in this facility** | | |
| Yes | 183 | 44.0 |
| Don't know | 75 | 18.0 |
| No | 158 | 38.0 |

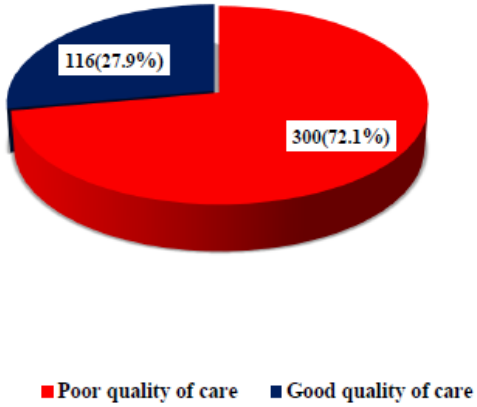


**Figure 1.** Patients' Assessed Quality of Care

## Patient's Engagement and Communication During Health Care Provision

Table 3 below presents the results on patient's engagement and communication during health care provision. More than half of the respondents 211{50.7%) had never experienced language barriers when communicating with their healthcare providers. Most of the respondents 200(48.1%) reported that they felt very involved in making decisions about their healthcare and 162(38.9%) were very comfortable asking questions about their health condition and treatment. Most of the respondents were comfortable sharing personal or sensitive information with their healthcare providers. Almost half of the respondents 191(45.9%) reported that they were given the opportunity to express their concerns about treatment options or procedures and 208(50.0%) completely agreed that healthcare providers explained their diagnosis or condition in a way that they could easily understand. Majority of the respondents 198(47.6%) sometimes felt confused or unclear about the instructions given for their care or medication. Most of the respondents 183(44.0%) agreed that their healthcare provider always encouraged them to ask questions if they needed further clarification and 206(49.5%) rarely ever felt dismissed or not taken seriously by their healthcare provider. More than half of the respondents 222(53.4%) rated the communication skills of their healthcare providers (e.g., listening, explaining, showing empathy) to be good.

Figure 2 below is a graphical illustration of patients assessed engagement and communication during health care provision. Findings from this study show that 225(54.1%) of the respondents assessed the engagement and communication during healthcare provision to be low and only 191(45.9%) of the respondents assessed it to be high.

**Table 3.** Patient's Engagement and Communication during Healthcare Provision

| Variables | Frequency (n=416) | Percent (%) |
|---|---|---|
| **How often you experience language barriers when communicating with your healthcare provider** | | |
| Never | 211 | 50.7 |
| Sometimes | 141 | 33.9 |
| Often | 51 | 12.3 |
| Always | 13 | 3.1 |
| **How involved you feel in making decisions about your healthcare** | | |
| Very involved | 200 | 48.1 |
| Somewhat involved | 102 | 24.5 |
| Not very involved | 93 | 22.4 |
| Not at all involved | 21 | 5.0 |
| **How comfortable you feel asking questions about your health condition and treatment** | | |
| Very comfortable | 162 | 38.9 |
| Comfortable | 160 | 38.5 |
| Neutral | 81 | 19.5 |
| Uncomfortable | 13 | 3.1 |
| **You feel comfortable sharing personal or sensitive information with your healthcare provider** | | |
| Very comfortable | 115 | 27.6 |

| | | |
|---|---|---|
| Comfortable | 147 | 35.3 |
| Neutral | 131 | 31.5 |
| Uncomfortable | 23 | 5.5 |
| **You were given the opportunity to express your concerns about treatment options or procedures** | | |
| Yes | 191 | 45.9 |
| Partially | 84 | 20.2 |
| No | 141 | 33.9 |
| **The healthcare provider explained your diagnosis or condition in a way that you could easily understand** | | |
| Yes completely | 208 | 50.0 |
| Partially | 176 | 42.3 |
| No, not at all | 32 | 7.7 |
| **How often you feel confused or unclear about the instructions given for your care or medication** | | |
| Never | 126 | 30.3 |
| Sometimes | 198 | 47.6 |
| Often | 73 | 17.5 |
| Always | 19 | 4.6 |
| **The healthcare provider encourages you to ask questions if you needed further clarification** | | |
| Yes, always | 183 | 44.0 |
| Sometimes | 124 | 29.8 |
| Rarely | 96 | 23.1 |
| Never | 13 | 3.1 |
| **Ever felt dismissed or not taken seriously by your healthcare provider** | | |
| Yes, often | 76 | 18.3 |
| Occasionally | 134 | 32.2 |
| Rarely | 206 | 49.5 |
| **How you rate the communication skills of your healthcare provider (e.g., listening, explaining, showing empathy)** | | |
| Excellent | 104 | 25.0 |
| Good | 222 | 53.4 |
| Fair | 84 | 20.2 |
| Poor | 6 | 1.4 |

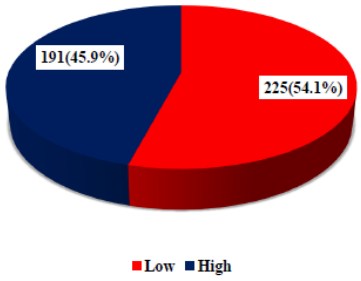


**Figure 2.** Patient's Engagement and Communication during Healthcare Provision

## Patients' Satisfaction with the Quality of Healthcare

Table 4 below illustrates the results of patients' satisfaction with the quality of healthcare. Most of the respondents 128(30.8%) were neutral on if the healthcare facility was clean and well-maintained. Most of the respondents 173(41.6%) were also neutral on if the healthcare facility had modern and up-to-date equipment. A significant proportion of the respondents 149(35.8%) agreed that staff members appear well-groomed and professionally dressed. Most of the respondents 141(33.9%) were neutral on how comfortable and organised the waiting areas and consultation rooms were. About 144(34.6%) of the respondents agreed that healthcare providers were consistent in the quality of care provided and 130(31.3%) agreed that they felt confident in the accuracy of the diagnosis and treatment provided. Most of the respondents 118(28.4%) of the respondents were neutral on if test results and reports were provided in a timely manner. Most of the respondents 128(30.8%) agreed that healthcare providers demonstrated thoroughness and attention to detail and 154(37.0%) agreed that healthcare providers were available when needed. Majority of the respondents 124(29.8%) agreed that they were able to get an appointment within a reasonable timeframe and 157(37.7%) of the respondents agreed that their healthcare providers spend sufficient time addressing their concerns. However, 128(30.8%) of the respondents were neutral on if staff members responded promptly to their inquiries and requests and 137(32.9%) of the respondents were also neutral on if emergency services were quick and responsive. Most of the respondents 152(36.5%) agreed that staff members were courteous and respectful. Also, 143(34.4%) of the respondents agreed that their healthcare provider inspires confidence in their treatment and care. About 116(27.9%) of the respondents were neutral on if they felt treated as an individual rather than just a patient and finally, 137(32.9%) of the respondents were neutral on if healthcare providers were compassionate and empathetic in their care.

Figure 3 below is an illustration of respondents' level of satisfaction with the quality of care they received. Majority of the respondents 387(93%) had high satisfaction with the quality of care received and while 29(7%) of the respondents had low satisfaction.

**Table 4.** Patients' Satisfaction with the Quality of Healthcare

| STATEMENTS | SD | D | N | A | SA |
|---|---|---|---|---|---|
| The healthcare facility is clean and well-maintained | 43(10.3%) | 68(16.3%) | 128(30.8%) | 119(28.6%) | 58(13.9%) |
| The healthcare facility has modern and up-to-date equipment. | 44(10.6%) | 63(15.1%) | 173(41.6%) | 113(27.2%) | 23(5.5%) |
| Staff members appear well-groomed and professionally dressed. | 25(6.0%) | 31(7.5%) | 155(37.3%) | 149(35.8%) | 56(13.5%) |
| The waiting areas and consultation rooms are comfortable and organized | 15(3.6%) | 69(16.6%) | 141(33.9%) | 120(28.8%) | 71(17.1%) |
| Healthcare providers are consistent in the quality of care provided. | 19(4.6%) | 54(13.0%) | 127(30.5%) | 144(34.6%) | 72(17.3%) |
| I feel confident in the accuracy of the diagnosis and treatment provided. | 12(2.9%) | 54(13.0%) | 123(29.6%) | 130(31.3%) | 97(23.3%) |
| Test results and reports are provided in a timely manner. | 46(11.1%) | 62(14.9%) | 118(28.4%) | 110(26.4%) | 80(19.2%) |

| | | | | | |
|---|---|---|---|---|---|
| Healthcare providers demonstrate thoroughness and attention to detail | 36(8.7%) | 56(13.5%) | 109(26.2%) | 128(30.8%) | 87(20.9%) |
| Healthcare providers are available when I need them. | 38(9.1%) | 54(13.0%) | 104(25.0%) | 154(37.0%) | 66(15.9%) |
| I am able to get an appointment within a reasonable timeframe. | 34(8.2%) | 54(13.0%) | 115(27.6%) | 124(29.8%) | 89(21.4%) |
| My healthcare provider spends sufficient time addressing my concerns | 33(7.9%) | 40(9.6%) | 110(26.4%) | 157(37.7%) | 76(18.3%) |
| Staff members respond promptly to my inquiries and requests. | 40(9.6%) | 52(12.5%) | 128(30.8%) | 127(30.5%) | 69(16.6%) |
| Emergency services are quick and responsive in this facility. | 22(5.3%) | 53(12.7%) | 137(32.9%) | 128(30.8%) | 76(18.3%) |
| Healthcare providers demonstrate a high level of expertise and knowledge. | 31(7.5%) | 45(10.8%) | 113(27.2%) | 145(34.9%) | 82(19.7%) |
| Healthcare providers explain medical conditions and treatments clearly. | 17(4.1%) | 51(12.3%) | 105(25.2%) | 157(37.7%) | 86(20.7%) |
| I feel safe and secure while receiving treatment in this facility | 36(8.7%) | 64(15.4%) | 104(25.0%) | 142(34.1%) | 70(16.8%) |
| Staff members are courteous and respectful. | 27(6.5%) | 59(14.2%) | 96(23.1%) | 152(36.5%) | 82(19.7%) |
| My healthcare provider inspires confidence in my treatment and care. | 35(8.4%) | 54(13.0%) | 88(21.2%) | 143(34.4%) | 96(23.1%) |
| I feel that I am treated as an individual rather than just a patient. | 43(10.3%) | 59(14.2%) | 149(35.8%) | 116(27.9%) | 49(11.8%) |
| Healthcare providers are compassionate and empathetic in their care. | 17(4.1%) | 59(14.2%) | 137(32.9%) | 120(28.8%) | 83(20.0%) |

**SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SD = Strongly Agree*

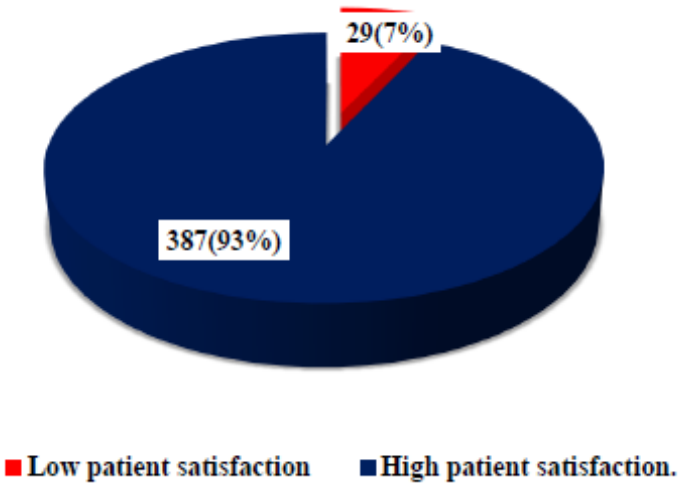


**Figure 3.** Patients' Satisfaction with the Quality of Healthcare

## The Statistically Significant Association between the Sociodemographic Characteristics of Respondents and Perception of Quality of Care

Table 5 below presents a Chi-square analysis showing the association between the conceptual framework moderating factors and perception of quality of care in selected healthcare facilities in Cross River State. There was a statistically significant association between the sex of respondents and assessed quality of care ($\chi2$= 6.267, df= 1, P=0.012). Being female was statistically significantly associated with good patient assessed quality of care. Phi statistic indicates an effect size of 0.123 (P = 0.012), implying that there is a small effect of respondents' sex on their assessed quality of care. Also, there was a statistically significant association between marital status and patient assessed quality of care ($\chi2$= 11.265, df= 4, P=0.024). Being single was statistically significantly associated with good patient assessed quality of care. Cramer's V statistic indicates an effect size of 0.165 (P = 0.024), implying that there is a small effect of respondents' marital status on their assessed quality of care. Additionally, there was a statistically significant association between religion and patient assessed quality of care ($\chi2$= 6.681, df= 2, P=0.035). Being a Christian was statistically significantly associated with good patient assessed quality of care. Cramer's V statistic indicates an effect size of 0.127 (P = 0.035), implying that there is a small effect of respondents' religion on their assessed quality of care. Also, tertiary educational attainment was statistically significantly associated with good patient assessed quality of care ($\chi2$= 11.841, df= 3, P=0.008). Cramer's V statistic indicates an effect size of 0.169 (P = 0.008), implying that there is a small effect of respondents' educational attainment on their assessed quality of care. Also, there was a statistically significant association between income level and patient assessed quality of care ($\chi2$= 16.573, df= 4, P=0.002). Earning less than ₦18,000 was statistically significantly associated with good patient assessed quality of care. Cramer's V statistic indicates an effect size of 0.200 (P = 0.002), implying that there is a small effect of respondents' income level on their assessed quality of care. Lastly, there was a statistically significant association between type of healthcare services received and patient assessed quality of care ($\chi2$= 18.251, df= 4, P=0.001). Receiving general healthcare services was statistically significantly associated with good patient assessed quality of care. Cramer's V statistic indicates an effect size of 0.209 (P = 0.002), implying that there is a small effect of type of healthcare services received by respondents on their assessed quality of care.

**Table 5.** Association Between the Sociodemographic Characteristics of Respondents and Perception of Quality of Care

| | **Patient assessed quality of care** | | | | |
|---|---|---|---|---|---|
| **Variables** | **Poor n (%)** | **Good n (%)** | **P-value** | **$\chi2$** | **df** |
| **Sex** | | | | | |
| Male | 114(79.7%) | 29(20.3%) | | | |
| Female | 186(68.1%) | 87(31.9%) | 0.012* | 6.267 | 1 |
| **Age in years** | | | | | |
| 18-35 (Younger adults) | 227(70.1%) | 97(29.9%) | 0.210 | 3.123 | 2 |
| 36-55 (Middle-age adults) | 68(79.1%) | 18(20.9%) | | | |
| >55 (Older adults) | 5(83.3%) | 1(16.7%) | | | |
| **Marital status** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Single | 134(65.7%) | 70(34.3%) | 0.024* | 11.265 | 4 |
| Married | 123(75.5%) | 40(24.5%) | | | |
| Divorced | 23(85.2%) | 4(14.8%) | | | |
| Separated | 11(91.7%) | 1(8.3%) | | | |
| Widowed | 9(90.0%) | 1(10.0%) | | | |
| **Religion** | | | | | |
| Christian | 250(69.8%) | 108(30.2%) | 0.035* | 6.681 | 2 |
| Islam | 23(85.2%) | 4(14.8%) | | | |
| Traditional religion | 27(67.1%) | 4(12.9%) | | | |
| **Level of education** | | | | | |
| No formal education | 28(87.5%) | 4(12.5%) | | | |
| Primary | 34(77.3%) | 10(22.7%) | | | |
| Secondary | 105(77.8%) | 30(22.2%) | | | |
| Tertiary | 133(64.9%) | 72(35.1%) | 0.008* | 11.841 | 3 |
| **Income level** | | | | | |
| Less than 18,000 | 79(65.8%) | 41(34.2%) | 0.002* | 16.573 | 4 |
| 18,000 – 39,000 | 73(83.0%) | 15(17.0%) | | | |
| 40,000 – 59,000 | 56(82.4%) | 12(17.6%) | | | |
| 60,000 – 79,000 | 51(71.8%) | 20(28.2%) | | | |
| 80,000 and above | 41(59.4%) | 28(40.6%) | | | |
| **Occupation** | | | | | |
| Trading | 123(73.7%) | 44(26.3%) | 0.656 | 1.616 | 3 |
| Artisan | 53(67.5%) | 27(32.5%) | | | |
| Farming | 56(67.5%) | 27(32.5%) | | | |
| Civil servant | 68(70.8%) | 28(29.2%) | | | |
| **Type of healthcare services received** | | | | | |
| General | 124(62.6%) | 74(37.4%) | 0.001* | 18.251 | 4 |
| Emergency services | 27(77.1%) | 8(22.9%) | | | |
| Specialized treatment | 76(80.9%) | 18(19.1%) | | | |
| Preventive care | 67(80.7%) | 16(19.3%) | | | |
| Other (please specify) | 6(100%) | 0(0%) | | | |
| **Frequency of visit to this facility** | | | | | |
| First visit | 62(75.6%) | 20(24.4%) | | | |
| Occasionally | 192(73.5%) | 68(26.2%) | 0.104 | 4.531 | 2 |
| Regularly | 46(62.2%) | 28(37.8%) | | | |

*$\chi 2$= Chi Square statistics; P-value= Probability value; *= statistical significance based on P<0.05, **=Statistical significance based on P<0.001*

## Discussion

The results from the present study, where 72.1% of respondents assessed the quality of healthcare delivery as poor, underscore significant dissatisfaction with healthcare service delivery in the selected healthcare facilities in Cross River State. This outcome aligns with a growing body of literature across sub-Saharan Africa indicating suboptimal quality of healthcare services, particularly in maternal and antenatal care. The findings of Fagbamigbe and Idemudia [20] reinforce the observation of poor healthcare quality. In their nationwide analysis using NDHS data, only 4.6% of women received high-quality antenatal

care (ANC) services, while approximately 11.3% attained the minimum acceptable standard. This low level of quality correlates with the 27.9% who reported receiving good care in the present study, suggesting a consistent trend of substandard service delivery, especially in resource-limited settings. Similar factors may be responsible, including late initiation of ANC, low frequency of visits, and a lack of skilled providers, issues that often plague healthcare systems in many regions of Nigeria, including Cross River State. Also, Fagbamigbe and Idemudia [20] only reported better quality when care was received from skilled professionals in formal health settings, a view that helps explain why many of the participants in the current study might have rated healthcare as poor if services were mostly provided by unskilled or poorly supported staff in resource-constrained environments. Similarly, Kruk, Leslie [21] reported poor quality of maternal care in lower-level facilities across five African countries, particularly in primary care settings without caesarean capabilities. Their findings that primary care centres scored significantly lower on quality indices (0.38 vs 0.77 for secondary care) mirror the likely reality in Cross River State, where many healthcare facilities at the primary level lack sufficient infrastructure, skilled personnel, and emergency preparedness. This resonates with the 72.1% of respondents in the current study who rated healthcare delivery as poor, suggesting that facility type and care complexity directly influence patient perceptions. In a study by Kanyangarara et al. (2017), even though facility readiness for common ANC interventions such as IPTp, iron supplementation, and tetanus toxoid vaccinations was relatively high (median values above 80%), the overall delivery of quality care was uneven. Their findings highlight a crucial distinction between facility readiness and actual service delivery, a gap that may also explain the poor ratings observed in the current study. Facilities may be well-equipped on paper but fail to deliver quality services in practice due to weak health systems, poor staff attitudes, or inefficient processes [22]. The consistent pattern across studies highlights an urgent need for policy interventions targeted at improving the quality not just quantity of healthcare services, especially at the grassroots level where the majority of the population seeks care. Without this, national and global efforts toward Universal Health Coverage and improved health outcomes will remain unmet.

Based on the findings of this study, a substantial proportion of respondents 225(54.1%) assessed the level of engagement and communication during healthcare provision as low, while only 191(45.9%) rated it as high. This outcome reflects a divided perception among patients concerning how effectively healthcare providers engage and communicate during service delivery in the selected healthcare facilities in Cross River State. The present study's finding of low engagement and communication aligns closely with Ukonu, Nwachukwu [23], who reported low patient satisfaction with doctor-patient communication in Enugu and Ebonyi States. In both studies, the dissatisfaction stemmed largely from an authoritarian or paternalistic communication style often adopted by healthcare professionals. This suggests that in some regions, particularly in public health institutions, there is a prevalent communication dynamic where doctors dominate interactions without adequately involving patients in the decision-making process. Additionally, Ukonu et al. highlighted cultural, religious, and linguistic factors that inhibit open communication, which may also be relevant in the Cross River State context particularly in its multicultural setting with multiple ethnic groups and languages.

Conversely, the findings of Onyechi and Babalola [24] contradict the present study, as their respondents in Ibadan positively assessed doctors' communication skills, noting that communication during consultations enhanced

understanding and compliance. Onyechi and Babalola employed the Patient Enablement and Satisfaction Model (PESM), which emphasises shared decision-making and communication that empowers the patient. The positive findings in their study could reflect the success of such models in their study area, whereas such frameworks may not be actively implemented or practiced in Cross River facilities. It is also possible that differences in facility types (e.g., teaching hospitals vs. primary care centres), staff workloads, and patient expectations influenced the perception of communication. Patients in tertiary hospitals may expect and experience more detailed consultations compared to those in general or rural health facilities. The study by Ogaji, Giles [25] presents a nuanced view. While a significant proportion of their respondents were satisfied with their interactions with healthcare staff (84%), other aspects of service delivery such as infrastructure (e.g., waiting area space) received less favourable ratings. This partial alignment suggests that while communication may be effective in some PHC facilities across Nigeria, such positive experiences are not uniformly distributed. Regional disparities, variations in staff-patient ratios, and institutional support systems could influence these outcomes. Several factors may contribute to the low ratings of engagement and communication found in this study Firstly, staff shortages and high patient loads may limit the time healthcare providers can spend on meaningful patient interaction [26]. Also, many healthcare professionals in Nigeria receive limited training in patient-centred communication, especially in non-urban settings [27]. There is also a cultural norm that places doctors as authoritative figures may discourage patients from asking questions or participating in their care plans. Lastly, some patients may lack the knowledge or confidence to assert their communication needs or actively engage during consultations [28].

The findings of this study indicate that the majority of respondents (93%) expressed high satisfaction with the quality of care received, while only a small proportion (7%) reported low satisfaction. This high level of satisfaction highlights the complexity and contextual nature of patient satisfaction as an outcome. For instance, Manulik, Karniej [29] found a nuanced perception of healthcare quality in both public and private settings, where patients' expectations often exceeded their actual experiences. Although their study did not find a clear influence of socio-demographic factors on satisfaction, the distinction between expectations and perceptions is crucial. It suggests that satisfaction is influenced not only by the objective quality of care but also by patients' preconceived expectations, which vary across settings. The current study's high satisfaction rate might reflect either genuinely high-quality services or relatively modest patient expectations in the selected healthcare facilities, particularly if services met or surpassed what patients anticipated. Conversely, the findings by Asamrew, Endris [30] in a specialized hospital in Ethiopia showed a notably lower satisfaction rate of 46.2%. This stark difference could be attributed to various factors, including differences in healthcare infrastructure, resource availability, staff training, and cultural perceptions of care quality. It is also possible that patients in specialized hospitals have more complex health needs and thus higher expectations, leading to relatively lower satisfaction. Similarly, the study by Shagaya [31] among Nigerian university students reported moderate overall satisfaction of 57.1%, with variation across different service domains such as waiting times and staff attitudes. The low satisfaction with waiting times highlights a common challenge in healthcare delivery that can heavily influence overall satisfaction, even when other aspects are rated positively. The research by Umoke, Prince [5] in Ebonyi State, Nigeria, further complements these findings by providing a

detailed breakdown of satisfaction across SERVQUAL dimensions, with higher satisfaction in responsiveness, assurance, and empathy, but comparatively lower scores in tangibility and reliability. Their reported satisfaction levels are generally lower than those in the current study but show consistent trends that human factors such as staff attitudes and communication play a critical role in shaping patient satisfaction. These softer elements of care may have been particularly well managed in the facilities surveyed in our study, explaining the higher overall satisfaction observed. Gishu, Weldetsadik [17] offer an important perspective by focusing on nursing care quality in a tertiary centre in Ethiopia. Their results, indicating only 36% satisfaction with nursing care and highlighting gaps in patient education and home care preparation, underscore the multidimensional nature of quality and satisfaction. Their findings suggest that satisfaction is not merely a reflection of care delivery but also involves how well patients are prepared and supported to manage their health beyond the healthcare setting. The relatively lower satisfaction rates in Gishu et al.'s study might reflect challenges in nursing care education and support that were either less prominent or better addressed in our study settings.

## Conclusion

This study reveals a marked disconnect between patients perceived quality of healthcare services and their self-reported satisfaction levels in selected health facilities in Cross River State, Nigeria. Although the majority expressed satisfaction with the care received, most respondents rated overall healthcare quality and patient–provider engagement as poor, highlighting gaps in communication and service delivery. Key determinants of satisfaction included transparency in treatment costs, respectful provider attitudes, effective care, clear communication, feelings of safety, and the availability of modern and functional medical equipment. Furthermore, perceived quality of care showed significant associations with socio-demographic factors such as sex, marital status, religion, educational attainment, income level, and type of healthcare service received.

To enhance healthcare experiences and outcomes, it is recommended that at the personal level, patients be empowered through health literacy initiatives to foster active participation in care decisions and improve health-seeking behaviour. At the community level, local leaders and organisations should promote structured feedback channels and health awareness programmes that strengthen accountability and responsiveness of health facilities. At the national level, policymakers should prioritise investments in healthcare infrastructure, ensure consistent availability of essential medical equipment, institutionalise patient-centred care practices, and support continuous training of healthcare providers to improve communication, professionalism, and overall service quality.

## Conflict of Interests

The authors declare that they have no competing interests.

## Ethics and Guidelines

All ethical considerations were judiciously adhered to in the cause of this work. Ethical approval was obtained from the Cross River State Research Ethics Committee, Ministry of Health, Calabar with REC NO: CRSMOH/PR/REC/2024/104.

## Consent to Participate

Informed consent was collected from participants, who were informed about the study's objectives, significance, and benefits. Participation was voluntary, and respondents were allowed to withdraw at any point without facing any penalties. A confidentiality agreement was established between the researcher and participants to ensure their privacy and protection throughout the research

process. Additionally, the researcher upheld integrity by properly citing all relevant literature.

## Consent for Publication

All authors agree to the publication of the manuscript

## Availability of Data and Materials

The datasets generated and/or analyzed during the current study are not publicly available due participants' privacy but are available from the corresponding author on reasonable request.

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## Authors' Contributions

Ekpenyong, David Janet and Bernadine Nsa Ekpenyong conceptualized this study and also drafted the manuscript while Peter Enyievi clean, analyzed and interpreted the patient data. All authors were involved in literature review, data collection, proof reading and approved the final manuscript.

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Not applicable.

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# The Impact of Corporate Governance on Women's Financial Inclusion and Economic Empowerment in Selected Ethiopian Private Commercial Banks located in Addis Ababa

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***Abstract***

*This study examined the effect of corporate governance on women's financial inclusion and economic empowerment in Addis Ababa's private commercial banks. Utilizing a mixed-methods approach and both primary and secondary data, the research employed descriptive and inferential statistics like Pearson correlation and regression to analyze the relationships between variables. The findings revealed several challenges. There was a notable lack of saving promotion for women through various media, despite banks' general efforts to boost savings. While banks discussed women's credit policies, women's participation in decision-making and accountability for financial inclusion plans were major issues. The study also found that despite a well-organized female workforce, there was a shortage of influential female leadership, knowledgeable staff for complex tasks, and sufficient training to bridge skill gaps. Additionally, while relevant digital financial service information was provided, it often lacked timeliness, completeness, and user-friendliness. Customer relations were also found to be deficient, with a failure to properly address customer feedback, arrange meetings, and recognize or award female customers. Ultimately, the study concluded that initiatives focused on increasing savings, improving access to credit, boosting female labor force participation, and enhancing digital financial services have a significant positive impact on women's financial inclusion and economic empowerment.*

***Keywords:*** *Increasing Saving, Access to Credit, Women's Women Labor Force Participation, Digital financial Service, Women's Economic Empowerment Programs, Women's Financial Inclusion.*

## Introduction

Ethiopia's National Financial Inclusion Strategy II (2021-2025) aims to enhance women's access to financial services and leadership opportunities in the sector, reflecting a commitment to addressing gender inequality amid the country's rapid economic growth. Despite significant progress in poverty reduction, women face challenges such as limited credit access, lower bank account ownership, and underrepresentation in financial leadership, hindering their economic empowerment and participation in national development. Corporate governance plays a vital role by promoting transparency and accountability, which can enhance women's inclusion in the financial system, ultimately contributing to social and economic equality.

This paper investigates the impact of corporate governance on women's financial inclusion and economic empowerment within Ethiopian private banks. It examines how factors like board composition, risk management practices, and transparency influence women's access to financial services, representation in the workforce, and overall economic well-being. The study aims to enrich

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the literature on gender and finance by offering empirical insights specific to the context of Ethiopian private banks.

### Statement of the Problem

Globally, gender inequality persists, hindering development, particularly in Global South countries where women lack economic control and face higher poverty rates [26] In Ethiopia, women are underrepresented in financial services and leadership despite progress in financial inclusion, with systemic barriers limiting their participation (NBE, 2025). Studies show that only 35% of adults in Ethiopia have formal bank accounts, with only 29% being women.

Research gaps exist regarding the relationship between financial inclusion and women's economic empowerment, especially in developing countries like Ethiopia [31]. Existing studies often lack comprehensive coverage and rely on methodologies that raise concerns about generalizability. Country-specific studies are needed to address contextual factors affecting women's financial empowerment, as the impact of financial tools may vary across different settings [23].

Ethiopian women face obstacles in education, employment, and property ownership, reflected in Ethiopia's gender gap index score [20, 27]. Prior research on financial inclusion has mainly focused on the non-financial sector with inconclusive results, necessitating more research within the banking sector. The banking sector's unique characteristics require further exploration of corporate governance's role in women's financial inclusion.

This study aims to address the knowledge gap concerning the impact of corporate governance on women's financial inclusion and economic empowerment in Ethiopian private commercial banks. Prior studies on corporate governance in Ethiopian microfinance institutions have yielded contradictory findings [5, 28]. This research seeks to contribute to the literature by examining the interplay between corporate governance and women's financial inclusion in the Ethiopian banking sector, where limited research exists. Therefore, this study tries to fill knowledge and time gaps about the Impact of Corporate Governance on Women's Financial Inclusion and Economic Empowerment in Selected Private Commercial Banks of Ethiopia, with the following devised specific objectives:

1. To examine the impact of Increasing saving mechanisms on women’s financial Inclusion
2. To analyze the impact of Access to credit affects Women’s financial inclusion in private commercial banks of Ethiopia
3. To determine the impact of Women Labour force participation policies on Women’s financial inclusion
4. To analyze the impact of Access to Digital Banking Service Affects Women’s financial inclusion in private commercial banks of Ethiopia
5. To examine the impact of impact of Women’s economic empowerment on attaining a complete women’s financial inclusion

## Literature Review

### Theoretical Literature Review

Corporate governance is a system of rules, practices, and processes by which a company is directed and controlled, balancing the interests of stakeholders such as shareholders, employees, suppliers, customers, and the community [9, 12]. It defines power structures, accountability, and decision-making processes, enabling management and the board to address challenges effectively Good corporate governance promotes transparency, accountability, and fairness, protecting shareholder interests and fostering ethical business practices, which in turn attracts investors and increases company value.

Different scholars have defined corporate

governance, with [6] viewing it as a mechanism to protect outside investors from expropriation by insiders, while [32] focus on assuring returns on investment for financiers. [14] emphasizes balancing economic and social goals, aligning the interests of individuals, corporations, and society. [13] defines it as a set of relationships between a company's board, shareholders, and stakeholders, providing a structure for setting objectives and monitoring performance.

Corporate governance structures are categorized as internal and external. Internal structures include the board of directors, management motivation policies, and stakeholder relationships, while external structures encompass the regulatory system, market control, and protection of minority ownership interests. Internal corporate governance includes a company's code of conduct, setting ethical standards for employees. External corporate governance involves communication with customers, the government, and the community, enhancing the company's image and reputation.

Internal corporate governance ensures ethical conduct and reflects the company's credibility, fostering trust among investors. External corporate governance boosts a company's image through reputation, credibility, and positive public perception. Effective corporate governance requires both internal and external mechanisms to ensure accountability, transparency, and alignment with stakeholder interests.

Implementing good governance practices incurs costs, such as hiring specialized staff and external consultants, which can be more manageable for larger companies; however, strong corporate governance benefits all organizations regardless of size, emphasizing the need for tailored approaches rather than a one-size-fits-all strategy.

Good corporate governance is crucial for economic growth, promoting efficient resource use and attracting both domestic and foreign investment by enhancing company transparency, accountability, and adherence to shareholder rights [13]. It positively impacts firm valuation and access to financing, leading to increased investments, job creation, and overall economic development [16]. The effectiveness of corporate governance can be measured by analyzing variables such as board size, independence, and CEO duality, while factors such as transparency, stakeholder engagement, and regulatory quality significantly influence governance outcomes [1, 17].

The corporate governance framework ensures effective management control, board accountability, and shareholder protection, with the OECD Principles serving as a global reference point for best practices (OECD). These principles are built on four core values: fairness, responsibility, transparency, and accountability, which aim to protect shareholder rights, recognize stakeholder interests, ensure accurate disclosures, and provide strategic guidance (OECD). Corporate governance is distinct from corporate management, focusing on legal compliance and stakeholder benefits, while management emphasizes business growth and operational tools. Despite their differences, both governance and management intersect in corporate strategy, which incorporates essential governance considerations.

In a corporation, the board of directors selects and oversees the CEO, the management team implements company strategy and financial reporting, while shareholders provide funding and elect board representatives without engaging in daily management.

## Financial Inclusion Definition

Financial inclusion is a critical indicator of societal development, emphasizing the need for affordable financial services for all, particularly women, to achieve gender equality and sustainable development goals (G-20 Nations). The current research explores the impact of financial inclusion on women's empowerment

dimensions social, political, and economic using various financial schemes in India [3].

## Financial Inclusion Mechanism

Financial inclusion strategies aim to provide accessible banking services, especially for underserved populations, through initiatives like digital financial inclusion, services for women, and Sharia-compliant products [21]. These mechanisms focus on ensuring that low-income individuals can access necessary financial services to secure their financial futures.

## The Function of Financial Inclusion

Financial inclusion aims to provide affordable financial services to disadvantaged groups, enhancing economic growth and reducing poverty levels [33]. It supports entrepreneurship, job creation, and overall economic empowerment, particularly for women, by ensuring access to credit, savings, and investment opportunities [15].

## Women's Financial Inclusion Program

Despite progress in financial inclusion, a gender gap persists, necessitating targeted recommendations for G20 countries to support women's financial services and business development [18]. Social norms need to be addressed to enhance women's access to financial resources, as they significantly impact their economic empowerment [22].

## Corporate Governance and Women's Financial Inclusion

Corporate governance plays a crucial role in enhancing women's financial inclusion and economic empowerment, with organizations like the Bill and Melinda Gates Foundation advocating for improved access to financial services for women [11]. Effective corporate governance can significantly influence women's participation in financial systems, contributing to equitable economic growth [16].

## Determinants of Financial Inclusion and Corporate Governance

Social, banking, and political factors are significant determinants of financial inclusion, with governance oversight critical for identifying and mitigating risks [10]. Empowering women through enhanced access to financial services can lead to improved household incomes and living standards, fostering economic development [2].

## Empirical Literature Review

Various author has so far conducted the rigorous of studies on the areas of financial inclusion, through associating corporate governance and firm performances, and the following are some of the study results;

1. **Impact of Corporate Governance on Firm Performance**: Empirical studies indicate that strong corporate governance practices significantly enhance economic value, firm value, and productivity while reducing the risk of financial failure, as shown in research by [32] and [58].
2. **Barriers Faced by Women Entrepreneurs**: Women in sub-Saharan Africa encounter multiple challenges, including socio-cultural and economic barriers, which hinder their entrepreneurial activities [4]. Studies by [10] highlight that gender discrimination exacerbates difficulties in accessing funds for women entrepreneurs in India.
3. **Financial Barriers to Women's Microenterprises**: [24] identifies financial and management-related barriers as significant obstacles for women starting microenterprises, while [10] point to work-life conflict and poor networking as key challenges faced by female entrepreneurs.
4. **Financial Inclusion in Ethiopia**: Limited research has explored financial inclusion in Ethiopia, with [7] revealing that Kenya has higher financial inclusion levels than

Ethiopia, attributed to differences in policies and economic conditions. [20] emphasizes the influence of education, wealth, and gender on financial inclusion in Ethiopia.

5. **Corporate Governance and Women's Financial Inclusion**: There is a notable gap in research specifically examining the impact of corporate governance on women's financial inclusion in Ethiopia. This study aims to address this gap by analyzing the determinants and barriers to financial inclusion among women, building on insights from [31].
6. **Call for Professional Practice in Corporate Governance**: The literature underscores the need for organized and professional corporate governance practices to improve prospects for economic growth and support women's empowerment through enhanced financial inclusion [19].

## Conceptual Framework

The conceptual framework of the study posits that Corporate Governance serves as an independent variable influencing Financial Inclusion, which in turn impacts Women's Economic Empowerment, with key elements such as increased savings, access to credit, and women's labor force participation acting as influential factors.

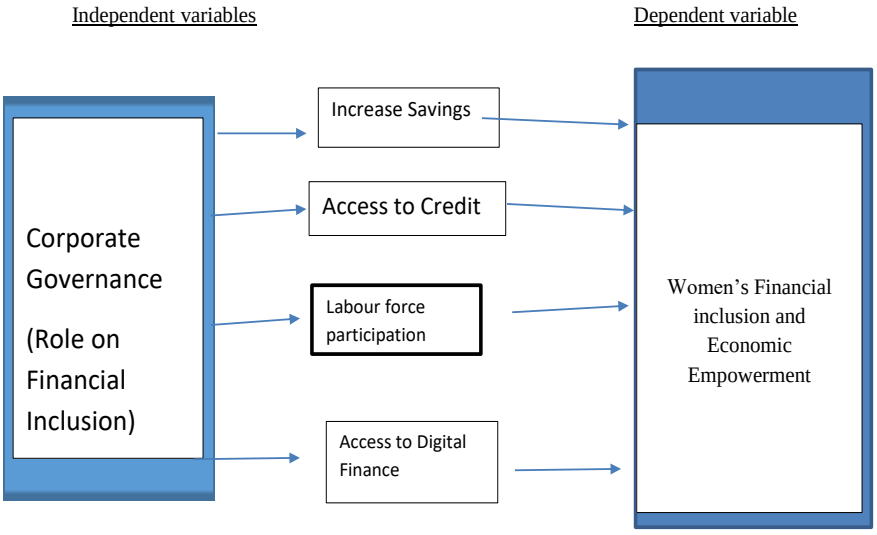


**Figure 1.** Conceptual Framework

**Finally based on the theoretical and empirical literature review and the knowledge gap identified, the study has the following research hypothesis:**

**H1**: Increase Savings has a significant and positive impact on women's financial inclusion

**H2**: Access to credit has significant and positive impact on women's financial inclusion

**H3:** Women Labour force participation has a significant and positive impact on women's financial inclusion

**H4:** Access to Digital Finance has a significant and positive impact on women's financial inclusion.

## Research Design and Methodology

This study examines the impact of corporate governance on women's financial inclusion and economic empowerment in Ethiopian private banks using a mixed-methods approach. By integrating qualitative and quantitative research, the study will gather comprehensive data through interviews and questionnaires to assess respondents' attitudes. Employing both descriptive and explanatory designs, the research will explore corporate governance practices such as savings, credit access, and women's labor participation. This dual approach enhances the robustness of findings by combining qualitative and quantitative data.

The research will utilize both primary data, collected through surveys of board members and management teams, and secondary data from existing sources. This will ensure the integrity and relevance of the information used in the study. Self-administered questionnaires with a five-point Likert scale will be employed for data collection, facilitating efficient and reflective responses from participants across a wider geographical area.

A census sampling method will be utilized, targeting 100 corporate governance members (20 Board of Directors, and 80 Management Teams) from Ethiopian private banks in Addis Ababa, ensuring comprehensive representation of the study population. Validity will be assessed through content and criterion measures, while reliability will be evaluated using Cronbach's alpha, aiming for a score of 0.70 or higher to ensure internal consistency.

Quantitative data will be analyzed using SPSS software, utilizing descriptive and inferential statistics, including multiple linear regression. Qualitative data will be thematically analyzed and cross-checked with quantitative findings.

## Data Analysis, Presentation and Results

In this chapter, the results of the study are detailed, beginning with a summary of the respondents followed by descriptive statistics, correlation, and regression analysis. Out of 100 distributed questionnaires to employees of Ethiopian Private Commercial Bank, 95% were returned and deemed valid for analysis.

**Table 1.** Demographic Characteristics of the Respondents

| **Items** | **Description** | **Frequency** | **Percentage** |
|---|---|---|---|
| Gender | Male | 56 | 58.9 |
| | Female | 39 | 41.1 |
| | Total | 100 | 100.0 |
| Age of the respondents | Less than equal 30 year | 27 | 28.4 |
| | 31 to 40 years | 22 | 23.2 |
| | 41 to 50 years | 42 | 44.2 |
| | Above 50 years | 4 | 4.2 |
| | Total | 95 | 100.0 |
| Educational status of the respondents | Diploma | 13 | 13.7 |
| | Degree | 38 | 40.0 |
| | Masters | 36 | 37.9 |
| | Other | 8 | 8.4 |
| | Total | 95 | 100.0 |
| Nationalities | Ethiopian | 69 | 72.6 |
| | Dual citizen | 26 | 27.4 |
| | Total | 95 | 100.0 |
| Experience | 1 to 3 years | 12 | 12.6 |
| | 4 to 6 years | 9 | 9.5 |
| | 7 to 10 years | 52 | 54.7 |
| | Above 10 years | 22 | 23.2 |
| | Total | 95 | 100.0 |

***Source:*** *Survey (2025)*

The demographic analysis of 100 valid respondents revealed that 58.9% were male, the majority (44.2%) were aged 41-50, and most held college degrees (40%), indicating a well-educated and experienced workforce predominantly comprised of Ethiopian nationals (72.6%), suggesting strong engagement and opportunities for local professionals in the banking sector.

## Reliability Statistics of the Variables

Reliability, defined as the consistency of a construct measure [8] was assessed using Cronbach's alpha for the study's variables, with scores above 0.70 indicating adequate reliability, while those between 0.6 and 0.7 were considered fair [34]. Thus, the following reliability statistics results has been drawn.

**Table 2.** Reliability Test Results

| Variables | Number of Items | Cronbach's Alpha |
|---|---|---|
| Increasing Saving | 4 | 0.833 |
| Access to Credit | 4 | 0.828 |
| Women Labour force participation | 4 | 0.835 |
| Digital Finance | 7 | 0.713 |
| Women's Economic empowerment programs | 8 | 0.880 |
| Women's Financial inclusion | 11 | 0.871 |

***Source:*** *Survey Data (2025)*

As shown the reliability result indicated above, the internal consistency of the data was acceptable Ethiopian Private Commercial Banks use the alpha coefficient was greater than 0.7.

## Descriptive Statistics Analysis

The study aims to examine the impact of corporate governance on women's financial inclusion and economic empowerment in selected Ethiopian private banks. An itemized rating scale was utilized to measure respondents' perceptions, with score ranges indicating levels of agreement: 1.00 - 1.80 (strong disagreement), 1.81 - 2.60 (disagreement), 2.61 - 3.40 (neutrality), 3.41 - 4.20 (agreement), and 4.21 - 5.00 (strong agreement).

### The Impact of Increasing Saving on women's financial inclusion in the case of Ethiopian Private commercial banks in Addis Ababa

Increasing Saving as its the tools for corporate governance practice which help to impact implemented women's financial inclusion in the Banks. Based on this, the responses of the respondents are indicated in the following table.

**Table 3.** Respondents Response towards Increasing Saving

| S/No | Statements | N | Mean | Std. Dev |
|---|---|---|---|---|
| 1 | The Banks uses adequate communication through radio, to avail information and establish ongoing communication with its new female customer to increase savings | 95 | 2.56 | 1.35 |
| 2 | The Banks uses adequate campaigns, out reaches, rewards to avail banking information and create appeal for its new female customer | 95 | 2.57 | 1.35 |

| | | | | |
|---|---|---|---|---|
| 3 | The Banks uses strategic approach to serve the unbanked women's in the society to save money through bank | 95 | 2.51 | 1.30 |
| 4 | The Banks works to create a common understanding with the public about increasing savings for women's financial inclusion | 95 | 4.03 | 0.61 |

***Source:*** *Survey Result (2025)*

The Table presents the responses regarding the effectiveness of communication strategies employed by Ethiopian private banks to enhance women's financial inclusion through increased savings. The mean scores of the respondents ranged from 2.51 to 4.03, indicating varying levels of satisfaction with the banks' outreach efforts. Specifically, the scores of 2.56 and 2.57 reflect a notable inadequacy in utilizing media channels like radio and TV to inform female customers about savings opportunities. Furthermore, a mean score of 2.51 suggests that the banks have not effectively implemented strategic approaches to engage unbanked women, hindering their ability to save.

Despite these shortcomings, the banks scored significantly higher on the statement regarding their efforts to create a common understanding about increasing savings among the public, with a mean score of 4.03. This indicates that while there are gaps in communication strategies, the banks are making strides in fostering awareness and understanding of women's financial inclusion. Interviews with corporate governance board directors underscored the critical role of effective communication in building trust and credibility with stakeholders, emphasizing that management teams must actively engage with female customers, employees, and the wider community.

The board directors highlighted that maintaining strong relationships with stakeholders, including journalists, is essential for increasing visibility and public awareness of tailored savings products for women. They noted that effective communication strategies, including newsletters and team meetings, contribute to employee engagement and alignment with the banks' goals. By leveraging these channels, management teams can disseminate information about new products, recognize achievements, and ultimately foster a culture of inclusion that supports women's financial empowerment.

## The Impact of Access to credit on women's financial inclusion in the case of Ethiopian Private commercial banks in Addis Ababa

Access to credit and financial resources is crucial for women, as it enables them to secure loans and investment capital, thereby enhancing their financial resources, entrepreneurial capabilities, and economic independence. Based on this, the responses of the respondents are indicated in the following table.

**Table 4.** Respondent's Response towards Access to Credit

| S/No | Statements | N | Mean | Std. Dev |
|---|---|---|---|---|
| 1 | The Banks discusses on credit policies and strategic plan with top Management Team s. | 95 | 4.17 | 0.49 |
| 2 | The Banks participates applicable credit packages for women in business | 95 | 2.38 | 1.31 |

| | | | | |
|---|---|---|---|---|
| 3 | The Management Team in the Banks takes responsibility for the success or the failure of credit products for women | 95 | 2.51 | 1.29 |
| 4 | The top Management Team in the Banks follows the implementation of credit access to potential women applicant's | 95 | 2.46 | 1.28 |

***Source:*** *Survey Result (2025)*

The analysis of responses regarding access to credit in Ethiopian private banks reveals a generally positive sentiment towards the involvement of the top management team in discussions on credit policies, with an average rating of 4.17. However, lower scores of 2.38 and 2.51 for the management's participation in decision-making and responsibility for credit product outcomes suggest significant shortcomings in their engagement and accountability. Additionally, a score of 2.46 indicates that the management team has not effectively followed through on implementing credit access for potential women applicants.

Interviews with board directors further emphasized the crucial role of a well-defined credit policy and strategic plan in achieving financial inclusion goals. They highlighted that corporate governance must actively shape the bank's approach to meet the needs of its stakeholders, particularly in designing credit packages that support women's financial empowerment. The findings underscore the need for improved resource allocation, employee empowerment, and monitoring to facilitate the successful execution of credit initiatives aimed at enhancing women's economic independence.

**The Impact of Women Labor force participation on women's financial inclusion in the case of Ethiopian Private commercial banks in Addis Ababa**

Women Labor force participation is played a vital role in order to run impact women's financial inclusion programs. For this case, labor participation delivers prompt result for the customers in particular and bring a positive image of the Banks in general. Therefore, the response of the respondents briefly indicated as follows. Based on this, the responses of the respondents are indicated in the following table.

**Table 5.** Respondent's Response towards Women Labor Force Participation of Corporate Governance Practice

| S/No | Statements | N | Mean | Std. Dev |
|---|---|---|---|---|
| 1 | Your Bank has well organized Women Labor force participation policy | 95 | 4.03 | .61 |
| 2 | Your Bank has well recognized and influential trained women staffs | 95 | 2.51 | 1.30 |
| 3 | Women Labor force participation activity of the Banks considers highly knowledgeable women's in bank | 95 | 2.57 | 1.35 |
| 4 | Women Labor force participation policy of the Banks provide capacity building training to fill the skill gap of women employees | 95 | 2.51 | 1.29 |

***Source:*** *Survey Result (2025)*

The analysis of responses regarding women's labor force participation in banks indicates a strong recognition of the banks' policies, with a mean score of 4.03 reflecting well-organized governance in this area. Board directors confirmed that human resources are

actively engaged in attracting and selecting qualified female candidates, as well as providing training programs aimed at enhancing the skills and communication abilities of female bank professionals. This commitment is crucial for fostering a positive image of the banks and supporting effective financial inclusion initiatives.

However, the responses also reveal significant shortcomings in the recognition and training of female staff. With a mean score of 2.51 for both the acknowledgment of trained women staff and the banks' capacity-building efforts, it is evident that there is a lack of influential and well-trained female manpower within the banks. Additionally, low scores for the consideration of knowledgeable women in banking activities and the delivery of capacity-building training highlight gaps in addressing skill deficiencies among female employees. These findings suggest a need for improved training and support mechanisms to empower women and enhance their contributions to the banking sector.

**The Impact of Digital Service on women's financial inclusion in the case of Ethiopian Private commercial banks in Addis Ababa**

Digital financial services can help bridge the gender gap in account ownership and access to credit by decreasing the cost of access to financial services. Digital Financial Services (DFS) are financial services that rely on digital technologies for their delivery and utilization by consumers. These services leverage digital platforms, such as mobile devices and the internet, to provide convenient, accessible, and secure financial solutions. Digital Financial Services (DFS) include a broad range of financial services accessed and delivered through digital channels, including payments, credit, savings, remittances and insurance. Based on this, the responses of the respondents are indicated in the following table.

**Table 6.** Respondents' Response towards the Impact of Digital Service on women's Financial Inclusion in the case of Ethiopian Private Commercial Banks in Addis Ababa

| S/No | Statements | N | Mean | Std. Dev |
|---|---|---|---|---|
| 1 | Provides Digital financial service information in a timely fashion to people like me. | 95 | 2.43 | 1.29 |
| 2 | Provides Digital financial service that is relevant to Ethiopian women. | 95 | 4.17 | .58 |
| 3 | Provides Digital financial service that can be compared to other banking services. | 95 | 3.76 | .99 |
| 4 | Provides Digital financial service awareness that is completely applicable by women's. | 95 | 2.34 | 1.22 |
| 5 | Provides Digital financial service that is easy for any women . | 95 | 2.23 | 1.14 |
| 6 | Provides accurate Digital financial service features to women. | 95 | 2.15 | 1.33 |
| 7 | Provides Digital financial service that is reliable. | 95 | 3.93 | 1.02 |

***Source**: Survey Result (2025)*

The responses regarding the practice of digital financial services in banks reveal a mixed picture. While a mean score of 4.17 indicates that the services provided are relevant and comparable to other banking services, a lower score of 2.43 suggests that timely information access for female customers is lacking. This indicates that corporate governance has not effectively ensured that digital financial services are readily accessible for women. Furthermore, scores of 2.34 and 2.23 highlight deficiencies in providing comprehensive and easily understandable digital financial service information, underscoring a gap in communication and outreach efforts.

On a positive note, the board directors emphasize the importance of digital financial services as a key component of women's financial inclusion. By utilizing data to monitor customer perceptions and preferences, banks can adapt their strategies to better meet the evolving needs of female clients. The establishment of key performance indicators (KPIs) enables banks to track the effectiveness of their digital services, while ongoing analysis of customer feedback allows for targeted improvements. Despite the challenges in information dissemination, a mean score of 3.93 reflects that banks are perceived as reliable in providing digital financial services, contributing to a positive image among female customers.

**The Impact of Women's economic empowerment programs on women's financial inclusion in the case of Ethiopian Private commercial banks in Addis Ababa**

Women's economic empowerment refers to women's ability to participate in markets, control productive resources and access decent work as well as their autonomy over their time, bodies and lives. It involves equipping women with the skills, knowledge, and opportunities needed to improve their economic well-being. This empowerment can take various forms, including income generation, entrepreneurship, and employment opportunities.

**Table 7.** Respondents' Response Towards Women's Economic Empowerment Programs on women's Financial inclusion

| S/No | Statements | N | Mean | Std. Dev |
|---|---|---|---|---|
| 1 | The Banks has good Women's economic empowerment programs | 95 | 2.48 | 1.32 |
| 2 | The Banks recognizing and awarding women customers to reinforce their economic empowerment | 95 | 2.59 | 1.38 |
| 3 | The Bank has good efforts in initiating and arranging conferences, meetings and get together with its customers to promote better Women's economic empowerment programs | 95 | 2.58 | 1.37 |
| 4 | The Banks has good effort in requesting suggestion from its female customers as an input for strategic plans on Women's economic empowerment programs | 96 | 4.17 | .72 |
| 5 | the role the Banks board/Management Team in playing to help the bank to retain its female existing customer and unbanked women | 95 | 4.15 | .65 |

| | | | | |
|---|---|---|---|---|
| 6 | The Banks has a good effort to implement Women's economic empowerment programs in impact way in order to accomplish its objectives | 95 | 2.60 | 1.36 |
| 7 | The Banks prompt in addressing customer comments, suggestion and complaints and making Women's economic empowerment programs impact | 95 | 2.57 | 1.39 |
| 8 | The Banks compatibility of the Women's economic empowerment activities with public interest | 95 | 4.00 | .79 |

***Source:*** *Survey Result (2025)*

The responses regarding women's economic empowerment programs in Ethiopian private banks reveal significant areas for improvement. The first statement, which asked respondents to evaluate the effectiveness of the banks' empowerment programs, received a mean score of 2.48 with a standard deviation of 1.32. This indicates a lack of strong customer relationships, particularly in providing timely and relevant information. In contrast, insights from the Corporate Governance department highlighted that new MSME and startup programs are crucial initiatives aimed at enhancing women's economic empowerment.

Further analysis showed that the banks' efforts to recognize and reward women customers received a mean score of 2.59 (SD = 1.38), suggesting insufficient recognition to foster customer loyalty. Additionally, while the banks have made efforts to organize conferences and meetings to promote empowerment programs (mean score of 2.58, SD = 1.37), there remains a gap in effectively engaging with customers.

On a positive note, the banks demonstrated a strong commitment to customer input, with mean scores of 4.17 and 4.15 for their efforts in soliciting suggestions and the perceived effectiveness of corporate governance in retaining female customers. These high scores reflect that customers feel valued, and that their feedback is actively considered in strategic planning.

The role of corporate governance and management teams is also recognized as vital for customer retention, with a consistent positive perception among respondents (SD = 0.65). Effective management of communication and customer relationships contributes to overall satisfaction and loyalty, essential for long-term success.

However, there are notable challenges. The banks scored 2.60 (SD = 1.36) in their implementation of impactful economic empowerment programs, indicating a need for improvement. Similarly, a score of 2.57 (SD = 1.39) regarding their responsiveness to customer comments and suggestions highlights the need for quicker action to enhance program effectiveness.

Finally, the banks' activities align well with public interest, as indicated by a mean score of 4.00 (SD = 0.79). This reflects a commitment to conducting operations responsibly and ethically, contributing positively to the community, especially regarding women's empowerment.

## The Corporate Governance representative emphasized that

*"The Board of Directors plays a vital role in fostering a shared understanding with the public and internal stakeholders regarding women's economic empowerment and financial inclusion programs, highlighting that these initiatives not only impact the bank directly but also contribute to broader societal goals;*

*aligning the bank's objectives with community financial needs is essential for achieving meaningful progress and improvements in both the banking sector and the overall industry".*

**Response of respondents towards women's Financial Inclusion in the case of Ethiopian Private commercial banks in Addis Ababa**

Financial inclusion provides women the tools for accumulating assets, generating income, managing financial risks, and fully participating in the economy. Women's Financial inclusion can boost women's economic empowerment by providing services such as loans, savings and insurance that build economic agency and resilience. *Based on this, the responses of the respondents are indicated in the following table.*

**Table 8.** Women's Financial Inclusion in Ethiopian Private Commercial Banks

| S/No | Statements | N | Mean | Std. Dev |
|---|---|---|---|---|
| 1 | Collecting women's Financial Inclusion information such as economy of the country , inclusion policy, financial institutions environment and so on | 95 | 4.07 | .93 |
| 2 | Realizing women's Financial Inclusion programs to the outside to gain the public's understanding and support | 95 | 2.58 | 1.38 |
| 3 | Strengthening the belongings awareness of the staff to sufficiently mobilize women's Financial Inclusion program and creativity to create a harmonious environment for women's Financial Inclusion program planning and implementation | 95 | 2.56 | 1.36 |
| 4 | Getting women's Financial Inclusion program information through means of inquiring, observing and questionnaire etc in research. | 95 | 4.16 | .72 |
| 5 | Using activities such as a new women-tailored products, demonstration meeting , learning communication , speech and exhibition | 95 | 4.13 | .62 |
| 6 | Remedying the advertisements short coming of lack of deepness in women's Financial Inclusion program propagation | 95 | 2.58 | 1.36 |
| 7 | Through propagating women's tailored service and investment of the bank for the social commonwealth activities to set up a good image of the bank caring and returning to the society | 95 | 4.02 | .74 |
| 8 | Cultivating female customers and establishing customer relationship Management Team . | 95 | 2.55 | 1.38 |
| 9 | Influencing the media about women's Financial Inclusion opinions so as to influence the public opinions about women's financial inclusion. | 95 | 2.38 | 1.39 |

***Source:*** *Survey Result (2025)*

The analysis of respondents' opinions regarding women's financial inclusion in banks reveals several key insights. The banks successfully collected relevant information

about the economy and inclusion policies, as indicated by a mean score of 4.07. However, there is a significant gap in effectively communicating women's financial inclusion programs to the public, reflected in a lower score of 2.58.

Furthermore, the banks appear to lack staff awareness and mobilization in promoting these programs, with a mean score of 2.56. In contrast, they have effectively gathered information through various research methods (mean score 4.16) and engaged in activities such as product demonstrations and exhibitions (mean score 4.13).

Despite these efforts, there are shortcomings in advertising strategies, as indicated by a score of 2.58, suggesting inadequate depth in promoting women's financial inclusion. Conversely, a mean score of 4.02 demonstrates that the banks are perceived positively for their tailored services and community investment.

Finally, low scores of 2.38 and 2.52 for cultivating customer relationships and influencing media perceptions indicate a need for more proactive efforts by senior management to educate and engage customers about women's financial inclusion. Overall, while there are strengths in data collection and community engagement, significant improvements are needed in communication and relationship-building efforts.

## Inferential Statistics Data Analysis

### Correlation Analysis

Correlation coefficient statistics measure the degree to which two sets of numbers are related. In this section, the researcher tried to accomplish the goal of the study through applying Pearson's correlation (r) as it is the most widely used method of measuring the degree of relationship between two variables. The relationship between two variables will be: a correlation of .10 is described as a small impact size, a correlation of .30 is described as a medium impact size and a correlation .50 is described as a large impact size.

The correlation coefficient (r) ranging from 0.10 to 0.29 may regarded as indicating a low degree of correlation, r ranging from 0.30 to 0.49 may considered as a moderate degree of correlation, and r ranging from 0.50 to 1.00 may be regarded as a high degree of correlation Cohen, (1988). The table herewith summarizes the correlational results with analysis.

**Table 9.** Correlational Results and Analysis

| | | **Women's Financial Inclusion** | **Increasing Saving** | **Access to credit** | **labour force participation of women** | **Digital Finance** | **Women Economic Programs** |
|---|---|---|---|---|---|---|---|
| Women's Financial Inclusion | Pearson Correlation | 1 | .886** | .831** | .727** | .723** | .932** |
| | Sig. (2-tailed) | | .000 | .000 | .000 | .000 | .000 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 |
| Increasing Saving | Pearson Correlation | .886** | 1 | .792** | .596** | .642** | .879** |
| | Sig. (2-tailed) | .000 | | .000 | .000 | .000 | .000 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 |
| Access to credit | Pearson Correlation | .831** | .792** | 1 | .578** | .581** | .815** |
| | Sig. (2-tailed) | .000 | .000 | | .000 | .000 | .000 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| labour force participation of women | Pearson Correlation | .727** | .596** | .578** | 1 | .562** | .593** |
| | Sig. (2-tailed) | .000 | .000 | .000 | | .000 | .000 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 |
| Digital Finance | Pearson Correlation | .723** | .642** | .581** | .562** | 1 | .667** |
| | Sig. (2-tailed) | .000 | .000 | .000 | .000 | | .000 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 |
| Women economic empowerment Programs | Pearson Correlation | .932** | .879** | .815** | .593** | .667** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | .000 | .000 | |
| | N | 95 | 95 | 95 | 95 | 95 | 96 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | | | | |

***Source:*** *Survey Result (2025)*

The relationship between various corporate governance practices and women's financial inclusion was examined, revealing strong positive correlations across several key independent variables. Notably, Increasing Savings exhibited a high correlation (r = .886) with women's financial inclusion, indicating that effective communication between management and female customers significantly enhances the implementation of financial inclusion programs. Conversely, ineffective communication can hinder these efforts. Similarly, Access to Credit demonstrated a strong positive correlation (r = .831), suggesting that consistent credit programs for women, facilitated by the board and management, lead to impactful financial inclusion outcomes. Lack of such access could result in ineffective implementation.

Additionally, other factors such as labor force participation of women (r = .727) and Digital Services (r = .723) also showed positive correlations with women's financial inclusion. This implies that well-trained female employees and effective dissemination of digital financial service information are essential for achieving financial inclusion goals. Moreover, Women's Economic Empowerment Programs had the highest correlation (r = .932) with women's financial inclusion, indicating that an increase in these programs directly contributes to successful financial inclusion initiatives. Overall, the findings underscore the importance of corporate governance practices in fostering women's financial inclusion within banks.

**Regression Analysis Assumption Test**

Before applying regression analysis, the researcher tests its assumptions like Linearity, Multicollinearity assumption, Homoscedicity Test, Normality and Autocorrelation.

Linearity test ： in order to determine normality graphically, one can use the output of a normal P-P Plot. If the data are normally distributed, the data points will be close to the diagonal line. If the data points stray from the line in an obvious non-linear fashion, the data are not normally distributed. As shown in the figure below the normal P-P plot below, the data is normally distributed.

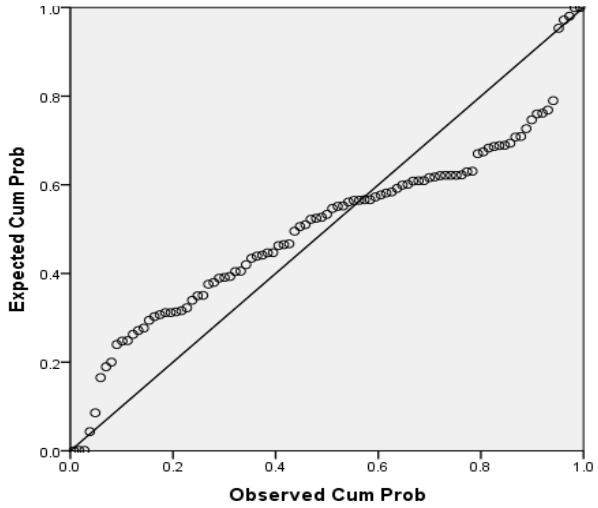


**Figure 2:** Normal-P Plot of Regression Standardized Residual Dependent Variables-Women's Financial Inclusion

**Normality Test**

Multiple linear regressions require that the independent variables in the analysis be normally distributed. The skewness and Kurtosis statistics for variables shows this normality distribution.

**Table 10.** Skewness and Kurtosis Statistics

| | N | Mean | Std. Deviation | Skewness | | Kurtosis | |
|---|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| Increasing Saving | 95 | 3.3737 | .75166 | .328 | .247 | -.913 | .490 |
| Access to credit | 95 | 2.8184 | .95472 | .313 | .247 | -1.372 | .490 |
| labour force participation of women | 95 | 2.9605 | .72779 | .646 | .247 | .228 | .490 |
| Digital Finance | 95 | 3.0000 | .67103 | .705 | .247 | -.840 | .490 |
| Women economic empowerment programs | 96 | 3.1602 | .87673 | .304 | .246 | -1.186 | .488 |
| Women's Financial inclusion | 95 | 3.1933 | .75680 | .462 | .247 | -.940 | .490 |
| Valid N (listwise) | 95 | | | | | | |

The result of the normal distribution for independent variables, skewness and Kurtosis shows that the variables are within the acceptable range for normality (-1.0 to +1.0).

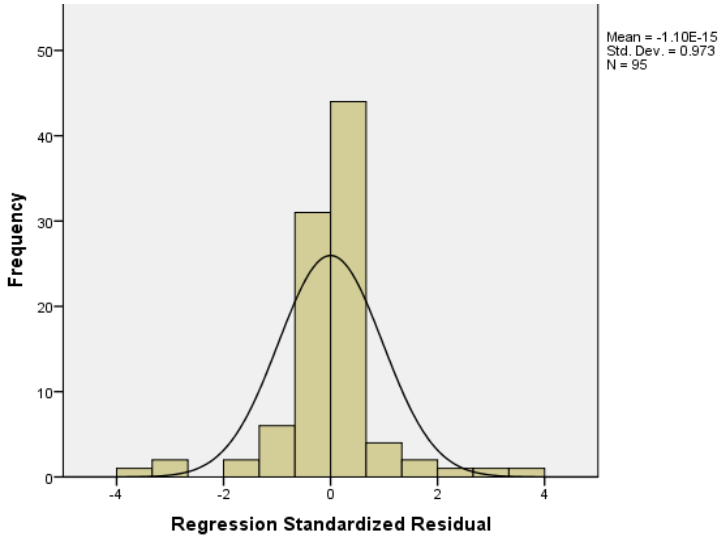


**Figure 3.** Histogram: Dependent Variables-Women's Financial Inclusion:

The above graph shows the data was normally distributed. This implies the data wasn't skewed to the right or left. It was just normally distributed in the study.

**Multicollinearity Analysis Test**

The researcher has checked whether multicollinearity problem exist or not before running the regression. Multicollinearity refers to the situation in which the independent/predictor variables are highly correlated. When independent variables are highly correlated, there is "overlap" or sharing of predictive power. Multicollinearity can be checked using the tolerance and variance inflation factors (VIF) which are the two Collinearity diagnostics factors Multi collinearity Test, as the following table witnessing.

**Table 11.** Multicollinearity Test

| | **Collinearity Statistics** | |
|---|---|---|
| Model | Tolerance | VIF |
| Increasing Saving | .204 | 4.913 |
| Access to credit | .302 | 3.307 |
| Women Labour force participation | .569 | 1.756 |
| Digital Finance | .507 | 1.974 |
| Women economic empowerment programs | .178 | 5.612 |

***Source:*** *Survey Result (2025)*

The analysis of multicollinearity among the independent variables related to women's financial inclusion shows that the tolerance values for all variables are greater than 0.1, indicating no multicollinearity issues. Additionally, the Variance Inflation Factor (VIF) for all independent variables is below 10, further confirming the absence of multicollinearity. These results suggest that the independent variables are not excessively correlated with one another, allowing for a reliable interpretation of their individual effects on women's financial inclusion.

**Homoscedasticity Test**

The scatter plot in Figure 4.3 illustrates the relationship between actual and predicted values, with actual values represented on the X-axis and predicted values on the Y-axis. A line indicating perfect prediction is included,

demonstrating where predicted values match actual values. The plot reveals a straight line that suggests an expected linear relationship, while the scattered points around this line indicate the degree of divergence from the ideal model. This visual analysis provides insights into the correlation between the results and the independent variables, highlighting the extent of variation from the expected outcomes.

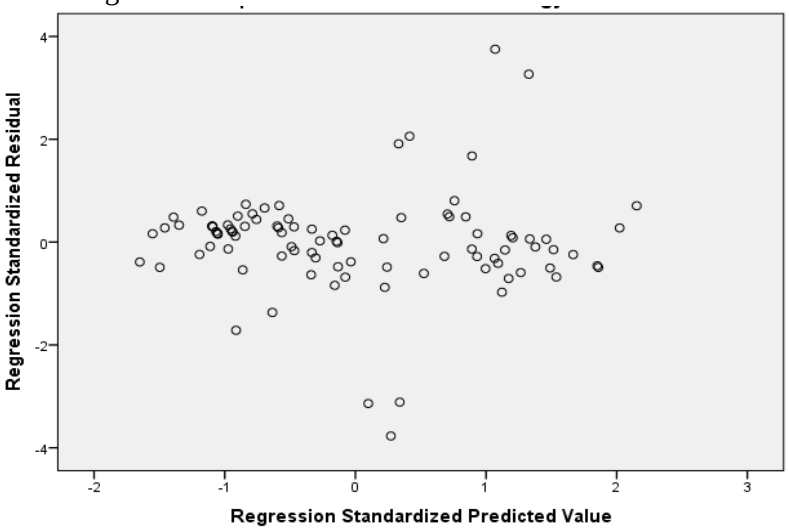


**Figure 4.** Scatter Plot: Dependent Variables-women financial Inclusion

***Source:*** *Survey Result (2025)*

### Autocorrelation Test

Autocorrelation means the relationship between each value of errors in the equation. Or in the other hand, autocorrelation means the self-relationship of errors. In order to determine autocorrelation, Durbin-Watson test was used. As shown the result of Durbin-Watson test in table 4.12 the value is 1.487. In order to know the autocorrelation of independent and dependent variables it is possible to understand the following assumptions.

Note: Durbin-Watson test= 2 No autocorrelation

Durbin-Watson test > 2 Negative autocorrelation

Durbin-Watson test < 2 positive autocorrelation

Therefore, the result of Durbin-Watson test was 1.487. This indicates there is positive auto correlation among the independent and dependent variables Ethiopian Private Commercial Banks use its value is less than 2.

## Interpreter Analysis of Regression Results

Multiple linear regressions are an inferential statistics analysis technique which helps to know which variables is significant impact on Women's Financial inclusion.

**Table 12.** Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 1 | .966[a] | .934 | .930 | .20034 | 1.487 |
| a. Predictors: (Constant), Increasing Saving, Access to credit, Women Labour force participation , Digital Finance ,Women economic empowerment programs | | | | | |
| b. Dependent Variable: Women's Financial inclusion | | | | | |

According to Table 4.12, the independent factors account for 93.4% of the variance in the dependent variable (adjusted R2 is 93% with an estimated standard error of 0.20034). (Women's financial inclusion). This shows that the independent variable in the model accounts for 93.4% of the variance in the dependent variable. It also shows that other variables not included in the model can account for the 6.6% of the variance, indicating the need for additional research to find the other factors that affect women's financial inclusion.

**Table 13.** Analysis of Variance (ANOVA)

| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 50.267 | 5 | 10.053 | 250.490 | .000[b] |
| | Residual | 3.572 | 89 | .040 | | |
| | Total | 53.839 | 94 | | | |
| a. Dependent Variable: Women's Financial inclusion | | | | | | |
| b. Predictors: (Constant), Increasing Saving, Access to credit, Women Labour force participation , Digital Finance ,Women economic empowerment programs | | | | | | |

The table above reflects F-ratio, which explains whether the results of regression model could have occurred by chance, the F value, is 250.490 at 0.000 significant levels which show that the model is good as its value is less than 0.05.

**Table 14.** Coefficients of Determination

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Tolerance | VIF |
| 1 | (Constant) | .009 | .113 | | .080 | .937 | | |
| | Increasing Saving | .168 | .061 | .167 | 2.760 | .007 | .204 | 4.913 |
| | Access to credit | .083 | .039 | .105 | 2.112 | .038 | .302 | 3.307 |
| | labour force participation of women | .217 | .038 | .209 | 5.771 | .000 | .569 | 1.756 |
| | Digital Finance services | .109 | .043 | .097 | 2.516 | .014 | .507 | 1.974 |
| | Women economic empowerment programs | .450 | .057 | .512 | 7.910 | .000 | .178 | 5.612 |
| a. Dependent Variable -Women's Financial inclusion | | | | | | | | |

Table 4.14 presents the causal relationships between independent variables and women's financial inclusion, with the latter serving as the dependent variable. The analysis utilizes unstandardized Beta coefficients to gauge the effectiveness of each independent factor, indicating that larger Beta values correlate with greater significance in influencing women's financial inclusion within Ethiopian Private Commercial Banks. The regression analysis reveals critical insights into how changes in independent variables affect the dependent variable.

The results indicate that Increasing Savings has a significant positive effect on women's financial inclusion, with a significance value of 0.007 and a Beta coefficient of 0.168. This suggests that as savings increase, women's financial inclusion also improves. Similarly, Access to Credit shows a significant relationship with a sig-value of 0.038, implying that improved access to credit for women leads to an increase of 0.083 in financial inclusion. Both findings underscore the importance of these factors in enhancing financial inclusion for women.

Furthermore, the analysis highlights that Women Labor Force Participation has the most significant impact, with a sig-value of 0.000 and an increase of 0.217 in financial inclusion per unit increase in female workforce participation. Digital Finance Services also positively influence financial inclusion, with a Beta coefficient of 0.109, while Women's Economic Empowerment Programs demonstrate the highest Beta value of 0.450, indicating they have the most substantial effect on financial inclusion. Overall, the findings rank the independent variables in terms of their impact on women's financial inclusion, with women's economic empowerment programs leading, followed by women labor force participation, digital services, access to credit, and increasing savings.

## Testing Hypothesis with Results and Discussions

### H1: Increasing Savings and Women's Financial Inclusion:

The study identifies a significant relationship between increasing savings and women's financial inclusion. Managing risk and smoothing consumption are crucial for economic empowerment, yet women in developing regions often have lower savings account ownership and balances [29]. Research highlights the gender gap in savings, particularly in South Asia, prompting a need for accessible savings products tailored to women's lifecycle needs. For instance, specific savings goals for pregnant women or adolescents can enhance financial stability and mitigate income shocks [30]. Overall, the findings affirm that increasing savings positively impacts women's financial inclusion, which is vital for their economic participation [25].

### H2: Access to Credit and Women's Financial Inclusion:

The study confirms that access to credit significantly affects women's financial inclusion. Tailored financial products that consider women's unique needs can broaden client bases and enhance loan portfolios. This aligns with the theory of strategic communication, emphasizing that financial institutions can better serve women by addressing their specific requirements. While progress has been made in increasing credit access for women, gaps remain in deepening financial relationships and ensuring that products support long-term resilience and growth.

### H3: Women's Labor Force Participation and Financial Inclusion:

Women comprise nearly half of Ethiopia's population, and their participation in the labor market is crucial for economic development. The regression results indicate that increased female labor force participation significantly impacts women's financial inclusion. Trained female employees in corporate governance can raise awareness about financial inclusion among customers. Insights from interviews with bank management emphasize the importance of skilled female labor in successfully implementing financial strategies aimed at empowering women.

### H4: Digital Finance and Women's Financial Inclusion:

Research shows that women represent only 22% of digital financial service accounts and 14% of mobile money accounts in Ethiopia, highlighting a significant digital divide . This

gap is more pronounced among rural women who face barriers like limited access to identification and lower financial literacy. Closing these gaps is crucial for improving productivity and resilience, as digital financial services have the potential to enhance women's economic opportunities [11]. However, studies indicate mixed results in the transformative impacts of financial interventions on female-owned enterprises, suggesting the need for more tailored approaches.

**H5: Women's Economic Empowerment Programs and Financial Inclusion:**

The findings support the notion that women's economic empowerment programs significantly enhance financial inclusion. The systems theory underpins this relationship, suggesting that corporate governance can benefit from fostering women's economic capabilities and agency [9]. The analysis highlights the importance of empowerment as a multifaceted process that transcends political, economic, and social dimensions [18]. Given the historical context of gender inequality and the concept of "missing women," the study emphasizes the need for comprehensive empowerment initiatives that engage multiple levels of interaction.

**H6: Implications for Policy and Practice:**

The findings suggest that tailored financial products, increased access to credit, and focused economic empowerment initiatives can significantly enhance women's financial inclusion. Policymakers and financial institutions should prioritize these areas to improve women's economic participation. Strategies should consider the unique challenges women face and aim to create supportive infrastructures that promote financial literacy and accessibility.

Overall, the study underscores the interconnectedness of savings, credit access, labor force participation, digital finance, and empowerment programs in advancing women's financial inclusion. By addressing these factors, Ethiopian Private Commercial Banks can play a pivotal role in enhancing women's economic empowerment and fostering broader economic growth. The insights provided by this research contribute to the ongoing discourse on gender equality and the necessity of inclusive financial systems.

## Summary of Major Findings

The study's primary findings highlight the impact of various corporate governance practices specifically Increasing Savings, Access to Credit, Women's Labor Force Participation, Digital Financial Services, and Women's Economic Empowerment Programs on women's financial inclusion in Ethiopian Private Banks.

1. Regarding **Increasing Savings**, the research revealed that while banks strive to communicate savings opportunities, their efforts through traditional media like radio and TV are inadequate. Additionally, there is a lack of tailored campaigns aimed at unbanked women, hindering effective outreach.
2. For **Access to Credit**, the findings indicated that while discussions around credit packages occur at the board level, the implementation remains weak. The lack of actionable credit strategies and failure to address the outcomes of corporate governance plans contribute to ineffective credit access for women.
3. Concerning **Women's Labor Force Participation**, the study found that banks have inclusive human resource policies, but they fail to adequately recognize and train skilled female employees. This gap limits women's effective participation in financial inclusion initiatives.
4. In terms of **Digital Financial Services**, while banks provide relevant information, issues such as untimely and incomplete communication hinder female customers' understanding of these services.

5. Lastly, the research highlighted that while banks seek input from female customers regarding economic empowerment programs, they fall short in organizing events and initiatives to promote these programs effectively. Additionally, the lack of recognition for female customers diminishes their loyalty and engagement.

## Major Concluding Remarks

The analysis led to several conclusions. First, the study found that essential saving information is not easily accessible for female customers and unbanked women. Furthermore, while discussions on credit policies are held, decision-making involvement from the board is lacking, impacting the effectiveness of credit access plans. Female labor participation in banks is insufficient to support financial inclusion initiatives, with limited recognition for skilled women. Digital financial services are not communicated effectively, and customer suggestions and complaints are not promptly addressed. Overall, the correlation and regression results indicate that increasing savings, access to credit, labor force participation, digital services, and economic empowerment programs positively impact women's financial inclusion, with economic empowerment programs having the most significant effect.

## Key Recommendations

Based on the findings and conclusions, several recommendations are proposed to enhance corporate governance practices:

1. **Promoting Savings**: Banks should improve access to saving information through radio, TV, and websites to reach female customers and unbanked women effectively.
2. **Ensuring Access to Credit**: Management teams must actively participate in decision-making regarding credit access for women, taking responsibility for the outcomes of inclusive credit plans.
3. **Enhancing Women's Labor Force Participation**: Capacity-building programs should be tailored to female employees to address skill gaps, focusing on communication and leadership to support financial inclusion initiatives.
4. **Improving Digital Financial Service Accessibility**: Banks need to provide timely, complete, and easy-to-understand digital financial service information to better inform female customers about financial inclusion opportunities.
5. **Strengthening Women's Economic Empowerment Programs**: Banks should implement up-to-date entrepreneurial programs and recognize female customers to foster loyalty. Regular meetings and conferences should be organized to raise awareness about women's financial inclusion.
6. **Addressing Customer Feedback**: Banks should establish a structured approach to quickly address customer comments, suggestions, and complaints, enhancing engagement and trust among female clients.

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## Conflict of Interest

The author hereby declares that this Thesis is written alone by me and it is a record of my own study and I confirm that there is no conflict of interest.

## Author Contributions

The sole author, *[Meti Leta Gonfa]*, confirms the sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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## Ethical Approval

The author declares that all procedures involving through interview and questionnaires were conducted in strict adherences to the ethical standards and guidelines. Thus, administrative clearances and approval were initially obtained from all Ethiopian Private Banks involved in the study. Furthermore, the participation was entirely voluntary; written informed consent was obtained from all individual participants prior to their inclusion in the study.

## Data Availability

The author, *Meti Leta Gonfa*, declares that the data supporting the findings of this study are available within the article and its supplementary materials. Any additional raw datasets generated during the interview and questionnaire phases are available from the author upon reasonable request, provided that such requests comply with the ethical and confidentiality agreements established with the participating *Ethiopian Private Commercial Banks.*

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# Determinants of Mother-to-Child Transmission of Human Immunodeficiency Virus among Clients Enrolled in a Prevention of Mother-to-Child Transmission of HIV Program in Plateau State, Nigeria

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***Abstract***

*Maternal-to-child transmission (MTCT) of the human immunodeficiency virus (HIV) accounts for the majority of new pediatric HIV infections. Preventing MTCT of HIV (PMTCT) remains a critical intervention for ensuring that women and children survive and have a high quality of life. This study reflects on the determinants of MTCT in Plateau State. A retrospective analysis of mother-infant pairs enrolled in the PMTCT program across 29 HIV treatment sites in Plateau State between 2017 and 2021 was carried out. Data were extracted from facility registers and Electronic Medical Record (EMR). HIV-positive mothers and infants' pairs who met inclusion criteria were enrolled. HIV MTCT predictors were ascertained using a logistic regression model at a 5% level of statistical significance. Data from 3,430 mother-infant pairs were analyzed. EID PCR-positive results were found in 0.8% of infants at six weeks and 1.2% at 18 months. Predictors at six to eight weeks included maternal gravidity (OR= 0.13, 95% CI 0.018:0.927, p<0.05), point of entry (PoE) into the PMTC program (OR= 10.9, 95% CI 4.7:25.4, p<0.001), and high viral load count among mothers (OR= 3.4, 95% CI 1.40:8.71, p<0.05). Predictors at 18 months were gravidity (OR = 0.19.95% CL 0.05:0.84, p = 0.05), and PMTCT program PoE (OR= 12.5, 95% CI 5.51:28.20, p < 0.001). This study identifies key determinants in mother-to-child HIV transmission in Plateau State, including PMTCT entry of point, gravidity, and high maternal viral load, underscoring the need for targeted interventions focusing on enhancing healthcare accessibility.*

***Keywords****: Determinant, Human Immunodeficiency Virus, Prevention of Mother–child Transmission, Plateau.*

## Introduction

Mother-to-child transmission of HIV has remained a major cause of new HIV infection in children [1, 2]. Globally, an estimated 27,000 mothers acquired new HIV infections during pregnancy and delivery, and 65,000 mothers did not receive antiretroviral treatment (ART) during pregnancy or delivery in 2022 [3], Western and Central Africa home to 20% of pregnant and breastfeeding mothers living with HIV, accounting for more than 52% of mothers who did not have ART during pregnancy and delivery in 2022 [3, 4]. The coverage of antiretroviral therapy among pregnant and breastfeeding women living with HIV has

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improved globally. Nevertheless, progress has stagnated in recent years, with coverage remaining in the range of 53–61% since 2016 [5, 6].

Prevention of mother-to-child transmission of HIV has played a vital role in reducing the number of children infected with HIV [7-10]. The risk of MTCT can be reduced to less than 2% by interventions that include the use of antiretrovirals (ARVs) as either prophylaxis or therapy given to women during pregnancy, labor, and breastfeeding [3, 11]. However, the implementation of PMTCT has varied in terms of the degree of success and challenges.

Nigeria had a high MTCT burden of 14% in 2020 [12, 1, 13]. In response, the Government of Nigeria, through the National AIDS and STIs Control Program, has implemented a comprehensive approach to the PMTCT since 2003 [14]. The current PMTCT guidelines advocate four pronged approaches for addressing the mother-to-child transmission of HIV. These four prongs represent the key components of broad PMTCT service provision: primary prevention of HIV infection among women of childbearing age (prong 1), prevention of unintended pregnancies among women living with HIV (prong 2), prevention of HIV transmission from a woman living with HIV to her infant (prong 3), and treatment, care, and support for women living with HIV, their children, and families (prong 4) [13]. The uptake of PMTCT services in Nigeria remains notably low despite significant advances in HIV/AIDS treatment and care [13, 15, 2, 14]. To ensure that all HIV-positive pregnant women are reached, the Nigerian government and implementing partners introduced several interventions, including community-based PMTCT [14, 2]. Community-based PMTCT is a strategy to provide PMTCT services by formal (trained health personnel) or informal care providers such as traditional birth attendants [14]. It emphasizes community collaborative work and aims at improving referral practices between traditional birth attendants and primary health care clinics and induces self-referral to skilled birth providers [14, 13]. Notably, the Federal Ministry of Health initiated the National Clinical Mentorship Program to drive the capacity development of health care workers and achieve HIV epidemic control [16]. Other interventions, such as the Accelerating Progress in Pediatric and PMTCT as well as the National Treatment and PMTCT Program, aim at closing the gaps identified in pediatric, adolescent, and mother-to-child HIV cases to ensure that everyone has access to life-saving medication [17, 18].

The plateau state has an HIV prevalence of 6.84% among pregnant women [19]. This means that every six to seven infants born to a hundred HIV-positive women are potentially exposed to HIV and are at high risk of morbidity and mortality [19]. and MTCT was reported to be 2% [20]. Effective PMTCT services require women–infant pairs to have access to all relevant interventions. This study aims to assess the factors affecting the MTCT rate in Plateau State, Nigeria, to improve HIV healthcare for mothers and their children with HIV.

## Methodology

### Study Area

The study was conducted in Plateau State, Northcentral Nigeria [21]. The plateau state has 17 local government areas (LGAs), which are politically divided into northern, central, and southern Senatorial districts [21]. Each of these has people of diverse tribes and traditions. The plateau state has a projected population of 4,717,300 people as of 2022 [22].

Twenty-nine comprehensive treatment sites and six PMTCT sites supported by the United States Center for Disease Control and Prevention (CDC) President's Emergency Plan for AIDS Relief (PEPFAR) program through the APIN Public Health Initiative are distributed in 14 of the state's 17 LGAs. The State AIDS STI Control Program coordinates

health sector HIV activities in the state, whereas the Plateau State AIDS Control Agency coordinates non-health sector HIV activities.

## Study Design

A retrospective data review of a cohort of pregnant women and infants enrolled in PMTCT programs on the Plateau State between 2017 and 2021 was performed.

## Study Population

The study population included all HIV-positive pregnant women and their infants in the PMTCT program across 29 health facilities in plateau states between 2017 and 2021.

## Inclusion Criteria

HIV-positive mothers and infants who were enrolled and received care at PEPFAR-supported sites in Plateau State from 2017–2021.

## Exclusion Criteria

HIV-positive mothers and infant pairs who transferred out of the program or died during the period of receiving PMTCT care. Those with incomplete EMRs were also excluded.

## Sample Size Determination and Sampling Technique

We reviewed 3,641 mother–infant pairs in the state from 2017--2021. Three thousand four hundred thirty (3,430) HIV-positive mothers and infant pairs who met the inclusion criteria were included in the study.

## Data Collection Method

The study participants' data were extracted from the facility registers (PMTCT, mother–infant cohort, and pediatric registers) and EMRs via an Excel-based data abstraction tool. State clinical mentors served as research assistants throughout the study period. To standardize study tools across sites, a two-day virtual training was held with all the clinical mentors.

The primary outcome of interest in the study was the infant HIV MTCT rate at six weeks and 18 months (final outcome), which was measured via a binary response category: positive and negative. The independent factors considered were grouped into maternal-related factors: sociodemographic characteristics, maternal ART regimen, timing of maternal ART (commencement of ART prior to pregnancy or during pregnancy), maternal viral load timing (when the last viral load was carried out), viral load suppression status, and interruption in treatment (IIT), as well as infant factors such as comorbidity, infant postexposure prophylaxis, and cotrimoxazole uptake. The viral load was defined as suppressed if it was less than 1,000 copies/ml at 32–36 weeks of pregnancy and unsuppressed if it was ≥1000 copies/ml. IIT was defined as the number of ART patients (currently on ART or newly initiating ART) with no clinical contact or ARV pick-up for more than 28 days since their last expected clinical or ARV pick-up.

## Data Analysis

All the generated data were entered into Microsoft Excel version 2016. The Statistical Package for Social Sciences (SPSS) version 26 was used to analyze the data. A p value $< 0.05$ was considered statistically significant for all the statistical tests. Descriptive data are presented in tables and frequencies. Continuous data were summarized using means and standard deviations. Associations between the independent variables (sociodemographics of mothers and infants and clinical characteristics) and the outcome variables (HIV status of an infant at six weeks and at 18 months) were assessed at the bivariate level via an independent chi-square test. The significant variables in the bivariate analysis were modeled via multiple logistic regression at the 5% level of significance and the 95% confidence interval to ascertain the determinants.

## Results

A total of 3,430 mother–infant pairs of data were analyzed. The mean age of the mothers was 33.7±7.16 years. The majority of the pregnant mothers were aged 25--34 years (n=1,465, 42.7%), had completed secondary education (n=1692 49.35%), were employed (n=2449 71.4%), and had undergone fewer than four pregnancies (n=2573 75.0%). Additionally, a majority of mothers who lived in rural areas (n=2,058, 60.0%), smoked before 32 weeks of gestation (n=2,842, 82.9%) were on the first-line ART regimen (n=3,272, 95.4%), were initiated on ART before pregnancy (n=2,842, 82.9%), and had one to four clinic visits throughout the antenatal period (n=2943, 85.8%). Among the 3,430 mothers, 3,188 (92.9%) had a viral load below 1,000 copies/ml, 3,057 (89.1%) had viral load assessments within the critical window of 32--36 weeks of pregnancy, and 143 (4.2%) had an IIT (Table 1).

**Table 1.** Background Characteristics of HIV Pregnant Mothers Enrolled in PMTCT in Plateau State (2017–2021) (N = 3,430)

| S/N | Variables | Frequency (n=3430) | Percentage (%) |
|---|---|---|---|
| **1** | **Age** | | |
| | 15-24 | 319 | 9.3 |
| | 25-34 | 1465 | 42.7 |
| | 35-44 | 1461 | 42.6 |
| | ≥ 45 | 185 | 5.4 |
| **2** | **Gravidity** | | |
| | 1-4 | 2573 | 75.0 |
| | > 4 | 857 | 25.0 |
| **3** | **Educational Level** | | |
| | None | 221 | 6.4 |
| | Primary | 787 | 23.0 |
| | Secondary | 1692 | 49.3 |
| | Tertiary | 730 | 21.3 |
| **4** | **Occupation** | | |
| | Employed | 2449 | 71.4 |
| | Unemployed | 891 | 28.6 |
| **5** | **Place of residence** | | |
| | Rural | 2058 | 60.0 |
| | Urban | 1372 | 40.0 |
| **6** | **Point of entry into PMTCT** | | |
| | Antenatal clinic | 3312 | 96.6 |
| | Others* | 118 | 3.4 |
| **7** | **Maternal ART regimen** | | |
| | First line | 3272 | 95.4 |
| | Second line | 156 | 4.5 |
| | Third line | 2 | 0.1 |
| 8 | **Timing of Mothers ART** | | |
| | Before pregnancy | 2842 | 82.9 |
| | Initiated during pregnancy < 36 weeks | 552 | 16.1 |

| | | | |
|---|---|---|---|
| | Initiated after 36 weeks pregnancy | 36 | 1.0 |
| 9 | **Total number of clinic visits** | | |
| | 1-4 | 2943 | 85.8 |
| | > 4 | 487 | 14.2 |
| 10 | **Mother viral load level** | | |
| | Suppressed | 3188 | 92.9 |
| | Unsuppressed | 242 | 7.1 |
| 11 | **Maternal viral load timing** | | |
| | Viral load done within 32 to 36 weeks | 3057 | 89.1 |
| | Viral load done any other time | 373 | 10.9 |
| 12 | **Maternal IIT during PMTCT** | | |
| | Active | 3287 | 95.8 |
| | IIT | 143 | 4.2 |

** Others include labor and delivery, breastfeeding*

Among the infants included, 3,358 (97.9%) were enrolled in PMTCT programs between zero and two months of age, 2,509 (73.1%) were delivered at a healthcare facility, 1,804 (52.6%) attended tertiary healthcare facilities, 3,190 (93.0%) commenced ARV (nevirapine (and zidovudine, if the baby is high risk)) within 72 hours, and 3,405 (99.3%) commenced cotrimoxazole at six weeks (Table 2).

**Table 2.** Background Characteristics of HIV-Exposed Infants of Mothers Receiving PMTCT in the Plateau State (2017–2021) (N = 3,430)

| S/N | Variables | Frequency (n=3430) | Percentage (%) |
|---|---|---|---|
| 1 | **Age at enrollment of infant** | | |
| | 0-2 months | 3,358 | 97.9 |
| | >2 months | 72 | 2.1 |
| 2 | **Sex** | | |
| | Male | 1708 | 49.8 |
| | Female | 1722 | 50.2 |
| 3 | **Place of delivery** | | |
| | Facility | 2509 | 73.1 |
| | Outside facility | 921 | 26.9 |
| 4 | **Facility type** | | |
| | Primary | 25 | 0.7 |
| | Secondary | 1601 | 46.7 |
| | Tertiary | 1804 | 52.6 |
| 5 | **Timing of ARV prophylaxis** | | |
| | Within 72 hours | 3190 | 93.0 |
| | > 72 hours | 240 | 7.0 |
| 6 | **Cotrimoxazole uptake by 6 weeks** | | |
| | Yes | 3405 | 97.3 |
| | No | 25 | 0.7 |

Twenty-nine (0.8%) HEIs tested positive at six weeks, and 42 (1.2%) were positive at eighteen months (Table 3).

**Table 3.** MTCT Outcomes of HEIs of Mothers on PMTCT in the Plateau State (2017–2021) (N = 3,430)

| S/N | MTCT Outcome | Frequency (n=3430) | Percentages (%) |
|---|---|---|---|
| 1 | **PCR at six weeks** | | |
| | Positive | 29 | 0.8 |
| | Negative | 3401 | 99.2 |
| 2 | **Rapid Test at eighteen months** | | |
| | Positive | 42 | 1.2 |
| | Negative | 3388 | 98.8 |
| | | | |

There was a statistically significant association between gravidity and HIV test results at six weeks (p=008) and 18 months (p=0.011). The point of entry was significantly associated with the HIV test results at six weeks (p<0.001) and at 18 months (p< 0.001). Gestational age at booking was statistically associated with HIV test results at six weeks (p<0.001) and at 18 months (p<0.001). We also found that facility type was not associated with HIV test results at six weeks (p=0.744), but it was significantly associated with HIV results at 18 months (p=0.002). The timing of mothers' initiation of ART, viral load timing and mothers' viral load status were associated with HIV test results at six weeks (p< 0.001) and 18 months (p<0.001) (Table 4).

**Table 4.** Maternal Factors Associated with Infant MTCT Status at Six Weeks and Eighteen Months in the Plateau State (2017–2021) (N = 3,430)

| Variables of the mother | Child outcome | | | |
|---|---|---|---|---|
| | Six weeks | | Eighteen months | |
| | Negative | positive | Negative | positive |
| **Age** | | | | |
| 15-24 | 317(99.4) | 2(0.6) | 311(97.5) | 8(2.5) |
| 25-34 | 1453(99.2) | 12(0.8) | 1449(98.9) | 16(1.1) |
| 35-44 | 1449(99.2) | 12(0.8) | 1446(99.0) | 15(1.0) |
| ≥ 45 | 182(98.4) | 3(1.6) | 182(98.4) | 3(1.6) |
| | X=1.269, p value= 0.675** | | X=5.062, p value= 0.153* | |
| **Gravidity** | | | | |
| 1-4 | 2545(98.9) | 28(1.1) | 2534(98.5) | 39(1.5) |
| > 4 | 856(99.9) | 1(0.1) | 854(99.6) | 3(0.4) |
| | X=7.238, p value = **0.008** | | X=7.222, p value = **0.011** | |
| **Place of residence** | | | | |
| Rural | 2038(99.0) | 20(1.0) | 2033(98.9) | 25(1.2) |
| Urban | 1363(99.3) | 9(0.7) | 1358(99.0) | 14(1.0) |
| | X=0.960, p value = 0.349 | | X=p-0.325, value = 0.636 | |
| **Point of entry** | | | | |
| Antenatal clinic | 3303(99.7) | 9(0.3) | 3296(99.5) | 16(0.5) |
| Others‡ | 98(83.1) | 20(16.9) | 92(78.0) | 26(22.0) |
| | X=102,870, p value =**<0.001**** | | X=126.285, p value = **<0.001**** | |
| **Time of booking** | | | | |
| Before 32 weeks | 32936(99.6) | 12(0.4) | 2932(99.7) | 9(0.3) |

| | | | | |
|---|---|---|---|---|
| After 32 weeks | 465(96.5) | 17(3.5) | 456(93.3) | 33(6.7) |
| | X=106.963, p value = **0.001**** | | X=143.882, p value = **0.001** | |
| **Type of facility** | | | | |
| Primary | 25(100.0) | 0(0.0) | 22(88.0) | 3(12.0) |
| Secondary | 1589(99.3) | 12(0.7) | 1585(99.0) | 16(1.0) |
| Tertiary | 1787(99.1) | 17(0.9) | 1781(98.7) | 23(1.3) |
| | X=0.591, p value = 0.744** | | X=p value 24.709, P= **0.002*** | |
| **Maternal ART regimen** | | | | |
| First line | 3246(99.2) | 26(0.8) | 3235(98.9) | 37(1.1) |
| Second line | 153(98.1) | 3(1.9) | 151(96.8) | 5(3.2) |
| Third line | 2(100.0) | 0(0.0) | 2(100.0) | 0(0.0) |
| | X=1.724, p value = 0.422** | | X=6.579, p- value = 0.063* | |
| **Timing of Mothers ART start** | | | | |
| Before pregnancy | 2837(99.8) | 5(0.2) | 2834(99.7) | 8(0.3) |
| Initiated before < 36 weeks | 541(88.0) | 11(2.0) | 538(97.5) | 14(2.5) |
| Initiated at > 36 weeks and above | 23(100.0) | 13(36.1) | 16(44.4) | 20(55.6) |
| | X=106.154, p value = **0.001**** | | X=163.374, p value = **0.001**** | |
| **Maternal Viral Load Timing** | | | | |
| VL done within 32 to 36 weeks | 3038(99.4) | 19(0.6) | 3033(99.2) | 24(0.8) |
| Viral load done any other time | 363(96.3) | 10(2.7) | 355(95.2) | 19(4.8) |
| | X=11.530, p value = **0.001**** | | X=28.592, p value = **0.001**** | |
| **Viral load status of the mother** | | | | |
| Suppressed | 3187(99.9) | 1(0.1) | 3196(99.9) | 2(0.1) |
| Unsuppressed | 214(98.6) | 28(1.4) | 202(83.5) | 40(16.5) |
| | X=143.051, p value = **0.001**** | | X=202.816, p value = **0.001**** | |

ǂ *Labor & delivery, Breast feeding *chi-square, **Fisher's exact*

Infant age at first PCR was significantly associated with HIV test results at six weeks (p<0.00) and 18 months (p<0.001). The sex of the child was found to be statistically associated with HIV test results at six weeks (p=0.041) but not at 18 months (p=0.218). In addition, the place of delivery of HEIs was significantly associated with HIV test results at 6 weeks (p<0.001) and 18 months (p<0.001) (Table 5).

**Table 5.** Infant-Related Factors Associated with Positive MTCT Status at Six Weeks and Eighteen Months in the Plateau State (2017–2021) (N = 3,430)

| **Variables of the child** | **Child outcome** | | | |
|---|---|---|---|---|
| | **Six weeks** | | **Eighteen months** | |
| | **Negative** | **positive** | **$\chi^2$ (P value)** | **$\chi^2$ (P value)** |
| **Age at First PCR** | | | | |
| 1-2 months | 3010(99.7) | 10(0.3) | 3002(98.4) | 18(0.6) |
| > 2 months | 391(95.4) | 19(4.6) | 386(94.1) | 24(5.9) |
| | X=46.663, p value < **0.001*** | | X=82.504, p value< **0.001*** | |

| | | | | |
|---|---|---|---|---|
| **Sex of infant** | | | | |
| Male | 1688(98.8) | 20(1.2) | 1683(98.5) | 25(1.5) |
| Female | 1713(99.5) | 9(0.5) | 1705(99.0) | 17(1.9) |
| | X=4.299, p value = **0.041**** | | X=1.619, p value = 0.218 | |
| **Place of delivery** | | | | |
| Facility | 2485(99.8) | 4(0.2) | 2475(99.4) | 14(0.6) |
| Others | 916(99.1) | 25(0.9) | 913(97.0) | 28(3.0) |
| | X=50.747, p value < **0.001*** | | X=32.875, p value < **0.001*** | |

**Chi-square test, **Fisher's exact test*

Compared with infants of mothers who had one to four pregnancies at six weeks, infants of mothers who had >4 pregnancies had 87% lower odds of MTCT (AOR = 0.13, 95% CI 0.018–0.927, p = 0.047). Compared with those who had undergone PMTCT at the antenatal clinic, those who did not have PMTCT at the antenatal clinic had 10.89 times greater odds of having MTCT at the antenatal clinic at six weeks (AOR = 10.89, 95% CI 4.67--25.42; p < 0.001). Mothers with a viral load >1000/copy/ml had 3.4 times greater odds of MTCT than those with a viral load < 1000 copies/ml at six weeks (AOR = 3.4, 95% CI 1.39–8.70, p = 0.008). (Table 6).

**Table 6.** Predictors of Positive MTCT Outcomes among HEIs at Six Weeks via Multiple Logistic Regression in the Plateau State (2017–2021) (N = 3,430)

| **Variables** | **Child outcome** | | **Six weeks** | | |
|---|---|---|---|---|---|
| | **Negative** | **positive** | **AOR** | **95%CI** | **p value** |
| **Gravidity** | | | | | |
| 1-4 | 2545(98.9) | 28(1.1) | 1 | | **1** |
| > 4 | 856(99.9) | 1(0.1) | 0.131 | **0.018-0.927** | **0.047** |
| **Point of entry** | | | | | |
| Antenatal clinic | 3306(99.4) | 20(0.6) | 1 | | |
| Others‡ | 95(91.3) | 9(8.7) | 10.899 | **4.672-25.423** | **<0.001** |
| **Viral load count of the mother** | | | | | |
| < 1000 | 3198(99.3) | 22(0.7) | 1 | | |
| ≥ 1000 | 203(96.7) | 7(3.3) | 3.4184 | **1.394-8.708** | **0.008** |
| **Child's Sex** | | | | | |
| Male | 1688(98.8) | 20(1.2) | 1 | | |
| Female | 1713(99.5) | 9(0.5) | 0.454 | 0.203-1.103 | 0.054 |

‡ *Labor & delivery, Breastfeeding*

Compared with infants of mothers who had one to four pregnancies at 18 months, infants of mothers who had >4 pregnancies were 81% less likely to have MTCT (AOR = 0.198, 95% CI 0.046–0.845; p = 0.029). Compared with those who had undergone PMTCT at the antenatal clinic, those who did not have PMTCT at the antenatal clinic were 12.5 times more likely to have MTCT (AOR = 12.46, 95% CI 5.51--28.20; p < 0.001). Mothers who attended tertiary facilities with their infants were 81 percent less likely to have MTCT than mothers who attended primary health facilities at 18 months (AOR = 0.19, 95% CI 0.04–0.85, p = 0.030) (Table 7).

**Table 7.** Predictors of Positive MTCT Outcomes among HEIs at Eighteen Months via Multiple Logistic Regression in the Plateau State (2017–2021) (N = 3,430)

| Variables | Child outcome | | | 18 months | |
|---|---|---|---|---|---|
| | Negative | positive | AOR | 95% CI | p value |
| **Gravidity** | | | | | |
| 1-4 | 2536(98.6) | 37(1.4) | 1 | | |
| > 4 | 855(99.8) | 2(0.2) | 0.198 | **0.046-0.845** | **0.029** |
| **Point of entry** | | | | | |
| Antenatal clinic | 3299(99.2) | 27(0.8) | 1 | | |
| Others‡ | 92(88.5) | 12(11.5) | 12.469 | **5.512-28.206** | **<0.001** |
| **Type of facility** | | | | | |
| Primary | 22(88.0) | 3(12.0) | 1 | | |
| Secondary | 1576(99.1) | 14(0.9) | 1.148 | 0.525-2.511 | 0.729 |
| Tertiary | 1782(98.8) | 22(1.2) | 0.186 | **0.041-0.846** | **0.030** |
| **Viral load count of the mother** | | | | | |
| < 1000 | 3188(99.0) | 32(1.0) | 1 | | |
| ≥ 1000 | 203(96.7) | 7(3.3) | 1.611 | 0.646-4.016 | 0.306 |
| **Maternal viral load timing** | | | | | |
| Viral load within 32 to 36 weeks | 3258(99.0) | 34(1.0) | 1 | | |
| Viral load done any other time | 133(96.4) | 5(3.6) | 2.578 | 0.818-8.124 | 0.106 |

## Discussion

In this study, we found an HIV MTCT rate of 1.2% after 18 months. This prevalence could be related to women's increased use of PMTCT services and the fact that the majority of mothers who are already on treatment adhere to their regimen [23]. This finding was consistent with research conducted in southern and northcentral Nigeria, which attributed increased enrollment efforts of people living with HIV to care and maintaining continuity of care (14) [24]. This low HIV MTCT rate lends credence to the country's multiple PMTCT programmatic efforts, which ensure that all HIV-positive women are treated and that their children receive prophylaxis[14, 17, 18]. Other studies in Ethiopia and the Democratic Republic of the Congo reported MTCT rates of 7.7% and 16%, respectively [25, 26]. These higher rates could be because both studies were conducted before 2015 when the 'test and treat' paradigm had not yet been implemented in HIV programs and before the scale-up of tenofovir disoproxil, lamivudine, and dolutegravir ART by the PEPFAR program in sub-Saharan Africa.

This study revealed that most of the women started ART before they became pregnant, which may have contributed substantially to the reduction in the MTCT rate. Similar findings were reported in earlier studies carried out in Plateau State [27] and sub-Saharan Africa [28]. This study also revealed a low incidence and prevalence rate of HIV among pregnant women during the study period. Other studies reported a higher HIV prevalence among pregnant women [19, 1]. Methodological differences could explain this, as these studies were carried out in tertiary health facilities as opposed to this study, which included facilities at all levels of care. Despite this positive progress, gaps still exist in antenatal attendance, and case detection

for PMTCT, pediatrics and adolescents is still below the 95-95-95 UNAID target. Further strategies deployed to improve ANC for mothers in the state have a greater chance of improving case finding and decrease the rate of transmission from mother to child [10].

Infants of mothers who had assisted reproductive technology (ART) initiation before conception had a lower risk of contracting HIV. Similar findings were reported in Kenya and southeast Nigeria [24, 29]. This further highlights the importance of the prepregnancy initiation of ART and supports the first and second 95% of the UNAIDS goal, which requires that 95% of people living with HIV should know that status and that those who know their status should be in care [11]. This implies that HIV case finding should be intensified in the community to enable individuals to know their status.

Mothers of HEIs who were not virally suppressed were more likely to have an infant with positive PCR results at six and eighteen months. This was similar to the findings of a study in Enugu State, Nigeria, and Kinsasha, Democratic Republic of the Congo [26, 15]. This bolsters the importance of a strategic program for identifying cases, early initiation of ART, ART adherence, viral suppression and an undetectable viral load during pregnancy, and the period after delivery (from delivery to six weeks) for PMTCT programs.

Our study revealed that infants who delivered outside a health facility were more likely to be HIV positive than those who delivered in a health facility were. Since PMTCT services in Nigeria and many parts of the world are accessible in facilities with skilled birth attendants present at birth [30]. skilled birth attendants at birth are necessary to reduce the rate of mother–child transmission of HIV. Those who delivered in health facilities received nevirapine, and there were greater odds of having positive infants for those who did not receive nevirapine at birth than for those who received it. This further stresses the need for facility delivery for all women in care. The factors associated with the lack of uptake of nevirapine include delivery outside the health facility, which could be due to distance from the health facility, lack of transportation to the facility, and fear of stigma, among others. Nevirapine uptake at birth is necessary because it is one of the interventions that has helped decrease MTCT, and factors associated with decreased uptake should be addressed.

## Limitations

This was a retrospective review of records; the reliability of the recorded data could not be ascertained, and potential bias was associated with poor documentation. Data collected in clinical settings may only account for clients who presented to medical facilities.

## Conclusion

Our study revealed a low prevalence of MTCT, buttressing the impact of the PMTCT scale-up program. We found that pre-pregnancy ART initiation, ART medication adherence, nevirapine prophylaxis, gravidity, maternal viral load suppression, and facility type were important determinants of MTCT. Further knowledge of the socioeconomic and cultural factors that contribute to defaulting PMTCT, as well as the deployment of effective interventions to track and retain infants in PMTCT, is needed. Eliminating MTCT will require tremendous efforts by all involved to scale up treatment coverage and PMTCT in facilities and communities.

### Ethical Considerations

The study utilized secondary data from the HIV program in Plateau State. The State Ministry of Health granted permission, and ethical approval was obtained from the Jos University Teaching Hospital Health Research and Ethical Review Committee. The article was reviewed by the US Centers for Disease Control and Prevention’s human research protection procedures, and this project was determined to be non-research.

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## Conflict of Interest

The authors declared no conflict of interest

## Disclaimer

This study provides the manuscript for informational and research purposes. The findings, interpretations, and conclusions expressed in this manuscript are those of the authors and do not necessarily reflect the views of any affiliated institutions, organizations, or funding organization.

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# Climate Change and Malaria: Impact, Vulnerability, and Adaptation Pathways in Homa Bay County, Kenya

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***Abstract***

*This paper presents the relationship between climate change (temperature, rainfall, humidity) and incidence of malaria in Homabay County, Kenya. Climate change impacts, household exposure, sensitivity, and adaptive capacity were analysed to inform policy. The study combined ecological time-series analysis, household surveys, and key informant interviews. It analysed climate and morbidity data from 2010-2024, supplemented with primary data from 401 households and insights from 19 stakeholders. Standardized questionnaires and in-depth interviews guided data collection. The ARDL models assessed short and long-run climate effects on malaria, logistic regression examined determinants of household vulnerability, and thematic analysis generated qualitative insights. The findings showed malaria cases averaged 23,082 per month (SD = 13,402), mean temperature 23.3°C (SD = 1), rainfall 117.7 mm (SD = 67), and humidity 74%. The long-run model showed a significant baseline incidence and a highly significant first-month lag (IRR ≈ 1.92). Similarly, short-run results confirmed strong persistence, with first differenced lag significant (IRR ≈ 1.82). The household survey showed an overall moderate vulnerability to malaria (median 0.35), driven by high exposure, moderate sensitivity and adaptive capacity. Sensitivity linked to older household-head, low education, poor housing, and climate-dependent livelihoods significantly increased odds of malaria by 52%. Exposure had a positive effect on malaria incidence (OR ≈ 1.29) while stronger adaptive capacity lowered malaria risk. The study concluded that climate change has a significant impact on malaria in Homa Bay County. It highlights the need for real-time climate-health early warning systems by integrating meteorological data into IDSR for timely outbreak detection.*

***Keywords:*** *Adaptation, Climate Change, Impact, Malaria, Vulnerability.*

## Introduction

Globally, climate change presents a fundamental threat to human health [1]. The health effects of climate change can arise directly from weather events like heat stress, floods, droughts, and storms, or indirectly from factors such as displacement, mental health issues, and spread of disease vectors [2]. Worldwide, an estimated 263 million malaria cases and 597,000 deaths were recorded in 2023, with 94% of the burden being in Africa. Children under five remain the most vulnerable group, representing close to 76% of malaria deaths across the continent [3]. The World Health Organization projects a further increase in annual mortalities by 250,000 between 2030 and 2050 due to extreme weather, rising disease burdens, and the global spread of vector-borne infections [4].

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In many parts of Africa, climate change threatens to undermine many of the public health gains made in the last decades [5]. Locally, Kenya faces rising health risks from climate change, including higher temperatures, heavy rainfall, and flooding, which worsen existing health challenges, particularly for vulnerable groups [6]. Evidence from the studies conducted in Kenya provide baseline relationship between climate and malaria outcomes. For example, temperature and heat in informal settlements in Nairobi [7]; and the impact of warming temperatures on malaria vector species habitat and lifecycles in coastal regions of Kenya [8].

The Homa Bay County climate change policy highlights the region's growing challenges-including declining water quality, frequent flooding, and droughts; and calls for more research on climate impacts, vulnerability, and adaptation [9]. In response, this study examined the relationship between climate factors (temperature, rainfall, and humidity) and malaria incidence, assessed household vulnerability, and identified public health adaptation measures to reduce the impact of climate change on malaria in Homa Bay County, Kenya. This paper acknowledges that human activities play a central role in causing climate change, shaping its impacts, and fostering resilience. Its findings will improve understanding of both current and future health effects of climate change and support the formulation of effective public health policies.

## Materials and Methods

### Study Design

This study adopted a mixed-method design that integrates quantitative and qualitative approaches to explore relationships between climate variables and malaria, population vulnerability, and local adaptation strategies.

### Study Area

The study was conducted in Homa Bay County in western Kenya, a predominantly rural region situated (*Latitude $0^0$ 15 - $0^0$52' South: Longitudes $34^0$ - $35^0$ East)* along the shores of Lake Victoria. The county, with over 1.13 million people, features two main ecological zones, the lakeshore lowlands and the upland plateau, and experiences a moderate inland equatorial climate. Its economy is largely driven by agriculture and an expanding blue economy supported by extensive lake access [10]. The Figure 1 below shows the study area of Homabay County in Kenya.

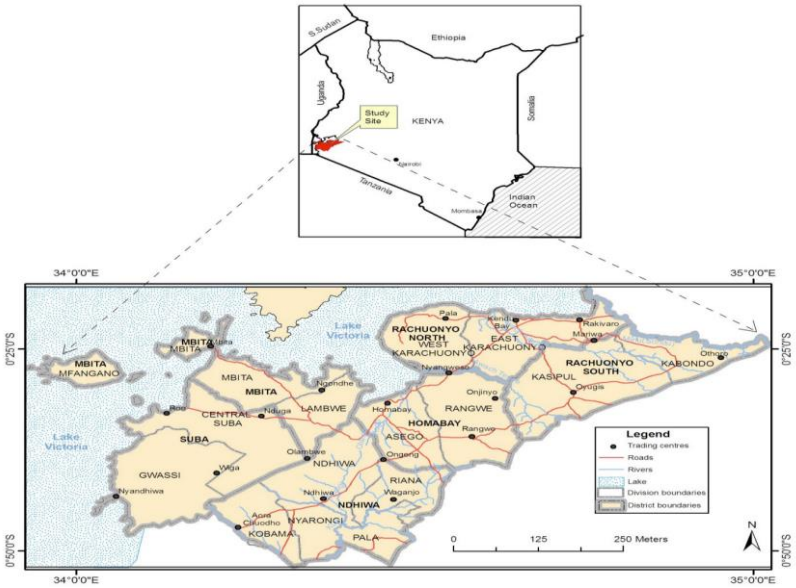


**Figure 1.** A map showing the study location of Homa Bay County, Kenya

*Source, (Ochieng, 2017).*

## Study Population

The 15 years (2010-2024) secondary data for malaria illnesses were extracted from the Kenya Health Information System, while climate variables (rainfall, temperature, and humidity) were obtained from the Kenya Meteorological Department. The target population for assessing household vulnerability comprised of all 262,036 households in Homa Bay County. The head of the household served as the primary unit of analysis. Further, 19 respondents from key sectors such as health, water, agriculture, climate, and local governance volunteered as participate in the qualitative in-depth interviews.

## Sample Size and Sampling Technique

All patients diagnosed with confirmed malaria in Homabay County from January 2010 to December 2024 were included in this study. Further, climate related data (temperature, rainfall and humidity) for the same 15 year-period were obtained from Kenya Meteorological Department. According to the World Meteorological Organisation, more than 10 years of data can offer predictive accuracy.

A multi-stage sampling was applied to determine the sample size for the household survey. The initial stage comprised selecting 4 sub-counties based on the ecological strata, followed by proportional allocation of households. The sample size for household survey was determined using Leslie Fischer's formula Equation 1, $n = \frac{Z^2 p(1-p)}{\quad}$ where; *n* is required sample size at 95% confidence interval, standard deviation z =1.96 with a default margin of error e =0.05.The degree of variability for the targeted households is not known, thus the study assumed the maximum variability of p = 0.5 to determine a more conservative sample size [11]. A total of 384 households were recruited as study participants, later adjusted to 422 to account for potential non-response. Systematic sampling with an interval of five households was used to select survey participants. Additionally, purposive simple random sampling was used to identify 19 key stakeholders across health, water, agriculture, climate, and local governance sectors for key informant interviews.

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**Results**

**Secondary Data**

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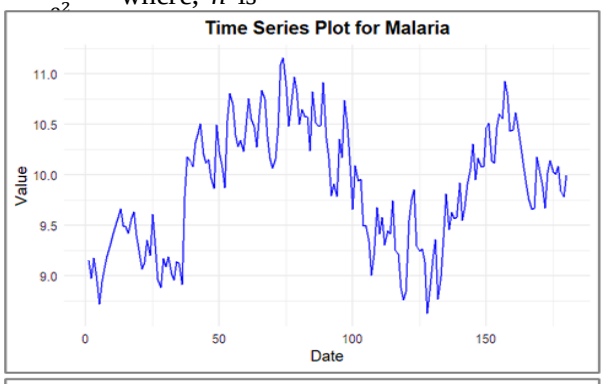
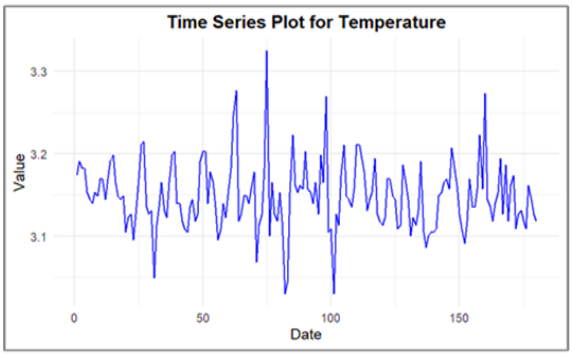
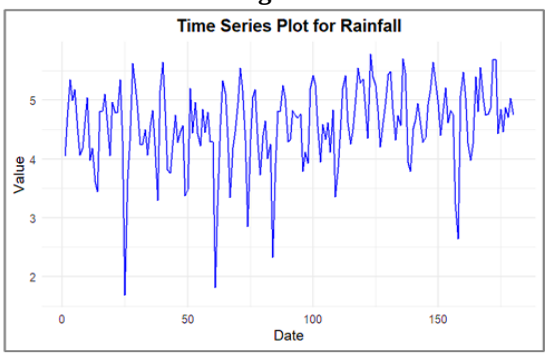


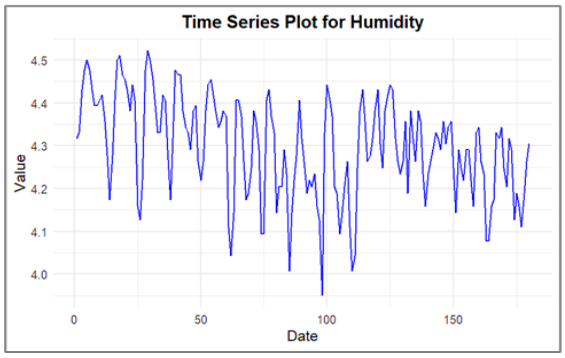

**Figure**




**Figure**




**Figure**




**Figure**

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**Table**

| Variable | [a]Statistic | Decision | [b]Statistic | Decision |
|---|---|---|---|---|
| Malaria | 9.573 | Not | na | Not |
| Temperature | 60.041 | Detected, | 2.362 | Deseasonalized |
| Rainfall | 91.361 | Detected, | 2.032 | Deseasonalized |
| Humidity | 58.899 | Detected, | 0.916 | Deseasonalized |

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**Table**

| | First | | | Second | | |
|---|---|---|---|---|---|---|
| **Variable** | **ADF p-** | **PP pvalue** | **Decision** | **ADF p-** | **PP pvalue** | **Decision** |
| Malaria | 0.567 | 0.216 | NS | 0.010** | 0.010** | S |

| | | | | | | |
|---|---|---|---|---|---|---|
| Temperature | 0.010** | 0.010** | S | 0.010** | 0.010** | S |
| Rainfall | 0.010** | 0.010** | S | 0.010** | 0.010** | S |
| Humidity | 0.010** | 0.010** | S | 0.010** | 0.010** | S |

*Significant*

*Note:*

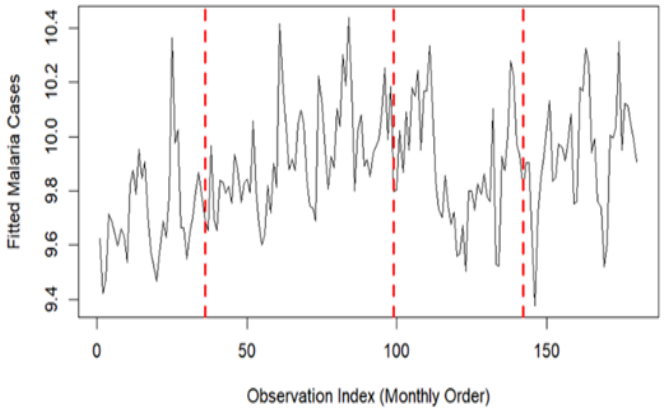
Correlation

Table

**Table**

| | **Malaria** | **Temperature** | **Rainfall** | **Humidity** |
|---|---|---|---|---|
| Malaria | 1.000 | 0.099 | - | - |
| Temperature | | 1.000 | - | - |
| Rainfall | | | 1.000 | 0.439 |
| Humidity | | | | 1.000 |

Structural




**Figure**

## Checks

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**Table**

| **Variable** | **Outlier(s)** | **Dates** | **Skewness** | **Kurtosis** |
|---|---|---|---|---|
| Malaria | No | n/a | - | 2.032 |
| Temperature | Yes | March | 0.626 | 5.407 |
| Rainfall | Yes | January | - | 5.755 |
| Humidity | No | n/a | - | 2.651 |

No

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## Secondary

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**Table**

| **Variable** | **Mean** | **SD** | **Median** | **IQR** | **Min** | **Max** |
|---|---|---|---|---|---|---|
| Malaria | 23,081.76 | 13,402.86 | 20,303.00 | 20,021.00 | 5,603.00 | 70,224.00 |
| Temperature | 23.3 | 1 | 23.2 | 1.1 | 20.7 | 27.8 |
| Rainfall | 117.4 | 67 | 103.2 | 82.7 | 5.4 | 324.5 |
| Humidity | 74 | 8.4 | 74.5 | 12 | 52 | 92 |

## Results

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**Table**

| Coefficient | [r]Estimate | P- | IRR | VIF |
|---|---|---|---|---|
| Intercept | 9.077 | 0.005** | na | na |
| L(Malaria, | 0.652 | <0.001*** | 1.920 | 6.171 |
| L(Malaria, | - | 0.154 | 0.925 | 5.801 |
| L(Temperature, | - | 0.333 | 0.602 | 1.421 |
| L(Temperature, | - | 0.035* | 0.291 | 1.382 |
| L(Rainfall, | - | 0.596 | 0.974 | 1.731 |
| L(Rainfall, | - | 0.850 | 0.992 | 1.629 |
| L(Humidity, | 0.436 | 0.090† | 1.546 | 3.550 |
| L(Humidity, | - | 0.292 | 0.724 | 3.450 |
| Break1 | 0.522 | <0.001*** | 1.686 | 3.685 |
| Break2 | - | <0.001*** | 0.639 | 4.258 |
| Break3 | 0.355 | <0.001*** | 1.427 | 2.592 |
| R | 0.847 | | | |
| Adjusted | 0.836 | | | |
| Model | 83.200 | <0.001*** | | |
| Residual | 1.294 | 0.524 | | |
| [r]Serial | 17.143 | 0.002** | | |
| Heteroskedasticity | 11.324 | 0.417 | | |
| Ramsey | 0.116 | 0.891 | | |
| Recursive | 0.340 | 0.934 | | |
| OLS- | 0.627 | 0.827 | | |
| Bounds | 8.400 | <0.001 | | |

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| Coefficient | [r]Estimate | P- | IRR | VIF |
|---|---|---|---|---|
| (Intercept) | 0.016 | 0.669 | na | na |
| L(ΔMalaria, | 0.598 | <0.001*** | 1.819 | 3.891 |
| L(ΔMalaria, | - | 0.222 | 0.930 | 1.070 |
| L(ΔTemperature, | - | 0.588 | 0.768 | 1.789 |
| L(ΔTemperature, | - | 0.091† | 0.399 | 1.781 |

| | | | | |
|---|---|---|---|---|
| L(ΔRainfall, | - | 0.949 | 0.997 | 1.620 |
| L(ΔRainfall, | 0.002 | 0.960 | 1.002 | 1.596 |
| L(ΔHumidity, | 0.312 | 0.335 | 1.367 | 1.746 |
| L(ΔHumidity, | 0.217 | 0.384 | 1.242 | 1.716 |
| L(ECT, | - | <0.001*** | na | 3.811 |
| Break1 | - | 0.900 | 0.994 | 1.240 |
| Break2 | - | 0.662 | 0.980 | 1.740 |
| Break3 | 0.019 | 0.732 | 1.020 | 1.483 |
| R | 0.232 | | | |
| Adjusted | 0.175 | | | |
| Model | 4.069 | <0.001*** | | |
| Residual | 1.407 | 0.495 | | |
| Serial | 16.075 | 0.003** | | |
| Heteroskedasticity | 11.992 | 0.446 | | |
| Ramsey | 1.689 | 0.188 | | |
| Recursive | 0.979 | 0.040 | | |
| OLS- | 0.623 | 0.833 | | |

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Table

**Table**

| **Characteristic** | **N** |
|---|---|
| **Sex** | |
| Male | 198 |
| Female | 203 |
| Age | 49 |
| **Age** | |
| Young | 90 |
| Middle- | 243 |
| Older | 68 |
| **Highest** | |
| Primary | 93 |
| Secondary | 175 |
| Tertiary/University | 96 |
| None | 37 |
| Number | 5.00 |
| Number | 1.00 |
| **Number** | |

| | |
|---|---|
| No | 177 |
| 1– | 218 |
| 3 | 6 |
| **Main** | |
| Farming | 158 |
| Fishing | 40 |
| Casual | 56 |
| Business | 120 |
| Salaried | 27 |
| **Malaria** | |
| | 297 |
| | 104 |
| **Sub-** | |
| Homa | 96 |
| Rachuonyo | 138 |
| Rachuonyo | 94 |
| Suba | 73 |
| **Domains** | |
| Sensitivity | 0.44 |
| Exposure | 0.63 |
| Adaptive | 0.61 |
| Household | 0.35 |

*1n*

Household-
Environmental

**Household**
Overall,

**Test**
Table

**Table**

| | **Household** | | |
|---|---|---|---|
| **Characteristic** | **No,** | **Yes,** | **P-** |
| Sub- | | | 0.180[a] |
| Homa | 17 | 79 | |
| Rachuonyo | 38 | 100 | |
| Rachuonyo | 26 | 68 | |
| Suba | 23 | 50 | |
| Sex | | | >0.900[a] |
| Male | 51 | 147 | |
| Female | 53 | 150 | |
| Age | 44 | 52 | <0.001[c] |
| Age | | | <0.001[a] |
| Young | 35 | 55 | |
| Middle- | 62 | 181 | |
| Older | 7 | 61 | |

| | | | |
|---|---|---|---|
| Highest | | | <0.001[a] |
| Primary | 12 | 81 | |
| Secondary | 52 | 123 | |
| Tertiary/University | 38 | 58 | |
| None | 2 | 35 | |
| Main | | | 0.028[a] |
| Farming | 34 | 124 | |
| Fishing | 14 | 26 | |
| Casual | 8 | 48 | |
| Business | 40 | 80 | |
| Salaried | 8 | 19 | |
| Number | | | 0.820[b] |
| No | 45 | 132 | |
| 1– | 57 | 161 | |
| 3 | 2 | 4 | |
| Household | | | 0.006[b] |
| >120,000 | 2 | 6 | |
| 24,000– | 32 | 48 | |
| <23,000 | 70 | 243 | |
| Any | | | <0.001[a] |
| Yes | 22 | 131 | |
| No | 82 | 166 | |
| Main | | | <0.001[b] |
| Piped | 5 | 10 | |
| Borehole | 64 | 96 | |
| Surface/River/Pond | 35 | 191 | |
| Type | | | 0.740[b] |
| Flush | 0 | 2 | |
| Pit | 53 | 164 | |
| Pit | 51 | 130 | |
| Open | 0 | 1 | |
| Primary | | | <0.001[b] |
| LPG/Electricity | 5 | 7 | |
| Charcoal | 37 | 49 | |
| Firewood | 62 | 241 | |
| Any | | | 0.015[a] |
| Yes | 6 | 47 | |
| No | 98 | 250 | |
| Heard | | | 0.002[a] |
| Yes | 94 | 224 | |
| No | 10 | 73 | |
| Climate | | | 0.162[b] |
| Yes | 99 | 291 | |

| | | | |
|---|---|---|---|
| No | 5 | 6 | |
| Household | | | 0.919[a] |
| Yes | 53 | 155 | |
| No | 51 | 142 | |
| Household | | | <0.001[a] |
| No | 48 | 72 | |
| Yes | 56 | 225 | |
| Area | | | 0.003[b] |
| Yes | 96 | 293 | |
| No | 8 | 4 | |
| Area | | | >0.900[b] |
| Yes | 104 | 296 | |
| No | 0 | 1 | |
| Education | | | <0.001[a] |
| Secondary | 2 | 35 | |
| Primary | 12 | 81 | |
| None | 90 | 181 | |
| Access | | | 0.046[a] |
| Yes | 74 | 241 | |
| No | 30 | 56 | |
| Any | | | 0.466[a] |
| Yes | 90 | 246 | |
| No | 14 | 51 | |
| Own | | | 0.186[a] |
| Yes | 94 | 251 | |
| No | 10 | 46 | |
| Household | | | 0.002[a] |
| Never | 13 | 48 | |
| Occasionally | 88 | 206 | |
| Regularly | 3 | 43 | |
| Household | | | 0.005[b] |
| Never | 3 | 8 | |
| Occasionally | 95 | 235 | |
| Regularly | 6 | 54 | |
| Household | | | 0.044[a] |
| Yes | 52 | 113 | |
| No | 52 | 184 | |
| Any | | | 0.004[a] |
| Yes | 60 | 121 | |
| No | 44 | 176 | |
| Domain | | | |
| Sensitivity | 0.44 | 0.50 | <0.001[c] |
| Exposure | 0.50 | 0.63 | <0.001[c] |

| | | | |
|---|---|---|---|
| Adaptive | 0.72 | 0.61 | 0.017[c] |
| Household | 0.12 | 0.46 | <0.001[c] |
| | | | |
| | | | |

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[a]*Pearson's*

## Logistic

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Equation 5 results for malaria indicate that household-level climatic vulnerability significantly influences disease occurrence. Sensitivity to climatic factors was positively associated with malaria, with each unit increase in sensitivity raising the odds of reporting malaria by 1.52 times (OR = 1.52, 95% CI: 1.15-2.05, p = 0.005), while higher Exposure also increased risk (OR = 1.29, 95% CI: 1.01-1.67, p = 0.045).

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Conversely, stronger Adaptive Capacity reduced the likelihood of malaria by 24% (OR = 0.76, 95% CI: 0.58-0.99, p = 0.046), highlighting the protective role of coping mechanisms. Age of the household head was another significant predictor, with middle-aged (OR = 1.76) and older adults (OR = 2.74) more likely to report malaria than younger adults. These findings underscore that high sensitivity and exposure elevate malaria risk, whereas adaptive capacity can buffer households against climatic vulnerabilities. Post-model diagnostics support the reliability and adequacy of the fitted logistic regression model

Table **10**.

**Table 10.** Malaria Model

| **Predictor** | **Estimate (β) (95% CI)** | **OR (95% CI)** | **P-value** |
|---|---|---|---|
| Sensitivity | 0.422 (0.131, 0.713) | 1.520 (1.150, 2.050) | 0.005** |
| Exposure | 0.258 (0.006, 0.510) | 1.290 (1.010, 1.670) | 0.045* |
| Adaptive capacity | -0.274 (-0.543, -0.005) | 0.760 (0.580, 0.990) | 0.046* |
| **Age of Household Head** | | | |
| Young Adult (18-<40 years) | - | - | - |
| Middle-aged Adult (41-<65 years) | 0.566 (0.033, 1.099) | 1.760 (1.030, 3.000) | 0.037* |
| Older Adult (>65 years) | 1.007 (0.037, 1.977) | 2.740 (1.080, 7.670) | 0.042* |

*Abbreviations: CI = Confidence Interval, OR = Odds Ratio*

*Signif. codes: <0.001 '***' 0.001 '***' 0.01 '**' 0.05 '*' 0.1 '†'*

## Malaria Model Diagnostics

– The model recorded a null deviance of 459.05 and a residual deviance of 417.35, resulting in a reduction of approximately 41.7 points Figure 7. This reduction in deviance indicates an improvement in model fit when the predictors were included, compared to the null model containing only the intercept. The Akaike Information Criterion (AIC) for the final model was 429.35, suggesting a reasonably good fit with moderate model complexity. A lower AIC value generally reflects a better trade-off between goodness of fit and parsimony, implying that the selected model achieves an acceptable level of explanatory power without overfitting.

Variance Inflation Factor (VIF) diagnostics were used to check for multicollinearity among

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5

the independent variables. The generalized VIF (GVIF) values ranged from 1.09 to 1.31, corresponding to adjusted values between 1.04 and 1.15. These results fall well below the conventional threshold of 5, suggesting that multicollinearity was not a concern in the model. Therefore, the estimates for Sensitivity, Exposure, Adaptive Capacity, and Age of Household Head can be considered stable and independently meaningful.

The Hosmer-Lemeshow goodness-of-fit test further confirmed the adequacy of the model. The test yielded a Chi-square statistic of 3.42 with a p-value of 0.906, indicating that the model's predicted probabilities align well with the observed outcomes. A non-significant result ($p > 0.05$) implies that there is no evidence of lack of fit, hence the model accurately captures the observed distribution of malaria cases across households.

The McFadden pseudo-$R^2$ for the model was 0.091, while the ML and Cragg-Uhler (Nagelkerke) $R^2$ values were 0.099 and 0.145, respectively. These indicate that the model explains between 9% and 14% of the variation in the likelihood of malaria occurrence across households. Although pseudo-$R^2$ values are typically lower than those of linear models, these results are consistent with acceptable explanatory power in epidemiological and behavioural studies where multiple unobserved factors may influence disease outcomes.

The predictive ability of the model was further evaluated using the Receiver Operating Characteristic (ROC) curve, which yielded an Area Under the Curve (AUC) of 0.706. This suggests that the model has moderate discriminative ability, correctly distinguishing between households that reported malaria and those that did not approximately 71% of the time (Figure 6). According to standard interpretation, an AUC between 0.7 and 0.8 indicates satisfactory model performance for prediction in public health and social science contexts.

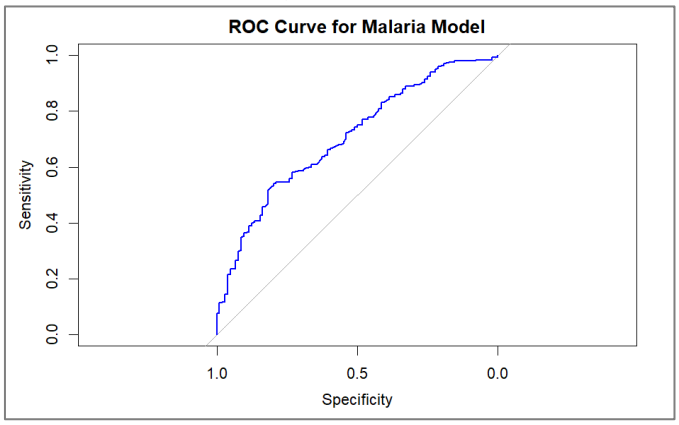


**Figure 7.** Malaria Model ROC Curve

Overall, the diagnostic checks confirm that the logistic regression model is statistically sound, well-fitted, and free from multicollinearity. The Hosmer-Lemeshow test indicates excellent calibration, and the AUC value suggests a moderate ability to discriminate between malaria and non-malaria households. These diagnostics collectively validate the robustness of the model and the reliability of its estimates for inferential and policy interpretation.

## Discussion

### Relationship Between Climate Factors and Malaria Incidence

The results of this study provide clear empirical evidence that climatic factors, particularly temperature and humidity, exert a significant influence on the incidence of malaria diseases in Homa Bay County. Using the ARDL framework, the analysis revealed both long-run and short-run relationships, with

incidence rate ratios (IRRs) quantifying the magnitude of these effects. These results extend previous evidence from Kenya and Sub-Saharan Africa by identifying lag-dependent and disease-specific responses, offering actionable insights for early warning and adaptive disease control strategies.

The positive and highly significant autoregressive component of malaria incidence ($\beta = 0.652$, $p < 0.001$; IRR $\approx 1.92$) indicates strong temporal persistence, suggesting that elevated case levels tend to carry over across months. This persistence underscores the need for continuous, rather than episodic, vector control and surveillance activities, as outbreaks are likely to sustain themselves even after climatic conditions stabilize. These findings support the argument that malaria transmission in highland and lake regions of Kenya is characterized by self-reinforcing dynamics linked to environmental and behavioural stability [12, 13].

The significant negative long-run association between temperature and malaria at a two-month lag ($\beta = –1.233$, $p = 0.035$; IRR $\approx$ 0.29) implies that sustained high temperatures may reduce mosquito survival and parasite development. This aligns with the "thermal limit hypothesis" [14, 15], suggesting that beyond certain temperature thresholds, vector reproduction and parasite incubation decline sharply. In policy terms, this has implications for spatial targeting of interventions. As warming trends continue, malaria control programs may need to shift focus from traditional hotspots to cooler, highland areas that are becoming newly suitable for transmission.

Humidity exhibited both immediate and delayed effects. The marginally positive short-term association ($\beta = 0.436$, $p = 0.090$; IRR $\approx$ 1.55) suggests that transient rises in humidity increase malaria risk, while the strong negative effect at a three-month lag ($\beta = –0.753$, $p <$ 0.001; IRR $\approx$ 0.47) indicates that prolonged humid conditions eventually suppress transmission. This underscores the importance of integrating meteorological monitoring with entomological surveillance in the County Integrated Disease Surveillance and Response (IDSR) system. Predictive models that incorporate humidity thresholds could support the Ministry of Health and Kenya Meteorological Department (KMD) in issuing climate-informed vector control advisories.

The structural stability analysis for the malaria ARDL models, identified three key structural breaks, in December 2012, March 2018, and October 2021, indicating shifts in the malaria-climate relationship over time. The 2012 break, which was positive and significant (IRR = 1.686), corresponds to a period when malaria incidence increased markedly. This coincided with transitional phases in Kenya's malaria control programs, likely linked to variations in intervention coverage following the earlier *Kenya Malaria Strategy (2009-2017)*. The 2018 break, which was negative and significant (IRR = 0.639), aligns with intensified malaria prevention campaigns, including mass distribution of insecticide-treated nets (ITNs) and implementation of county-level surveillance strengthening. This structural shift suggests that public health interventions may have temporarily weakened the sensitivity of malaria transmission to climatic variations.

Conversely, the 2021 break (IRR = 1.427) reflects a resurgence in malaria incidence, coinciding with the COVID-19 pandemic period, which disrupted routine control measures, health-seeking behavior, and supply chain operations. Collectively, these breaks underscore that malaria transmission dynamics in Homa Bay County are shaped by an interaction between climate variability and episodic policy or environmental shocks. Adjusting for these breaks improved model fit and interpretability, reaffirming that malaria-climate linkages must be interpreted within the broader context of intervention intensity and health system resilience [12, 16].

## Influence of Sensitivity to Climate-Related Risks on Malaria Incidence

In relation to malaria occurrence, the sensitivity domain showed a statistically significant positive association: β = 0.422 (95% CI: 0.131-0.713, p = 0.005), translating to an odds ratio (OR) of approximately 1.52 (95% CI: 1.15–2.05). This indicates that households with higher sensitivity to climatic stressors, such as older household head, lower education, poor housing and more climate-exposed livelihoods, had about 52 % higher odds of reporting malaria cases. These results align with the bivariate association findings where households with malaria had higher median sensitivity scores [0.50 (IQR 0.39-0.61) vs. 0.44 (IQR 0.33-0.50), p < 0.001]. Studies in similar African settings show that household fragility (low socioeconomic status, limited preventive capacity) amplifies vector-borne disease risk under climatic variability [17]. This finding underscores the necessity of strengthening household-level resilience, through improved housing, education, and livelihood diversification, as part of malaria control in climate-sensitive zones.

## Influence of Exposure to Climate-Related Risks on Malaria Incidence

The exposure domain showed a statistically significant positive effect: β = 0.258 (95% CI: 0.006-0.510, p = 0.045), OR ≈ 1.29 (95% CI: 1.01-1.67). This suggests that households with greater direct exposure (living near stagnant water, poor drainage, flood-prone zones) experienced about 29 % higher odds of experiencing malaria. In the bivariate analysis, malaria-affected households had higher median exposure scores [0.63 (IQR 0.50-0.75) vs. 0.50 (IQR 0.25-0.75), p < 0.001], reinforcing this association. Recent empirical work confirms that exposure to vector habitats and environmental risk zones is a significant mediator of malaria transmission in coastal and lakeside African communities [18]. This outcome highlights the importance of environmental management (drainage improvement, mosquito-breeding site elimination) combined with climate-informed spatial targeting of vector control in high-exposure zones.

## Influence of Adaptive Capacity on Malaria Incidence

Adaptive capacity in the model showed a statistically significant and protective effect: β = -0.274 (95% CI: -0.543 to -0.005, p = 0.046), OR ≈ 0.76 (95% CI: 0.58-0.99). This indicates that households with stronger adaptive capacity, such as diversified income, health-information access, insecticide-treated net use and early treatment options, were around 24 % less likely to experience malaria. Although bivariate exposure to malaria prevention measures was high and not significantly different between groups, the regression result reiterates the importance of measured capacity beyond mere possessions. Recent reviews emphasise that adaptation (behavioural and structural) under climate stress is central to maintaining disease resilience [19, 20]. As such, strengthening readable climate-health communication, ensuring equitable access to preventive tools, and fostering household adaptive behaviours should be integral to malaria interventions.

## Equations

The following equations were applied to quantitatively assess the relationship between climate change factors and malaria occurrence within the study area. These formulas provided the analytical framework for examining how variations in temperature, rainfall, and humidity influence malaria transmission patterns over time.

Equation 1: Leslie Fischer's formula

$$n = \frac{Z^2 p(1-p)}{e^2} \quad (1)$$

Equation 2:Autoregressive Distributed Lag (ARDL) model

$$Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{j=0}^{q_1} \beta_{1j} X_{1,t-j} + \sum_{j=0}^{q_2} \beta_{2j} X_{2,t-j} + \cdots + \sum_{j=0}^{q_k} \beta_{kj} X_{k,t-j} + \varepsilon_t \quad (2)$$

Equation 3: Long-run equilibrium ARDL form

$(Y_t = Y_{t-1} = Y_{t-2} = \cdots = Y^* \text{ and } X_{k,t} = X_{k,t-1} = \cdots = X_k^*)$:

$$Y_t = \gamma_0 + \gamma_1 X_{1,t} + \gamma_2 X_{2,t} + \cdots + \gamma_k X_{k,t} + u_t \quad (3)$$

Equation 4: Short-run equilibrium ARDL form

$$\Delta Y_t = \lambda_0 + \sum_{i=1}^{p-1} \phi_i \Delta Y_{t-i} + \sum_{j=0}^{q_1} \theta_{1j} \Delta X_{1,t-j} + \sum_{j=0}^{q_2-1} \theta_{2j} \Delta X_{2,t-j} + \cdots + \sum_{j=0}^{q_k-1} \theta_{kj} \Delta X_{k,t-j} + \psi ECT_{t-1} + \mu_t \quad (4)$$

Equation 5: General logistic regression model

$$\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \sum_{k=1}^{n} \gamma_k Z_{ik} + \varepsilon_i \quad (1)$$

## Conclusion

The study concludes that climate variables, particularly temperature and humidity, play a significant role in shaping malaria incidence in Homa Bay County. Malaria showed strong temporal persistence, with temperature reducing long-term malaria risk and humidity demonstrating mixed but meaningful effects. Structural breaks aligned with major public health milestones, confirming that disease patterns emerge from the interplay between climate variability and health system interventions.

The household sensitivity substantially increases the likelihood of malaria, driven largely by age, education, housing quality, and livelihood vulnerability. Higher sensitivity elevated malaria odds, highlighting the central role of social and structural disadvantages in amplifying disease risk. This study concludes that strengthening household resilience, through improved housing, education, diversified livelihoods, is essential in mitigating climate-sensitive disease burdens. Moreover, the analysis concludes that exposure to environmental risks significantly increases malaria risk, underscoring the importance of environmental management and climate-responsive vector control.

Finally, the study concludes that stronger adaptive capacity, reflected in diversified livelihoods, access to health information, ITN use, and prompt treatment, meaningfully reduces malaria incidence, lowering the odds by about 24%. This demonstrates the importance of empowering households with preventive tools and climate-health information.

## Conflict of Interest

We declare no conflict of interest.

## Ethical Approval

Ethical clearance for the study was granted by the AMREF Health Africa Ethical and Scientific Review Committee (AMREF-ESRC; Approval No. P1863/2025). Authorization to conduct the research in Kenya was provided by the National Commission for Science, Technology and Innovation (NACOSTI). Written informed consent was obtained from all participants before data collection commenced.

## Author Contribution

Author A: Conceptualization, Investigation, Methodology, Writing Original Draft, Formal analysis; Author B: Conceptualization, Review & editing, Supervision; Author C: Review & editing, Supervision, Project Administration

## Data Availability

The data supporting the findings of this study are available on request from the authors.

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# Socio-Cultural and Economic Barriers to Facility-Based Delivery: Perspectives of Men and Community Gatekeepers in Nasarawa State

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***Abstract***

*This study examined the socio-cultural and economic barriers influencing the uptake of facility-based delivery in Nasarawa State, Nigeria, from the perspectives of men and community gatekeepers, while proposing policy recommendations for strengthening male engagement and traditional birth attendant (TBA) collaboration. A mixed-methods cross-sectional design was employed, combining quantitative data from 443 married men across Akwanga, Keffi, and Lafia LGAs, alongside qualitative insights from 12 FGDs, 21 KIIs, and 46 IDIs with male decision-makers, TBAs, elders, and health workers. Quantitative data were analyzed using descriptive statistics, chi-square tests, and logistic regression ($p < 0.05$). Qualitative data were thematically coded to explore cultural norms, economic barriers, gendered decision-making, and perceptions of health facilities. Economic constraints, including financial hardship (61.2%), transport limitations (57.8%), and long distances to facilities (54.9%), were the most frequently cited barriers. Socio-cultural beliefs that childbirth is a strictly female domain, community reliance on TBAs (48.5%), and the influence of elders significantly reduced support for facility delivery. Mistrust of healthcare workers, perceived disrespect, and fear of hidden charges also discouraged facility utilization. Qualitative narratives highlighted that TBAs were preferred due to cultural alignment, affordability, flexible payment systems, and emotional support. Facility-based delivery in Nasarawa State is constrained by intersecting socio-cultural, economic, and health-system barriers. Strengthening male involvement, improving community, facility trust, addressing transport and affordability constraints, and integrating TBAs into supervised referral frameworks are vital. A context-specific Health Belief Model (HBM) is proposed to guide interventions.*

***Keywords:*** *Cultural Norms, Economic Barriers, Facility-based Delivery, Male Involvement, Nasarawa State, Traditional Birth Attendants.*

## Introduction

Maternal mortality in Nigeria remains one of the highest globally, accounting for nearly 20% of maternal deaths worldwide [1]. Despite extensive investments in the health sector, the utilization of facility-based delivery, one of the most effective interventions to reduce maternal mortality, remains low, particularly in rural regions [2, 3]. Evidence from sub-Saharan Africa consistently shows that decisions around childbirth are influenced by complex interactions of socio-cultural beliefs, economic capacity, spousal power dynamics, and perceived quality of health services [4–6].

In northern Nigeria, including Nasarawa State, childbirth is often viewed through the lens of cultural identity, traditional norms, and family hierarchy. These beliefs shape preferences for TBAs, who are perceived as more accessible, experienced, respectful, and culturally aligned with community expectations [7, 8]. Studies show that TBAs maintain strong influence due to trust, proximity, affordability,

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and emotional support during labour, factors often absent in overcrowded or under-resourced health facilities [9–11].

Economic barriers also play a decisive role. Transport costs, informal fees, out-of-pocket charges for supplies, and the opportunity cost of leaving home for facility care significantly reduce the likelihood of facility attendance [12, 13]. Long distances and poor road networks in rural Nasarawa further exacerbate delays in seeking skilled birth attendance (SBA) [14]. According to the Three Delay Model, delays in deciding to seek care and delays in reaching care contribute significantly to preventable maternal deaths [15].

Men play a pivotal role as financial providers and household decision-makers in northern Nigeria. However, studies reveal that men often perceive childbirth as a women-only affair, resulting in limited involvement in birth preparedness or emergency planning [16, 17]. This gap is critical because men also control the financial resources required for facility delivery. When male partners lack knowledge, awareness, or trust in health facilities, the likelihood of facility-based delivery declines [18–20]. Similarly, community leaders, including elders, religious leaders, and TBAs, shape norms that either support or discourage facility utilization [21].

Health-system constraints also contribute. Perceived disrespect, poor communication, long waiting times, discriminatory attitudes, and limited staffing reinforce mistrust of skilled birth attendants [22, 23]. Several studies in Nigeria have shown that women avoid facilities not only because of cost but also due to past negative experiences or stories within their communities [24–26].

Given these multidimensional barriers, a holistic behavioral framework is needed to understand and address the determinants of maternal health-seeking behavior. The Health Belief Model (HBM) provides a useful lens for examining how perceived susceptibility to complications, perceived severity, perceived benefits of facility delivery, perceived barriers, self-efficacy, and cues to action shape decision-making [27–29]. Adapting this model to the specific socio-cultural realities of Nasarawa State enables the development of more effective interventions targeting male involvement, community mobilization, and TBA collaboration.

## Materials and Methods

### Study Design

A mixed-methods cross-sectional design was used to examine the socio-cultural and economic barriers influencing facility-based delivery in Nasarawa State. The combined design allowed for triangulation of quantitative and qualitative findings, strengthening the interpretation of both community-level beliefs and individual determinants of health-seeking behavior [30–32].

### Study Setting

The study was conducted across three Local Government Areas (LGAs), Akwanga, Keffi, and Lafia, which represent distinct socio-cultural zones of Nasarawa State. These LGAs include rural and peri-urban populations with historically low facility-delivery rates, strong reliance on TBAs, and limited access to transport and emergency obstetric services [33, 34].

### Study Population

The quantitative component included married men aged 18–65 years who had at least one childbirth experience within the past five years. This population was selected because men are typically the primary decision-makers and financial providers in childbirth-related health-seeking behavior in northern Nigeria [16, 18, 35].

The qualitative component included:

1. Male community leaders
2. Traditional birth attendants (TBAs)
3. Religious leaders
4. Women leaders

5. Senior family elders
6. Health workers (nurses, CHEWs, and midwives).

These actors were purposively selected because they influenced maternal health decisions in rural households [21, 36].

## Sample Size and Sampling Strategy

### Quantitative Sample

A sample size of 443 men was derived using the Cochran formula for cross-sectional studies, assuming a 50% prevalence of barriers to facility delivery, a 5% margin of error, and 95% confidence level. A multistage sampling approach was used: LGAs were randomly selected; wards were stratified; households were selected through systematic sampling; and eligible men were interviewed [37].

### Qualitative Sample

A total of:

1. 12 FGDs (6–10 participants each)
2. 21 KIIs
3. 46 IDIs were conducted until thematic saturation was attained [38].

## Research Instruments

### Quantitative Tool

A structured questionnaire adapted from validated maternal health and male-involvement studies in Nigeria, Kenya, and Ghana [39–40] was used. It comprised:

1. Socio-demographic characteristics
2. Economic barriers (transport, costs, opportunity cost)
3. Cultural norms and gender roles
4. Knowledge of danger signs
5. Perceptions of healthcare workers
6. Household decision-making processes

Reliability testing yielded a Cronbach's α of 0.81 and KR-20 of 0.74, indicating internal consistency.

### Qualitative Guides

Interview guides covered themes such as:

1. Men's perceptions of childbirth
2. Cultural norms regarding facility delivery
3. Trust in TBAs versus health workers
4. Transport and cost barriers
5. Community expectations for male involvement
6. Decision-making hierarchies in childbirth

Tools were reviewed by maternal health experts and pilot-tested in a rural community.

### Data Collection Procedures

Trained research assistants fluent in Hausa and Eggon conducted household surveys and interviews. Qualitative interviews were audio-recorded with consent, transcribed verbatim, and translated into English where necessary.

## Data Analysis

### Quantitative Analysis

Data were analyzed using SPSS v25. Descriptive statistics (frequencies, percentages, means) were used to summarize variables. Chi-square tests examined associations between socio-demographic variables and perceptions of facility delivery. Logistic regression assessed predictors of non-facility delivery, controlling for economic and socio-cultural variables [31].

### Qualitative Analysis

Thematic analysis was conducted following Braun & Clarke's six-step approach. Codes were grouped into themes such as:

1. Financial barriers
2. Cultural norms and gender roles
3. Perception of health workers
4. TBA preference
5. Decision-making dynamics

Findings were merged with quantitative patterns in the interpretation stage.

## Ethical Approval

Ethical approval was obtained from the Texila American University Research Ethics Committee (Ref: TAU/PH/025/2025) and the

Nasarawa State Ministry of Health Ethics Board. Community entry was facilitated through local leaders. Written informed consent was obtained from all participants after explaining the purpose, benefits, and risks of the study. Confidentiality was ensured by using identification codes instead of names and by storing data in password-protected files.

## Results

### Sociodemographic Characteristics

**Table 1.** Sociodemographic Characteristics of Male Respondents (N = 443)

| Variable | Frequency (n) | Percentage (%) |
|---|---|---|
| **Age (years)** | | |
| 18–30 | 126 | 28.4 |
| 31–45 | 203 | 45.8 |
| 46–65 | 114 | 25.8 |
| **Occupation** | | |
| Farmer | 214 | 48.3 |
| Trader | 96 | 21.7 |
| Artisan | 57 | 12.9 |
| Civil servant | 76 | 17.2 |
| **Household income (monthly)** | | |
| < ₦30,000 | 258 | 58.2 |
| ₦30,000–₦60,000 | 121 | 27.3 |
| > ₦60,000 | 64 | 14.4 |
| **Education level** | | |
| No formal education | 128 | 28.9 |
| Primary | 102 | 23.0 |
| Secondary | 156 | 35.2 |
| Tertiary | 57 | 12.9 |

Table 1 presents the sociodemographic characteristics of the 443 male respondents included in the study. The distribution highlights that the majority of participants were in their economically active years, with most engaged in farming or informal occupations, reflecting the rural economic profile of Nasarawa State. Education levels varied widely, though a substantial proportion had only primary schooling or no formal education, which may influence health-related knowledge and decision-making. Household income levels were generally low, underscoring the economic constraints that shape access to maternal health services. These characteristics provide important context for understanding how socio-economic realities intersect with cultural norms to influence support for facility-based delivery.

These results indicate that the majority of men were in their economically productive years (31–40), mostly farmers with low to moderate income levels. Similar socioeconomic patterns have been found to limit access to maternal health services across rural Nigeria [7].

## Economic Barriers to Facility Delivery

**Table 2.** Economic Barriers Reported by Respondents

| Barrier | Frequency (n) | Percentage (%) |
|---|---|---|
| Lack of transport money | 256 | 57.8 |
| Long distance to the facility | 243 | 54.9 |
| High cost of delivery items | 221 | 49.9 |
| Unexpected charges at facilities | 187 | 42.2 |
| Loss of daily wages during facility visit | 169 | 38.1 |

Table 2 shows the key economic barriers reported by male respondents that hinder women's access to facility-based delivery in Nasarawa State. The most frequently cited constraints include lack of transport money, long distances to health facilities, and the high cost of delivery-related supplies. Respondents also noted concerns about unexpected or informal charges at health facilities, as well as the loss of daily wages when accompanying their wives for delivery. These findings highlight how household financial limitations and broader structural challenges significantly reduce the likelihood of seeking skilled birth care.

Lack of transport funds was the most common constraint (57.8%), consistent with evidence from similar rural health studies in Nigeria and Kenya [12, 13].

## Qualitative Insight

A male FGD participant noted:

> *"Even if we want our wives to deliver in the hospital, the transport alone can finish one's pocket. And if labour starts at night, it is even harder."*

Another TBA emphasized:

> *"People come to us because we don't ask for big money. In the hospital, they will tell you to buy this and buy that."*

These narratives reinforce the quantitative findings and align with studies showing that affordability and flexibility attract women to TBAs [9, 10].

## Socio-Cultural Barriers

**Table 3.** Socio-Cultural Barriers Reported by Men

| Barrier | Frequency (n) | Percentage (%) |
|---|---|---|
| Belief that childbirth is a women's affair | 205 | 46.3 |
| Family elders influence delivery decisions | 187 | 42.2 |
| Preference for TBA due to cultural familiarity | 215 | 48.5 |
| Perception that facility delivery is unnecessary for "normal labour." | 164 | 37.0 |
| Religious or traditional beliefs discouraging facility delivery | 129 | 29.1 |

Table 3 outlines the socio-cultural factors that influence men's support for facility-based delivery in Nasarawa State. The responses show that cultural expectations, such as the belief that childbirth is solely a woman's affair, and the strong influence of family elders

significantly shape delivery decisions. Nearly half of the respondents expressed a preference for traditional birth attendants due to cultural familiarity and longstanding community trust. Many men also viewed facility delivery as unnecessary for "normal" labour, reflecting deep-rooted perceptions about childbirth. These socio-cultural norms play a critical role in reinforcing home delivery practices and limiting male involvement in maternal health.

Nearly half of respondents (46.3%) believed childbirth planning was strictly a woman's role, consistent with patriarchal norms documented in northern Nigeria [7, 16].

## Qualitative Insight

A community elder remarked:

> *"Our tradition is that birth happens at home unless there is a sign of danger. That is how our mothers delivered."*

Another man noted:

> *"If the elders say she should stay home, who am I to go against them?"*

Such hierarchies are consistent with findings from West African studies showing the strong influence of senior men and mothers-in-law in maternal decisions [21, 36].

## Perceptions of Health Workers and Facility Quality

**Table 4.** Perceptions Influencing Trust in Health Facilities

| Perception | Frequency (n) | Percentage (%) |
|---|---|---|
| Fear of disrespectful treatment | 192 | 43.3 |
| Long waiting time | 175 | 39.5 |
| Lack of empathy from health workers | 167 | 37.7 |
| Fear of unnecessary procedures | 98 | 22.1 |

Table 4 presents respondents' perceptions of health facility quality and the behaviors of healthcare workers that influence trust and willingness to support facility-based delivery. Many men reported concerns about disrespectful treatment, long waiting times, and a perceived lack of empathy from health workers, factors that discourage families from choosing facility births. A notable proportion also expressed fear of unnecessary medical procedures, which further reduces confidence in formal maternal health services. These perceptions highlight how interpersonal experiences and facility-level practices shape community trust and ultimately influence delivery decisions.

Over 40% expressed fear of disrespect, a major deterrent also highlighted in national maternal health research [22, 24, 26].

## Qualitative Insight

A woman leader shared:

> *"Many women come back crying because nurses insult them. That is why they go to TBAs who treat them with care."*

### Predictors of Non-Facility Delivery

Logistic regression identified:

1. Low household income (AOR = 2.41, $p < 0.01$)
2. Preference for TBA (AOR = 2.89, $p < 0.01$)
3. Negative perception of health workers (AOR = 1.74, $p < 0.05$)
4. Distance > 5 km to facility (AOR = 2.16, $p < 0.05$)

as significant predictors of home delivery, similar to findings in Ghana, Kenya, and Ethiopia [39].

## Qualitative Themes

### *Theme 1: Strong Influence of TBAs*

TBAs were described as:

1. Trustworthy
2. Available at all hours
3. Culturally aligned
4. Flexible with payment
5. Familiar members of the community

These attributes mirror findings across West Africa [11, 36].

### *Theme 2: Male Financial Control*

Men acknowledged their role as financial gatekeepers but lacked adequate information:

> *"If we don't have money, how can she go to the hospital? Labour does not give you notice."*

### *Theme 3: Limited Male Participation*

Most men expressed willingness to support facility delivery if given information and engaged through community channels.

### *Theme 4: Mistrust of Health Facilities*

Reports of:

1. Rude treatment
2. Hidden charges
3. Poor communication
4. Long queues

were echoed consistently across interviews.

## Discussion

This mixed-methods study examined the socio-cultural and economic barriers affecting the uptake of facility-based delivery among rural communities in Nasarawa State. Findings reveal a complex interplay of financial constraints, deeply rooted cultural norms, influence of community gatekeepers, and health-system perceptions, echoing patterns observed across low-resource settings in sub-Saharan Africa [1–6].

### Economic Barriers as Primary Determinants of Delivery Location

Economic constraints, including unaffordable transport, long distances, opportunity cost, and informal facility fees, emerged as the most significant drivers of home delivery. The majority (57.8%) cited lack of transport money as a major limitation, consistent with reports from rural Nigeria, Ethiopia, and Kenya where transportation cost remains a major contributor to "Delay 2" in the Three Delay Model [12, 13].

The high proportion of farmers and low-income respondents in this study reinforces the finding that poverty directly influences maternal health-seeking behavior [7].

Qualitative findings underscored this: men and TBAs described transportation as "the first obstacle" and facility care as expensive, aligning with similar studies showing that households often resort to TBAs because of flexible payment arrangements, accessibility, and perceived affordability [9–11].

### Cultural Norms and Gender Dynamics in Childbirth Decision-making

The belief that childbirth is a private, predominantly female affair, reported by 46.3% of respondents, mirrors findings from northern Nigeria, Ghana, and Mali, where childbirth is culturally situated within women's spheres and male involvement is not traditionally emphasized [7, 14, 16, 17].

However, paradoxically, men remain the primary financial decision-makers and thus significantly influence women's access to skilled birth attendance [18–20].

FGD and KII narratives revealed that community elders, including mothers-in-law and senior male relatives, often overshadow the husband's preferences through culturally grounded authority structures, reinforcing findings from studies on patriarchal family systems in West Africa [21, 36].

The perceived normalcy of childbirth ("only a problem when something goes wrong")

strongly influenced decisions to bypass facilities, replicating patterns described in maternal studies across sub-Saharan Africa where complications are not anticipated and preventive facility-based delivery is undervalued [14].

## Preference for Traditional Birth Attendants (TBAs)

TBAs emerged as highly trusted figures due to cultural alignment, emotional support, proximity, and flexible payments. Nearly half (48.5%) of respondents preferred TBAs for these reasons.

This finding aligns with evidence that TBAs remain the cornerstone of childbirth care in many African rural communities, especially where health facilities are perceived as unfriendly, distant, or unaffordable [9–11, 36].

Qualitative narratives reinforced TBAs' role as:

1. culturally accepted
2. always available
3. empathetic and patient
4. financially negotiable

This confirms studies demonstrating that even when TBAs lack formal skills, their interpersonal relations and cultural embeddedness allow them to maintain strong influence [10, 35].

## Mistrust of Healthcare Workers and Facility Quality

A major barrier identified was negative perception of health workers, reported by 43.3% as fear of disrespect, 39.5% citing long waiting time, and 37.7% pointing to lack of empathy.

These findings are consistent with literature showing that women frequently avoid facility-based delivery due to perceived or experienced mistreatment, discrimination, verbal abuse, and lack of dignity in care [22–26].

Poor communication and strained provider–patient relationships reinforce mistrust, particularly among low-literate populations who already feel marginalized. This supports earlier findings that person-centered maternity care remains weak in Nigeria and many LMICs [24].

## Predictors of Non-Facility Delivery

Logistic regression results indicate that:

1. Low income,
2. TBA preference,
3. Negative perception of facility staff, and
4. Distance to health facility

significantly predicted non-facility delivery.

These findings align with multi-country evidence showing that socioeconomic disadvantage, reliance on TBAs, and poor facility experiences remain strong predictors of home births [11].

## Implications for the Health Belief Model (HBM)

Adapting the HBM reveals that:

1. Perceived susceptibility to complications remains low, childbirth is viewed as natural.
2. Perceived severity is recognized only retrospectively after complications occur.
3. Perceived benefits of facility delivery are overshadowed by mistrust, distance, and cost.
4. Perceived barriers (economic + cultural) strongly outweigh motivations to seek skilled delivery.
5. Self-efficacy is low regarding men's involvement in planning or accompanying spouses.
6. Cues to action remain weak due to limited community-level mobilization.

This confirms findings that HBM constructs strongly predict maternal health behavior in LMICs and should guide program interventions [27–29]. The Health Belief Model is depicted in Figure 1 below:

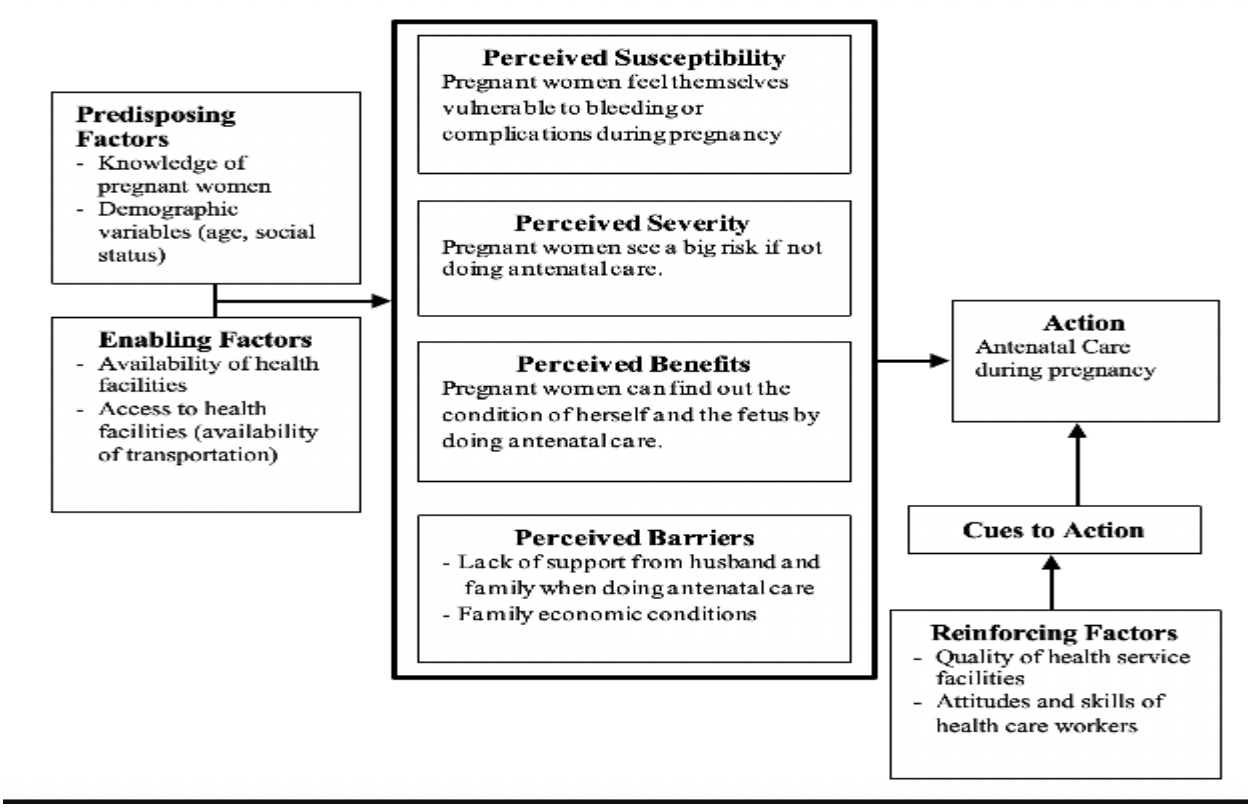


**Figure 1.** The Health Belief Model

***Source:*** *Adopted and modified from Glance et al, 2002.*

## Conclusion

This study highlights that facility-based delivery in Nasarawa State is influenced by multilayered barriers that intersect across economic, cultural, and health-system domains.

Economic constraints remain the most dominant impediment, while socio-cultural norms, patriarchal decision-making, TBA preference, and mistrust of health workers further discourage the uptake of skilled birth attendance.

The findings underscore that improving facility delivery requires:

1. Strengthened male involvement in birth preparedness,
2. Community-driven behaviour change strategies,
3. Improved interpersonal quality of care and respectful maternity care, and
4. Collaborative partnerships between TBAs and the formal health system.

To address these complexities, a context-specific adaptation of the Health Belief Model (HBM) is proposed as a foundation for designing high-impact behavioural interventions.

Only by addressing these interconnected barriers can Nasarawa State achieve significant improvements in maternal and neonatal outcomes.

## Policy and Program Recommendations

1. Strengthen Male Engagement Strategies
   - Implement community education programs targeting male heads of households.
   - Introduce couple-focused antenatal counseling sessions.
   - Engage men's groups, farmers' associations, and religious institutions in maternal health promotion.
   - Provide male-friendly ANC hours to increase participation.

Evidence shows male involvement improves emergency preparedness and increases facility delivery rates [17, 18].

2. Integrate and Supervise Traditional Birth Attendants (TBAs)
    - Train TBAs on early recognition of danger signs.
    - Establish referral linkages between TBAs and nearest PHCs.
    - Incentivize TBAs for timely referrals rather than direct delivery services.
    - Include TBAs in community surveillance and outreach activities.

Studies show that supervised TBA collaboration significantly increases facility utilization and reduces delays [9–11].

3. Address Transport and Cost Barriers
    - Introduce community emergency transport schemes (motorcycles, community ambulances).
    - Expand free delivery services and reduce informal charges.
    - Provide vouchers or conditional cash transfers for facility delivery.

Transport interventions have been shown to reduce maternal deaths in rural African settings [13].

4. Improve Quality of Care and Reduce Disrespectful Practices
    - Implement respectful maternity care (RMC) training for health workers.
    - Strengthen supervision and feedback mechanisms.
    - Reduce waiting times by reorganizing triage and labour ward flow.
    - Encourage multilingual communication in local languages.

Quality improvements have been directly linked to increased health facility utilization [22–26].

5. Community-Led Behaviour Change Communication (BCC)
    - Engage village heads, religious leaders, women leaders, and TBAs as change advocates.
    - Disseminate narratives and testimonials of safe facility deliveries.
    - Use radio programs, community theatre, and peer educators to challenge harmful norms.

Culturally contextual BCC has proven effective in shifting maternal health behaviours [7, 21].

6. Strengthen the Primary Healthcare (PHC) System
    - Upgrade rural facilities, ensure availability of skilled birth attendants, and equip labour rooms.
    - Improve night-time service availability to reduce reliance on TBAs.
    - Ensure essential drug and supply availability to eliminate hidden costs.

Stronger PHC systems correlate with higher facility delivery rates across Africa [24].

## Strengths and Limitations

### Strengths

This study employed a rigorous mixed-methods design, allowing for a comprehensive understanding of the socio-cultural and economic barriers influencing facility-based delivery in Nasarawa State. The inclusion of diverse community actors, men, elders, traditional birth attendants, women leaders, and healthcare workers, provided rich, multi-layered insights into decision-making dynamics that are often overlooked in maternal health research. The large quantitative sample of married men strengthened the statistical validity of findings, while qualitative interviews enhanced contextual interpretation and cultural depth. Using the Health Belief Model (HBM) further enabled systematic analysis of behavioural constructs shaping maternal health-seeking patterns.

### Limitations

The cross-sectional design limits causal inference, as the study captures perceptions and behaviours at a single point in time. Self-

reported data may also be subject to recall bias or social desirability bias, especially regarding sensitive cultural practices and male involvement. Qualitative findings, though rich, reflect the perspectives of selected participants and may not fully represent all communities in Nasarawa State. Additionally, the study did not include direct observations of childbirth practices, which could have provided further behavioural context.

## Ethical Approval

Ethical approval was obtained from the Ethics Review Committee of the Nasarawa State Ministry of Health in accordance with the National Code of Health Research Ethics Committee (NHREC Protocol No:18/06/2017), before commencement of the study. Verbal and written consent were obtained from the study participants. Also, participants were given the exclusive right to opt out of the study at any time. The benefits of the research were clearly explained to the participants. No harm was done to the participants, and their personal information was kept on a password-protected computer to ensure confidentiality. The password was only accessible to the investigators and the data analyst.

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There was no form of funding associated with this study.

## Data Availability

The datasets that were used for this study are available from the corresponding author upon reasonable request.

## Author Contributions

Abraham Ajigasokoa Ahmadu: Conceptualization of the study, development of data collection tools, data collection, quantitative and qualitative analysis, drafting and critical revision of the manuscript.

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## Conflict of Interest

The author declares that there is no conflict of interest regarding the publication of this manuscript.

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# Feasibility of Establishing Community-Based Health Insurance (CBHI) Scheme: A Comparative Analysis of Existence of CBHI Preconditions, and Capacity and Willingness to Pay in 5 Locations in Adamawa, Nigeria

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***Abstract***

*Health systems financing in Adamawa is heavily dependent on out-of-pocket (OOP) expenditure. These expenditures predispose poor households to financial hardship, and blocks progress towards universal health coverage. Hence, adopting alternative health financing mechanisms is critical to expanding informal sector and vulnerable population' access and utilization of quality healthcare services. This study evaluated the feasibility of establishing community-based health insurance (CBHI) scheme based on findings from assessment of six preconditions for setting up CBHIs, and respondents' capacity and willingness to pay for CBHI in five locations in Adamawa. The mixed method study adopted used the sequential explanatory design classification method. The method used to elicit willingness to pay (WTP) is an adaptation of the contingent valuation method and specifically, the bidding game method using the Dutch system sequence. Findings showed respondents willing to pay a fee to join as individuals and enrol household members comprised 88.5% and 85.3% respectively. The mean individual out-of-pocket (OOP) expense was N3,820 in Damare, N5,617 in Dumne, N4,819 in Imburu, N4,732 in Mbilla, and N7,863 in Sabon Pegi. These amounts were at least twice the highest willingness to pay premium option of 1,500 offered for a standard CBHI service package. Expressing mean personal income left after spending on basic necessities as a percentage of mean personal monthly income in each district resulted in values which ranged from 9.94% in Imburu, to 56.2% in Damare. Findings from this study has demonstrated the existence of the six preconditions for setting up CBHI scheme, and ultimately, the feasibility for establishing CBHI scheme in Adamawa. The study also showed that the willingness and capacity to pay was substantial enough to promote the successful roll out of a viable community driven CBHI scheme.*

***Keywords:*** *Adamawa, Capacity to Pay, Community-Based Health Insurance, Feasibility, Willingness to Pay.*

## Introduction

One of the major barriers to achieving universal health coverage (UHC) is the fiscal cost of equitably expanding healthcare access. To achieve UHC, substantial human, financial, and technical resources will have to be mobilised. The financial cost is considered higher in lower-middle-income countries like Nigeria, which are characterised by widespread poverty and multi-dimensional deprivations, such as inadequate access to healthcare and other basic necessities like clean water, sanitation, and education [1]. Poor healthcare and illness are universally dreaded as a source of destitution due to the cost of healthcare and the income loss associated with illness. In the absence of governments' subsidies, direct

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provision of care, donor intervention, and a prepayment system such as health insurance and tax-based healthcare financing, households are exposed to the financial risk of paying large medical bills from out-of-pocket expenses that in some cases can be described as either catastrophic or impoverishing [2]. Countries like Nigeria with relatively large informal sectors and limited information around household income often experience the exclusion of many households from national income tax schemes. This poses challenges when designing social protection programmes. The implication is that standard frameworks used in expanding formal sector health insurance enrolment are largely difficult to apply to the expanding informal sector in lower middle-income countries [3].

Nigeria's multidimensional poverty index report, in 2022, placed Adamawa's unemployment rate at 54.9% for 2020. Out of the 44.1% of residents who were employed in the state, more than half, 24.7% were considered underemployed [4]. Furthermore, Adamawa's fiscal performance ranking characterised it as one of the states with limited capacity for generating internal revenues**.** Hence, financing for health and social protection interventions through a broad tax base is inherently difficult considering the high poverty index, high unemployment rate, high debt profile, and the largely informal sector-based economy available in the state [5].

A British Broadcasting Corporation (BBC) publication on maternal mortality provided ample illustration of the state's performance around a key health outcome. The report indicated Nigeria as the world's worst country to give birth in, considering the country accounts for 29 percent of maternal deaths recorded worldwide [6]. The problem of access to skilled birth attendants is considered a major contributor to maternal deaths, given that less than half, or about 50 per cent, of all births in Nigeria were delivered by a skilled health worker. In Adamawa, the percentage of births assisted by skilled providers such as doctors, nurses or midwives is 24.4 percent. This is less than the North Eastern region's average of 32.3 percent and also far less than the national average of 45.9 percent. The percentage of institutional deliveries was 41.6 percent compared to the Northeastern states' average of 37.2 percent, and a national average of 43.4 percent. For under-5 mortality rates, while the national average is 110 deaths per 1,000 live births, the average rate for Adamawa and the six North Eastern states is 144 and 127, respectively [7]. With the relatively low percentage of births assisted by skilled providers, the problem of poor access is arguably a major contributor to the high maternal and child mortality rate recorded in Nigeria [8]. Factors including lack of access to antenatal care services, emergency caesarean sections, and delays in seeking care experienced by especially rural and low-income communities have been linked to the state's relatively high maternal mortality rate. This is corroborated by findings from studies which showed most maternal deaths at the state's teaching hospital, Modibbo Adama University Teaching Hospital (MAUTH), occurred within 24 hours of admission. The study further attributes delayed access, and specifically, delay in seeking care, as a major contributor to the high mortality rates documented [5].

Furthermore, the World Health Organization (WHO) asserts that chronic diseases account for approximately 71% of all global deaths. WHO also forecasted that by 2030, about 70% of all deaths in Nigeria will result from chronic diseases [9]. Poor access to quality healthcare, especially in rural communities, also contributed to hindering effective management of chronic conditions, negatively impacting a large population of Nigerians. Delayed access or outright lack of access may lead to delayed diagnosis, complications, and rising mortality rates for poorly managed cases. In Adamawa, only 62.3 percent of women prescribed medication following a diagnosis of high blood

pressure were actually taking medications for high blood pressure [7].

Because many chronic disease sufferers lack health insurance, catastrophic and even impoverishing health spending can result from households' efforts to treat chronic conditions, including complications arising from poorly managed cases. Nigeria is reported to have covered about 21 million Nigerians, an estimated 9 percent of her population, in health insurance schemes, with more than 2.4 million new enrollees covered in 2024 alone. At about 9 percent coverage, health insurance enrolment in Nigeria is relatively low, suggesting poor access to quality healthcare in a country with more than 237 million people. Nigeria's government plans to expand health insurance enrolment to at least 44 million residents by 2030 [10]. This plan amounts to expanding coverage to 18 percent within the next 5 years, implying an additional 19 million people by 2030, at an average annual enrolment of about 3.1 million new enrollees.

Adamawa is among the 27 states with health insurance enrolment rates that are at or below Nigeria's average coverage of 9 percent. Adamawa has enrolled 6 per cent of its population into health insurance [11]. As of September, 2025, Adamawa's total health insurance coverage of 364, 436 is the highest coverage amongst the six North Eastern states of Bauchi, Taraba, Borno, Yobe, and Gombe state. Enrolment is distributed among the following health insurance programs currently in existence in Adamawa: the Public Sector Social Health Insurance Program For Government Employees with 95,078 enrolees; the Group, Individual, And Family Social Health Insurance Programme (GIFSHIP) with 7,229 enrolees; Organized Private Sector Social Health Insurance Program (OPSSHIP) which is administered by National Health Insurance Authority (NHIA); and the State Social Health Insurance Schemes (SSHIAS) managed by the Adamawa State Health Insurance Management Agency (ASCHMA) which has a total of 113, 160 enrolees; Others include the Tertiary Institution's Social Health Insurance Programme (TISHIP) with 25, 709 enrolees; and the Private Health Plan provided by Health Maintenance Organizations (HMOs) with 7,211 enrolees. The Basic Healthcare Provision Fund (BHCPF), managed by ASCHMA, covers 116,045 enrollees. As of September, 2025, Adamawa has the 3rd highest BHCPF enrolment in the country after Kano with 231, 406 enrolments, and Oyo with 116, 805 enrolments [12].

A study which evaluated the effectiveness of Nigeria's National Health Insurance Policy from inception to date identified the following factors to have contributed to the low enrolment status. They include inadequate public awareness, limited enrolment of the rural population and the informal sector, healthcare funding constraints, public apathy, and the scheme's poor management with its associated delays in payment to health facilities by HMOs [13].

CBHI has widely been acknowledged to increase healthcare access among the largely uninsured informal sector who comprised the majority of Nigeria's population. There is the need for community-led effort targeted at implementing adaptable and potentially sustainable health insurance schemes that are best suited for Nigeria, and more specifically, Adamawa's socio-economic contexts. Given that social health insurance accounted for 90 percent of all health insurance enrolments, social health protection schemes such as community-based health insurance schemes should be painstakingly explored for their inherent potential to improve access to healthcare services, reduce out-of-pocket expenses, reduce catastrophic health spending, and pool resources for more effective and qualitative service delivery [10].

It follows that designing sustainable CBHIs will not only require drawing lessons from the experiences of other countries, but more importantly, will require that contextual factors

are evaluated, understood, and accounted for during the design and implementation phase. The transformation of the Rwandan healthcare systems resulting from the introduction and expansion of the Community Based Health Insurance (CBHI) schemes can be considered a viable case study for other countries to draw out lessons from. As of 2014, CBHI schemes alone accounted for 76.4 percent of health insurance coverage compared with national health insurance and private or employer health insurance which accounted for 5 percent and 0.7 percent respectively. And by 2015/2016, health insurance enrolment rose to 81.6 percent for CBHI alone, and a cumulative 87 percent for CBHI, national and private health insurance.

Coverage from the Rwandan brand of CBHI before 2006 was recognised as one of the highest in Sub-Saharan Africa even while the scheme was still voluntary. This success is largely attributed to the country's adoption of a unique brand of health insurance that evolved from an essentially voluntary CBHI scheme to one whose enrolment became mandatory and also subsidised. Rwanda also faced the typical challenge of low enrolment associated with voluntary interventions that were prone to adverse selection. To mitigate the challenge of low coverage, the Rwandan government made CBHI enrolment compulsory for Rwandans in 2006 [15].

Nonetheless, literature is rife with evidence of CBHI's positive impact on healthcare financing systems and its role as a promising tool for effectively delivering easily accessible, affordable, and efficient healthcare services [16, 17]. A 2025 publication of the World Health Organization (WHO) suggests that a CBHI that relies only on voluntary, small-scale schemes with little or no subsidisation of poor and vulnerable populations is bound to play a limited role in helping countries advance towards universal health coverage [18].

It follows that designing viable and sustainable community-based health insurance schemes will not only require drawing lessons from the experiences of other countries, but more importantly, will require that contextual factors are evaluated, understood, and accounted for during the design and implementation phase. CBHIs have been implemented in a few states in Nigeria but at a relatively low scale. Early efforts to establish CBHI in Kwara, Lagos, Ogun, the FCT, Plateau, and Anambra states offer valuable lessons. Notable lessons from Kwara's experience include the need to adopt an intensive marketing approach to attracting and retaining enrollees; the need to align premium thresholds to enrollees' willingness and especially capacity to pay; the need for standards for quality of care to be established and monitored for universal compliance across participating health facilities; the understanding that an attractive CBHI package cannot be funded by low-income households without subsidisation; and lastly, the fact that requiring even the poorest enrollee to pay a token, no matter how small, will make them value their membership [19].

A better perspective on how insurance works will largely depend on how well we understand contextual factors such as clients' perception of health insurance and the challenges they face while accessing services. It is also important to analyse affordability by assessing households' capacity and willingness to pay several flat-rate premiums for hypothetical CBHI schemes. In effect, establishing an alternative health financing mechanism that, amongst other benefits, increases access to quality healthcare, offers protection from the catastrophic impact of high out-of-pocket health spending, improves quality of life, and strengthens health systems is paramount.

The general objective of this research was to assess the feasibility of establishing a community-based health insurance scheme and also assess household willingness and capacity to pay for community-based health insurance premiums. The specific objectives included the following: the assessment of the existence of

the six preconditions for establishing a community-based health insurance scheme in target communities; the determination of status of institutional readiness for the establishment of CBHI scheme; and the assessment of the willingness and capacity to pay for a hypothetical community-based health insurance service package. A comparative analysis of findings from all 5 communities was also made.

The six preconditions for establishing CBHI scheme which were assessed included (1) assessed the existence of traditions of mutual aid based on assessment of the presence of functional cooperative societies. (2) assess that health services of acceptable quality exist and were informed by public perception of the quality of healthcare services. (3) State of public confidence in the promoters of health service delivery. The other two preconditions include (4) assessed the existence of a trend of socio-economic development and (5) assessed the likelihood that the number of enrollees of a pilot scheme will be sufficiently high within the first year of establishing a scheme. ILO considers the first four preconditions to be indispensable and strongly advocates for a halt in the process of establishing CBHI if any of these preconditions are lacking [20].

Literature around the feasibility of establishing community-based insurance schemes in Adamawa is limited. This is the first comparative study around the feasibility of piloting a community-based health insurance scheme and household willingness and capacity to pay for CBHI scheme in Adamawa state. Findings from this study are expected to inform policy decisions around scaling up health insurance access beyond its current state coverage of below 10%. Data and technical insights generated will inform the tailored design and implementation of context-specific and community-driven – community-based – health insurance schemes. This serves as a baseline and an important technical resource for other scholars interested in carrying out further research around CBHI establishment and scale-up. Insights obtained from capacity and willingness to pay will also help programme managers address highlighted challenges. An important outcome expected from this study will be the policy implication of findings around the inter-relationship between out-of-pocket expense, capacity to pay, and willingness to pay, against the backdrop of the state's vulnerability status.

## Materials and Methods

### Study Setting

The study was carried out in five wards within four local government areas (LGAs) in Adamawa, Nigeria. These wards include Damare in Girei LGA; Sabon Pegi and Imburu wards in Numan LGA; Dumne in Song LGA; and Mbilla in Mayobelwa. On the other hand, FGDs were conducted in Girei I ward of Girei LGA, Namtari ward of Yola South LGA, and Ajiya ward in Yola North LGA (Figure 1).

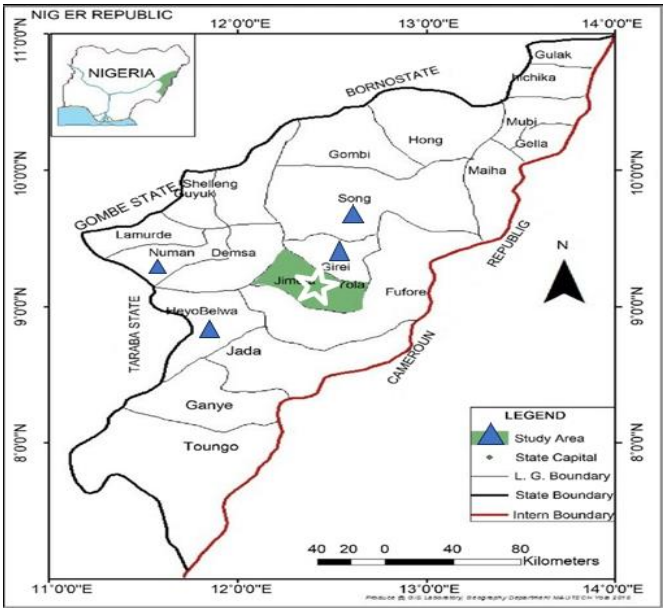


**Figure 1:** A map of Adamawa showing study areas

*Source: Adapted from Adebayo, 1999 with modifications [45].*

## Study Design

This study adopted the mixed-method approach involving qualitative and quantitative studies. The sequential explanatory design classification method was adopted. While the descriptive cross-sectional survey, a quantitative method, informed the strategy for conducting all household-based assessments, the qualitative explorative approach, guided by semi-structured key informant interviews (KIIs) and focused group discussions (FGDs), was adopted for assessing the existence of preconditions for setting up CBHIs in five (5) communities, and institutional readiness.

The method used to elicit willingness to pay (WTP) is an adaptation of the contingent valuation method, and more specifically, the bidding game method using the Dutch system sequence (moving from highest amount to lowest amount). The willingness to pay assessment sought respondents' most preferred WTP amounts for the same standard basic minimum package of health service (BMPHS) currently offered by the Basic Healthcare Provision Fund (BHCPF) supported health facilities. Six bid premium options were determined following interviews with community members (FGDs), interviews with health facility managers of BHCPF-supported health facilities, and interactions with officials of the Adamawa State Contributory Health Management Agency (ACHMA). The current premium for BHCPF-supported health insurance's basic minimum service package is N1,000, while the capitation paid to health facilities for each enrollee is N570. The perceived affordability of the following six premium-price variants for a hypothetical standard CBHI health service package was also elicited: N300, N400, N600, N800, N1000, N1200, and N1500.

## Sampling and Sample Size

The sample size for each community participating in the household-based survey was determined using Cochran's formula for determining a representative sample for proportions of large populations. No = Z2pq/e2. Where n is the minimum required sample size for a target population larger than 10,000; Z is the standard normal deviate set at 95% confidence interval (i.e., 1.96 for a 95% confidence interval); P is the estimated population proportion; (1 – p) or q is the complement of the population proportion; and D is the margin of error (or the desired level of

precision set at 0.05). Assuming a prevalence of rate of 60%, a minimum sample size of 368 was obtained. A total sample size of 480 was adopted to give room for at least 10% attrition and other potential data-related issues, such as missing data and data validation, that may lead to the discard of data. A significantly larger sample size was needed to accommodate the desired confidence interval and reliability expected for willingness to pay elicitation using the contingent valuation method.

This study's quantitative assessments adopted the convenience sampling technique as only participants who were available and accessible at the time of the research were considered. Participants of KIIs and FGDs were identified using purposive and criterion sampling techniques. This technique was adopted based on the need to identify individuals with relevant knowledge, experience, and authority. Criteria included those willing to engage in at least a 45-minute-long interview session.

## Data Collection

Quantitative household-based data was collected by trained enumerators distributed across the five study locations while using the pretested interviewer-administered paper and mostly mobile phone-assisted personal interviewing (MPAPI) technique using the Kobo toolbox software. Qualitative data was collected using audio recorded in-depth interviews and focused group discussions. Twelve (12) FGDs and ten (10) KII involving high-level public officials, persons of interest with knowledge of the healthcare system, leaders of mutual aid organisations, influential community persons, and representatives of international organisations.

Data collection was conducted between September 2024 and February 2025. Each enumerator signed a digital non-disclosure agreement pledging to keep respondents' information confidential and private. The initial questionnaire was revised following observation from pilot studies covering 100 households in Namtari and Doubeli wards in Yola South and Yola North LGAs, respectively.

The household-based questionnaire comprised the following sections: demographic and household characteristics; education and socio-economic characteristics; knowledge, attitude, and perception about health insurance; household income and out-of-pocket expenditure; preference for different health insurance packages; and source of income for paying the CBHI scheme. Other key sections include affordability and willingness to pay for six variants of willingness to pay premiums for hypothetical individual and family insurance service packages. Out of the 2,539 households targeted, informed consent and responses were obtained from 2,309 respondents, giving a response rate of 90%. Given that 110 data points were discarded for incompleteness, 95% of data (2,199) were eventually exported from the Kobo Collect toolkit and analysed using SPSS software (version 30.0).

## Data Analysis

1. Analysis of quantitative and descriptive data was conducted using Microsoft Excel 2016 and SPSS software version 30. Analysed data was presented in tables in the form of frequencies and percentages. All variables were subjected to frequency runs and logical data quality checks.
2. The content validity and reliability of this study's research instrument were enhanced by a total of five thematic area professionals with experience in health insurance, healthcare service delivery, and mixed-method research. Several important revisions were made following inputs from subject matter experts.
3. Analysis of qualitative data from FGDs and KIIs was done using the thematic analysis method, which is a qualitative research method used to identify, organise, analyse, and also interpret themes within a collated data set.

## Result of Quantitative Studies

### Descriptive Statistics & Sociodemographic Variables

#### Socio-Demographic Variables & Descriptive Statistics

Analysis of key socioeconomic variables is summarised in table 1. Overall, farming and trading, the two most prevalent occupations in all five communities, accounted for 44% (968) and 24.5% (539) of occupations, respectively. Farming was the highest preoccupation in 3 out of the 5 communities assessed. The three communities include Dumne in Song, Imburu in Numan, and Sabon Pegi, also in Numan. The highest distribution of respondents who were farmers was found in Dumne, Song, with 75.1% (307). Those who identified trading as their preoccupation were highest in Imburu, Numan, at 226 (50.3%). Overall, almost half of all the participants, 45.1% (991), in this study identified as self-employed.

The descriptive statistical analysis presented in Table 2 show that the mean age of respondents across the entire study is 42.25 years. The distribution of elderly participants above 65 years old was highest in Imburu with 54 (12%) and lowest in Mbilla with 0 (0%).

Descriptive data presented in table 2 showed the mean age of respondents in the entire study is 42.25 while the lowest mean age of study participants is 39.3 in Damare. The highest mean age was recorded in Imburu (45.83), Sabon Pegi (44.15), and Dumne (44.01). The distribution of elderly participants was therefore highest in Imburu with 54 (12%) and lowest in Mbilla with 0 (0%). Deviation from the mean was higher in Mbilla and lowest in Sabon Pegi ward. The mean number of children was lowest in Damare (2.44) and highest in Sabon Pegi (3.64) and Dumne (3.61). The number of children in households ranged from 0 to 9 across all 5 communities.

### Assessing Preconditions for Establishing Community-Based Health Insurance Scheme

#### Existence of Traditions of Mutual Aid or Solidarity within Target Populations (Precondition 1)

Table 3 showed the percentages of respondents who were current members of mutual aid organisations. The existence of mutual aid organisations has been established in all the study locations. The highest proportion of residents who are members of mutual aid organisations reside in Mbilla with 30.7% (95) compared to all other 4 study locations. Only 14.1% (309) of respondents in the entire study were current members of cooperative societies. Across all locations, farmers' cooperatives had the highest proportions of membership, and was present in all 5 study locations at the following percentages: 39.6% (190); 70.2% (287); 65.5% (294); 29.4% (124); and 66.3% (291) for Damare, Dumne, Imburu, Mbilla, and Sabon Pegi, respectively.

**Table 1.** Socio-demographic Characteristics by Ward

| | | **Total** | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** |
|---|---|---|---|---|---|---|---|
| | | Freq (%) | Freq (%) | Freq (%) | Freq (%) | Freq (%) | Freq (%) |
| | | 2199 (100) | 480 (100) | 409 (100) | 449 (100) | 422 (100) | 439 (100) |
| Age of Respondents | 18 – 29 | 318 (14.5) | 102 (21.3) | 38 (9) | 75 (16.7) | 48 (11.4) | 55 (12.5) |
| | 30 – 39 | 684 (31.1) | 180 (37.5) | 101 (24.7) | 97 (21.6) | 175 (41.5) | 131 (25.8) |
| | 40 – 49 | 618 (28.1) | 111(23.1) | 153 (37.4) | 106 (23.6) | 148 (35.1) | 100 (22.8) |
| | 50 – 59 | 353 (16.1) | 49 (10.2) | 80 (19.6) | 91 (20.3) | 43 (10.2) | 90 (20.5) |
| | 60 – 65 | 106 (4.8) | 19 (4.2) | 26 (6.4) | 26 (5.8) | 8 (1.9) | 27 (6.2) |
| | Above 65 | 120 (5.5) | 19 (4) | 11 (6.7) | 54 (12.0) | 0 (0) | 36 (8.2) |
| | Rural | 1735 (78.9) | 133 (27.7) | 406 (99.3) | 372 (88.2) | 401 (89.3) | 423 (96.4) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Geographical location | Urban | 464 (21.1) | 347 (72.3) | 3 (0.7) | 50 (11.8) | 50 (11.8) | 16 (3.6) |
| Gender | Male | 1369 (62.3) | 277 (57.7) | 301 (73.6) | 213 (47.4) | 336 (79.6) | 242 (55.1) |
| | Female | 830 (37.7) | 203 (42.3) | 108 (26.4) | 236 (52.6) | 86 (20.4) | 197 (44.9) |
| Occupation | Farmer | 968 (44.0) | 78 (16.3) | 307 (75.1) | 226 (50.3) | 77 (18.2) | 280 (63.8) |
| | Trader | 539 (24.5) | 149 (31.0) | 10 (2.4) | 163 (36.3) | 107 (25.4) | 110 (25.1) |
| | Artisan | 353 (16.1) | 147 (30.6) | 22 (5.4) | 21 (4.7) | 84 (19.9) | 84 (19.9) |
| | Carpenter | 88 (4.0) | 20 (4.2) | 1 (0.2) | 18 (4.0) | 32 (7.5) | 17 (3.9) |
| | Health worker | 33 (1.5) | 6 (1.3) | 0 (0) | 5 (1.1) | 9 (2.1) | 13 (3.0) |
| | Transportation | 53 (2.4) | 11 (2.3) | 24 (5.9) | 1 (0.2) | 10(2.4) | 7 (1.6) |
| | Others | 135 (7.5) | 69 (14.4) | 45 (9.4) | 15 (3.1) | 103 (21.5) | 72 (15) |
| Educational Status | Above tertiary | 37 (1.7) | 10 (2.1) | 4 (1.0) | 10 (2.2) | 7 (1.7) | 6 (1.4) |
| | Tertiary | 337 (15.3) | 18 (16.9) | 52 (12.7) | 59 (13.1) | 72 (17.1) | 73 (16.6) |
| | Senior Secondary | 1348 (61.3) | 291 (60.6) | 305 (74.6) | 276 (61.5) | 207 (49.1) | 269 (61.3) |
| | Junior Secondary | 128 (5.8) | 9 (1.9) | 1 (0.2) | 31 (6.9) | 19 (4.5) | 68 (15.5) |
| | Primary school | 195 (8.9) | 62 (12.9) | 27 (6.6) | 52 (11.6) | 48 (11.4) | 8 (1.8) |
| | Islamic education only | 84 (3.8) | 15 (3.1) | 5 (1.2) | 10 (2.2) | 48 (11.4) | 6 (1.4) |
| | No formal education | 70 (3.2) | 12 (2.5) | 15 (3.7) | 11 (2.4) | 23 (5.5) | 9 (2.1) |
| Marital Status | Married | 1583 (72.0) | 320 (66.7) | 317 (77.5) | 326 (72.6) | 301 (71.3) | 319 (72.7) |
| | Single | 401 (18.2) | 116 (24.2) | 62 (15.2) | 79 (17.9) | 62 (14.7) | 82 (18.7) |
| | Engaged | 61 (2.8) | 15 (3.1) | 1 (0.2) | 11 (2.4) | 21 (5.0) | 13 (3.0) |
| | Divorced | 29 (1.3) | 0 (0) | 9 (2.2) | 3 (0.7) | 13 (3.1) | 4 (0.9) |
| | Separated | 50 (2.3) | 11 (2.3) | 12 (2.9) | 12 (2.7) | 11 (2.6) | 4 (0.9) |
| Employment Situation | Employed | 478 (21) | 109 (22.7) | 120 (29.3) | 60 (13.4) | 88 (20.9) | 101 (23.0) |
| | Self-employed | 991 (45.1) | 255 (53.1) | 91 (22.2) | 243 (54.1) | 182 (41.5) | 182 (41.5) |
| | Unemployed | 449 (20.4) | 73 (15.2) | 163 (39.9) | 66 (14.7) | 73 (16.6) | 73 (16.6) |
| | Retired | 90 (4.1) | 16 (3.3) | 10 (2.4) | 21 (4.7) | 33 (7.5) | 33 (7.5) |
| | Housewife | 157 (7.1) | 24 (5.0) | 14 (3.4) | 39 (8.7) | 50 (11.4) | 50 (11.4) |
| | Unable to work | 34 (1.5) | 3 (0.6) | 11 (2.7) | 20 (4.5) | 0 (0) | 0 (0) |
| Relation to Head of Household | Head of household | 1395 (63.4) | 259 (54.0) | 291 (71.1) | 244 (54.3) | 309 (73.2) | 298 (67.9) |
| | Spouse | 369 (16.8) | 104 (21.7) | 54 (13.2) | 80 (17.6) | 52 (12.3) | 79 (18.0) |
| | Sibling | 39 (1.8) | 15 (3.1) | 6 (1.5) | 11 (2.4) | 4 (0.9) | 3 (0.7) |
| | Song or Daughter | 226 (10.32) | 84 (17.5) | 24 (5.9) | 44 (9.8) | 39 (9.2) | 29 (6.6) |
| | Parent | 138 (6.3) | 8 (1.7) | 28 (6.8) | 63 (14.0) | 12 (2.8) | 27 (6.2) |
| | Others | 32 (1.5) | 10 (2.1) | 6 (1.5) | 7 (1.6) | 6 (1.4) | 3 (0.7) |

**Table 2.** Descriptive Analysis of Key Socio-demographic Variables

| | **Damare** | | **Dumne** | | **Imburu** | | **Mbilla** | | **Sabon Pegi** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** |
| Age of Respondent | 39.3 | 11.819 | 44.01 | 11.274 | 45.83 | 15.603 | 39.22 | 8.885 | 44.15 | 13.925 |
| Number of children | 2.44 | 2.34 | 3.61 | 2.199 | 3.43 | 2.37 | 3 | 2.314 | 3.64 | 2.295 |
| Number of children under 5 years | 0.71 | 0.896 | 0.98 | 0.888 | 0.98 | 0.938 | 0.88 | 1.005 | 0.96 | 0.899 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of adults between 18 and 64 | 1.1 | 1.328 | 1.8 | 1.317 | 1.8 | 1.377 | 1.6 | 1.438 | 1.7 | 1.167 |
| Number of adults above 65 | 0.09 | 0.369 | 0.18 | 0.566 | 0.42 | 0.752 | 0.28 | 0.63 | 0.26 | 0.608 |
| Total number. of persons in household | 4.33 | 1.993 | 5.5 | 2.176 | 5.64 | 2.23 | 5.39 | 2.534 | 5.72 | 2.072 |

### Determining if Health Services are of Acceptable Quality Exists

Table 4 showed results of respondents' overall experience with health facilities. Respondents' perception about how satisfied or dissatisfied they were was assessed using a 5-point scale; 1 for very satisfied and 5 for very dissatisfied. Results of the service quality assessment indicate cumulatively 70% of all respondents were (either satisfied or very satisfied) with health service delivery, while 8.8% expressed dissatisfaction (dissatisfied or very dissatisfied). High levels of satisfaction with healthcare services were recorded in Damare with rural-based respondents of 27.7% and Imburu with rural-based respondents of 89.3% (85.2% and 4.2%, respectively). Respondents who selected either 'satisfied' or 'very satisfied' were highest in Damare, with a combined percentage of 89.4%. Mbilla also recorded the highest percentage of consumers who were neutral, that is, neither satisfied nor dissatisfied, at 45.7%.

### Priority Need for Protection Against Financial Risk Associated with Sickness

Trends in the number of respondents with chronic conditions and delayed healthcare seeking. Data shown in table 4 provided insights into the potential health status of study participants. It was observed from table 5 that Dumne, with the highest mean age of 45.83, recorded the highest proportion of respondents with chronic conditions, which is 1 in every 5 participants – 21.0% (86). Damare, with a mean age of 44.01, recorded that 5.0% (24) of its study population acknowledged they have at least one chronic condition. Percentage distribution of chronic conditions in the other study sites include 14.4% (65) in Imburu, 13.3% (56) in Mbilla, and 20.7% (91) in Sabon Pegi. Apart from Damare with 5.0%, at least 1 in every 10 respondents in Imburu and Mbilla and 1 in every 5 respondents in Damare and Sabon Pegi have a priority need for protection against financial risk associated with sickness, including chronic illnesses.

**Table 3.** Existence and Membership of Cooperative or Mutual Aid Organisations

| | | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** |
|---|---|---|---|---|---|---|
| | | **Freq (%)** | **Freq (%)** | **Freq (%)** | **Freq (%)** | **Freq (%)** |
| Membership of mutual aid or cooperative societies | Farmer's Cooperative | 190 (39.6) | 287 (70.2) | 294 (65.5) | 124 (29.4) | 291 (66.3) |
| | Fishermen's cooperative | 39 (8.1) | 10 (2.4) | 36 (8.0) | 35 (8.3) | 25 (5.7) |
| | Artisan or worker cooperative | 80 (16.7) | 4 (1.0) | 11 (2.4) | 23 (5.5) | 20 (4.6) |
| | Transport-related cooperative | 30 (6.3) | 19 (4.6) | 15 (3.3) | 47 (11.1) | 12 (2.7) |
| | Multipurpose cooperative | 79 (16.5) | 192 (4.2) | 49 (10.9) | 66 (15.6) | 149 (33.9) |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Consumer cooperative | 11 (2.3) | 90 (22) | 13 (2.9) | 11 (2.6) | 13 (3.0) |
| | Savings and loans cooperative | 105 (21.9) | 3 (0.7) | 72 (16.0) | 44 (10.4) | 120 (27.3) |
| | Other | 187 (39.0) | 0 (0) | 92 (20.5) | 207 (49.1) | 5 (1.1) |
| Current membership of cooperative societies by ward | N (% within each ward) | 52 (10.8%) | 81 (19.8%) | 48 (10.7%) | 95 (22.5%) | 33 (7.5%) |
| | N (% among the membership of the cooperative society | 52 (16.8%) | 81 (26.2%) | 48 (15.5%) | 95 (30.7%) | 33 (10.7%) |

**Table 4.** Overall Performance Rating of Health Facility

| | | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** |
|---|---|---|---|---|---|---|
| | | **Freq (%)** | **Freq (%)** | **Freq (%)** | **Freq (%)** | **Freq (%)** |
| How would you RATE your overall experience with this health facility? | Very Satisfied | 20 (4.2) | 11 (2.7) | 87 (19.4) | 32 (7.6) | 14 (3.2) |
| | Satisfied | 409 (85.2) | 229 (56.0) | 302 (67.3) | 166 (39.3) | 269 (61.3) |
| | Neither satisfied nor dissatisfied | 32 (6.7) | 45 (11.0) | 53 (11.8) | 193 (45.7) | 145 (33.0) |
| | Dissatisfied | 16 (3.3) | 40 (9.8) | 1 (0.2) | 21 (6.0) | 5 (1.1) |
| | Very dissatisfied | 3 (0.6) | 84 (20.5) | 6 (1.3) | 10 (2.4) | 6 (1.4) |
| | Total | 480 (100) | 409 (100) | 449 (100) | 422 (100) | 439 (100) |

**Table 5.** Chronic Disease Prevalence among Respondents/Household Members

| | | **Total** | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** |
|---|---|---|---|---|---|---|---|
| | | **Freq (%)** | **Freq (%)** | **Freq (%)** | **Freq (%)** | **Freq (%)** | **Freq (%)** |
| Mean age | | 43.13 | 44.01 | 45.83 | 39.22 | 44.15 | 42.46 |
| Standard Deviation (SD) | | 12.51 | 11.274 | 15.603 | 8.885 | 13.925 | 12.843 |
| Do you have any chronic conditions, such as hypertension, diabetes, etc., that you are currently receiving treatment for or taking medication for? | Yes | 327 (14.8) | 24 (5.0) | 86 (21.0) | 65 (14.5) | 56 (13.3) | 91 (20.7) |
| | Refuse to say | 108 (4.9) | 7 (1.5) | 45 (11.0) | 13 (2.9) | 35 (8.3) | 8 (1.8) |
| | No | 1769 (80.4) | 449 (93.5) | 278 (68.0) | 371 (82.6) | 331 (78.4) | 340 (77.4) |
| | Total | 2199 (100) | 480 (100) | 409 (100) | 449 (100) | 422 (100) | 439 (100) |

As shown in table 6, 13.8% (66) in Damare visited the doctor for diagnosis or management of high blood pressure issues while 8.3% (40) said their visit was associated with diabetes management. Comparatively, diabetes-associated consultations were highest in Sabon Pegi with 22.1% (97) and lowest in Damare (8.3%). Similarly, high blood pressure-associated visits were highest in Sabon Pegi with 37.1% (163) and lowest in Mbilla with 16.8% (71). The number of times respondents delayed seeking needed care due to lack of financial capacity or cost constraints is also presented in table 6. Results showed those who experienced delays were 9.2% (44), which is approximately 1 in every 11 respondents in Damare; 39.6% (162) in Dumne; 57% (256) in Imburu; 34.4% (145) in Mbilla; and 64.1% (286) in Sabon Pegi.

**Trends in Out-of-Pocket Expenses of Respondents**

Table 7 showed that the mean score for the highest out-of-pocket expense on health for 25% of respondents in the entire study population of 2,199 is N1,500 at the individual level and 3,900 at the household level. This implies that the mean out-of-pocket expense at the individual level is equal to or more than the highest set premium for a hypothetical individual package of N1,500 being proposed in this study.

The mean highest monthly out of pocket expense during the last three months is 5,341 for individual and N11,163 for households. The standard deviation from the mean is 8, 166 for personal income, and N14, 113 for household highest out of pocket expense. Overall, the mean income left for savings after spending on basic necessities such as food, transport, education, rent, utilities, groceries is N14, 927 while the standard deviation from this mean score is N30,121. Table 7 clearly revealed that at the 25$^{th}$ percentile, estimated monthly income was N25,000 for individual and N30,000 at household level. A relatively higher value was observed at the 75$^{th}$ percentile where monthly income was N70,000 at individual and N95,000 at household level.

From table 8, it was observed that the mean highest individual out-of-pocket expense is distributed as follows: N7,863.3 for Sabon Pegi, N5,617.4 for Dumne, N4,819.5 for Imburu, N4,732.7 for Mbilla, and N3,820 for Damare. The highest and lowest mean individual expenses were found in Sabon Pegi (N7,863.3), with 96.4% of respondents living in rural settings. The standard deviation from the mean individual out-of-pocket expense was lowest in Sabon Pegi with a mean of N7,863 and SD of 7,520 and highest in Damare with a mean of N3,820 and SD of 7,529 and highest in Damare with a mean of N3,820 and SD of 7,529.

**Table 6.** Healthcare Access and Utilization within the last 6 Months

| **Occurrences/utilisation within the last 6 months.** | | **Total** | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** |
|---|---|---|---|---|---|---|---|
| | | Freq (%) | Freq (%) | Freq (%) | Freq (%) | Freq (%) | Freq (%) |
| No. of visits you or a household member made to a doctor within the last 6 months | Never | 791 (36) | 157 (12.7) | 215 (52.6) | 119 (26.5) | 209 (49.5) | 91 (20.7) |
| | Once | 661 (30.1) | 185 (38.5) | 117 (28.6) | 113 (25.2) | 72 (17.1) | 174 (19.6) |
| | Twice | 540 (24.6) | 107 (22.3) | 59 (14.4) | 142 (31.6) | 90 (21.3) | 142 (32.3) |
| | Thrice | 163 (7.4) | 22 (4.6) | 15 (1.7) | 62 (13.8) | 35 (8.3) | 29 (6.6) |
| | More than thrice | 44 (2) | 9 (1.9) | 3 (0.7) | 13 (2.9) | 16 (3.8) | 3 (0.7) |
| Have you or a household member visited a doctor for these health conditions? (Yes/No) | High blood pressure (yes) | 567 (25.9) | 66 (13.8) | 139 (34.0) | 128 (28.5) | 71 (16.8) | 163 (37.1) |
| | Diabetes (Yes) | 285 (13) | 40 (8.3) | 37 (9.0) | 48 (10.7) | 63 (14.9) | 97 (22.1) |
| | Eye condition (Yes) | 203 (9.7) | 28 (5.8) | 39 (9.5) | 72 (16.0) | 29 (6.9) | 45 (10.3) |
| Number of times you or a household member delayed seeking care due to cost or lack of funds. | Never | 1306 (59.4) | 436 (90.8) | 247 (60.4) | 193 (43.0) | 277 (65.6) | 153 (34.9) |
| | Once | 578 (26.3) | 32 (6.6) | 133 (32.5) | 136 (30.3) | 87 (20.6) | 190 (43.2) |
| | Twice | 237 (10.8) | 6 (1.3) | 22 (5.4) | 96 (21.4) | 39 (9.2) | 74 (16.9) |
| | Thrice | 54 (2.5) | 2 (0.4) | 7 (1.7) | 19 (4.2) | 5 (1.2) | 21 (4.8) |
| | More than thrice | 24 (1.1) | 4 (0.8) | 0 (0) | 5 (1.1) | 14 (3.3) | 1 (0.2) |

**Table 7.** Descriptive Statistics of Personal and Household Out-of-Pocket Expenses on Health

| | **Mean** | **Median** | **Std. Deviation** | **Percentiles** | | |
|---|---|---|---|---|---|---|
| | | | | **25** | **50** | **75** |
| Highest personal monthly out-of-pocket (OOP) expense on health within the last 3 months. | 5,341 | 3,000 | 8,166 | 1,500 | 3,000 | 5,000 |
| Estimated household highest monthly out-of-pocket (OOP) expense on health within the last 3 months. | 11,163 | 6,000 | 14,113 | 3,900 | 6,000 | 12,000 |
| Total personal income left for savings after spending on basic necessities such as food, transport, education, rent, etc. | 14,927 | 3,000.00 | 30,121 | - | 3,000 | 15,000 |
| Out-of-pocket expense as a percentage of discretionary income. | 35.80% | - | - | - | - | - |

**Table 8.** Descriptive Analysis of Estimated Monthly Personal Income Left after Expenses on Necessities

| | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** |
|---|---|---|---|---|---|
| Mean Individual/Personal Income | 62,345.8 | 64,063.1 | 43,291.6 | 37,335.6 | 58,164 |
| Mean Combined Household Income | 103,668 | 94,603.8 | 52,512.4 | 52,745.5 | 65,508 |
| Mean Personal Highest Out-of-Pocket (OOP) Expense | 3,820.3 | 5,617.4 | 4,819.5 | 4,732.7 | 7,863 |
| Mean Household Highest Out-of-Pocket (OOP) Expense | 9,849.8 | 10,375.0 | 8,621.4 | 10,904.0 | 16,182 |
| Mean Personal income left after spending on basic necessities (discretionary income). | 35,033.9 | 144,28.9 | 4,302.2 | 10,349.3 | 8,674.3 |
| Mean percentage of personal income left after spending on basic necessities. | 56.20% | 22.52% | 9.94% | 27.70% | 14.90% |
| Out-of-pocket expense as a percentage of discretionary income. | 10.90% | 38.90% | 112% | 45.70% | 90.60% |

*NB: Basic necessities include food, transport, education, groceries, rent*

From table 8, it was observed that the mean highest household out-of-pocket expense on health was also highest in Sabon Pegi with a mean score of N16,182.04 and lowest in Imburu with a mean score of N8,621.4. Table 8 also showed personal income left after savings on basic necessities for all study sites. The mean personal income left after expenses is N35,023.96 (SD 44,006.4) in Damare, N14,428.9 (SD 33,969.9) in Dumne, and 10,349.3 (SD 30,850.7) in Mbilla. These values are thus higher than the maximum starting point premium offered for the hypothetical family CBHI health service package while trying to elicit willingness to pay. This implied that a significant percentage of respondents in each of the 5 study sites were forecasted to be able to afford premiums for a standard individual service package starting at N1,500.

Table 9 showed the overall estimated personal monthly out of pocket expense within the last 3 months. Overall, the cumulative proportion of respondents whose personal monthly out of pocket expense exceeded the highest premium or willingness to pay price offer of N1,500 comprise 75.2% (1655) of the entire study's' respondents. This implied that 75.2% and 84.1% of respondents have already spent more than N1,500 and N1,000 as out of

pocket expense. A higher 31.3% have spent more than N4,000.

Table 10 presented the distribution of personal out of pocket (OOP) expense in each of the five study locations. Data showed the proportion of respondents whose OOP is above N1,500 is 81% (331) in Dumne, 77.5% (348) in Imburu, 73.9% (355) in Damare, 72.9% (320) in Sabon pegi, and 65.7% (277) in Mbilla. Suffice we use N1,500 as a bench mark OOP since this was the maximum premium price or higher premium option for individual hypothetical CBHI model. In effect, across all study sites, at least 4 out of every 5 respondents in Dumne have spent this amount (N1,500) as out-of-pocket expense on health. Furthermore, at least 7 out of every 10 respondents have already spent at least N1,500 on personal OOP in Damare, Imburu, and Sabon pegi. Cumulatively, 75.2% (1654) respondents across all study sites have spent the starting price of N1,500.

Therefore, the priority need for financial protection from health care expenses has already been established since making respondents aware of this existing OOP experience is likely to encourage greater willingness to pay the same N1,500.

**Table 9.** Overall Estimated Personal Monthly Out of Pocket Expense within the last 3 Months

| **Personal Income** | **Freq (%)** | **Household Income** | **Freq (%)** |
|---|---|---|---|
| Less than 500 | 169 (7.7%) | Less than 1000 | 158 (7.2%) |
| 500 to 1000 | 182 (8.3%) | 1001 to 2000 | 131 (6.0%) |
| 1001 to 1500 | 193 (8.8%) | 2001 to 3000 | 194 (8.8%) |
| 1501 to 2000 | 231 (10.5%) | 3001 to 4000 | 264 (12.0%) |
| 2001 to 2500 | 204 (9.3%) | 4001 to 5000 | 243 (11.1%) |
| 2501 to 3000 | 233 (10.6%) | 5000 to 6000 | 196 (8.8%) |
| 3001 to 3500 | 133 (6.0%) | 6000 to 7000 | 174 (7.9%) |
| 3501 to 4000 | 166 (7.5%) | More than 7000 | 839 (38.2%) |
| More than 4000 | 688 (31.3%) | | |

**Table 10.** Personal Highest Monthly Out of Pocket (OOP) Expenses on Health by Ward

| | | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** |
|---|---|---|---|---|---|---|
| | | **N (% within Ward)** | | | | |
| Estimated personal highest monthly out of pocket expense on health within the last 3 months. | Less than 500 | 36 (7.5) | 31 (7.6) | 26 (5.8) | 43 (10.2) | 33 (7.5) |
| | 500 to 1,000 | 45 (9.4) | 21 (5.1) | 33 (7.3) | 38 (9.0) | 45 (10.3) |
| | 1001 to 1,500 | 45 (9.4) | 26 (6.4) | 42 (9.4) | 39 (9.2) | 41 (9.3) |
| | 1,501 to 2,000 | 45 (9.4) | 39 (9.5) | 53 (11.8) | 44 (10.4) | 50 (11.4) |
| | 2,001 to 2,500 | 47 (9.8) | 38 (9.3) | 46 (10.2) | 37 (8.8) | 36 (8.2) |
| | 2,501 to 3,000 | 42 (8.8) | 42 (10.3) | 61 (13.6) | 45 (10.7) | 43 (9.8) |
| | 3,001 to 3,500 | 18 (3.8) | 22 (5.4) | 37 (8.2) | 30 (7.1) | 26 (5.9) |
| | 3,501 to 4,000 | 36 (7.5) | 40 (9.8) | 25 (5.6) | 33 (7.8) | 32 (7.3) |
| | More than 4,000 | 166 (34.6) | 150 (36.7) | 126 (28.1) | 113 (20.8) | 133 (30.3) |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Total | 480 (100) | 409 (100) | 449 (100) | 422 (100) | 439 (100) |
| Estimated household highest monthly out of pocket expense on health within the last 3 months. | Less than 1000 | 45 (9.4) | 24 (5.9) | 22 (4.9) | 41 (9.7) | 26 (5.9) |
| | 1001 to 2000 | 19 (4.0) | 22 (5.4) | 32 (7.1) | 32 (7.6) | 26 (5.9) |
| | 2001 to 3000 | 34 (7.1) | 35 (8.6) | 43 (9.6) | 41 (9.7) | 41 (9.3) |
| | 3001 to 4,000 | 45 (9.4) | 44 (10.8) | 64 (14.3) | 51 (12.1) | 60 (13.7) |
| | 4,001 to 5,000 | 49 (10.2) | 44 (10.8) | 52 (11.6) | 58 (13.7) | 40 (9.1) |
| | 5,001 to 6,000 | 55 (11.5) | 25 (6.1) | 40 (8.9) | 35 (8.3) | 41 (9.5) |
| | 6,001 to 7,000 | 38 (7.9) | 38 (9.3) | 45 (10.0) | 24 (5.7) | 29 (6.6) |
| | More than 7,000 | 195 (40.6) | 177 (43.3) | 151 (33.6) | 140 (33.2) | 176 (40.1) |
| | Total | 480 (100) | 409 (100) | 449 (100) | 422 (100) | 439 (100) |

Estimated self-reported household OOP health expense also shown in table 10 showed respondents who have experienced OOP of more than N7,000 were highest in Dumne with 43.3% (177), 40.6% (195) in Damare, and 40.1% (176) in Sabon pegi. Therefore, an estimated 2 out of every 5 respondents in Damare, Dumne and Sabon pegi spent more than 7,000 as household OOP within the last 3 months. With the right education, these categories of respondents were more likely to rationalize and justify paying N7,000 for a family health service package. Cumulatively, across all five locations, 38.2% (83) of respondents experienced household OOP of N7,000 and above.

## The Potential Number of Covered Persons will be Sufficiently High from the First Year

### Attitude towards Community-Based Health Insurance

Results presented in table 11 showed respondents' attitude towards CBHI, their interest in joining CBHI schemes, and their willingness to pay a fee to join a hypothetical CBHI scheme's service package. Those who thought participating in health insurance is a very good idea comprised 79.7% (350) in Sabon Pegi, 87.1% (391) in Imburu, 78.2% (320) in Dumne and 65.2% (313) in Damare. Those who thought participating in health insurance was either a very good or somewhat good idea comprised 88.3% in Damare, 97.8% in Dumne, 93.3% in Mbilla and 95.4% in Sabon Pegi. Table 11 also highlighted respondents' attitudinal disposition towards the establishment of CBHI in their communities. Less than 5% of respondents expressed a negative opinion in each of the 5 study sites. Positive attitude (either a very good idea or a somewhat good idea) was expressed by 90.6% (1992) across all 5 study locations.

**Table 11.** Attitude towards Health Insurance

| | | **Total** | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** |
|---|---|---|---|---|---|---|---|
| | | **Freq (%)** | **Freq (%)** | **Freq (%)** | **Freq (%)** | **Freq (%)** | **Freq (%)** |
| Do you think participating in health insurance is a good idea or a bad idea? | Very good idea | 1598 (72.7) | 313 (65.2) | 320 (78.2) | 391 (87.1) | 224 (53.1) | 350 (79.7) |
| | Somewhat of a good idea | 449 (20.4) | 4111 (23.1) | 80 (19.6) | 28 (6.2) | 161 (38.2) | 69 (15.7) |
| | Somewhat of a bad idea | 40 (1.8) | 11 (2.3) | 3 (0.7) | 3 (0.7) | 11 (2.6) | 12 (2.7) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Very bad idea | 16 (0.7) | -0.8 | 0 (0) | 15 (3.3) | 12 (2.8) | 4 (0.9) |
| | I don't know. | 77 (3.5) | 41 (8.5) | 6 (1.5) | 12 (2.7) | 14 (3.3) | 4 (0.9) |
| Do you think it's a good idea or a bad idea to establish a community-based health insurance scheme (CBHI)? | Very good idea | 1542 (70.1) | 282 (58.8) | 305 (74.6) | 402 (89.5) | 208 (49.3) | 345 (78.6) |
| | Somewhat of a good idea | 450 (20.5) | 121 (25.2) | 75 (18.3) | 14 (3.1) | 164 (38.9) | 76 (17.3) |
| | Neither a good nor a bad idea | 96 (4.4) | 32 (6.7) | 22 (5.4) | 7 (1.6) | 22 (5.2) | 13 (3.0) |
| | Somewhat of a bad idea | 13 (0.6) | 6 (1.3) | 0 (0) | 0 (0) | 7 (1.7) | 0 (0) |
| | Very bad idea | 14 (0.6) | 4 (0.8) | 0 (0) | 0 (0) | 10 (2.4) | 0 (0) |
| | I don't know. | 3.8) | 35 (7.3) | 7 (1.7) | 26 (5.8) | 11 (2.6) | 5 (1.1) |

**Willingness to Join and Promote Community Enrolment into the CBHI Scheme**

Overall findings from the assessment of the respondent's willingness to join the CBHI scheme across all 5 study sites are shown in table 12 below. Cumulatively, 88.5% (1947) of respondents were willing to pay a fee to join as individuals; 85.3% (1877) were willing to pay a fee to enrol a family or household member; and 89.6% (1928) were willing to encourage a neighbour to join. The potential for mutual aid and solidarity among residents of the study location was found in 4 out of 5 respondents. Ward level distribution of willingness to pay a fee to join is presented in table 13. Findings around respondents' willingness to pay a fee to enrol a family or individual member depicted in table 12 showed that at least 4 out of every 5 respondents also indicated positive interest (very interested or somewhat interested) in Imburu with 87.5% (393), Mbilla with 90.5% (382), and Sabon Pegi with 96.2% (422).

**Preferred Willingness to Pay Amounts for Hypothetical Individual CBHI Health Service Package**

Table 14 presents data on preferred willingness to pay amounts from premium offers ranging from 1,500/7,000 to 300/1,500 as monthly fees for individual and family package of CBHI service.

**Table 12.** Respondent's Overall Willingness to Join and Promote Enrolment of Others into the CBHI Scheme

| Variable | Yes (N/%) | Neutral (N/%) | No (N/%) |
|---|---|---|---|
| Willingness to pay a fee to join CBHI | 1947 (88.5%) | 103 (4.7%) | 149 (6.8%) |
| Willingness to pay a fee to enrol FAMILY | 1877 (85.3%) | 140 (6.4%) | 149 (6.8%) |
| Willingness to encourage your neighbour to join | 1928 (89.6%) | 116 (5.3%) | 155 (5.1%) |

**Table 13.** Willingness to Pay a Fee to Join the CBHI Scheme (by Ward)

| | | Damare | Dumne | Imburu | Mbilla | Sabon Pegi |
|---|---|---|---|---|---|---|
| | | N (% within Ward) | | | | |
| Willingness to pay a fee to join. | Yes, I am very interested. | 242 (50.4) | 278 (68.0) | 367 (81.7) | 202 (47.9) | 323 (73.8) |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Yes, I am somewhat interested. | 135 (28.1) | 96 (23.5) | 31 (6.9) | 171 (40.5) | 102 (23.2) |
| | No, I am somewhat disinterested. | 18 (3.8) | 2 (0.5) | 0 (0) | 12 (2.8) | 0 (0) |
| | No, I am not interested. | 53 (11.0) | 7 (1.7) | 44 (9.8) | 10 (2.4) | 3 (0.7) |
| | Neither interested nor disinterested | 32 (8.7) | 26 (8.4) | 7 (1.6) | 27 (6.4) | 11 (2.5) |
| Willingness to pay a fee to enrol your FAMILY or household members**.** | Yes, I am very interested. | 236 (49.2) | 199 (48.7) | 352 (78.4) | 208 (49.3) | 312 (71.1) |
| | Yes, I am somewhat interested. | 138 (28.8) | 107 (26.2) | 41 (9.1) | 174 (41.2) | 110 (25.1) |
| | Neither interested nor disinterested | 30 (8.3) | 69 (16.9) | 9 (2.0) | 17 (4.0) | 15 (3.4) |
| | No, I am somewhat disinterested. | 19 (4.0) | 26 (6.4) | 1 (0.2) | 13 (3.1) | 0 (0) |
| | No, I am not interested. | 57 (11.9) | 8 (2.0) | 46 (10.2) | 10 (2.4) | 2 (0.5) |
| Willingness to encourage your neighbour and/or community members to join. | Yes, I am willing. | 238 (49.6) | 304 (74.3) | 354 (78.8) | 193 (45.7) | 315 (71.8) |
| | Yes, I am somewhat willing. | 131 (27.3) | 73 (17.8) | 43 (9.6) | 177 (41.9) | 100 (22.8) |
| | Neutral | 41 (8.5) | 23 (5.6) | 4 (0.9) | 26 (6.2) | 22 (5.0) |
| | No, I doubt if I will. | 17 (3.5) | 6 (1.5) | 4 (0.9) | 14 (3.3) | 0 (0) |
| | No, I will not. | 53 (11.0) | 3 (0.7) | 44 (9.8) | 12 (2.8) | 2 (0.5) |

**Table 14.** Willingness to Pay Monthly Premium for Standard CBHI Packages

| | | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** | **Total (Yes)** |
|---|---|---|---|---|---|---|---|
| | | Freq (%) | Freq (%) | Freq (%) | Freq (%) | Freq (%) | |
| | | 480 (100) | 409 (100) | 449 (100) | 422 (100) | 439 (100) | 2199 (100) |
| Monthly fee of N1,500 per person for a standard plan of all services, and N7,000 for a family of up to 6 | Yes | 64 (13.2) | 64 (15.6) | 10 (2.2) | 10 (2.4) | 11 (2.5) | 159 (7.2) |
| | No | 416 (86.7) | 345 (84.4) | 439 (97.8) | 412 (97.6) | 428 (97.5) | 2040 (92.8) |
| | Not Sure | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Monthly fee of N1,200 per person for a standard plan of all service, and N6,000 for a family of up to | Yes | 64 (13.3) | 64 (15.6) | 10 (2.2) | 10 (2.4) | 11 (2.5) | 159 (7.2) |
| | No | 416 (86.7) | 345 (84.4) | 439 (97.8) | 412 (97.6) | 428 (97.5) | 2040 (92.8) |
| | Not Sure | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Monthly fee of N1,000 per person for a standard plan of all services, and N5,000 for a family of up to 6 | Yes | 292 (60.8) | 220 (53.8) | 204 (45.4) | 147 (34.8) | 215 (49.0) | 1078 (49.0) |
| | No | 188 (39.2) | 172 (42.1) | 245 (54.6) | 275 (65.2) | 224 (51.0) | 1104 (50.2) |
| | Not Sure | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Monthly fee of N0,800 per person for a standard plan of all service, and N4,200 for a family of up to 6 | Yes | 440 (91.7) | 388 (94.9) | 404 (90.0) | 387 (91.7) | 375 (85.4) | 1994 (90.7) |
| | No | 40 (8.3) | 21 (5.1) | 45 (10) | 35 (8.3) | 64 (14.6) | 205 (9.3) |
| | Not Sure | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Monthly fee of N0,600 per person for a standard plan of all service, and N3,400 for a family of up to 6 | Yes | 464 (96.7) | 402 (98.3) | 435 (96.9) | 414 (98.1) | 425 (96.8) | 2140 (97.3) |
| | No | 16 (3.3) | 7 (1.7) | 14 (3.1) | 8 (1.9) | 14 (3.2) | 59 (2.7) |
| | Not Sure | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Monthly fee of N0,400 per person for a standard plan of all service, and N2,200 for a family of up to 6 | Yes | 464 (96.7) | 402 (98.3) | 435 (96.9) | 414 (98.1) | 425 (96.8) | 2140 (97.3) |
| | No | 16 (3.3) | 7 (1.70 | 14 (3.1) | 8 (1.8) | 14 (3.2) | 59 (2.7) |
| | Not Sure | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Monthly fee of N0,300 per person for a standard plan of all service, and N1,500 for a family of up to 6 | Yes | 464 (96.7) | 402 (98.3) | 435 (96.9) | 414 (98.1) | 425 (96.8) | 2140 (97.3) |
| | No | 16 (3.3) | 7 (1.70 | 14 (3.1) | 8 (1.8) | 14 (3.2) | 59 (2.7) |
| | Not Sure | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |

The distribution of those willing to pay each variant of the premium offer is as follows. In Damare, 13.2% (64) indicated yes for 1500; 13.3% (64) said yes for 1,200; and 60.8% (292) said yes for 1000. Those willing to pay 800, 600, 400 and 300 in Damare comprised 91.7% (440), 96.7% (464), 96.7 (464) and 96.4% (464) respondents respectively. For Dumne, the percentage increase moved from 15.5% (64) for 1500 to 53.8% (220) for 1,000, and 94.9% (388) for 800. Comparatively, the two study sites, Imburu and Sabon pegi located in the same local government area recorded similar proportion of respondents willing to pay for each amount.

Table 15 showed results of rural or urban distribution of preferred willingness to pay premiums for CBHI individual service package. Percentage distribution within each geographical segment showed that among rural dwellers, 93% (1,614) were willing to pay N800, while 94.8% (440) of those living in urban settlements were willing to pay N800. Above N800 (i.e. 1000 to 1500), proportion who were willing to pay were 49% (832) for 1,000; 7.4% (129) for 1,200; and 7.4% (129) for 1,500. Among dwellers of urban settlements, the price N800 had 94.8% (440) willing to pay. Beyond this price, the willingness ranged from 25.6% (286) for 1,000; 9.3% (43) for 1,200; and 8.3% (43) for 1,500 (Note N = 1,735). Among residents of urban settlements, 94.8% (440 out of 464) indicated willingness to pay N800. Beyond this price, the percentage ranged from 25.6% (280) for 1,000, 9.3% (43) for 1,200, and 9.3% (43) for 1,500.

Table 16 also presents the distribution of respondents willing to pay a monthly fee of N1,000 and N800 by ward. Findings reveal that as the premium price offering decreased from N1,000 to 800, the proportion of those willing to pay N800 as at against N1,000 moved from 63.5% (305) to 95.2% (457) in Damare; 55.3% (226) to 96.6% (393) in Dumne; 47.4% (213) to 93.1% (418) in Imburu; and 35.5% (150) to 93.6% (395%) in Mbilla. For Sabon pegi, the proportion moved from 51% (224) who were willing to pay N1,000 to 88.6% (439) who were willing to pay N800.

**Table 15.** Willingness to Pay for Individual CBHI Package by Geographical Location

| **Geography** | **1500** | **1200** | **1000** | **800** | **600** | **400** | **300** |
|---|---|---|---|---|---|---|---|
| Rural (N = 1735) | 129 (7.4%) | 129 (7.4%) | 832 (48%) | 1614 (93%) | 1735 (100%) | 1735 (100%) | 1735 (100%) |
| Urban (N = 464) | 43 (9.3%) | 43 (9.3%) | 286 (25.6%) | 440 (94.8%) | 464 (100%) | 464 (100%) | (100%) |

**Table 16.** Willingness to Pay a Monthly Fee of 1000 (Current Benchmark Premium) by Ward

| Willing to pay N1000 and N800 | Damare | Dumne | Imburu | Mbilla | Sabon Pegi | Total |
|---|---|---|---|---|---|---|
| Yes, to N1000 | 305 (63.5%) | 226 (55.3%) | 213 (47.4%) | 150 (35.5%) | 224 (51%) | 1118 (50.8%) |
| Yes, to N800 | 457 (95.2%) | 395 (96.6%) | 418 (93.1%) | 395 (93.6%) | 439 (88.6%) | 2054 (93.4%) |

Overall, across all study location, while 50.8% were willing to pay N1,000, 93.4% (2054) indicated willingness to pay N800. Respondents who were willing to pay N800 (93.4%) and N1,000 (50.8%) had a mean highest monthly out-of-pocket expense of N5,414 and N6,518, respectively.

## Trends in Socio-Economic Developments

### Assessing Household Income and Capacity to Pay for CBHI Service Package

Table 17 contained details of the estimated personal and household income percentage distribution by income range. From table 17, it was observed that 29.8% (656) and 26.2% (577) of respondents in the entire study earned less than N30,000 at personal and household level on a monthly basis. The highest income range was the range, 30,001 to 50,000, at individual level, and 50,001 to 100,000 range, at household level. The percentage of respondents in the above two categories was 33.2% (729) for personal income range of 30,001 to 50,000, and 31.5% (692) for household income range of 50,001 to 100,000.

Descriptive statistics of overall respondent's monthly income and out-of-pocket expense is presented in table 18. The table indicates that across all 5 study sites, the mean score for the number of persons in households was 5.3. The median score and standard deviation are 5.00 and 2.262, respectively. The mean score for estimated total personal monthly income based on respondent's recall was N53,140. Findings from the evaluation of trends in respondents' capacity to pay for health insurance showed the mean score for estimated total personal and household monthly income is N53,140 (SD 48,508) and N74,147 (SD 72,064), respectively.

At the 25th percentile, the mean score for the highest out-of-pocket expense on health is 1,500 and 3,900 at the individual and household levels, respectively. Therefore, the mean out-of-pocket expense at the individual level is equal to the highest willingness to pay amount of 1,500. The mean highest monthly out-of-pocket expense during the last three months is N5,341 at the individual level and N11,163 at the household level. From table 18, it was also observed that the 25th percentile estimated monthly income was 25,000 for individuals and 30,000 at the household level. A relatively higher value was observed at the $75^{th}$ percentile, where monthly income was 70,000 at the individual level and 95,000 at the household level. Overall, the mean personal income left for savings after spending on basic necessities such as food, transport, education, rent, utilities, and groceries is N14,927 (SD 30,121).

Table 19 showed data around distribution of personal and household income by ward. The estimated personal monthly income of less than N30,000 was earned by 37.4% (158) of respondents in Mbilla, 38.1% (171) of respondents in Imburu, 27.3% (120) of those in Sabon pegi, and 22.9% (110) of respondents in Damare ward.

**Table 17.** Estimated Personal and Household Monthly Income of Respondent

| Income Range | Personal Income | Household Income |
|---|---|---|
| Less than 30,000 | 656 (29.8%) | 577 (26.2%) |
| 30,001 to 50,000 | 729 (33.2%) | 455 (20.7%) |
| 50,001 to 100,000 | 558 (25.4%) | 692 (31.5%) |
| 100,001 to 200,000 | 190 (8.6%) | 341 (15.5%) |
| 200,001 to 300,000 | 51 (2.3) | 73 (3.3%) |
| More than 300,000 | 15 (0.7%) | 61 (2.8%) |

**Table 18.** Descriptive Statistics of Personal and Household Income Distribution

| | Mean | Median | Std. Deviation | Percentiles | | |
|---|---|---|---|---|---|---|
| | | | | 25 | 50 | 75 |
| Total number of persons in household. | 5.30 | 5.00 | 2.262 | 4 | 5 | 7 |
| Estimated total personal monthly income. | 53,140 | 40,000 | 48,508 | 25,000 | 40,000 | 70,000 |
| Estimated total household combined monthly income. | 74,147 | 50,000 | 72,064 | 30,000 | 50,000 | 95,000 |
| Total personal income left for savings after spending on basic necessities such as food, transport, education, rent, etc. | 14,927 | 3,000. | 30,121 | - | 3,000 | 15,000 |

**Table 19.** Personal and Household Income of Respondents (Estimated)

| | | Damare | Dumne | Imburu | Mbilla | Sabon Pegi |
|---|---|---|---|---|---|---|
| | | N (% within Ward) | | | | |
| Estimated personal total monthly income | Less than 30,000 | 110 (22.9) | 97 (23.7) | 171 (38.1) | 158 (37.4) | 120 (27.3) |
| | 30,001 to 50,000 | 146 (30.4) | 131 (32.0) | 158 (35.2) | 128 (30.3) | 166 (37.8) |
| | 50,001 to 100,000 | 132 (27.5) | 129 (31.5) | 104 (23.2) | 100 (23.7) | 93 (21.2) |
| | 100,001 to 200,000 | 65 (13.5) | 37 (9.0) | 12 (2.7) | 27 (6.4) | 49 (11.2) |
| | 200,001 to 300,000 | 22 (4.6) | 12 (2.9) | 2 (0.4) | 6 (1.4) | 9 (2.1) |
| | More than 300,000 | 5 (1.0) | 3 (0.7) | 2 (0.4) | 3 (0.7) | 2 (0.5) |
| | Total | 480 (100) | 409 (100) | 449 (100) | 422 (100) | 439 (100) |
| Estimated household combine total monthly income | Less than 30,000 | 47 (9.8) | 157 (38.4) | 160 (35.6) | 160 (37.9) | 53 (12.1) |
| | 30,001 to 50,000 | 71 (14.8) | 28 (0.8) | 90 (20.0) | 102 (24.2) | 164 (37.4) |
| | 50,001 to 100,000 | 190 (39.6) | 78 (19.1) | 160 (35.6) | 110 (26.1) | 154 (35.4) |
| | 100,001 to 200,000 | 121 (25.2) | 87 (21.3) | 28 (6.2) | 42 (10) | 63 (14.4) |
| | 200,001 to 300,000 | 32 (6.7) | 29 (7.1) | 4 (0.9) | 4 (0.9) | 4 (0.9) |
| | More than 300,000 | 19 (4.0) | 30 (7.3) | 7 (1.8) | 4 (0.9) | 1 (0,2) |
| | Total | 480 (100) | 409 (100) | 449 (100) | 422 (100) | 439 (100) |

The cumulative percentage of respondents earning a monthly income between 0 and 100,000 is 80.8% in Damare, 87.2% in Dumne, 96.5% in Imburu, 91.4% in Mbilla, and 86.3% in Sabon pegi. This implies that at least 4 out of every 5 residents in all five locations earned less than 100,000 or equal to 100,000 at the most, as personal monthly income.

## Assessing Respondents' Preference for Various Hypothetical CBHI Packages

Table 20 showed respondents' preference for various hypothetical CBHI health service package by ward or study location. The most preferred CBHI service package was a package that covered 'everything", the one that covered only basic illness, and one that covered only outpatient services. These are the popular 3 out of the 8 options available. Respondents who preferred a package that covered everything (in-patient, outpatient, emergencies, and including basic illness) comprise 24.4% (117) in Damare; 52.6% (215) in Dumne; 58.9% (240) in Mbilla; and 30.3% (133) in Sabon pegi. The preference for a package that covered only basic illness is distributed as follows: 49.8% (239) in Damare; 68.6% (308) in Imburu; and 52.8% (232) in Sabon pegi. A package that covered everything was the most preferred package in Dumne (52.6%), and Mbilla (58.9%).

## Value Added Services

Table 21 contained respondents' preference for various value-added services they think would most likely encourage and sustain enrolment especially among young adults. CBHI service package with subsidisation of enrolment into skill acquisition centres featured as the most preferred in Damare with 55.4% (266). In Dumne, a scheme with agricultural input subsidisation was the most recommended, with 38.9% (159). A scheme with weekly free recharge cards was preferred in Imburu and Mbilla. The distribution of respondents who recommended the provision of weekly free recharge cards as a value-added service comprised 40.1% (80) in Imburu and 50.4% (214) of respondents in Mbilla. In Sabon Pegi, a CBHI service package providing bi-weekly health information messages via text messages on key health-promoting topics was recommended by 44.4% (195) of respondents.

**Table 20.** Preference for Various CBHI Service Packages

| | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** | **Total** |
|---|---|---|---|---|---|---|
| | **Freq (%)** | **Freq (%)** | **Freq (%)** | **Freq (%)** | **Freq (%)** | **Freq (%)** |
| Everything (Complete Package) | 117 (24.4%) | 215 (52.6%) | 41 (9.1%) | 240 (58.9%) | 133 (30.3%) | 746 (33.9%) |
| Inpatient and Emergencies | 15 (3.1%) | 0 (%) | 5 (1.1%) | 7 (1.7%) | 7 (1.6%) | 34 (1.5%) |
| Impatient and Outpatient | 10 (2.1%) | 4 (1.0%) | 7 (1.6%) | 5 (1.2%) | 7 (1.6%) | 33 (1.5%) |
| Outpatient and Emergencies | 36 (8.1%) | 5 (1.2%) | 28 (6.2%) | 33 (7.8%) | 23 (5.2%) | 125 (5.7%) |
| Basic illness | 239 (49.8%) | 135 (33.0%) | 308 (68.6%) | 100 (23.7%) | 232 (52.8%) | 1,014 (46.1) |
| Only emergencies services | 4 (0.8%) | 0 (0%) | 4 (0.9%) | 3 (0.7%) | 1 (0.2%) | 12 (0.5%) |
| Only inpatient services | 2 (0.4) | 6 (1.5) | 9 (2.0) | 2 (0.5) | 6 1.4) | 25 (1.1%) |
| Only outpatient services | 54 (11.3%) | 44 (10.8%) | 47 (22.7%) | 32 (15.5%) | 30 (14.5%) | 207 (9.4%) |

**Table 21.** Household Preference for Value-Added/Add-on Services likely to Enhance Youth Enrolment

| | **Damare** | **Dumne** | **Imburu** | **Mbilla** | **Sabon Pegi** |
|---|---|---|---|---|---|
| | **480 (100)** | **409 (100)** | **449 (100)** | **422 (100)** | **439 (100)** |
| | **Yes - N (%)** | **Yes - N (%)** | **Yes - N (%)** | **Yes - N (%)** | **Yes - N (%)** |
| CBHI with weekly free recharge cards provided by telecom partners in collaboration with ACHMA. | 156 (32.5) | 159 (38.9) | 180 (40.1) | 214 (50.4) | 161 (36.7) |
| CBHI with biweekly health information on selected topics in your preferred language delivered to your phone (facilitated by ACHMA in collaboration with UNICEF (U-report)). | 187 (39.0) | 89 (21.8) | 171 (38.1) | 197 (46.7) | 195 (44.4) |
| CBHI with prospects of savings and loan facility provided by microfinance bank. | 104 (21.7) | 49 (12.0) | 149 (33.2) | 34 (8.1) | 185 (42.1) |
| CBHI with agricultural input subsidies, food stamps, and consumer product subsidies | 170 (35.4) | 188 (46.0) | 68 (15.1) | 67 (15.9) | 110 (25.1) |
| CBHI with subsidised transport fees organised in partnership with NURTW, MoT, ACHMA, and philanthropists | 73 (15.2) | 38 (9.3) | 25 (5.6) | 47 (11.1) | 49 (11.2) |
| CBHI with free or subsidised children's education organised by ACHMA in collaboration with ADSUBEB, CSOs, INGOs, MoE, etc. | 104 (21.7) | 128 (31.3) | 48 (10.7) | 97 (23.0) | 110 (25.1) |
| CBHI with free or subsidised enrolment to skill acquisition centres or adult education centres. | 266 (55.4) | 82 (20.0) | 55 (12.2) | 76 (18.0) | 80 (18.2) |

## Results of Qualitative Studies

Results presented below comprised findings from qualitative studies. FGDs were held with internally displaced persons (IDPs); Ward and Village Development Community (WDC) chairmen; leaders of cooperative societies; youth groups; and women leaders. Men and women from various occupations, including traders, farmers, artisans, and fishermen were involved. Other participants of FGDs include health facility managers and women of childbearing age. Participants of key informant interviews (KII) include various categories of health managers and high-level stakeholders. Locations of FGDs and KII include Girei, Yola South, Yola North, and Song LGA.

### Perceptions of Quality and Acceptability of Service Delivered by Health Facilities

Enquiries made during FGDs and KII also explored participants' perception of service delivery quality, the likelihood of referring these facilities to friends and families, and the quality and state of drug supply. Findings indicated higher quality service delivery perceptions were observed among participants accessing basic healthcare provision fund (BHCP)-supported health facilities compared to those accessing non-BHCPF-supported health facilities. Findings also indicated both positive and negative reviews were prevalent. For example, while the majority of participants

appraised service delivery quality to be satisfactory, there were others who expressed concerns over poor services. Even contrasting reviews were given for the same health facility. This subjective perception was based on the personal experience of participants and seemed to be dependent on the age of participants, marital status, and whether participants visited these facilities for maternal and child health-related issues. A key informant asserts all BHCPF-supported health facilities were accredited by the National Health Insurance Agency through the State Health Insurance Contributory Health Management Agency. To attain accreditation, he reported that these health facilities met predefined standards, which include the provision of health services that were of acceptable quality. In his word, key informant (KII-1) stated

"For all the wards in Adamawa State—there are 226 wards—we have focal health facilities that currently provide health insurance services to enrollees under the basic healthcare scheme. Even under the public sector, some have chosen these facilities as their service providers. Before any health facility begins providing services, it must be accredited by the National Health Insurance Agency through the State Contributing Health Management Scheme. All the health facilities have attained this level of accreditation. So, I believe the health services provided are of acceptable quality."

**Perceptions around the Existence of Mutual Aid Organisations**

This session of FGDs also soughted to examine perceptions around the existence, functionality, and extent of community participation in mutual aid organisations. Overall, findings revealed the existence of various types of cooperatives or mutual aid organisations. Findings indicated some of these organisations have been in existence for more than ten years, are currently active, and, in some cases, up to seventy percent of adult community members were active members. Revelation from FGD-2, which essentially comprised of community leaders and high-level community stakeholders, including ward development community chairmen, suggests the availability of several solidarity groups, jointly established for the purpose of supporting active community members during times of emergencies or times when some sort of solidarity or welfare support was needed. Participant 9 from FGD-2A highlighted thus:

"In my community, we have several cooperative societies that we established. We have the "Njaredi" cooperative society and the "Gadalgasol" cooperative society. Our members are engaged in farming and small businesses. We contribute weekly into a common purse, with members contributing according to their financial capacity. The funds are used to support members in their times of need. We also help each other with grants and loans to boost members' small-scale businesses, but the amount we give is not more than N50,000"

**Attitudes Towards Health Insurance Among Young Adults**

When focused group discussions transitioned to assessing attitudes of participants towards health insurance, findings revealed a favourable disposition towards the establishment of health insurance by the majority of participants. Discussion bordering on the enrolment of young adults did not attract the sort of fervour and consensus position that discussion on whether establishing community-based health insurance was a good idea attracted. A few participants believed since young adults are less likely to fall sick, they do not necessarily have to pay to be enrolled into the scheme. Participants (11 from FGD 1) posited that

"I don't think it is a good idea to pay if, as a young person, you rarely fall sick."

There were indications that community-based health insurance may be prone to adverse selection if communities are not adequately sensitised. The attitude of key informants

towards establishing community-based health insurance was also assessed. The key informant considered the establishment of community-based health insurance to be a good idea. The key informant also added that

"Any policy can succeed if people are properly educated and if relevant stakeholders, including radio hosts, TV presenters, traditional rulers, and religious leaders, are involved in advocating for it. If people understand the importance of the programme, they will participate willingly."

**Affordability and Willingness to Join and Pay for Community-Based Health Insurance**

Participants provided their views on what premium amounts they considered to be the most affordable for them and the majority of community residents. Participants were asked to state how much they considered affordable for individual and family packages. Premium amounts considered affordable varied and included N200, N300, N500, and N800. Virtually all participants indicated a willingness to join and pay for the scheme. Some participants hinged their willingness-to-pay decision on the scope of services covered by the package under review. The majority of the willingness to pay amount was between N500 and N800. The starting fee of N1,500 was considered unaffordable by almost all participants in both FGDs. For example, participant 11 of FGD-2 said

"There is economic hardship in the country. N1,500 is too much for my community. They won't be able to keep up. I think they can afford to pay N800 naira per person."

**Experience with Monthly Out-of-Pocket (OOP) Expenses on Health within the Last 3 Months**

To enable FGD participants better understand the difference between the suggested individual monthly starting premium of N1,500 and the potential marginal cost of care for those who happen to need care during a one-month period, they were asked what their highest monthly out-of-pocket expenditure on healthcare was within the last three months. Out-of-pocket expenditure ranged between N2,000 and 25,000 for the majority of participants. Everywhere this subject was discussed during the course of this study, there were many compelling anecdotes demonstrating how community members are constantly exposed to high out-of-pocket health spending. The poor and vulnerable, including persons living under the poverty trap, are usually most affected. Out-of-pocket expenses of up to 250,000 for childcare and 1,000,000 for an individual's surgical care were reported. For example, a female participant reported

"A few days ago, I spent N25,000 on my daughter's treatment."

Eventually, participants recognised that most of these amounts were much higher than the highest individual premium fees for a hypothetical community-based health insurance service package of N1,500. It is worthy to note that there was also a significant majority who personally did not spend money on healthcare within the last 1 to 3 months but had household members who did or for whom they purchased healthcare. There were also a significant number who were enrolled in the basic healthcare provision fund, supported health insurance, and only spent money to purchase prescribed drugs that were not available at the health insurance service provider.

**Perception around Institutional Readiness**

Institutional readiness as it relates specifically to this feasibility study soughted to understand the perception of stakeholders on whether the necessary structures, support systems, and technical expertise required to launch, manage, and sustain a viable community-based health insurance scheme were in place. Interviewees shared insights on their perception about how readily the state is able to roll out and mobilise community ownership, participation, and

support for establishment and effective management of a successful pilot community health insurance scheme following a favourable feasibility study outcome. The respondents acknowledged the existence of functional health facilities across all 226 wards in the state that have collectively enrolled more than 116,000 enrollees into the Basic Healthcare Provision Fund (BHCPF)-supported health insurance, with Adamawa having the third largest enrolment nationally [12]. The respondent expressed the conviction that the state has also demonstrated the requisite capacity to mobilise the necessary financial and technical expertise needed to run a successful scheme. For example, a key informant expressed confidence that

"The state has the necessary ingredients, including state actors, a stand-alone health insurance agency, an active primary healthcare agency coordinating primary healthcare activities across all 226 wards, and the presence of the national health insurance authority."

### Perception around the Existence of Political Will and Legal Framework

Perceptions around the existence of political will including the legal framework for establishing community-based health insurance was examined. High-level government health managers shared their perspectives. Two key informants affirmed the existence of a strong political will at the state and federal levels. They based this assertion on the various health interventions the state government had implemented, including the declaration of health as an emergency.

"There's political will, but more needs to be done. As I've mentioned from the beginning, we need more resources to be injected into the state's health agencies. They are implementing many medical programmes for the people, but they need resources to implement them."

## Discussions

This study explored the feasibility of establishing a community-based health insurance scheme (CBHIS), including willingness and capacity to pay for a standard CBHI service package in 5 wards in Adamawa. Feasibility was hinged on how well the state met the following six preconditions for establishing CBHIs. The willingness and capacity to pay for the scheme in each of the five districts was also examined. Findings from this study have, to varying degrees, demonstrated the existence of these six preconditions in all five districts studied, consequently earning the state a favourable feasibility rating. Key findings include.

### Preconditions for establishing CBHI

Findings from affordability, willingness to join, and willingness to pay assessments suggest the potential number of enrolees will be sufficiently high from the first year. A positive attitude towards the establishment and participation in community-based health insurance scheme was expressed by a cumulative 93.1% of the study population. At least 9 out of 10 respondents in Damare, Imburu, Mbilla and Sabon Pegi believed participating in health insurance was either 'a good idea' or 'a somewhat good idea'. The high willingness to pay for other household members observed was consistent with results reported by a cross-sectional study of seven communities in East and West Africa showed 54.7% were willing to pay for all household members [21]. Qualitative findings also showed a favourable disposition towards the establishment of community-based health insurance was observed among the majority of participants without objections.

All study locations demonstrated the existence of a culture of mutual aid and solidarity. This is evidenced by the presence of functional cooperative societies and the participation of a substantial proportion of the sampled population in cooperative schemes.

For example, proportions of members with current membership of mutual aid organisations are distributed as follows: 10.7% in Sabon Pegi; 15.5% in Imburu; 16.8% in Damare; 26.2% in Dumne; and 30.7% in Mbilla. Overall, an average of 14.1% of respondents in the entire study are currently members of cooperative societies. Across all locations, farmers' cooperatives had the highest proportions of membership. This is consistent with findings from studies showing occupations such as agriculture comprise the majority of membership of cooperative societies [22, 23]. There is a simple correlation between the proportion of rural dwellers among respondents and inclination towards solidarity. For example, Damare, with a relatively far lower rural population of 27.7%, had the lowest proportion of respondents inclined towards mutual aid engagement at 58.8%. In contrast, all the other four study sites with rural populations ranging from 88.2% to 99.8% had between 72% and 88.8% of their population inclined towards supporting others. Solidarity among members of cooperative organisations appears to be stronger in rural and mostly homogenous communities.

The existence of favourable trends in socio-economic development positively impacting the capacity to pay for health insurance has also been established. This key success factor, required for CBHIs to thrive, was influenced by the distribution of mean personal and household income levels in relation to out-of-pocket expense (OOP), the availability and state of small businesses, the employment rate, and the frequency of financial inflows observed from socio-demographic assessments. Findings from these assessments showed at least 3 out of every 5 respondents in 4 out of the 5 study sites are reportedly self-employed, with many engaged in small businesses that mostly attract financial inflows necessary for subsistence living.

Furthermore, the source of livelihood for study locations provided either "throughout the year" or "seasonal" income flow in at least 3 out of every 5 respondents in 4 out of the 5 study locations. This indicates an enhanced capacity to enrol and especially sustain enrolment on a periodic basis. This is consistent with evidence of the potential impact of socioeconomics on capacity and willingness to pay demonstrated by studies showing employment to be a key determinant of increased health insurance enrolment [24, 25]. Further evidence of the association between socio-economic factors in determining the success of community-based health insurance initiatives has also been documented in several other studies [25, 26]. Given that at the 50th percentile, even the N1,500 starting premium was 3.75% of the mean total personal monthly income of N40,000, the trend in socio-economic development favoured a health expenditure to income ratio that was well within the benchmark for affordability informed by studies which showed typical households spend between 2% and 5% of income on healthcare [27].

Results of clients' assessment of overall performance of healthcare service delivery offered at health facilities showed that on average, 70% of all respondents expressed satisfaction with service delivery. However, in line with conclusions from a related study, this relatively high satisfaction ratings were associated with identified limitations cum facility-related administrative challenges [28]. Findings indicate satisfaction levels ranged from 46.9% in Mbilla to 58.7% in Dumne, followed by 64.5% in Sabon Pegi, and then 86.7% and 89.4% in Imburu and Damare, respectively. Higher satisfaction ratings of 89% were documented by a cross-sectional observational study of enrollees of health insurance in Aba, Kano, Lagos and Onitsha, located in Nigeria [28]. However, far lower satisfaction ratings were documented among subscribers of state-sponsored health insurance schemes in Enugu, with 40.5%, and Cross River, where only 32.7% (16) satisfaction was documented. The same study documented

relatively high satisfaction rates of 78.3% and 77.7% for Taraba and Oyo states, respectively [29].

The degree of public confidence in the promoters of a potential CBHI scheme varied considerably across study sites. In the context of this research, current health systems managers, especially service providers, administrators and managers of primary and secondary health facilities, sufficed as scheme promoters. The proportion of respondents who rated the quality of doctors and nurses to be good was 87.3% and 82.5%, respectively. Consistent with this position were findings which showed that a lack of confidence in promoters and managers of CBHI has a negative impact on CBHI enrolment [30].

The existence of a priority need for protection against financial risk associated with sickness was demonstrated by observed trends in healthcare access and utilization challenges. Further indication of the presence of priority need for protection are findings which showed 3 out of 5 districts had out-of-pocket expenses that were catastrophic in nature since health expenses exceeded 40% of income left after spending on basic subsistence needs (discretionary income). For example, health expense as a percentage of discretionary income was 112% in Imburu, 45.7% in Mbilla, and 90.7% in Sabon Pegi. The same districts also had mean health expenses exceeding 10% of total income at 11% for Imburu, 12.7% in Mbilla, and 13.5% in Sabon Pegi. These values exceed the 5% health expenditure to income ratio regarded as a common benchmark of affordability [27]. Furthermore, the proportion of households who self-reported receiving treatment for a chronic condition was 14.8%, while 13% and 25.9% reported visiting a doctor for diabetes and high blood pressure within the last 6 months. These findings contrasted with a study in 22 rural communities in Ethiopia, which reported 42% had chronic illness, while 44% encountered some illness in the past 12 months [31]. This study's findings contrasted with those of another study which reported a household chronic condition prevalence rate of 16.5% [24]. Findings also showed overall, 25.9% and 13% of all respondents reported visiting a hospital for high blood pressure and diabetes treatment respectively. This indicates a significant percentage of households may be exposed to high out-of-pocket expenditures.

Findings from the assessment of the number of times respondents delayed seeking care due to unaffordability of care or lack of financial capacity showed those who have delayed care seeking comprise at least 2 out of every 5 respondents in Dumne, one half of respondents in Imburu, 3 out of every 10 in Mbilla, and 3 out of every 5 in Sabon Pegi. This is in line with findings showing financial barriers resulting from high out-of-pocket expenses predispose especially low-income earners to delaying and/or even forgoing needed medical care [32]. Even for the insured, a descriptive study comparing rates of underinsurance among low-income adults with private versus public insurance suggests deferring or delaying medical care has been associated with a high-deductible health plan coverage where insured individuals have to make significant out-of-pocket expenditures before access to healthcare commences [9]. These findings all point to the existence of a priority need for financial protection via health insurance and a key precondition for setting up a health insurance scheme.

## Willingness to Pay

Willingness to pay assessments was anchored on an initial evaluation of attitude towards health insurance; willingness to pay a fee to join CBHI as an individual and as households; and a willingness to encourage a neighbour to join. Findings showed a favourable disposition (attitude) towards health insurance was expressed by 90.6% of all respondents. This is consistent with a study conducted in Osun and Porth Harcourt, where the proportion of respondents willing to pay for

a contributory social health insurance scheme was 82%, 87% and 89.7%, respectively [33,34]. A far lower willingness to pay of less than 40% was reported in an earlier study where 7% of rural communities sampled indicated they were willing to pay to join a scheme [35]. The marked difference in proportion may be due to differences in degree of satisfaction in health services, rising inflation, and socio-economic and geopolitical differences between the two study locations. When this study's observed rates for willingness to join (88.5% ), and willing to pay a fee to join (85.3%) were compared with actual enrolment rates in state-supported health insurance schemes from six geopolitical zones in Nigeria, results showed enrolment rates was 15.1% in Oyo, 4.45% in Taraba, 2.8% in Sokoto, 2.4% in Cross River, and 1% in Enugu [29].

The proportion of respondents willing to pay the various monthly individual package prices comprised 97.3% for N600; 90.7% for N800; 49% for N1,000 (benchmark price – current BHCPF premium); 7.2% for N1,200; and 7.2% for N1,500. The most preferred willingness to pay amount for an individual package was N600, subscribed to by 97.3% of respondents, followed by the more realistic N800, chosen by 90.7% of respondents of the entire study. A previous feasibility study conducted by the Centre for Health Economics and Development (CHECOD) in 2017 assessed the feasibility of establishing CBHI in Adamawa. Findings revealed 89% of respondents were willing to contribute a fee to join the scheme. However, a far lower percentage, 45 percent, were willing to pay between N200 and N500 to join the scheme [36]. The difference in proportion of those who considered 1,000 affordable and those who were willing to pay N1000 decreased from 83% to 60.8% in Damare; 73.5% to 53.8% in Dumne; 64% to 45% in Imburu; 54.8% to 34.8% in Mbilla; and 63.4% to 49% in Sabon pegi. Another related 2019 study found the mean willingness to pay amount for individual service packages was N542 for rural households and N555.23 for urban households [9].

When the overall mean highest OOP expense is compared with the highest willingness to pay amount for the individual and family package under consideration, it is readily observed that for the individual service package, the mean individual OOP of N5,341 was far higher than the highest willingness to pay premium of N1,500 offered. A similar study found that a monthly premium of N500 (US$ 4.2) was also far less than 3% of households' monthly out-of-pocket health spending [37].

## Rationalizing Willingness to Pay in Light of Out-of-Pocket Expense

Findings from focused group discussions (FGD) showed that participants who were presented with anecdotal evidence including reflections on the difference between their out-of-pocket expense, and the various willingness to pay premiums for CBHI service package, were more willing to not only join the scheme but also pay higher willingness to pay amounts offered. To nudge respondents into providing a more informed valuation of the CBHI service package and, in turn, provide a more realistic choice of willingness to pay amount, questions eliciting willingness to pay preferences were preceded by questions prompting respondents to recall and provide estimates of the highest monthly personal and household out-of-pocket expense incurred within the last 3 months. The result of this approach indicates some participants tended to increase their willingness to pay amount in FGDs where questioning moved from WTP preferences to OOP expense and then back to WTP amounts. This was compared to when OOP questions did not precede WTP questions.

Assuming we use N1,500 as a benchmark out-of-pocket expense (OOP) since this was the maximum willingness to pay amount under evaluation, results showed that at least 4 out of every 5 respondents in Dumne have at least this amount as the highest OOP expense within the

last 3 months in Dumne. Another 7 out of 10 have already spent this amount (N1,500) on personal OOP in Damare, Imburu, and Sabon Pegi. In line with this outcome, studies assessing willingness-to-pay for healthcare services in Greece showed that higher informal out-of-pocket payments increased the likelihood of both willingness to pay (WTP) and willingness to pay amounts for zero-cost insurance products [38].

It was readily observed from findings of this study that even at the 25th percentile, the mean out-of-pocket expense is equal to the highest monthly premium amount of N1,500 offered for the hypothetical CBHI package, and also far higher than the benchmark premium of N1,000 for BHCPF-supported health insurance. The proportion of respondents who expressed willingness to pay N1,000 compared to those who preferred to pay N800 increased dramatically from 50.8% to 93.4%. The more than 40 percentage point difference is too substantial to ignore. The implication is that either N800 or a middle ground between N800 and N1000 should be considered. During in-depth interviews, health managers have reiterated the inadequacy of the majority's preferred willingness to pay amount to adequately provide for services offered by the current BHCPF support service package. Thus, managers of healthcare facilities recommended a far higher willingness to pay amount, ranging between N2,000 and N3,000 per individual, compared to the currently BHCPF-adopted premium of N1,000 and capitation of N570 given to health facilities by ACHMA.

To address this concern, it is envisaged that the financial viability of this scheme is contingent upon subsidization. So, the final premium to be adopted should be a product of several considerations, especially where the main aim is to target as much as possible, the informal sector population, who comprise more than 70% of the state's population. The need to factor in majority interest when setting up insurance premiums was suggested in a study that highlighted how representatives of communities are involved during the price-setting and adjustment process [17]. A similar consideration should be factored following premiums informed by actuarial studies.

## Capacity to Pay

The relationship between the mean personal income left after spending on basic necessities and personal monthly income expressed as percentages of personal income provided insights into respondents' capacity to pay proposed willingness to pay amounts. The link between capacity to pay, willingness to pay, and feasibility of establishing CBHI in a given location has been demonstrated by studies asserting a linear relationship between higher income, greater capacity to pay, and a higher willingness to pay. A similar link is observed between education, awareness, capacity to pay, and willingness to pay [21, 39]. Results from this study's appraisal of trends in respondents' capacity to pay for health insurance showed the mean score for estimated total personal and household monthly income is N53,140 (SD 48,508) and N74,147 (SD 72,064), respectively. The distribution of personal and household income ranged from N0 to N330,000 and 0 to 410,000, respectively.

The mean personal monthly income left after expenses on basic necessities listed above ranged from N4,302 in Imburu to 35,033 in Damare. These values are thus higher than the highest premium offered for the hypothetical CBHI health service package. This implied that a significant percentage of respondents in each of the 5 study sites were forecasted to be able to afford premiums for a standard service package starting at N1,500. However, the opportunity cost of paying this premium may make the same premium unaffordable, considering that certain household needs may have been sacrificed in the process [40]. These findings are comparable to those of a Tanzanian study which found 75% of all households examined spent more than the recommended 10% threshold of their income

on purchasing health insurance packages, thus subjecting these households to catastrophic health expenditure [41]. Therefore, the income left after spending on basic necessities, also known as discretionary income, is considered a critical factor in determining a person's capacity to pay for insurance products.

Expressing the mean personal income left after spending on basic necessities as a percentage of mean personal monthly income in each district yielded 56.2%, 22.52%, 9.94%, 27.7% and 14.9% for Damare, Dumne, Imburu, Mbilla, and Sabon Pegi, respectively, while the average for all 5 locations is 26.25%. Thus, these percentages translate into the following amounts: N35,033 in Damare (with a predominantly urban population); N14,429 in Dumne (with the highest rural population of 99.3%); N4,302 in Imburu; N10,349 in Mbilla; and N8,674 in Sabon pegi. Given that N35,033 and N14,429, recorded in Damare and Dumne, are at least 5 times and 2 times the highest family willingness to pay premium of N7,000, respectively, these two LGAs, on average, appear to have the highest capacity to pay. The least capacity to pay was observed in Imburu, Mbilla and Sabon pegi. Despite being in the same LGA, Sabon Pegi's capacity to pay appears to be two times higher in Sabon pegi. This is despite having a similar proportion of respondents with at least tertiary education.

As much as 20 percent of households face catastrophic health expenditure, based on a study assessing the effect of community-based health insurance on catastrophic health expenditure in Northeast Ethiopia. A related 2011 study reported 28.7% of households incurred catastrophic health expenditure using a 40% benchmark for household non-food expenditure [42]. Other studies have also shown that high out-of-pocket expenditures of a magnitude characterised as catastrophic in nature have been reported in 20%, 18%, and 30% of respondents examined [43].

## Conclusion

Given the complementarity of findings from both qualitative and quantitative assessments, this study has demonstrated not only the feasibility but also the viability of establishing community-based health insurance scheme, an alternative health financing mechanism that, amongst other benefits, is able to promote increased and equitable access to quality care while offering protection from the catastrophic impact of high out-of-pocket expenses for the largely uninsured informal sector. Fundamentally, the existence of six preconditions for setting up viable CBHI schemes in all five study locations has also been demonstrated.

While findings from institutional readiness and capacity and willingness to pay studies favourably dispose study locations to a positive feasibility rating, the likelihood that a substantial number of enrollees will join the scheme from the first year will depend on the implementation of institutionalised mechanisms for mobilising subsidies and fostering a whole-of-society engagement.

There exists, to a substantial degree, the presence of a priority need for protection against financial risk associated with sickness. This is illustrated by the findings from the assessment of prevalences of chronic conditions within the study population; limited levels of access and utilization of healthcare services; the trends in out-of-pocket expenses in health; and the frequency of delays in seeking healthcare due to cost-related factors. Overall, findings across each study location suggested both rural and urban study populations were in dire need of protection against the risk of financial loss associated with sickness. This is arguably one of the most critical preconditions observed in this study.

Findings from qualitative studies have aided understanding of contextual factors that have impacted results of quantitative studies in a way that aligns with Poletti *et al.*'s (2007) assertion that feasibility should be systematically

examined while accounting for contextual constraints and enablers. For example, qualitative findings provided insights about differences in perspectives between the health provider's perception of marginal costs of care and the preferred willingness to pay amount selected by the majority of respondents of FGDs, in-depth interviews, and household-based surveys. A rich blend of diverse perspectives arising from the vantage point of human, and ultimately community-centredness, was synthesised during results analysis.

The following therefore sums up findings from this study: for institutional readiness, the structures, support systems, and technical expertise required to roll out pilot community-based health insurance schemes (CBHI) in Adamawa are well in place. The study concludes by highlighting the potential of a well-marketed community-based health insurance scheme to mobilise financing for informal sector micro-health insurance coverage to the tune of a speculative N4.3 billion annually. This projection is hinged on the assumption that a community-led effort driven by a diverse array of stakeholders, including traditional leaders, can jointly mobilise an average of 2,000 individuals in each of the 226 wards in the state to subscribe to a scheme costing between N800 and N1000 for a basic minimum package of healthcare services. This projection is also founded on the assumption that when presented with both anecdotal and statistical evidence of the high out-of-pocket expenses experienced by community members, the average person is likely to embrace financial risk protection associated with enrolment into health insurance schemes.

## Suggested Recommendations

1. Prioritise the development of a legislative framework that fosters the promotion of defined standards for quality of care; the integration of CBHI principles into broader health policy; the strengthening of administrative and managerial capacity of CBHI promoters; and the promotion of quality assurance procedures that are hinged on total quality management principle.
2. Establish a steering committee charged with the mandate of reviewing findings from this feasibility study; engage a development consulting firm to provide technical support for development of pilot CBHI strategy and implementation plan, including the development for whole of society engagement.
3. Traditional leaders' deep-rooted connections to tradition, cultural values and community relations can be effectively exploited to drive substantial community participation in community-based health insurance schemes. These leaders should be tasked to lead community efforts towards CBHI awareness and enrolment drives.
4. Consideration should be given to the introduction of a range of complementary value-added services that appeals to low-risk individuals, including young adults who consider health insurance as a poor value proposition. To increase overall satisfaction and retention of young adults, the adopted range of add-on services should be informed by wider consultations with young adults. Stakeholders can come together to deliberate on both funding mechanisms and the sustainability framework.

## Suggestions for Future Research Include

1. Conduct studies assessing public perception of quality of healthcare services delivered by all health facilities earmarked to participate in potential pilot CBHI scheme establishment in Adamawa.
2. Systematic reviews to identify factors contributing to why CBHI schemes have struggled to achieve large scale sustainable success in some countries, while

succeeding in others like Rwanda where CBHIs alone accounted for 81.6% of national health insurance enrollment between 2015/2016. In effect, studies should strive to identify the potential barriers and determinants of CBHI success in Adamawa.

3. A randomized controlled trial (RCT) study around the impact of value-added services on mitigating adverse selection, and sustaining enrolment into health insurance scheme is recommended.
4. Also suggested, is further research around determining the potential impact of deploying human-centered design (HCD) and related behavioural economics principles to identify and address individual and social characteristics potentially influencing capacity and willingness to pay for community-based health insurance premiums against the backdrop of rising inflation and the new tax policy in Nigeria set to take effect in January 2026.

## Study Limitations

Findings from willingness to pay should be interpreted in light of the following limitations: Assessment of "willingness to pay" for CBHI is based on a hypothetical health care package, hence, it does not accurately represent real-world circumstances. A second limitation is born out of the assumption that measured willingness to pay reflects the true valuation of households. But in reality, measured willingness to pay may not accurately reflect the true utility gain of a choice. This is informed by the concern that owing to information constraints, households may not fully understand the full extent of the value or benefits derivable from a choice. This may in turn result in households erroneously forecasting their willingness to pay for a product or service [44] Furthermore, responses to out-of-pocket expense, personal and household income, and health seeking behavior may be subject to recall and or social desirability bias.

The assumption that the limited amount of time available to enumerators to describe a hypothetical CBHI scheme and service package will be enough to elicit respondents' understanding necessary to inform a valid choice is a limitation. This time may be insufficient especially in households where respondents have little or no prior knowledge, and or experience of community-based health insurance or even health insurance. Therefore, the large degree of trust needed to buy an insurance product may also be lacking owing to this time constraint [44].

Moreso, this study's use of convenience sampling, a non-probability sampling method, is susceptible to selection bias as only participants who were available and accessible at the time of the research, and that met the survey inclusion criteria were considered in the sample. Hence, the influence of confounding factors may have negatively impacted the validity of the findings of this research to an undetermined extent necessitating a cautious consideration of the observed associations.

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## Data Availability

Quantitative data sets without sensitive personal identifiers, and contextual data are available on reasonable request made to the corresponding author. Qualitative data sets including audio recorded and transcribed information from Focused Group Discussion (FGD) and In-depth/Key Informant Interviews are not publicly available due to the need to uphold confidentiality, and privacy agreement.

## Conflict of Interest

The authors declare no conflict of interest.

## Ethical Clearance

Ethical clearance was provided by the Adamawa State Ministry of Health. Verbal informed consent from the study participants was obtained before commencement of the study.

## Author's Contributions

I.C.U: Conceptualization, design, methodology, research instrument development, validation, investigation, data collection, data analysis, result interpretation, data curation, and abstract and manuscript writing. E.O.D: Review of entire manuscript and thesis supervision. A.L: Critical revision of all sections of entire manuscript and thesis supervision (thesis co-guide). All authors read and approved the final version forwarded to Texila International Journal.

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# Food Safety Emergency Response in Africa: Institutional and Contextual Analyses from Eight Countries

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***Abstract***

*Foodborne diseases remain a public health and socioeconomic development challenge in Africa, where fragmented systems limit preparedness and response. This study examined the institutional and contextual dimensions of food safety emergency preparedness and response across eight African countries: Nigeria, Egypt, Ghana, Kenya, Ethiopia, Uganda, Cameroon, and South Africa. A mixed-methods design was used, combining structured questionnaires and key informant interviews with stakeholders from regulatory agencies, public health institutions, academia, food businesses, development partners, and the general public. Thematic analysis, supported by a triangulation of survey findings, interviews, and a regional desk review, enabled cross country comparison of system functionality. Benchmarking was conducted against three major frameworks: FAO/WHO Food Safety Emergency Management (FSEM), the WHO Joint External Evaluation (JEE) tool, and Ghana's Food Safety Emergency Response Plan (FoSERP). Findings revealed recurring gaps across most countries including fragmented governance, poor coordination, under-resourced surveillance, uneven laboratory capacity, limited training, inadequate financing, compliance and communication, and One Health integration. Although some strengths were identified in selected countries (Ghana and Egypt), these were insufficient to offset systemic weaknesses. The benchmarking exercise highlighted significant gaps between existing global guidance and operational reality. Overall, the results underscore the need for integrated governance structures, institutionalized rapid risk assessment and incident management processes, and sustained investment in laboratory networks, workforce development, and proactive risk communication. Strengthening these foundational elements is essential for building resilient and responsive food safety emergency systems across Africa.*

***Keywords****: Africa, Emergency Response, Food Safety, Governance, Surveillance.*

## Introduction

Food safety remains a critical public health issue across Africa, where foodborne diseases contribute substantially to illness, mortality, and economic strain. According to the World Health Organization [1], unsafe food is responsible for an estimated 137,000 deaths each year in the African region, being the highest burden globally. This persistent challenge is shaped by multiple structural weaknesses, including fragmented food control systems, limited surveillance and laboratory capacity, and poor multisectoral coordination [2, 3].

While food is essential for health and human development, it can also serve as a conduit for microbial pathogens, chemical contaminants,

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and natural toxins [4]. These risks are heightened in sub-Saharan Africa, where informal markets dominate food distribution and public awareness of food safety concerns is often low [3]. In many settings, emergency response structures for foodborne incidents are weak or absent, leaving food systems highly vulnerable to outbreaks that easily cross borders and escalate into national or regional crises.

A number of systemic challenges hinder timely and effective food safety emergency preparedness and response. These range from outdated or poorly implemented regulations to overlapping institutional mandates and insufficient funding or staffing for routine surveillance and incident management [5, 6]. Emergency responses tend to be reactive, with few countries conducting routine simulation exercises or adopting structured emergency management systems. The 2017 – 2018 listeriosis outbreak in South Africa, which remains the largest recorded globally, plainly illustrated limitations in traceability, surveillance, and inter-agency communication, resulting in delayed response and over 200 deaths [6, 7].

In contrast, high-income settings have developed more robust emergency response mechanisms. The European Union's Rapid Alert System for Food and Feed (RASFF) and the U.S. Food and Drug Administration's Emergency Operations Center exemplify integrated systems supported by strong legal mandates, coordinated communication channels, and institutionalized rapid response protocols [8, 9]. At the global level, the INFOSAN network provides a platform for rapid information exchange and coordination during cross-border food safety emergencies [10].

Across Africa, however, food safety governance remains uneven. National systems differ markedly in surveillance capacity, laboratory networks, and the presence or absence of emergency response plans. Even when policies exist, operational gaps persist due to resource constraints or institutional misalignment [11, 12]. The WHO Global Strategy for Food Safety 2022 – 2030 [13] underscores the urgency for African countries to adopt integrated food safety policies, build surveillance and laboratory infrastructure, and improve multisectoral collaboration. Some progress is emerging, Ghana's National Food Safety Emergency Response Plan (FoSERP) is one example of a formal, structured approach, but such initiatives remain the exception rather than the norm [14].

Existing research highlights recurring capacity gaps in preparedness, coordination, and risk communication [15, 16]. Emergency response efforts remain siloed, often excluding environmental or animal health actors despite the clear One Health dimensions of many foodborne hazards [17]. The One Health model, although increasingly recognized, is still not fully integrated into national food safety systems across the continent [13].

From a theoretical perspective, insights from systems theory, institutional theory, and risk governance suggest that effective preparedness and response depend on more than technical tools, they rely heavily on governance quality, institutional coherence, and responsive feedback structures [18-20]. Fragmented mandates, limited stakeholder engagement, and insufficient anticipation mechanisms collectively undermine the continent's ability to manage foodborne incidents proactively.

This study provides an institutional and contextual analysis of food safety emergency response systems across eight African countries. It draws on survey data and key informant interviews to explore strengths, gaps, and emerging opportunities within national systems. By triangulating stakeholder perceptions with desktop review evidence and benchmarking findings against international frameworks, the study aims to inform the development of more resilient, context-sensitive food safety emergency response systems in Africa, an increasingly critical need

as food systems become more complex and interconnected.

## Materials and Methods

### Study Design and Approach

This study used a structured questionnaire that combined multi-select items with open-text fields to capture both quantitative indicators and qualitative insights on food safety emergency response systems. The tool was administered across eight African countries: Nigeria, Egypt, Ghana, Kenya, Ethiopia, Uganda, Cameroon, and South Africa, to a wide range of stakeholders, including regulators, public health professionals, food business operators, academic experts, and community representatives. The closed-ended items enabled systematic assessment of institutional capacities and operational practices, while the open-ended responses allowed participants to share experiential knowledge and context-specific challenges. By integrating these complementary data types, the mixed-methods approach provided both statistical grounding and contextual depth, resulting in a more comprehensive understanding of strengths and weaknesses within national food safety emergency systems.

### Study Population and Sampling

The target population included stakeholders involved in food safety management, emergency preparedness, and response across the eight study countries. Participants were drawn from regulatory agencies, public health institutions, food business operators, academia, local communities, and regional or international organizations such as WHO, FAO, AU entities, and Regional Economic Communities (RECs). A purposive sampling strategy was employed to ensure that diverse perspectives were represented across different sectors, geographic areas, and institutional roles [21].

Sample size calculations were informed by national population figures [22] and the estimated annual foodborne disease burden in Africa (91 million cases) [1]. These parameters were applied in the RAOSOFT sample size calculator [23], using a 95% confidence level. To achieve balanced representation, the sample was distributed across stakeholder groups: public (40%), regulators (15%), public health officials (15%), researchers/academics (15%), and food business operators (15%). An additional ten participants were drawn from international and regional organizations, in line with widely adopted principles of stakeholder engagement and risk communication [24-26]. The resulting country-specific sample allocations are presented in Table 1.

### Data Collection

Data were collected primarily through structured questionnaires, supplemented in several cases by semi-structured key informant interviews (KIIs). Participants included national regulators, public health professionals, academic experts, food business operators, representatives of international agencies, and members of the general public. The questionnaire explored operational challenges, gaps in coordination, infrastructure limitations, and practical experiences with past food safety emergencies. It also captured perceptions of system functionality and capacity across surveillance, laboratory testing, risk communication, incident management, and governance structures.

All responses were consolidated into five datasets for qualitative and quantitative analysis. For thematic classification, responses were coded into eight predefined thematic areas: coordination/ governance, surveillance/ data, laboratories, human resources/ training, risk communication, compliance/ SOPs, funding/ logistics, and One Health/ laboratory networks [27].

### Data Analysis

Qualitative and quantitative data from the survey and KIIs were analysed using thematic methods guided by Braun and Clarke's

framework [28]. The analysis involved familiarisation with the dataset, generation of initial codes, identification of recurring themes, thematic refinement, and cross-country comparison. The aim was to identify institutional strengths, operational weaknesses, and systemic gaps across the eight countries. Special attention was given to cross-cutting issues affecting rapid detection, coordinated response, surveillance functionality, workforce capacity, laboratory readiness, and risk communication. These themes were examined both within and across stakeholder groups to ensure robust interpretation of the data.

## Triangulation of Findings

To strengthen the validity and depth of the analysis, findings from the survey and KIIs were triangulated with insights from a prior desk review [29] that examined policy documents, regulatory frameworks, and WHO Joint External Evaluation (JEE) reports. This triangulation enhanced context-specific interpretation and helped confirm areas of convergence between stakeholder perspectives and documented evidence [27].

## Comparative Benchmarking

To assess policy relevance and practical gaps, a comparative benchmarking exercise was conducted against three major frameworks:

1. FAO/WHO Food Safety Emergency Management (FSEM) guidance [30],
2. WHO Joint External Evaluation (JEE) Tool for Food Safety [17], and
3. Ghana's National Food Safety Emergency Response Plan (FoSERP) [14].

The benchmarking focused on three strategic dimensions:

1. National policy and institutional frameworks,
2. Emergency detection and response mechanisms, and
3. Infrastructure and capacity.

This process helped identify both transferable global best practices and context-specific gaps that must be addressed to strengthen food safety emergency systems across African countries.

**Table 1.** Country Population and Determination of Sample Size for Key Informant Interview through Questionnaires

| Country | Country population | Estimated Contribution to FBD incidence (%) | Population equivalent for FBD prevalence | Recommended sample size (95% C.L.) | General Public (40%) | Regulators (15%) | Public Health (15%) | Researchers (15%) | FBOs (15%) |
|---|---|---|---|---|---|---|---|---|---|
| Nigeria | 237 527 782 | 33% | 29 610 676 | 340 | 136 | 51 | 51 | 51 | 51 |
| Cameroon | 29 879 337 | 4% | 3 724 816 | 60 | 24 | 9 | 9 | 9 | 9 |
| Ethiopia | 135 472 051 | 19% | 16 888 210 | 237 | 95 | 36 | 36 | 36 | 34 |
| Egypt | 118 365 995 | 16% | 14 755 736 | 207 | 83 | 31 | 31 | 31 | 31 |
| Kenya | 57 532 493 | 8% | 7 172 113 | 114 | 46 | 17 | 17 | 17 | 17 |
| Uganda | 51 384 894 | 7% | 6 405 741 | 101 | 40 | 15 | 15 | 15 | 16 |
| Ghana | 35 064 272 | 5% | 4 371 181 | 73 | 29 | 11 | 11 | 11 | 11 |
| South Africa | 64 747 319 | 9% | 8 071 527 | 126 | 50 | 19 | 19 | 19 | 19 |
| International & Regional Organizations | | | | 10 | | | | | |
| **Total** | **729 974 143** | **100%** | **91 000 000** | **1,268** | **503** | **189** | **189** | **189** | **188** |

# Results

## Respondent Profile

A total of 1,259 stakeholders from eight African countries: Nigeria, Egypt, Ghana, Kenya, Ethiopia, Uganda, Cameroon, and South Africa participated in the survey, with several also completing key informant interviews. This represented a 99% completion rate relative to the planned 1,268 respondents. Stakeholder representation was strong and exceeded targets in most categories: regulators and public health institutions (102%), academic experts (101%), food business operators (102%), and development partners (250%). Participation from the general public reached 93%, still providing substantial insight into consumer-level perceptions. The broad geographical and institutional coverage delivered a robust and inclusive evidence base for analysis.

## Thematic Findings

Across all respondents, eight recurring themes emerged: industry compliance and SOPs, coordination and governance, surveillance and data, human resources and training, laboratory capacity, risk communication, funding and logistics, and One Health/laboratory networks. As illustrated in Figure 1, the most frequently referenced areas were industry compliance and SOPs (110 mentions), coordination and governance (106), and surveillance and data (87).

These thematic areas reflected not only weaknesses but also existing strengths. Many respondents identified functional assets such as operational food safety committees, accredited laboratories in selected countries, and the uptake of HACCP and GMP standards by segments of the private sector. At the same time, persistent challenges, including unclear institutional mandates, resource-limited laboratories, and weak enforcement among informal vendors, were repeatedly highlighted.

Different stakeholder groups emphasized different aspects based on their functional roles.

1. Regulators and public health officials pointed to coordination bottlenecks, lack of clear recall authority, and gaps in surveillance.
2. Food business operators frequently requested clearer SOPs, more educative inspection approaches, and strengthened recall processes.
3. Academic experts focused on the underuse of surveillance data, gaps in event-based detection, and uneven laboratory harmonization.
4. Development partners emphasized persistent fragmentation, limited sub-national capacity, and inconsistent multi-sectoral integration.
5. The general public highlighted low awareness of food safety risks and inadequate risk communication during outbreaks.

## Cross-Cutting Gaps

Although the eight themes provided a broad view of system strengths and weaknesses, five systemic gaps stood out across nearly all countries, as shown in Figure 2:

1. **Fragmented mandates and unclear leadership:** Overlapping responsibilities among ministries and agencies (health, agriculture, standards authorities, and local government) created uncertainty around incident command and recall authority, resulting in delayed responses.
2. **Under-resourced surveillance and trace-back systems:** Event-based surveillance signals, laboratory-confirmed foodborne disease reports, and market monitoring data were seldom integrated. Traceability in informal markets remained particularly limited.

3. **Uneven laboratory capacity and weak quality systems:** Outside capital cities, accredited laboratories were limited, shortages of reagents were frequent, and food-specific testing capabilities were inconsistent.

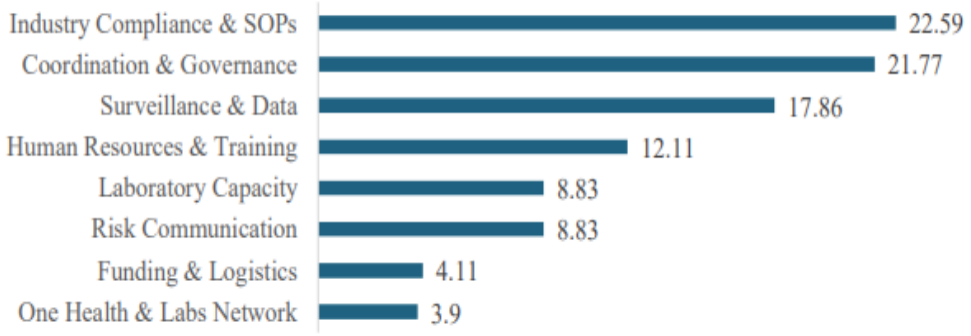


**Figure 1.** Percentage Distribution of Top Themes Across all Respondent

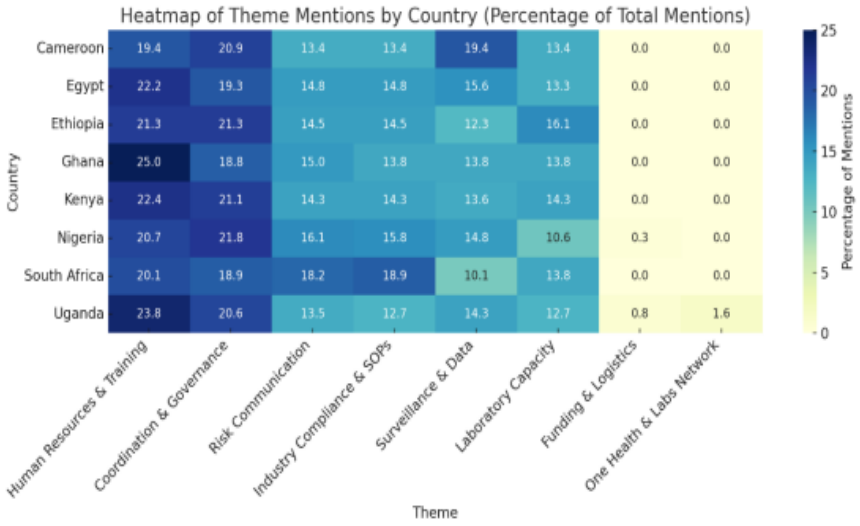


**Figure 2.** Heatmap of Gap-Related theme Mentions by Country (Percentage of total Mentions Per Count

1. **Skills gaps and limited continuous training:** Stakeholders noted insufficient training in outbreak investigation, risk communication, One Health incident management, and sub-national response capacity.
2. **Inadequate financing and logistics:** Few countries had dedicated budgets for food safety emergencies. Delays in fund mobilization, limited logistics capacity, and insufficient resources for sample transport were commonly reported.

Collectively, these systemic gaps interfered with rapid detection, slowed coordinated action, and reduced public confidence in food safety systems. Although some areas such as industrial compliance, risk communication, and One Health collaboration showed mixed performance, the five gaps above appeared consistently across all stakeholder groups.

## Country-Specific Patterns

While the five systemic gaps were common across the eight countries, their relative prominence differed, reflecting national contexts and institutional realities:

**Nigeria**: Respondents emphasized coordination/governance (21.8%) and human resources/training (20.7%), reflecting the complexities of a federal system and a large informal food sector.

**South Africa**: Priorities included human resources/training (20.1%), governance (18.9%), industry compliance (18.9%), and communication (18.2%), indicating challenges despite robust infrastructure.

**Ethiopia**: Coordination/governance (21.3%) and training (21.3%) dominated, with laboratory capacity (16.1%) also heavily cited.

**Ghana**: Training (25.0%), governance (18.8%), and risk communication (15.0%) were major concerns, alongside balanced challenges in surveillance, laboratory capacity, and compliance.

**Kenya**: Training (22.4%) and governance (21.1%) were central, with other issues (laboratories, communication, compliance, surveillance) evenly distributed.

**Cameroon**: Governance (20.9%), training (19.4%), and surveillance (19.4%) were major themes, reflecting broad systemic constraints.

**Egypt**: Training (22.2%), governance (19.3%), and surveillance (15.6%) dominated, consistent with challenges in operationalizing strong institutional frameworks.

**Uganda**: Training (23.8%) and governance (20.6%) led the themes, with Uganda being the only country to notably highlight One Health networks (1.6%), reflecting early adoption of integrated approaches.

These differences underscore the need for country-specific strategies that respond to unique structural and capacity challenges while addressing shared continental gaps.

## Dimensions of System Functionality

Three broader dimensions emerged when synthesizing thematic patterns across all countries:

1. **Policy and Institutional Frameworks**: Clear mandates, legal authority, and centralized structures were associated with stronger emergency responses, while fragmented mandates and outdated policies weakened system functionality.
2. **Emergency Detection and Response Mechanisms**: Integration of food safety into IDSR platforms, structured escalation pathways, and incident command arrangements were beneficial. However, under-reporting, weak traceability, and inconsistent risk communication remained widespread.
3. **Infrastructure and Capacity**: The availability of accredited laboratories, trained personnel, and operational logistics strengthened readiness. Nonetheless, most countries faced shortages in specialized laboratory capacity, workforce skills, and rapid mobilization mechanisms.

## Triangulation with Desk Review

Findings from the survey and KIIs aligned closely with insights from the prior desk review [29]. Countries with established frameworks, Ghana's FoSERP and Egypt's NFSA, demonstrated clearer institutional arrangements, whereas others such as Cameroon and Uganda showed sustained fragmentation. The desk review also confirmed that many documented plans remain underutilized or insufficiently operationalized in practice.

## Benchmarking with International Frameworks

Comparing empirical findings with the FAO/WHO FSEM guidance, WHO JEE Tool, and Ghana's FoSERP revealed broad alignment with global expectations regarding governance, surveillance, and capacity. However, significant operational gaps were evident, particularly in legal authority for recalls, institutionalized rapid risk assessment, laboratory accreditation, simulation exercises, and proactive risk communication. Table 2 provides a summary of these comparisons, highlighting specific enhancement needs for African contexts.

## Discussion

This study provides fresh empirical insight into how stakeholders across eight African countries perceive the performance, strengths, and persistent weaknesses of their food safety emergency response systems. The combined survey and interview findings reveal a mix of institutional assets and deep-rooted system deficits across eight thematic domains, with three overarching dimensions, policy and institutional frameworks, emergency detection and response mechanisms, and infrastructure and capacity, emerging as the foundation of system functionality.

### Policy and Institutional Frameworks

Across countries, stakeholders frequently emphasized governance arrangements as a major determinant of preparedness and response capacity. Regulators and development partners consistently highlighted fragmented mandates, unclear leadership structures and weak recall authority as major bottlenecks.

**Table 2.** Benchmarking International and National Food Safety Emergency Frameworks against Empirical Findings from Eight African Countries

| Strategic Dimension | International/National Framework Provisions | Empirical Findings | Enhancement Needs for the African Context |
|---|---|---|---|
| Policy and Institutional Frameworks | FSEM and JEE require national emergency plans with legal mandate, clear inter-agency roles, and a multisectoral approach.<br>FoSERP includes multi-tiered coordination (national, regional, district). | Only 2 of 8 countries had documented emergency plans.<br>Legal mandates are weak, unclear, or overlapping.<br>Limited authority to declare emergencies.<br>Inter-agency roles are not documented.<br>No centralized response structure in several settings. | Enact and enforce legal frameworks for food safety emergencies.<br>Develop/update national food safety emergency plans.<br>Formalize institutional roles (e.g., via ToRs, MoUs, SOPs).<br>Integrate food safety within national emergency response laws.<br>Cascade national plans to districts. |
| Emergency Detection and Response Mechanisms | FSEM promotes risk-based surveillance, early warning systems, and response triggers.<br>JEE assesses rapid risk assessment (RRA), early warning systems, escalation, and response protocols.<br>FoSERP features decision trees, incident command, and pre-assigned teams. | Fragmented surveillance systems.<br>Triggers for escalation are not well defined.<br>Limited RRA capacity.<br>Delays in mobilizing response teams.<br>Weak subnational response coordination. | Institutionalize multi-agency RRA teams with defined authority.<br>Standardize and operationalize escalation thresholds.<br>Train dedicated rapid response teams (RRTs) in foodborne outbreak investigation.<br>Ensure response SOPs are pre-approved.<br>Adapt Ghana's decision tree and field coordination models. |
| Infrastructure and Capacity | FSEM emphasizes SimEx, public communication, learning, laboratory systems, and after-action reviews.<br>JEE evaluates lab networks/capacity, simulation records, communication capacity, and INFOSAN contact. | Labs are under-resourced or lack food-specific capacity.<br>Rare or undocumented SimEx.<br>Weak or no public communication strategy.<br>INFOSAN focal points are often unknown/inactive. | Strengthen lab networks with food-specific testing capabilities.<br>Institutionalize annual SimEx and AARs.<br>Develop a public risk communication strategy and toolkits.<br>Develop digital repositories of response tools and partner lists. |

| | | | |
|---|---|---|---|
| | FoSERP includes templates, SitReps, and contact directories. | | Activate and train INFOSAN/IHR focal points.<br>Allocate domestic budget lines for preparedness. |

These concerns echo earlier lessons from significant foodborne disease outbreaks, such as the South African listeriosis event, where overlapping institutional roles and ambiguous responsibilities delayed decisive action [6, 31].

Conversely, countries with clearer and more centralized food safety frameworks—such as Ghana's FoSERP and Egypt's National Food Safety Authority were viewed as demonstrating comparatively stronger coordination and faster decision-making during emergencies [14, 32]. These observations reinforce institutional theory arguments that emphasize the role of clearly defined mandates, legitimacy, and enforcement power in shaping how effectively institutions function [19]. In essence, legal clarity and empowered leadership remain prerequisites for effective food safety emergency management.

## Emergency Detection and Response Mechanisms

Stakeholders repeatedly identified operational challenges related to early detection, risk assessment, and escalation. Many of the issues raised, fragmented surveillance systems, weak traceability mechanisms, delays in laboratory confirmation, and reactive rather than anticipatory responses, mirror concerns highlighted in global assessments and WHO JEE reports [33, 34]. Participants called for institutionalized multi-agency rapid risk assessment (RRA) teams, predefined escalation triggers, and standardized decision-support tools. These priorities are well aligned with FAO/WHO FSEM guidance and WHO JEE indicators, both of which emphasize structured detection and response pathways as critical elements of effective emergency management [15, 17]. Without these mechanisms, national systems default to a reactive posture, making timely containment difficult and eroding public confidence in the authorities' ability to manage food safety threats [18].

## Infrastructure and Capacity

Laboratory systems and workforce capabilities emerged as persistent weak points across the study countries. While some respondents highlighted existing accredited laboratories and noted pockets of HACCP implementation within the private sector, a more common narrative centered on inadequate laboratory coverage outside capital cities, shortages of reagents, insufficient food-specific testing capacity, and uneven workforce skills.

These deficiencies hinder both speed and accuracy during emergencies, underscoring the importance of foundational infrastructure, accredited labs, well-trained inspectors, epidemiologists, and risk communicators, as the backbone of readiness [35]. The limited emphasis on One Health approaches, noted mainly in Uganda, highlights a gap between stated policy aspirations and actual operational integration across human, animal, and environmental health sectors [13].

## Risk Communication and Public Engagement

Feedback from the general public and food business operators underscored risk communication as a critical challenge. Respondents noted that public awareness of food safety risks is low and that communication during emergencies, when it occurs, is often delayed or inconsistent. Such gaps create opportunities for misinformation and undermine public trust.

These concerns mirror earlier cases, such as Uganda's 2019 relief food poisoning incident,

where delays in official communication allowed speculation to spread [36]. Conversely, the transparent communication approach used during South Africa's listeriosis outbreak helped foster greater public collaboration and trust [7]. These examples illustrate why culturally responsive, proactive communication strategies must be embedded into national preparedness plans [26].

### Triangulation and Benchmarking

Triangulating survey and interview findings with desk review evidence [29] highlighted strong alignment between stakeholder perceptions and documented institutional realities. Countries with established frameworks (e.g., Ghana and Egypt) showed clearer organizational structures, while others (e.g., Cameroon and Uganda) continued to exhibit fragmentation.

Benchmarking against international/national frameworks, FAO/WHO FSEM, WHO JEE, and Ghana's FoSERP, revealed that while many countries broadly recognize the importance of governance, surveillance, and capacity-building, operationalization remains inconsistent. Respondents often identified the same priorities emphasized in the global frameworks, clear mandates, accredited laboratories, rapid risk assessment, and structured communication, but gaps remained in translating these priorities into day-to-day practice [17, 30]. Bridging this gap requires adapting international models to national realities, ensuring that legal authority, protocols, and institutional arrangements are formally embedded and functional.

### Implications

Overall, the findings suggest that food safety emergency systems across the eight countries assessed remain partially functional. While some institutional progress is evident, most systems continue to operate with fragmented mandates, reactive mechanisms, and resource limitations. Strengthening food safety emergency response will require attention to three core priorities:

1. Codifying institutional clarity and authority through national food safety emergency plans formally anchored in legislation [14, 32].
2. Institutionalizing rapid risk assessment, escalation protocols, and incident command tools to ensure that weak signals are detected and acted on quickly [15, 17].
3. Investing in foundational capabilities, including laboratory networks with food-specific testing capacity, sustained workforce development, simulation exercises, and proactive communication systems [8, 13].

Without these measures, emergency responses will continue to be delayed, fragmented, and insufficiently anticipatory, leaving countries vulnerable to recurring outbreaks.

## Limitations

Several limitations should be taken into account when interpreting these findings. Although the study achieved a high overall response rate (99%), participation from the general public fell slightly short of the target, which may have influenced the balance of perspectives across stakeholder groups. In addition, the sample size calculations were based on national population estimates and an assumed distribution of Africa's foodborne disease burden [1]; while this approach offered a reasonable foundation for determining sample adequacy, it may not fully reflect subnational variations in exposure or institutional capacity.

The qualitative components, survey open-text responses and key informant interviews, provided valuable contextual insights but are inherently subject to interpretation bias. This risk was mitigated through multi-coder thematic analysis and triangulation with secondary evidence [27], though some degree of subjective interpretation is unavoidable.

Finally, the diversity of political, institutional, and socioeconomic contexts across the eight countries limits the generalizability of findings to all AU Member States. Nonetheless, the consistency with which key gaps, fragmented governance, weak surveillance, limited laboratory capacity, and inadequate risk communication, appeared across countries suggests that the overarching conclusions are broadly relevant to many low- and middle-income African settings.

## Conclusion

This study provided a multi-country analysis of food safety emergency preparedness and response across eight African countries, drawing on perspectives from a wide spectrum of stakeholders. The findings highlight three interconnected domains: policy and institutional frameworks, emergency detection and response mechanisms, and infrastructure and capacity, as central to determining system effectiveness. While countries such as Ghana, Egypt, and South Africa displayed promising practices, most national food safety systems remain constrained by fragmented mandates, under-resourced surveillance structures, uneven laboratory capacity, and limited risk communication.

These results underscore the pressing public health and economic implications of food safety emergencies across the continent, which contribute to approximately 91 million foodborne disease cases annually [1]. By integrating systems theory, institutional theory, risk governance, and a One Health perspective, this study offers both conceptual insights and practical guidance for national and regional policymakers. The benchmarking exercise further highlights the need to adapt international frameworks, such as FAO/WHO FSEM and the WHO JEE, to the African context, emphasizing legal clarity, empowered leadership, and operationalized protocols.

The findings have clear policy and programmatic implications. National authorities can use this evidence to develop or revise food safety emergency response plans, institutionalize rapid risk assessment and incident management structures, and enhance laboratory and workforce capacity. Regional bodies and development partners may leverage these insights to harmonize approaches, strengthen cross-border surveillance networks, and align investments with identified national priorities. Beyond Africa, the results contribute to global dialogues on tailoring international food safety governance tools to low- and middle-income settings.

Strengthening food safety emergency systems is ultimately both a public health necessity and a development priority. Achieving durable improvements will require sustained political commitment, multi-sector collaboration, and targeted investments in foundational capacities to transition African food safety systems from reactive, fragmented arrangements toward integrated, proactive, and resilient emergency response models capable of safeguarding public health, trade, and livelihoods.

## Ethical Approval

This study used data obtained through structured questionnaires and key informant interviews. As no clinical or experimental procedures involving human subjects were undertaken, formal ethical approval was not required. Nonetheless, the research was conducted in accordance with established ethical principles, including integrity, transparency, confidentiality, and informed consent. Participation was voluntary, and respondents were informed of the purpose of the study and their right to decline or withdraw at any stage.

## Data Availability

The data supporting the findings of this study are available from the corresponding author upon credible request. Access is restricted to

safeguard confidentiality and comply with ethical commitments made to participants.

## Author Contributions

Modupe Adeyemo conceptualized and designed the thesis research, conducted data collection, performed data analysis, interpreted the findings, and drafted the manuscript presented here as part of the broader dissertation output under the guideship of Yemisi Jeff-Agboola. Both authors, Modupe Adeyemo and Yemisi Jeff-Agboola, reviewed the manuscript critically for intellectual content and approved the final version for submission.

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## Conflict of Interest

The authors declare that there are no conflicts of interest regarding the conduct of this study or the preparation of this manuscript.

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# A Clinical Perspective on Adult Cerebral Atrophy in Chronic Alcohol Use: Considering the Role of Neurotropic TORCH-Related Viruses (CMV, HSV-1, and Rubella)

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***Abstract***

*Chronic alcohol use is a well-recognized cause of cerebral atrophy and ventricular enlargement in adults. Neurotropic viral infections, including cytomegalovirus (CMV), herpes simplex virus type 1 (HSV-1), and rubella virus—pathogens traditionally grouped within the TORCH framework—may also contribute to central nervous system injury, particularly in states of immune dysfunction. This descriptive observational study draws on routine clinical observations of eight adults aged 42–65 years with long-standing alcohol use who presented with neurological symptoms at a district-level hospital with referral access to tertiary care. Non-contrast computed tomography imaging demonstrated diffuse cerebral atrophy with proportional ventricular enlargement consistent with hydrocephalus ex vacuo rather than true hydrocephalus. Clinical history and available serological data suggested prior exposure to CMV, HSV-1, and/or rubella in several patients, without evidence of acute viral encephalitis. Integrating these observations with a narrative review of the literature, this article explores plausible mechanisms through which alcohol-related neurotoxicity, immune dysregulation, and latent or prior neurotropic viral exposure may interact to accelerating neuronal injury, with particular vulnerability of temporal lobe structures. These mechanisms are discussed as hypothesized associations rather than proven causal relationships. Recognition of these interactions is clinically relevant for practitioners evaluating alcohol-exposed adults with cerebral atrophy and ventricular enlargement, especially in resource-limited settings where advanced neuroimaging and molecular viral diagnostics are not readily available.*

***Keywords****: Chronic Alcohol Use, Cerebral Atrophy, Cytomegalovirus, Herpes Simplex Virus Type 1, Hydrocephalus Ex Vacuo, Rubella, TORCH Infections.*

## Introduction

Chronic alcohol use is a well-established cause of structural and functional brain injury in adults, frequently manifesting as diffuse cerebral and cerebellar atrophy accompanied by ventricular enlargement on neuroimaging [1, 2]. Clinically affected individuals may present with cognitive impairment, gait disturbance, seizures, or neuropsychiatric symptoms, while radiological findings may raise concern for hydrocephalus. In many cases, however, ventricular enlargement reflects loss of surrounding brain parenchyma rather than disturbed cerebrospinal fluid (CSF) dynamics, a phenomenon referred to as hydrocephalus ex vacuo [3]. Differentiating these entities remains a diagnostic challenge, particularly in district-level and resource-limited settings where computed tomography (CT) predominates.

Neurotropic viral infections represent an additional, often under-recognized contributor to adult central nervous system (CNS) injury. Several pathogens traditionally grouped under

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the TORCH acronym—Toxoplasma gondii, Other (including syphilis), Rubella virus, Cytomegalovirus (CMV), and Herpes simplex virus (HSV)—are classically associated with congenital neurological disease but are also capable of causing CNS pathology later in life, particularly in immunocompromised hosts [4]. Among these, CMV and herpes simplex virus type 1 (HSV-1) are notable for their ability to establish lifelong latency within neural tissue, with potential for reactivation under conditions of impaired cell-mediated immunity [5, 6].

HSV-1 is highly prevalent globally and remains the most common cause of sporadic viral encephalitis in adults. Even in the absence of fulminant encephalitis, HSV-1 infection has been associated with persistent neuroinflammation, residual cerebral atrophy, and long-term cognitive sequelae following clinical or subclinical CNS involvement [7]. Similarly, CMV infection in adults—particularly when reactivated—may result in encephalitis, ventriculoencephalitis, or chronic inflammatory processes that contribute to neuronal loss and cerebral atrophy [5]. Although rubella infection in adults is typically mild, rare cases of rubella-associated encephalitis and immune-mediated neurological sequelae have been reported, especially in under-immunized populations [8].

Chronic alcohol consumption is increasingly recognized as a state of functional immune suppression. Alcohol disrupts innate and adaptive immune responses, impairs T-cell and natural killer cell function, alters cytokine signaling, and compromises blood–brain barrier integrity [9]. These effects increase susceptibility to infection and facilitate reactivation of latent neurotropic viruses, including CMV and HSV-1. In this context, alcohol-related neurotoxicity and viral-mediated CNS injury may plausibly act synergistically, amplifying neuroinflammation and accelerating cerebral atrophy beyond that attributable to alcohol alone [10].

Despite the biological plausibility of interactions between chronic alcohol use and neurotropic viral infections, the contribution of TORCH-related pathogens to adult cerebral atrophy remains underexplored in clinical literature. This gap is particularly relevant in district hospital settings, where patients often present late in the disease course, diagnostic resources are limited, and viral exposure may be inferred from clinical history and serology rather than advanced molecular testing. Although seropositivity for CMV, HSV-1, and rubella is common in the general population, its interpretation in individuals with chronic alcohol use requires careful consideration of immune dysfunction, cumulative neurological injury, and the potential for viral reactivation rather than assumptions of direct causality.

Accordingly, this article presents a clinical perspective based on observations from a district-level hospital with referral access to tertiary care, where adults with long-standing alcohol use demonstrated cerebral atrophy and ventricular enlargement in association with clinical suspicion or serological evidence of CMV, HSV-1, and rubella exposure. By integrating routine clinical observations with a narrative review of the literature, the paper explores hypothesized mechanisms through which alcohol-related neurotoxicity, immune dysfunction, and prior exposure to neurotropic viruses may interact to influence adult brain structure. These associations are presented explicitly as hypothesis-generating rather than established causal relationships, with the aim of informing diagnostic reasoning and clinical interpretation in resource-limited settings.

## Literature Review

### Chronic Alcohol Use and Structural Brain Changes

Chronic alcohol consumption is strongly associated with structural brain abnormalities, most notably diffuse cerebral and cerebellar atrophy [11]. Neuroimaging studies consistently demonstrate reductions in total

brain volume, cortical thinning, white matter loss, and ventricular enlargement among individuals with alcohol use disorder [1, 3]. The extent of these changes is closely related to the duration and intensity of alcohol exposure.

The pathophysiology of alcohol-related brain injury is multifactorial and includes direct neurotoxicity of ethanol and its metabolites, oxidative stress, glutamate-mediated excitotoxicity, neuroinflammation, and disruption of neurogenesis [2]. Nutritional deficiencies, particularly thiamine deficiency, further contribute to selective vulnerability of regions such as the mammillary bodies, thalamus, and cerebellum [1].

Ventricular enlargement observed in chronic alcohol use is typically attributable to loss of surrounding brain parenchyma rather than altered cerebrospinal fluid (CSF) dynamics. This phenomenon, known as hydrocephalus ex vacuo, may radiologically resemble true hydrocephalus but is distinguished by normal or reduced intracranial pressure and absence of obstructive pathology [3]. Accurate differentiation is clinically important, as misinterpretation may result in unnecessary neurosurgical referral or intervention.

Longitudinal imaging studies suggest partial reversibility of alcohol-related brain changes with sustained abstinence, particularly within white matter tracts. However, persistent cortical and cerebellar volume loss has been documented in individuals with prolonged or severe exposure [11, 12]. These findings indicate that while some alcohol-induced changes may be dynamic, a substantial proportion of neuronal injury becomes irreversible, increasing susceptibility to additional neurotoxic or inflammatory insults.

## Neurotropic Viruses and Adult Central Nervous System Injury

Neurotropic viruses can infect neural tissue and produce both acute and chronic central nervous system (CNS) pathology. In adults, viral CNS disease ranges from fulminant encephalitis to subclinical infection with long-term neurological sequelae, including residual cerebral atrophy [13]. Mechanisms of injury include direct cytopathic effects, immune-mediated inflammation, and interference with neural repair processes [4].

Several viruses associated with CNS injury are included in the TORCH group, a classification traditionally applied to congenital infections. However, many TORCH pathogens remain clinically relevant in adults, particularly in immunocompromised states, where they may contribute to encephalitis, chronic neuroinflammation, and residual cerebral atrophy [6].

## Cytomegalovirus (CMV) and Adult Cerebral Atrophy

Cytomegalovirus is a ubiquitous herpesvirus that establishes lifelong latency following primary infection. Although infection is usually asymptomatic in immunocompetent adults, CMV reactivation is well documented in individuals with impaired cell-mediated immunity, including those with HIV infection, organ transplant recipients, and patients with chronic systemic illness [5].

CMV exhibits tropism for glial cells and neurons and can cause CNS pathology through both direct viral replication and immune-mediated mechanisms. Adult CMV encephalitis and ventriculoencephalitis have been associated with neuroimaging findings such as periventricular abnormalities, cortical and subcortical atrophy, and ventricular enlargement [4]. In some cases, chronic or recurrent infection results in progressive neuronal loss and persistent neurocognitive impairment.

Importantly, CMV-related CNS involvement may be clinically subtle. Low-grade neuroinflammation and sustained microglial activation have been proposed as mechanisms by which CMV contributes to cumulative brain injury over time [5]. In immunocompromised populations, this pattern

has been described as a "smouldering encephalopathy," characterized by persistent inflammation, gradual neuronal loss, and progressive cognitive decline without overt encephalitis [14, 15]. While extrapolation to alcohol-exposed but otherwise immunocompetent adults must be cautious, alcohol-induced immune dysfunction may create a permissive environment for similar subclinical processes.

**Herpes Simplex Virus Type 1 (HSV-1) and Adult CNS Disease**

HSV-1 is among the most prevalent neurotropic viruses globally and remains the leading cause of sporadic viral encephalitis in adults [6]. Following primary infection, HSV-1 establishes lifelong latency in sensory ganglia and may reactivate under conditions of immune suppression or physiological stress.

Acute HSV-1 encephalitis is characterized by focal necrotizing inflammation with a predilection for the medial temporal and inferior frontal lobes—regions essential for memory, behavior, and executive function [7]. Survivors often demonstrate residual neurological deficits, including cognitive impairment and focal temporal lobe atrophy on follow-up imaging.

Beyond acute encephalitis, emerging evidence suggests that recurrent or subclinical HSV-1 reactivation may contribute to progressive brain changes through persistent neuroinflammatory signaling, microglial activation, and synaptic dysfunction [16–18]. Although these mechanisms remain largely hypothesis-driven in humans, they are supported by converging experimental and epidemiological data. In individuals with chronic alcohol use, HSV-1–associated neuroinflammation may exacerbate pre-existing alcohol-related neurotoxicity, particularly within vulnerable cortical regions.

**Rubella Virus and Neurological Sequelae in Adults**

Rubella virus is best recognized for its role in congenital rubella syndrome, where CNS manifestations include microcephaly, cerebral atrophy, and progressive encephalopathy. Postnatal rubella infection in adults is typically mild; however, rare cases of rubella-associated encephalitis and immune-mediated neurological sequelae have been reported [8].

Adult rubella encephalitis is thought to be primarily immune-mediated rather than the result of direct viral cytotoxicity. Reported sequelae include seizures, cognitive impairment, and residual cerebral atrophy. In settings with incomplete vaccination coverage, adult exposure remains possible, and prior rubella infection may contribute modestly to cumulative neurological injury, particularly when compounded by alcohol-related neurotoxicity or immune dysfunction.

**TORCH Pathogens as a Conceptual Framework in Adult Neurology**

Although TORCH infections are classically discussed in congenital disease, the pathogens within this group share features relevant to adult neurological pathology, including neurotropism, capacity for latency or persistence, and the potential to induce immune-mediated CNS injury [4]. In adults, TORCH-related pathogens such as CMV and HSV-1 are particularly relevant in immunocompromised states, where reactivation may lead to encephalitis, chronic inflammation, or progressive neuronal loss.

Reframing TORCH pathogens as a conceptual framework rather than a diagnostic category allows clinicians to consider cumulative infectious exposures interacting with host factors—such as chronic alcohol use—when evaluating complex neurological presentations.

### Alcohol-Induced Immune Dysfunction and Viral Reactivation

Chronic alcohol consumption exerts profound effects on immune function, including impaired antigen presentation, reduced T-cell proliferation, altered cytokine signaling, and dysfunction of natural killer cells [9]. Alcohol also compromises blood–brain barrier integrity, increasing CNS vulnerability to systemic inflammatory and infectious insults.

These immunological alterations facilitate reactivation of latent viruses, particularly herpesviruses such as CMV and HSV-1. Viral reactivation within the CNS may trigger sustained microglial activation and chronic neuroinflammation, thereby contributing to progressive neuronal injury [10]. Alcohol-related immune suppression has been shown to impair viral clearance and dysregulate inflammatory responses, providing a biologically plausible basis for synergistic interactions between chronic alcohol use and neurotropic viral persistence or reactivation [4, 19, 20].

## Methods

### Study Design

This study employed a descriptive observational design based on routine clinical observations. It was conducted as a retrospective case series without intervention, hypothesis testing, or inferential statistical analysis. The primary aim was to characterize clinical and neuroimaging patterns in adults with chronic alcohol use and to explore plausible explanatory mechanisms through integration with existing literature.

### Study Setting

The study was conducted at a district-level hospital in Namibia with referral access to tertiary care services. The facility serves a mixed urban and peri-urban population and operates with limited on-site diagnostic resources. Non-contrast computed tomography (CT) represents the primary neuroimaging modality available for neurological assessment in this setting.

### Study Population and Eligibility Criteria

Eight adult patients aged 42–65 years were included. Patients were identified consecutively through routine clinical care during the observation period, and no formal sampling strategy was employed.

Eligibility criteria included documented long-standing alcohol use, presentation with neurological symptoms warranting neuroimaging, and availability of CT findings. Patients with clinical or radiological evidence of acute central nervous system infection, intracranial mass lesions, or recent head trauma were excluded.

### Clinical Assessment and Data Collection

Clinical data were obtained from medical records and supplemented by direct clinical evaluation where applicable. Information collected included demographic characteristics (age and sex), alcohol use history, neurological presentation, relevant medical history, and available laboratory findings.

Assessment of infectious history was based on documented clinical information and serological results obtained as part of routine patient care. Data on prior exposure to neurotropic viral infections were derived from available serology and clinical history. No additional laboratory testing was performed for research purposes.

### Neuroimaging Assessment

All patients underwent non-contrast CT of the brain as part of standard clinical management. Imaging findings were reviewed descriptively, with attention to patterns of cerebral atrophy and ventricular enlargement. Ventricular dilatation was interpreted in relation to the degree of parenchymal loss to distinguish hydrocephalus ex vacuo from obstructive or communicating hydrocephalus.

### Data Analysis

Data analysis was descriptive. Given the small sample size, no statistical comparisons or modeling were performed. Findings are presented narratively and in aggregate, emphasizing common clinical and radiological patterns.

### Ethical Considerations

This study was based exclusively on anonymized clinical data derived from routine patient care. No patient identifiers were collected or retained, and no additional investigations or interventions were undertaken for research purposes.

## Results

### Patient Characteristics

Eight adult patients were included in the analysis. Ages ranged from 42 to 65 years, and the majority were male. All patients had a documented history of long-standing alcohol use extending over several years.

### Clinical Presentation

Patients presented with a range of neurological manifestations, including cognitive impairment, gait disturbance, behavioral changes, seizures, and altered level of consciousness. Several individuals had a history of recurrent hospital admissions related to alcohol use.

### Neuroimaging Findings

Non-contrast CT imaging demonstrated diffuse cerebral atrophy in all patients, accompanied by ventricular enlargement. Ventricular dilatation was proportional to parenchymal loss, consistent with hydrocephalus ex vacuo [2, 3], rather than obstructive or communicating hydrocephalus. No focal intracranial mass lesions or imaging features suggestive of acute infection were identified.

### Infectious History and Serology

Clinical history and available laboratory data suggested prior exposure to neurotropic viral infections. CMV and HSV-1 seropositivity were documented in several patients, while rubella exposure was inferred from serological findings or historical information in selected cases. No patient exhibited clinical features of acute viral encephalitis at presentation. Serological results were interpreted as evidence of prior exposure rather than active infection.

## Discussion

This clinical perspective explores the potential interplay between chronic alcohol use and neurotropic viral exposure—particularly cytomegalovirus (CMV), herpes simplex virus type 1 (HSV-1), and rubella virus—in contributing to adult cerebral atrophy. Although the descriptive nature of the observations does not permit causal inference, the findings raise clinically relevant hypotheses regarding synergistic mechanisms of neuronal injury in alcohol-exposed populations.

### Alcohol Use as a Central Modifying Factor

Chronic alcohol consumption is a well-established cause of diffuse cerebral and cerebellar atrophy. Beyond its direct neurotoxic effects, alcohol induces a state of functional immune suppression characterized by impaired cell-mediated immunity, altered cytokine signaling, and disruption of blood–brain barrier integrity [9]. These immunological alterations increase susceptibility to infection and facilitate reactivation of latent neurotropic viruses.

In this context, alcohol may be conceptualized not only as an independent etiological factor but also as a biological amplifier that enhances the neurological impact of prior or concurrent viral exposures. In the present series, all patients had prolonged histories of alcohol use, supporting alcohol-related neurotoxicity as the dominant substrate upon which additional infectious or

inflammatory factors may act. By simultaneously promoting neuronal injury and impairing immune surveillance, chronic alcohol use may lower the threshold at which latent or subclinical viral activity becomes clinically relevant. This multifactorial framework supports a model of cumulative cerebral injury rather than a single-agent disease process.

## Neurotropic Viral Reactivation and Chronic Neuroinflammation

Both CMV and HSV-1 establish lifelong latency within neural or immune cells and may reactivate in states of immune dysfunction [5, 6]. Viral reactivation within the central nervous system (CNS), even in the absence of overt encephalitis, can promote neuronal injury through direct cytopathic effects, sustained microglial activation, and chronic neuroinflammatory signaling.

HSV-1 is the most common cause of sporadic viral encephalitis in adults, and survivors frequently demonstrate residual focal or diffuse cerebral atrophy on follow-up imaging [7]. Emerging experimental and epidemiological evidence suggests that recurrent or subclinical HSV-1 reactivation may plausibly contribute to progressive neurodegeneration through persistent inflammatory mechanisms, particularly affecting temporal lobe structures [16–18]. This regional vulnerability is clinically relevant given the overlap between temporal lobe dysfunction and the cognitive, behavioral, and seizure-related manifestations commonly observed in chronic alcohol use. Although regional involvement could not be specifically assessed using computed tomography in this series, the well-described temporal lobe predilection of HSV-1 in the literature provides a plausible explanatory framework.

CMV similarly contributes to CNS injury through immune-mediated pathways. In immunocompromised populations, CMV encephalitis and ventriculoencephalitis have been associated with periventricular injury, ventricular enlargement, and cerebral atrophy [4, 14, 15]. A pattern of low-grade or "smouldering" encephalopathy has been described in transplant recipients and individuals living with HIV, characterized by persistent inflammation and gradual neuronal loss without overt encephalitis. While extrapolation to immunocompetent adults must be cautious, alcohol-induced immune dysfunction may create a permissive environment in which similar subclinical CMV-related neuroinflammatory processes contribute to cumulative brain injury.

Taken together, these observations support a hypothesis in which alcohol-related immune dysregulation permits episodic or persistent viral-driven neuroinflammation, thereby amplifying alcohol-associated neurotoxicity. Importantly, these relationships remain associative and hypothesis-generating rather than proven.

## Rubella and Cumulative Neurological Injury

Rubella virus is best recognized for its role in congenital neurological disease; however, rare adult neurological complications, including encephalitis and immune-mediated sequelae, have been reported [8]. In under-immunized populations, prior rubella exposure may contribute subtly to cumulative CNS injury that becomes clinically apparent in the presence of additional neurotoxic or immunosuppressive factors.

In the present context, rubella is unlikely to represent a primary cause of adult cerebral atrophy. Rather, it may function as a minor contributory factor within a broader milieu of alcohol-related neurotoxicity, immune dysregulation, and exposure to other neurotropic viruses. As with CMV and HSV-1, seropositivity alone should not be interpreted as evidence of causation.

### TORCH Pathogens as a Conceptual Framework in Adult Neurology

Although the TORCH classification was originally developed for congenital infections, the pathogens included share characteristics—neurotropism, immune-mediated injury, and potential for latency or persistence—that remain relevant in adult neurological disease [4]. Reframing TORCH pathogens as a conceptual framework rather than a diagnostic category allows clinicians to consider cumulative infectious exposures alongside host vulnerability factors such as chronic alcohol use.

Importantly, this perspective does not imply the existence of an adult TORCH syndrome. Instead, it provides a lens through which multiple low-grade or historical infectious insults may be integrated into the clinical assessment of adults presenting with non-specific neurological syndromes, particularly in settings with limited diagnostic resources.

### Ventricular Enlargement: Hydrocephalus or Hydrocephalus Ex Vacuo?

A key clinical implication of this analysis relates to the interpretation of ventricular enlargement on neuroimaging. In individuals with chronic alcohol use, ventricular dilatation most commonly reflects hydrocephalus ex vacuo secondary to parenchymal loss rather than disturbed cerebrospinal fluid dynamics. Viral-mediated neuronal injury may further accentuate this process, leading to imaging findings that mimic true hydrocephalus.

Accurate differentiation is critical, especially in district-level settings where CT imaging predominates. Misclassification may result in unnecessary referral or invasive intervention. Comprehensive clinical assessment—integrating alcohol history, neurological findings, and cautious interpretation of serological results—is therefore essential.

### Clinical and Public Health Implications

Clinically, these observations highlight the importance of maintaining a broad differential diagnosis when evaluating adults with chronic alcohol use and neurological symptoms. Awareness of potential interactions between alcohol-related neurotoxicity, immune dysfunction, and prior neurotropic viral exposure may improve diagnostic reasoning and prevent misinterpretation of imaging or serological findings.

From a public health perspective, the findings underscore the importance of alcohol use disorder prevention, improved vaccination coverage, and integrated care approaches addressing both infectious and non-communicable contributors to neurological disease. In resource-limited settings, heightened clinical awareness of these interactions may support conservative management, reduce unnecessary interventions, and inform targeted follow-up and preventive strategies.

## Limitations

This study is limited by its small sample size, descriptive design, reliance on computed tomography rather than advanced neuroimaging, and incomplete serological data. No inferential statistical analysis was performed. These limitations restrict generalizability and preclude causal inference.

## Conclusion

Adults with long-standing alcohol use may exhibit cerebral atrophy and ventricular enlargement consistent with hydrocephalus ex vacuo. While alcohol-related neurotoxicity remains the primary explanatory factor, immune dysfunction and prior exposure to neurotropic viruses such as CMV, HSV-1, and rubella may plausibly contribute to cumulative brain injury. Further prospective studies incorporating advanced imaging and immunovirological assessment are warranted.

## Ethical Clearance

This article is based on anonymized clinical observations from routine patient care. No patient identifiers were included, and formal ethical approval was not required under applicable institutional and national guidelines.

## Author Contributions

The author conceived the study, collected and analyzed the clinical data, conducted the literature review, and drafted and revised the manuscript.

## Data Availability

Data supporting the findings of this study are available from the author upon reasonable request.

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## Conflict of Interest

The author declares no conflict of interest.

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# Exploring the Effect of STEM Teaching Methods on Grade 9 Mathematics Students' Conceptual Understanding and Performance Compared to Traditional Instruction at a Non-Traditional High School in Halfway Tree in St. Andrew

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***Abstract***

*The ongoing dependence on conventional, lecture-centric mathematics teaching in Jamaican secondary schools has been linked to low levels of student engagement, restricted conceptual comprehension, and inadequate problem-solving results, especially in non-traditional high school environments. To address this issue, the present study sought to evaluate the efficacy of STEM-oriented teaching strategies in enhancing Grade 9 students' conceptual grasp and performance in mathematics, in contrast to traditional teaching methods. A mixed-methods research framework was utilized, involving 58 Grade 9 students from a non-traditional high school located in Half Way Tree, St. Andrew. During a five-day instructional timeframe, students participated in both STEM-integrated lessons—incorporating visual tools such as charts, graphs, and diagrams—and standard lecture-based instruction. Data collection was conducted through weekly mathematics evaluations and structured student surveys. Quantitative data were analyzed employing regression analysis and one-sample t-tests. The results indicated that STEM-based instruction had a statistically significant positive impact on student engagement, class participation, and understanding of mathematical concepts. Regression analysis revealed a moderate positive correlation between STEM variables and instructional effectiveness, while t-test outcomes confirmed significant differences favoring STEM instruction ($p < 0.05$). Despite facing challenges related to insufficient teacher training and resource limitations, the study concludes that STEM-focused teaching approaches are more effective than traditional methods in improving mathematical learning outcomes. The findings advocate for the incorporation of STEM pedagogy in mathematics education, particularly in under-resourced and non-traditional school settings.*

***Keywords:*** *Mathematical Comprehension, Non-traditional High School, STEM, Teaching.*

## Introduction

### Preface

This research was undertaken to investigate how the incorporation of STEM teaching methodologies could improve students' comprehension and performance in mathematics. It highlights the significance of connecting classroom theories to real-world applications through inquiry, problem-solving, and practical experiences. The preface outlines the justification for employing STEM strategies in Jamaican secondary schools and establishes the groundwork for evaluating their effectiveness in contrast to conventional instructional methods.

### Background of the Study

The field of mathematics often appears complex to numerous students throughout their

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educational journey, leading to a decline in their enthusiasm for the subject.

Furthermore, the reliance on monotonous and repetitive instructional techniques, particularly through pre-prepared lectures, contributes to students' disinterest in mathematics [1].

Traditional teaching methods predominantly emphasize theoretical knowledge at the expense of practical comprehension. This imbalance creates confusion among students regarding the correct application of mathematical concepts. In such contexts, the implementation of STEM teaching methodologies can serve as an effective alternative, fostering students' excitement about studying mathematics. STEM provides a dynamic framework that encourages students to engage with mathematics in an enjoyable manner. It equips them with critical and logical thinking skills, facilitating easier problem-solving [2]. Students gain higher-order thinking abilities that prioritize practical strategies and enhance their problem-solving proficiency.

## Statement of the Problem

The objective of this study is to investigate and evaluate the impact of the STEM teaching approach. Presently, few educational institutions have undertaken initiatives to determine whether the STEM methodology surpasses traditional teaching methods in effectiveness. This research aims to improve the conceptual understanding and performance of ninth-grade mathematics students.

Additionally, it will involve a comparison between traditional lecture-based methods and STEM teaching strategies to identify which approach is superior and more effective. For this analysis, a non-traditional high school, St. Andrew, situated in the Half-Way Tree area, has been selected.

## Purpose and Justification of the Study

The purpose of this research is to empirically investigate the effects of STEM-oriented teaching strategies on the conceptual comprehension and mathematical performance of Grade 9 students, as opposed to conventional lecture-based instruction, within a non-traditional high school environment in St. Andrew, Jamaica.

This research is based on the ongoing dominance of traditional teaching methods in mathematics classrooms, which have been associated with low levels of student engagement, restricted conceptual understanding, and poor problem-solving results. Although STEM pedagogy has been extensively advocated as a learner-centered and inquiry-based approach that can tackle these issues, there is still a scarcity of empirical evidence demonstrating its effectiveness in Jamaican secondary schools, especially in non-traditional and resource-limited settings.

By methodically contrasting STEM-integrated instruction with traditional teaching techniques, this study aims to offer evidence-based insights into whether STEM pedagogy can act as a feasible instructional alternative for enhancing mathematical learning outcomes among Grade 9 students.

## Significance of the Study

A substantial amount of research has underscored the practical benefits associated with the integration of STEM in mathematics education. Researchers have found that this instructional approach improves students' understanding of mathematical expressions and terminology. Additionally, the application of practical scenarios has bolstered their confidence in the subject and fostered an immediate and active interest [3].

In contrast to traditional teaching methods, where students often struggle to grasp mathematical concepts because materials are designed for the entire class, STEM instruction offers a more individualized learning experience. Given the advantages linked to STEM methodologies, it is crucial to

comprehend their practical implications when applied in real-world contexts.

## Research Objectives

The main aim of this research is to evaluate the effect of STEM-based teaching techniques on students' conceptual understanding and mathematical performance. More specifically, the study seeks to ascertain how STEM instruction affects students' engagement, critical thinking, and problem-solving abilities, as well as to compare these results with those obtained through traditional teaching methods.

## Research Questions

The study is guided by the following research questions:

1. In what ways does STEM-based instruction influence the mathematical comprehension of Grade 9 students attending non-traditional schools in St. Andrew, Jamaica?
2. What significant challenges do teachers and students face when implementing STEM-based mathematics instruction?
3. What notable advantages do teachers and students experience when utilizing STEM-based mathematics instruction?

## Operational Definition and Terms

**STEM:** Science, Technology, Engineering, and Mathematics. STEM-Focused

**Teaching:** An instructional approach that integrates technology, engineering, and mathematics to improve mastery outcomes [4].

**Mathematical Comprehension:** The ability of students to understand, observe, and analyse mathematical concepts effectively

**Non-Traditional High School:** An educational institution that admits students who do not fulfil standard academic entry criteria and frequently operates with limited resources [5].

Citing this research. It identifies the research questions and the aim of the study. The section signifies understanding the importance of STEM methods and assessing their effectiveness in schools. It draws evidence from existing research to rationalise why using STEM can make students more logical and effective.

## Research Hypothesis

Based on the survey, the following hypothesis was considered:

*H0*: STEM teaching method has no significant difference from traditional teaching methods, and does not help children understand mathematics concepts better.

*H1*: STEM teaching method is more effective than traditional teaching methods, and helps children understand mathematics concepts better.

## Limitations of the Study

This research was confined to a single non-traditional high school located in St. Andrew, Jamaica, with a relatively small sample of Grade 9 students. Constraints related to time and limited access to technological resources also impacted the extent of classroom implementation. Furthermore, students' previous exposure to technology and their diverse learning capabilities may have affected the outcomes, complicating the ability to generalize the findings to all Jamaican secondary schools.

## Organization of the Study

The study is structured into five distinct chapters. Chapter One outlines the background, objectives, hypotheses, and the scope of the research. Chapter Two offers a review of pertinent literature and theoretical frameworks related to STEM education. Chapter Three details the research design, sampling techniques, and data collection tools. Chapter Four emphasizes the presentation, analysis, and interpretation of the data, whereas Chapter Five addresses the findings, conclusions, and suggestions for enhancing STEM implementation in mathematics education.

# Literature Review

## Preface

The given section outlines the review of literature for the given study. It assesses and explains different research studies conducted on the subject of STEM education and its effectiveness. The section also identifies the theoretical frameworks that can justify STEM, followed by identifying the research gaps.

## A comparison of Traditional Teaching Methods and STEM Teaching Approaches

Traditional teaching methods, which have been employed for many years, primarily involve lectures followed by memorization. The emphasis is on imparting textbook-based knowledge to students. The researcher notes a notable lack of practical application in these methods, with curricula designed to cater to the entire class. In traditional mathematics instruction, students are more likely to experience monotony, which can diminish their interest in the subject.

In traditional teaching practices, the emphasis tends to be on rankings and grades rather than fostering a genuine interest in the subject matter. The constant reliance on textbooks makes it challenging for children to connect with the material. The focus is predominantly on encouraging students to memorize facts instead of developing skills [6].

Conversely, STEM education methods offer educators the chance to empower students and motivate them to tackle complex problems. These methods primarily highlight hands-on learning experiences. They aim to inspire students to think innovatively and approach challenging math problems with enthusiasm rather than apprehension. [7] assert that the adoption of STEM teaching fosters active participation among students and encourages them to engage with real-life applications, as opposed to abstract knowledge. This creates a supportive environment for students to generate new ideas and absorb information more effortlessly.

## The Significance of STEM in the Instruction of Mathematics

Mathematics plays a crucial role in STEM disciplines. It serves as a fundamental component of the STEM domain, facilitating a deeper comprehension of complex problems and concepts. As noted by [7]. One of the most advantageous aspects of teaching mathematics through STEM is the incorporation of practical experiments. This approach fosters curiosity among students regarding the subject.

It also enhances their engagement with the material. Furthermore, students are motivated to apply mathematical concepts and adopt a hands-on methodology. They are encouraged to utilize these concepts to tackle intricate numerical challenges in mathematics. By doing so, they embark on the journey of designing, analysing, and interpreting data based on their acquired knowledge. This process promotes independent thinking as students learn at their own pace [8].

One of the numerous advantages of employing STEM strategies in mathematics education is that it provides students with opportunities to engage with various interdisciplinary fields. According to [8], this approach fosters a research-oriented mindset, enabling students to appreciate the significance of mathematics and its connections to other disciplines. STEM facilitates the motivation for students to pursue mathematics in their future studies. It equips them with the skills necessary to address complex problems through logical reasoning and enhances their problem-solving abilities. In essence, it inspires students to embrace the subject and develop a mindset characterized by innovation and creativity.

## Challenges of Utilizing STEM in Mathematics Education

Despite the benefits associated with STEM disciplines, numerous challenges arise during

their implementation. According to [9], a primary obstacle in the adoption of STEM teaching is the insufficient availability of essential resources.

Contemporary educational institutions often lack the necessary equipment, materials, and technology required to effectively engage students in mathematics instruction.

This deficiency hinders hands-on learning opportunities and impedes students' ability to foster creativity and innovation [10].

Additionally, there exists a challenge regarding the preparedness of certain educators. For the successful cultivation and implementation of STEM teaching methodologies in the classroom, it is crucial for teachers to receive adequate training and possess sufficient experience to seamlessly integrate these methods into conventional teaching practices [11].

A critical aspect of STEM education involves the successful integration of its components and collaboration with everyday learning strategies within the classroom. [12]. Contend that achieving this integration can be challenging due to time constraints. A typical class spans 5-6 hours daily, making it difficult to incorporate a multitude of teaching methods within this limited timeframe.

Moreover, the presence of varying curriculum standards across different educational institutions may also present significant challenges. Each class adheres to its specific teaching curriculum, necessitating distinct strategies tailored to each group of students.

Time constraints represent one of the most crucial challenges, as STEM education demands specific applications that differ from traditional mathematics instruction. This divergence can be particularly challenging to implement within a standard mathematics curriculum in the classroom.

## Theoretical Foundations

Numerous theories can be examined to comprehend the efficacy of STEM-oriented teaching methodologies in imparting mathematics to ninth-grade learners.

The constructivist learning theory, as proposed by Piaget and Vygotsky, serves as a pertinent framework that elucidates how STEM education can enhance students' awareness and their capacity to tackle intricate problems.

This theory underscores the knowledge that students construct through active participation and experiential learning [13]. Furthermore, it highlights the significance of hands-on learning activities and experiments, which encourage students to cultivate creativity and innovation.

To tackle the obstacles linked to STEM-based instruction, educators might consider employing the 5E instructional model (engage, explore, explain, elaborate, evaluate). This model can offer a sustainable framework for teachers, assisting them in the systematic design of STEM lessons

[14]. They could adopt a blend of various strategies that would afford students a well-rounded education, integrating both practical and theoretical components.

Kolb, through his experiential learning theory, has delineated the process of learning as a sequence of activities [15]. This cycle encompasses concrete experiences, reflection, conceptualization, and experimentation. To effectively implement STEM-based teaching, educators should proactively incorporate more laboratory experiments and expose students to STEM fairs, thereby broadening their perspectives on the subject [15]. In this manner, students will have the chance to develop a greater interest in the subject matter through practical engagement.

To summarize, there are several benefits associated with the implementation of STEM teaching methods in the classroom. However, the set of challenges, such as time constraints and different curricula, might pose a challenge

that makes traditional teaching methods more favourable for many schools.

## Research Methodology

### Preface

This chapter provides you with a brief understanding of the methods that will be implemented for the given research study. The first part of the section will outline the research design that will be finalized so that a better understanding of the effectiveness of STEM teaching methods can be assessed. This has been followed by identifying the population and selecting the sampling method.

The section also outlines a brief understanding of the data collection process that has been selected, along with its justification. It also provides an outline of the research analysis methods that will be implemented, along with identifying the ethical considerations.

### Research Design

The research will make use of a mixed research design. In mixed methods, there is the use of both quantitative and qualitative methods [16]. The use of this method will help enhance the validity of the findings, because the understanding of the effectiveness of STEM teaching methods is still not very comprehensive and detailed

[16]. In order to provide a more comprehensive understanding of the concept, a positivist philosophy will be used. This will help to better explain the findings using existing theories and hard facts [16]. A deductive approach will also be used to help identify the causal relationship between the selected variables and gain more perspective about the research questions. Lastly, an exploratory design will be considered, which will contribute towards gaining more insight into the facets of STEM teaching and gaining a detailed comparison of the same with traditional teaching methods.

### Research Population and Sampling

The research population will consist of students in grade 9 studying mathematics. The objective is to gain an understanding of what methods of teaching, STEM or traditional, help make math easier for students to understand. A total of 58 students will be considered for grade 9, and to make the research manageable, the sample comprises students studying in grade 9 at a non-traditional high school in Half Way Tree in St. Andrew.

A random sampling method will be implemented to provide each student with an equal probability of being selected. [17]. Stated that it is a simple and flexible process that will make selecting the participants easier.

### Data Collection Methods

Data will be collected through the help of a questionnaire that consists of a total of 15 closed-ended questions. The 58 students will be given added instructions using STEM methods of visual aids, along with their regular classes. The visual aids will be used on their current syllabus, which is probability. The STEM method used in this case will be visual aids that will include graphs, charts, and diagrams, while the traditional methods will include the use of books.

A total of 5 classes will be given in an entire week, followed by which the students will be asked to take part in a weekly test that is organized by the school as part of their curriculum. The classes will each be of 1 hour, with each student being required to attend at least a minimum of 30 minutes of the class.

The students will have the choice to leave the class after 30 minutes. This will be followed by asking the students to fill out the common questionnaire at the end of the 5th day, after the test. The teachers who teach math will be provided with visual aids and resources, such as cue cards and visual charts that they will use to teach the same concepts of math to the students. The data that will be analysed will be based on the data from the questionnaire.

### Data Analysis Techniques

In the quantitative analysis, the statistical method of SPSS will be implemented. This will help analyse the causal relationship between the selected variable set. This will also help gain insight into the effectiveness of STEM teaching tactics compared to traditional teaching methods. A regression analysis will be run, followed by a t-test to test the feasibility of the hypothesis

[19]. The qualitative method will include justifying the findings using data from secondary sources. The use of secondary data will be to strengthen the validity of the findings and prove the effectiveness of STEM teaching methods.

### Ethical Considerations

The research will follow all ethical principles to ensure its reliability and validity. [18]. Talk about the importance of a consent form. This is why a consent form will be provided to all the participants, as well as the school administrator. It will outline information about the scope of the research, objectives, and proposed outcomes. Complete transparency in information will be maintained through the consent form with the students as well as school administrators, to ensure research authenticity during the data collection process.

## Data Presentation

### Preface

The given chapter outlines the analysis based on the collected data to assess the impact of STEM teaching methods on students. The data has been collected based on the classes given to the students, followed by a self-assessment. The self-assessment of the students has been to understand their preferences, in terms of which method has made it easier for them to understand mathematical concepts better. The section has implemented a regression analysis to identify the relationship between the causal variables, if any. This has been followed by a t-test to assess the validity of the hypothesis.

### Role of Testing

In order to better understand the effectiveness of STEM teaching methods in the classroom, the first step that was implemented was conducting a short class on mathematics for 5 days, each for an hour, using STEM methods. It is essential to note that the effectiveness was being measured by conducting weekly mathematics tests in the classroom. This was coupled with feedback received from the teacher to the students in terms of how they can improve.

The only new addition, because of this research, was the survey that was conducted. Hence, both quantitative and qualitative methods were used in this case to measure effectiveness. The selected school was already using traditional teaching methods, like books, to teach the students mathematics. The traditional method that was being considered included chalk and board work, the use of lectures, maintaining textbook-driven learning, memorization, and rote learning. There was not sufficient use of technology or applications being made.

Hence, the STEM method of visual aid was only being used for an hour each day, for the same class. There were no changes in the syllabus; rather, the class was taught using visual aids.

From the same existing syllabus. The class was learning about probability that week, so visual aids were prepared on the same topic. The objective of conducting this class was to expose the students to STEM teaching methods.

The school was already in the process of conducting weekly tests at the end of each week, as mentioned above. The tests provided the teachers with a comprehensive understanding of the progress made by the students. Using the method of weekly tests helped the students memorize the subject better. It was only after the students had given their weekly math test that the survey was given to the students to be completed for this research.

The test results were considered for this test, along with short verbal feedback from teachers.

The dependent variable for this study has been considered as the effectiveness of the Teaching Approach, while the independent variable considered was the effectiveness of STEM teaching and traditional teaching. Based on these variables, the research was conducted. The reason for choosing only two variables was to keep the research more focused and concise.

## Data Presentation and Analysis

In this section, the researcher will showcase the data gathered during the investigation through the use of tables to enhance clarity and facilitate understanding. In addition, the researcher will analyse the results to uncover patterns, trends, and insights regarding the topic. This analysis will assist in drawing significant conclusions based on the evidence.

## Presentation of Demographic Data

The section below briefly outlines the demographic distributions for the given study.

### Gender

**Table 1.** Gender of the Class

| Gender | | | | | |
|---|---|---|---|---|---|
| | | **Frequency** | **Percent** | **Valid Percent** | **Cumulative Percent** |
| Valid | Female | 26 | 44.8 | 44.8 | 44.8 |
| | Male | 32 | 55.2 | 55.2 | 100.0 |
| | Total | 58 | 100.0 | 100.0 | |

Table 1 above shows that a total of 55.2% of the participants were male students and 44.8% were female students.

It can be stated that the class did not comprise an equal representation of females. Each of the participants in the class was provided with equal treatment in terms of teaching mathematics through both STEM methods and traditional methods.

### Length of Math Class

**Table 2.** Length of Math Class

| Length of math class | | | | | |
|---|---|---|---|---|---|
| | | **Frequency** | **Percent** | **Valid Percent** | **Cumulative Percent** |
| Valid | 0-30 minutes | 2 | 3.4 | 3.4 | 3.4 |
| | 30-45 minutes | 7 | 12.1 | 12.1 | 15.5 |
| | 45 min-1 hour | 49 | 84.5 | 84.5 | 100.0 |
| | Total | 58 | 100.0 | 100.0 | |

As shown in Table 2, the majority of students (84.5%) reported attending mathematics classes for 45 minutes to one hour, while a smaller proportion attended for shorter durations. This suggests that most participants were exposed to extended instructional time, which is critical for effective engagement with both STEM-based and traditional teaching approaches.

The table above provides a general representation of the duration of math classes in the school. As can be seen, that 84.5% of the participants attend the classes for a minimum period of 1 hour, while only a significant set of other participants have stated that they attend classes for a minimum period of 30 minutes. The discrepancy is mostly related to the choice

provided to students, who can leave the class after attending for at least 30 minutes.

Based on the findings, it can be stated from the above table that the maximum participants attend math classes for a minimum period of an hour. This proves that students found a level of interest in the classroom when the STEM method was used to teach them math.

## Presentation of Specific Data

The above section provided a basic understanding of the distribution of the demographic population in the chosen sample. The idea remained to understand whether gender or the length of mathematics classes had any impact on students' learning math better. It was assessed from the section that the length of math classes created a divide in terms of grasping concepts of mathematics. Longer classes allowed students to be able to take time to better learn mathematics, as compared to shorter durations.

It allowed students to better be able to formulate the answers based on the questions presented. This outlines one of the primary requirements for students when learning mathematics, is having longer duration classes, irrespective of using STEM-based or traditional teaching methods. Thus, here the hypothesis testing based on demographic data was *H0*, which outlined that there is no significant difference in student understanding in terms of what teaching methods are used, unless there is sufficient time for classes to be present for students.

## Regression Analysis

A regression analysis was conducted on the data collected from the findings with the sole objective of identifying if there was any causal relationship present between the selected variables [19]. The analysis has also helped identify what aspects of these variables are causing the effectiveness of teaching methods to vary for this study. The independent variables selected for this study include the effectiveness of STEM teaching and traditional teaching methods.

The method that will be more effective for students to understand math concepts will be considered to have a higher degree of variation on the dependent variable. A higher degree of tradition will be signified through a higher value, which will help establish the effectiveness of the causal relationships.

The regression analysis for this study has been discussed in three stages: Model Summary, ANOVA, and Table of Coefficients.

## Model Summary

**Table 3.** Model Summary

| | | | | | Change Statistics | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | **R** | **R Square** | **Adjusted R Square** | **Std. Error of the Estimate** | **R Square Change** | **F Change** | **df1** | **df2** | **Sig. F Change** | **Durbin-Watson** |
| 1 | .574 | .330 | .220 | .83220 | .330 | 3.012 | 8 | 49 | .008 | 1.702 |

a. Predictors: (Constant), Teaching methods experience, Confidence STEM, Visual aid retains concept better, STEM Engagement, Class participation in math, Traditional methods performance, Effectiveness of traditional teaching, Confidence traditional
b. Dependent Variable: More effective approach

The regression model summary presented in Table 3 indicates a moderate positive relationship between the independent variables and the dependent variable ($R = 0.574$), with approximately 33% of the variance in teaching effectiveness explained by the model ($R^2 = 0.330$).

The table above shows the values of R and R-squared. The value of R-squared measures

the goodness of fit, where any value that is above 0.95 is stated to be statistically significant for that given research study. This makes the data suitable for conducting further research. [20]. As can be seen from the above table, in this table the percentage of variation in the dependent value has been estimated to be 0.330.

This shows that 33% of the selected variables can be effectively explained from the data collected. simultaneously, the value of R has been identified to be at 0.574. This value explains that there is a moderate degree of correlation present between the selected Independent and

dependent variables in this research. This means that the selected variables can adequately define the validity of the research hypothesis [20].

It is important to note that the model summary table provides an assessment of the degree of change. This is identified by the value of Sig. F Change. Any value that is less than 0.05 is considered to be significant [21]. As can be seen from the table, the degree of variation has been estimated to be 0.008.

This shows that there is a strong and significant variation present in the selected variables, and that there is indeed a causal relationship present. The 0.008 value highlights that the causal relationship is present in terms of the teaching methods affecting the ability of the students to understand math concepts better.

**ANOVA**

**Table 4.** ANOVA Table

| **ANOVA** | | | | | | |
|---|---|---|---|---|---|---|
| **Model** | | **Sum of Squares** | **Df** | **Mean Square** | **F** | **Sig.** |
| 1 | Regression | 16.686 | 8 | 2.086 | 3.012 | .008 |
| | Residual | 33.935 | 49 | .693 | | |
| | Total | 50.621 | 57 | | | |

a. Dependent Variable: More effective approach
b. Predictors: (Constant), Teaching methods experience, Confidence STEM, Visual aid retains concept better, STEM Engagement, Class participation in math, Traditional methods performance, Effectiveness of traditional teaching, Confidence traditional

The ANOVA results displayed in Table 4 confirm the overall statistical significance of the regression model ($F = 3.012$, $p = 0.008$).

The second step in the regression analysis is to analyse the ANOVA table. The objective of this table is to provide a better estimation of the regression equation. This is mostly to justify whether the data set selected for the analysis can be efficiently fitted in the regression equation to

test its validity [22]. Through this table, it becomes easier to assess whether the selected dependent variable is valid or not. The above table highlights the mean square value of 2.086. This shows that there is a positive relationship present between the predictor variables outlined with the dependent variable.

The high value of the mean square also stresses the significance of the relationship present between the variables. Similarly, this is also supported by the degree of significance that is at 0.008. The value of P is only considered to be significant when $p < 0.05$. In this case, the value of significance is significantly lower than 0.05, proving that there is a strong causal relationship present between the variables. This makes the model valid and effective, with the dependent variable being easily represented by the independent variables selected.

## Table of Coefficients

**Table 5.** Table of Coefficients

| Coefficients | | | | | | |
|---|---|---|---|---|---|---|
| **Model** | | **Unstandardized Coefficients** | | **Standardized Coefficients** | **T** | **Sig.** |
| | | **B** | **Std.** | **Beta** | | |
| 1 | (Constant) | | Error | | | |
| | | .845 | .530 | | 1.593 | .118 |
| | STEM Engagement | -.298 | .146 | -.326 | -2.041 | .047 |
| | Confidence STEM | -.124 | .119 | -.163 | -1.036 | .305 |
| | Effectiveness of traditional teaching | -.036 | .149 | -.042 | -.244 | .808 |
| | Confidence traditional | .014 | .141 | .018 | .100 | .921 |
| | Visual aids retain concept better | .106 | .156 | .088 | .681 | .499 |
| | Traditional methods performance | .272 | .189 | .243 | 1.440 | .156 |
| | Class participation in math | .144 | .139 | .144 | 1.034 | .306 |
| | Teaching methods experience | .340 | .113 | .391 | 3.009 | .004 |

a. Dependent Variable: More effective approach

As illustrated in Table 5, STEM-related variables demonstrated a stronger predictive influence on instructional effectiveness than traditional teaching variables.

The next step in the regression analysis is the table of coefficients, which helps predict the changes in responses and justify the validity of the proposed hypothesis. The regression equation is identified as: ***DV: (Constant Value) + (IV1) + (IV2) + … + (IVn).***

The higher the value in the table of coefficients, the more they contribute towards the variation in the responses collected [23]. This highlights the impact each of these variables has on changing the performance of students in conceptualizing and solving math problems.

A closer look at the above table shows that all the variables significantly impact student outcomes. It can be assessed from the table that while the students have positive responses towards STEM teaching methods, their confidence and the system have not been strong. However, most students have responded that traditional teaching is not effective when compared to the STEM method.

In this case, the one-sample T-test was implemented to test the effectiveness of the research variables and justify the validity of the proposed hypothesis. Through the implementation of this test, it became easier to prove the reliability of the findings.

**Table 6.** One-Sample Statistics

| One-Sample Statistics | | | | |
|---|---|---|---|---|
| | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** |
| Teaching methods experience | 58 | 2.0172 | 1.08404 | .14234 |
| STEM Engagement | 58 | 2.3103 | 1.02951 | .13518 |
| Effectiveness of traditional teaching | 58 | 2.2586 | 1.08515 | .14249 |
| Confidence traditional | 58 | 2.6897 | 1.21694 | .15979 |
| Visual aid effectiveness | 58 | 2.0172 | .76069 | .09988 |

| | | | | |
|---|---|---|---|---|
| More effective approach | 58 | 1.7586 | .94238 | .12374 |
| Confidence STEM | 58 | 2.7069 | 1.24264 | .16317 |
| Visual aids retain concepts better | 58 | 1.8103 | .78264 | .10277 |

Descriptive statistics presented in Table 6 show mean values above the test value across all constructs.

The above table highlights the one-sample T-test statistics where each of the values has been assessed and simultaneously compared to the main score of the discounted data to test its validity [24]. The data samples in this table have been based on both the dependent and independent variables.

A closer look at the table shows that the mean depression score of the variables is higher than the test value given, which proves the significance of the finding. higher values of the variables refer to higher significance and thereby make the data reliable.

**One-Sample Test**

**Table 7: One-Sample Test**

| Test Value = 0 | | | | | | |
|---|---|---|---|---|---|---|
| | **T** | **Df** | **Sig 2 tailed** | **Mean Difference** | **95% Confidence Interval of the Difference** | |
| | | | | | **Lower** | **Upper** |
| Teaching methods experience | 14.172 | 57 | .000 | 2.01724 | 1.7322 | 2.3023 |
| STEM Engagement | 17.091 | 57 | .000 | 2.31034 | 2.0396 | 2.5810 |
| Effectiveness of traditional | 15.851 | 57 | .000 | 2.25862 | 1.9733 | 2.5439 |
| Teaching | | | | | | |
| Confidence traditional | 16.832 | 57 | .000 | 2.68966 | 2.3697 | 3.0096 |
| Visual aid effectiveness | 20.196 | 57 | .000 | 2.01724 | 1.8172 | 2.2173 |
| More effective approach | 14.212 | 57 | .000 | 1.75862 | 1.5108 | 2.0064 |
| Confidence STEM | 16.590 | 57 | .000 | 2.70690 | 2.3802 | 3.0336 |
| Visual aids retain concepts better | 17.616 | 57 | .000 | 1.81034 | 1.6046 | 2.0161 |

The one-sample t-test results in Table 7 indicate statistically significant differences ($p < 0.05$), supporting the effectiveness of STEM-based instruction.

The t-test makes it easy to demonstrate the presence of causal relationships between the selected variables. It helps check the strength of the relationship and its significance to justify the acceptability of the proposed hypothesis [25]. Each of the findings in the one-sample T-test is our contribution of the variables on the normal population, where the research was conducted. Each of the values of T-Statistic (***t),*** Significance or P-Value ***(Sig),*** and Degrees of Freedom ***(df)*** helps provide a better understanding of the reliability of the assumptions proposed.

The T-statistic was used to measure the number of standard error units in the sample mean that is away from the hypothesized population mean. A larger absolute t-value refers to a greater difference between the sample mean and population mean. Similarly, the p-value indicates the probability of observing the sample data. Any value that is less than 0.05 is considered statistically significant. Lastly, the degrees of freedom highlight the number of independent values

present, with n being the number of observations considered in the study. As can be seen from the table that each of the values of the independent variables shows a degree of significance *(Sig)* estimated to be at 0.000 (where p = 0.05).

As per the assumptions of the research, when the value of significance is less than 0.05, they are considered to be significant and effective. The values of the mean difference of the selected variables are all positive, which highlights a strong dependency between them and the dependent variable. Therefore, based on these results, the null hypothesis is rejected and the alternative hypothesis is accepted. This means that STEM teaching methods are indeed effective in helping students understand math better when taught regularly to students in the class.

**Table 8.** Hypothesis Testing

| Hypothesis | Accepted/Rejected |
|---|---|
| ***H1***: The STEM teaching method is more effective than traditional teaching methods, and helps children understand mathematics concepts better. | **Accepted** |
| ***H0***: STEM teaching method has no significant difference from traditional teaching methods, and does not help the children understand mathematic. | **Rejected** |

## Interpretation, Implications for Teaching, Summary, and Conclusion

### Role of STEM-based instruction on the Mathematical Understanding of Grade 9 Students

Research analysis has identified that providing STEM-based learning to students indeed improves their ability to understand and conceptualize mathematical problems. The regression analysis reveals a strong causal relationship between visual aid effectiveness and class participation in math. In this case, it has been found that students were far more receptive towards solving complex math problems and participating actively in class when STEM methods were used. [26].

Existing literature has pointed out that STEM methods contribute towards enhancing conceptual understanding [26]. This makes it easier for students to understand mathematical problems and increases their interest in the classroom. The same has also been proven from the regression analysis, where students have shown to preference for STEM methods more than traditional methods.

### Challenges encountered by Students and Teachers when using STEM-based instruction

There have been certain challenges that have been identified from the analysis. As can be seen from the regression table of coefficients that students found it difficult to grasp the concepts of STEM methods completely, and thereby showed lower levels of confidence. This has been indicated by the negative value of -0.163. This can be mostly because of being exposed to the process for the first time and not having any prior experience.

Also, with students only being exposed to the use of visual aids for an hour at most per class left them with little time to understand how to implement them in their exams. In the case of the teachers, the major challenge was a lack of training in teaching students using STEM methods [27]. The teachers could only teach the students based on the visual aids that were provided to them. There were no resources related to STEM methods available in the classroom. The lack of proper resources left the

teachers unprepared to manage STEM teaching [28].

**Benefits encountered by Students and Teachers when using STEM-based instruction**

One of the major benefits witnessed from the students through this research was increased interest in math as a subject. Students were more proactive when visual aids were used to teach them concepts of probability [29]. This was proven by the positive values in the coefficients table for class participation. The weekly test results also showed a slight improvement in the performance of the students. For the teachers, it was found that they were more eager to learn about STEM methods, as they felt the confidence of the students was slightly improved when using STEM [30].

It can be justified that STEM methods are indeed more effective as compared to traditional methods, as they help students better understand complex mathematical concepts.

## Limitations

There have been several limitations that have presented themselves when researching this topic. The research limitations mostly arose due to time constraints and permission issues.

1. The research did not consider interviewing the teachers regarding their experience of using STEM methods in class to teach math to the students. This creates a significant gap in the research in terms of assessing whether the method was useful or not. Also, it was not assessed whether the teachers could effectively use the visual aids to teach in class. This left a significant area for bias.
2. The research conducted a common survey, where there was no control variable or independent variable. This leaves chances for the reliability and validity of the findings to be affected negatively.
3. The weekly test that was considered failed to effectively measure whether there were any improvements in student outcomes. This is because there was no comparison made with the previous week's test results. The lack of comparison makes it very difficult to measure and imply confidently that the use of STEM methods led to helping students understand math concepts better.

## Summary

It can be summarized from the above section that there is indeed a positive impact of STEM-based learning on a better understanding of mathematical concepts for grade 9 students in question. It has been assessed that the students found it easier to understand and solve complex math problems when visual aids were used as opposed to traditional teaching methods.

However, there was also a significant lack of confidence for students in both STEM and traditional teaching methods. The lack of confidence in STEM was mostly because of having no prior exposure. In the case of traditional methods, the lack of confidence mostly arose from the monotony in how math was being taught.

## Conclusion

It can be concluded from the given study that the use of traditional methods in teaching mathematics is useful but not very effective. The lack of practical demonstration often creates challenges for students and, as a result, causes difficulty in solving complex math problems. However, this problem can be easily mitigated with the implementation of STEM-based techniques. In this given research, the use of visual aids to teach math to grade 9 students proved to be effective in enhancing the ability of the students to comprehend complex math problems better. It made them more proactive in class in terms of participation in solving math.

At the same time, the research highlighted that the students found the use of visual aids to be interesting. It was also easier to manage.

Also, it was found that despite the effectiveness of STEM methods, the students were still not confident about their implementation. This is mostly as a result of a lack of exposure to these methods before the experimentation.

The research analysis highlighted that the students found it easier to retain mathematical concepts better when they were taught using visual aids. The students also found that STEM methods were more effective for them as they provided them with a positive class experience. However, it is important to note that there were significant challenges that were established, especially in the form of a lack of training in part for the teachers.

The school was also not prepared in terms of resources, as it implemented STEM-based learning in the classroom. There are several limitations that have been identified in this research, especially in terms of how the teachers were not considered for evaluation to understand their perception about using STEM teaching in the classroom.

Also, another limitation was not having a separate control and independent variable, which could have provided proper justification regarding what factors made STEM teaching more effective.

However, aside from these aspects, it can be concluded based on the research findings that STEM-based methods are indeed effective in helping students become actively interested in the Math subject. The use of visual aids indeed helps students to understand math better and solve complex problems easily.

## Scope for Future Research

There is significant scope for future research on the topic, as there have been several gaps identified in this case. Firstly, to better understand and prove the effectiveness of STEM teaching, it is essential to look into the literature for the perception of teachers and their experience with this method. Secondly, as opined by Yilmaz and Yanarates, there is also scope for research in understanding in what ways STEM-based teaching can help improve the logical thinking capabilities of the students and make math subjects more interesting for students.

## Conflict of Interest

The author declares no conflict of interest.

## Ethical Approval

This research was carried out in alignment with the ethical guidelines governing educational studies. The administration of the participating non-traditional high school in St. Andrew granted permission to conduct the research. Additionally, consent was secured from the Grade 9 Mathematics Department. All student participants, along with their guardians, were provided with comprehensive information regarding the study's objectives, methodologies, and anticipated outcomes. Participation was entirely voluntary, and no personal identifying information was gathered. Throughout all phases of data collection, analysis, and reporting, confidentiality and anonymity were strictly maintained.

## Data Availability

The data that underpin the conclusions of this research can be obtained from the corresponding author upon a reasonable request. In order to safeguard student confidentiality, the raw responses from questionnaires and test scores cannot be disclosed publicly. Nevertheless, aggregated data tables and the statistical outputs utilized for analysis can be made available upon request.

## Author Contributions

Dr. Mark A. Lewis is the sole author of this manuscript. He was responsible for conceptualizing the study, designing the methodology, executing the data collection and analysis, preparing all tables and figures, interpreting the results, and drafting and revising the complete manuscript.

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# Assessing Community Members' Knowledge about AEFI, Awareness about AEFI Reporting and Their Vaccine Safety Perception in Oyo State Nigeria

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***Abstract***

*Immunization as a cost-efficient has proven to be a successful public health initiatives, as it prevents more than 2.5 million child fatalities yearly. Worry about the possibility of adverse events after vaccination (AEFI) may lead to low vaccination rates, a reduction in vaccine confidence, or return of vaccine preventable diseases. This study aim to understand the community level knowledge about AEFI, their awareness about AEFI reporting and perception about vaccine safety. This study is a descriptive cross-sectional study that was carried out among 422 vaccine recipients in Oyo State that have at least received a dose of vaccine in the last 10 years. Semi- structured questionnare was used for data collection. The data was analyzed using SPSS24 and the descriptive statistical tools used are frequency, mean and standard deviation. The mean knowledge score out of 10 was 6.61± 2.34 and more than half (56.2%) of the respondents have good knowledge about the concept of AEFI. The mean awareness scores out of 10 was 4.75±1.48 and only few (3.3%) of respondents have good awareness about AEFI reporting. The majority (95.7%) of study respondents perceived vaccines as safe and effective against vaccine preventable diseases, however more than half (52.9%) of the respondents perceived that many HWs administer vaccines in a harmful manner. This study demonstrated community members' suboptimal awareness about reporting system for AEFI, as well as having perception that vaccines though safe and effective, their administration were in a harmful manner.*

***Keywords:*** *AEFI, AEFI Reporting, Perception, Vaccine Safety.*

## Introduction

Immunization prevents more than 2.5 million child fatalities each year and is considered one of the most cost-efficient and successful public health initiatives [1] (World Health Organization, 2022). It has significantly reduced the morbidity and mortality from diseases that can be prevented by vaccination. [2-5] A robust and effective health service infrastructure that can deliver and scale-up the vaccination service is essential to the success of any immunization program. However, because of immunization's accomplishments, the prevalence of vaccine-preventable diseases (VPDs) has fallen considerably, and the public's focus switches from VPDs to vaccine safety and unfavorable vaccine side effects.[6, 7] People are becoming more worried about the hazards connected with vaccines as the number of cases of infectious diseases preventable by vaccination continues to drop. Following any vaccine introduction, continued post-licensure safety monitoring and evaluation of vaccine-associated events (adverse events following immunizations, AEFI) is necessary to provide a more complete benefit-risk profile.[8, 9] In addition, research on the safety of current

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vaccines has expanded due to technological developments and the ongoing expansion in knowledge about vaccines has occasionally sparked further curiosity and some alarm.[2, 10] According to WHO, widespread worry about the possibility of adverse events after vaccination (AEFI) may result in poor vaccination, a downward trend in vaccine confidence, or even a 'comeback' of vaccine preventable diseases.[11] A typical example was seen in 2003 in Northern Nigeria OPV boycott.[12] Akwataghibe et al in their study also identified AEFI as main 'demotivating factor'[13]. At such, it is important to ensure a strenghthened pharmacovigilance on vaccine safety to confidently understand potential vaccine safety issues and unabigously provide vote of confidence in vaccines with evidence through scientific expert perspective.

People's knowledge about AEFI, information available to them about reporting channels as well as their perception about vaccine safety may impact the reporting rate of AEFI from the community to the health system structure where the information are expected to be aggregated. Having a previous medical experience, whether as a patient, caregiver or even acquaintance provides basis for improved knowledge about such medical condition and availability/ accessibility to care. The same is applicable to experience with AEFI. However, incident(s) that follows or experience surrounding the occurrence of the adverse event may positively or negatively affect subsequent reporting of AEFI in future.

Currently, there is no record that provide the social data about what the community members in Oyo State knows about AEFI, AEFI reporting or understanding of their perception about vaccine safety perception.

It is important to understand the current community level knowledge about AEFI, their awareness about AEFI reporting and perception about vaccine safety to understand the impact these may have on the current AEFI reporting rate to the health system and provide a great sense of direction for technical experts in information provision to the communities about AEFI, reporting and vaccine safety. Therefore, results from this study may provide a clear sense of guidance in the development of community targetted communication materials that may be used in enhancing AEFI reporting.

Accordingly, in addition to enhancing AEFI reporting, having a high level of knowledge about AEFI, greater awereness about reporting of AEFI and a favorable perception about vaccination and AEFIs may help to reduce immunization neglect and the related medical liabilities [14].

## Materials and Methods

This study is a descriptive cross-sectional study carried out among vaccine recipients in Oyo State who received at least a dose of vaccine in the last 10 years or the caregivers of the vaccine recipient. A sample size of 422, drawn using Cochran's infinite population technique was adopted for the study. Where Z is the standard normal deviate set at 1.96 (corresponding to 95% CI), p is the estimated proportion of an attribute that is present in the population ( 0.5 or 50% used as prevalence in the study population was unavailable), q is the complementary probability (1-p), and dis the margin of error set at 5% (0.05).

The respondents were selected by using multistage (3 stages) sampling procedure.

**The first stage**: Random selection of 3 LGAs, one per senatorial district in Oyo State.

**Second stage**: PPS sampling methodology was used in selecting the settlements.

Based on the master list of settlement showing Ibadan Northwest, Iseyin and Ogo Oluwa has 384, 439 and 204 communities/ settlements respectively, 16, 18 and 8 settlements were selected in the LGAs accordingly.

**The third stage**: random selection of 10 persons in the selected settlements to make

422 eligibles. One eligible was then selected per household.

A semi- structured questionnaire on ODK was used for the data collection to get information about socio -demographic characteristics, knowledge about AEFI, vaccine safety perception and awareness of AEFI Reporting among respondents. Validity and reliability of the tool was ensured through extensive literature search of relevant previous papers in development of the tool, pretesting of the tool in similar adjoining LGAs to study lcations (10% of sample size), incorporation of preliminary pretested outputs for apprpriate instrument modification and deployment of Cronbach's Alpha technique for reliability test ensuring coefficient reliability value of 0.8. In addition, content and construct validity were reviewed during the training of research assistants to ensure uniform understanding and interpretation by all research assistants that supported data collection.

The data was analyzed using IBM/ Statistic Package for Social Science (SPSS) (Version 24) statistical package. The descriptive statistical tools used are frequency, mean and standard deviation.

Respondents' knowledge was computed using scale of 1 to 10, score of =>7 was termed good knowledge, 5-6 average knowledge while <5 termed poor knowledge. The same scoring was applied to respondents' awareness about AEFI reporting. The frequency of responses for each of the enquiries to determine perception about vaccine safety was presented seperately to depict respondents' opinion about vaccine safety.

Prior to the commencement of the study, ethical approval was obtained from the Oyo State Ministry of Health Ethics Review Committee. Verbal informed consent was obtained from all participants and confidentiality, privacy and anonymity of information maintained by ensuring no identifier placed on each respondents questionnaire, only autocodes generated on ODK, each respondents were interviewed in a private space and all collected data were downloaded, kept confidentially by the investigator with no unauthorized access and utilized strictly for research purpose only.

## Results

A total of 422 respondents with 320 (75.8%) identified as females, 80 (19%) as males and 22 (5.2%) people who did not want to disclose their gender were interviewed. Respondents aged 36-50 years represented close to half (46.4%) of those interviewed, while respondents aged 21-35 years represented 39.3%. Only 10.5 % and 3.8% of the total interviewed were aged above 50 years and below or equal to 20 years. The mean age of respondents is 37.2+ 10.3. Majority (70.4%) of the respondents were of the Islamic faith, while 28.4% were Christians and only 1.2% practice the traditional religion. More than half (58.2%) of the respondents have at least secondary level education, while 23.9% and 17.5% of respondents had primary and tertiary level as their highest level of education at the time of interview. Close to half (48.1%) of respondents lived within 1-to-2-kilometer distance to the closest health facility, while 25.4% lived within 2–5-kilometer distance to closest health facility. only 7.8% of respondents lived within 1km of the closest health facility, but 18.7% lived a distance greater than 5km away from the closest health facility. People who have had 3 to 4 children represents 43.8% of the respondents, while slightly above one-third (34.6) of respondents have had 1-2 children. People who had no child were 12.1 of respondents and the remaining 9.5% were people with 5 or more children. Table1 provides the sociodemograhic information.

**Table 1.** Sociodemographic Distribution of Respondents (N=422)

| **Variables** | **Value (n)** | **Frequency** |
|---|---|---|
| Gender | | |
| Female | 320 | 75.8 |
| Male | 80 | 19.0 |
| Prefer not to answer | 22 | 5.2 |
| Age of Respondents (years) | | |
| <20 | 16 | 3.8 |
| 21-35 | 166 | 39.3 |
| 36-50 | 196 | 46.4 |
| 51-65 | 44 | 10.5 |
| | Mean Age (SD) | 37.2 (+10.32) |
| Religion | | |
| Christianity | 120 | 28.4 |
| Islam | 297 | 70.4 |
| Traditional | 5 | 1.2 |
| Highest level of education | | |
| primary | 101 | 23.9 |
| secondary | 247 | 58.5 |
| tertiary | 74 | 17.5 |
| Distance to closest HF | | |
| <1km | 33 | 7.8 |
| 2km | 203 | 48.1 |
| 5km | 107 | 25.4 |
| >5km | 79 | 18.7 |
| Ethnicity | | |
| hausa | 3 | 7 |
| igbo | 11 | 2.6 |
| yoruba | 403 | 95.5 |
| others | 5 | 1.2 |
| No of children | | |
| 0 | 51 | 12.1 |
| 1-2 | 146 | 34.6 |
| 3-4 | 185 | 43.8 |
| >=5 | 40 | 9.5 |

Based on the computed score for knowledge shown in table2, more than half (56.2%) of the respondents have good knowledge about the concept of AEFI, while 24.9% and 19% have average knowledge and poor knowledge respectively about AEFI. The mean Knowledge score out of 10 was 6.61+ 2.34.

**Table 2.** Computed Score of Respondents' Knowledge About AEFI (N=422)

| Variables | Value (n) | Frequency |
|---|---|---|
| Knowledge Score | | |
| good | 237 | 56.2 |
| Average | 105 | 24.9 |
| poor | 80 | 19.0 |
| | Mean (SD) | 6.61 (+2.34) |

As illustrates in table3, very few (3.3%) of respondents have good awareness about AEFI reporting. However, greater than half (58.3%) of the respondents have average awareness about reporting of AEFI while 38.4% are poorly aware about reporting AEFI. The mean awareness scores out of a total of 10, for the 422 respondents was 4.75+1.48.

**Table 3.** Respondents' Awareness About AEFI Reporting (N=422)

| Variables | Value (n) | Frequency |
|---|---|---|
| Awareness score grading about AEFI reporting | | |
| good | 14 | 3.3 |
| Average | 246 | 58.3 |
| poor | 162 | 38.4 |
| | Mean (SD) | 4.75 (+1.48) |

Table4 shows the perception of respondents about vaccine safety. The majority (95.7%) of respondents agreed that vaccines are safe and effective against vaccine preventable diseases while 2.4% responded not know and 1.9% disagreed. More than half (52.9%) of the respondents believed that many HWs administer vaccines in a harmful manner. Almost the same proportion of respondents (45.5% and 43.4%) agreed and disagreed respectively that vaccine is not necessary unless a person is sick, while 11.1% of respondents said they did not know. About two-third (67.7%) of the respondents believed that AEFI are commonly developed.

More than half (62.8%) of respondents got worried about developing AEFI when they/ ward/ family member was to go for vaccination.

Greater than two- third of respondents (8.5% strongly agree, 62.6% agree) disclosed to believing that pre-counselling about AEFI is usually conducted by HWs before vaccinating.

Similarly, two- third of respondents (6.9% strongly agreed, 59.5% agreed) disclosed to believing that follow-up counselling about AEFI is usually conducted by HWs after vaccinating. Close to three- quarter of respondents (7.6% strongly agreed, 65.4% agreed) also said HWs usually provide counselling about AEFI management. Higher proportion of participants (7.3% strongly agreed, 62.8% agreed) were satisfied with AEFI counselling provided by HWs.

Many (62.3% agreed, 7.6% strongly agreed) of the respondents believed that AEFI safety precaution are observed at the immunization posts.

Some of the respondents perceived that vaccines do more harm than good, with 20.1% of respondents agreeing and 7.3% strongly agreeing. However, majority of the respondents perceived otherwise (57.1% disagreed, 5.0% strongly disagreed). The remaining 10.4% of respondents responded that they did not know.

**Table 4.** Vaccine Safety Perception Among Respondents (N=422)

| Variables | Value (n) | Frequency |
|---|---|---|
| **Vaccines safe &effective** | | |
| Strongly agree | 146 | 34.6 |
| Agree | 258 | 61.1 |
| Don't Know | 10 | 2.4 |
| Disagree | 6 | 1.4 |
| Strongly disagree | 2 | 0.5 |
| **Many HWs administer vaccines in harmful manner** | | |
| Strongly agree | 21 | 5.0 |
| Agree | 202 | 47.9 |
| Don't Know | 63 | 14.9 |
| Disagree | 130 | 30.8 |
| Strongly disagree | 6 | 1.4 |
| **Vaccines not necessary unless sick** | | |
| Strongly agree | 25 | 5.9 |
| Agree | 167 | 39.6 |
| Don't Know | 47 | 11.1 |
| Disagree | 168 | 39.8 |
| Strongly disagree | 15 | 3.6 |
| **AEFI commonly developed** | | |
| Strongly agree | 47 | 11.1 |
| Agree | 239 | 56.6 |
| Don't Know | 62 | 14.7 |
| Disagree | 70 | 16.6 |
| Strongly disagree | 4 | 0.9 |
| **I get worried about vaccine safety when my family/ I am to receive vaccine** | | |
| Strongly agree | 40 | 9.5 |
| Agree | 225 | 53.3 |
| Don't Know | 29 | 6.9 |
| Disagree | 126 | 29.9 |
| Strongly disagree | 2 | 0.5 |
| **Pre-counselling about AEFI done by HWs before vaccination** | | |
| Strongly agree | 36 | 8.5 |
| Agree | 264 | 62.6 |
| Don't Know | 58 | 13.7 |
| Disagree | 63 | 14.9 |
| Strongly disagree | 1 | 0.2 |
| **Follow-up counselling about AEFI done by HWs after vaccination** | | |
| Strongly agree | 29 | 6.9 |
| Agree | 251 | 59.5 |
| Don't Know | 59 | 14.0 |
| Disagree | 78 | 18.5 |
| Strongly disagree | 5 | 1.2 |

| | | |
|---|---|---|
| **HWs provide counselling about AEFI management** | | |
| Strongly agree | 32 | 7.6 |
| Agree | 276 | 65.4 |
| Don't Know | 51 | 12.1 |
| Disagree | 61 | 14.5 |
| Strongly disagree | 2 | 0.5 |
| **Satisfy with AEFI counselling HWs provide** | | |
| Strongly agree | 31 | 7.3 |
| Agree | 265 | 62.8 |
| Don't Know | 50 | 11.8 |
| Disagree | 72 | 17.1 |
| Strongly disagree | 4 | 0.9 |
| **Safety precaution on AEFI observed at immunization posts** | | |
| Strongly agree | 32 | 7.6 |
| Agree | 263 | 62.3 |
| Don't Know | 85 | 20.1 |
| Disagree | 42 | 10.0 |
| Strongly disagree | 0 | 0.0 |
| **Vaccines do more harm than good** | | |
| Strongly agree | 31 | 7.3 |
| Agree | 85 | 20.1 |
| Don't Know | 44 | 10.4 |
| Disagree | 241 | 57.1 |
| Strongly disagree | 21 | 5.0 |

## Discussion

### Knowledge about AEFI among Community Members

This study shows that majority of the respondents have average to good knowledge about AEFI with mean knowledge score of 6.61+2.34. Participants exhibited understanding of the basic meaning of AEFI, the reactions that can be termed as AEFI, who can suffer an AEFI, when AEFI can occur and the need for AEFI surveillance. This aligns with results of the study by Afolaranmi et al conducted in Jos, Nigeria [15] where over two-third of respondents exhibited good knowledge about AEFI. This implies that many community members understands that AEFI can occur and AEFI surveillance can complement other efforts targeted at vaccine safety.

### Level of Awareness of AEFI Reporting among Community Members

Very few respondents in this study exhibited good awareness about reporting of AEFI. This compares with findings from Omoleke et al [16] conducted in Kebbi State, Nigeria but in contrast with the findings from a study by Afolaranmi et al in Jos Nigeria [15] and another study in Ondo State Nigeria by Olaoye et al.[17] This result from the later study may however not be surprising as the finding was among health workers who are usually expected to have regular training and sensitization about AEFI.

### Vaccine Safety Perception among Community Members

People are often driven to act based on their perception of the circumstance in relation to the constructs.[18] Majority of respondents in this study have the perception that vaccines are

safe and effective, and this finding aligns with findings from Lee & Sibley.[19] It is noteworthy that about 4% disagreed with this affirmation or stated not to know. These set of people and their likes should be targeted and carefully guided to prevent them from confusing some of those who already are convinced that vaccines are safe and effective.

In terms of community members perception about the health workers, more than half of the respondents in this study were convinced that many HWs administer vaccine in a harmful manner. This proportion is huge for a sensitive matter that hover around system trust and may be a strong reason for not showing up for vaccinations when due or as well be responsible for not reporting AEFI as there are no trust in the health workers. This results however contrast results from a Northern Nigeria study [20] that suggests that community members had complete trust in the health workers and satisfy with AEFI information provided.

In their perception, majority of respondents feels AEFI is commonly developed. In assessing respondents' perception about safety precaution being observed at the immunization posts, slightly above two- third perceived that vaccine safety precautions are usually being observed at the immunization posts, leaving a whooping one- third who perceived otherwise. Even the two- third with the positive impression contrasts the results seen for perception about health workers administering vaccines in a harmful manner in this same study, which indicates that many perceives harmful manners of administering vaccines by the health workers. The contrast is a confirmation that perception is often not from an informed judgement or actual occurrence/ situation.

The study further tries to understand the perception of respondents about whether vaccines do more harm than good, and the findings showed that 27% perceived that vaccines do more harm than good, but 62% perceived otherwise, while about 10% were undecided. This huge gap indicates a cry for help to intensified efforts to improve the public perception about the advantages vaccines has to offer through regular awareness creation, print media, TVs and radio broadcast and jingles, social media platforms.

## Conclusion

The research study has shown that many people have good knowledge about AEFI but in addition demonstrates limited awareness about the AEFI reporting system among community member which could have a huge impact on AEFI surveillance and subsequently on immunization coverage. The results from the perception about vaccine safety indicates that most community members believe in the safety and effectiveness of vaccines, however, there are still a handfull with disbelieve that requires being targeted for proper orientation. Furthermore, results from the vaccinne safety perception aspect of this study also suggest that majority of the community members do not trust the health system in providing the available safe and effective vaccine in an unharmful manner. Though, perception may not be from an informed judgement or actual occurrence/ situation, it often shape the cue to action. Therefore, this sensitive finding requires further guidance to healthworkers to be more sensitive in vaccine mangement and administration to leave a better impression on clients and vaccinnee and caregivers.

These findings are indication of a need for professionally crafted mass awareness messages about vaccine safety and AEFI reporting system targeted at improving community members' perception about vaccine safety and AEFI pharmacovigilance and in turn immunization coverage and VPD reduction.

## Conflict of Interest

Authors declare no conflict of interest.

## Ethical Approval

Ethical approval was obtained from the Oyo State Ministry of Health Ethics Review Committee, Ibadan, Nigeria prior to the commencement of the study.

## Data Availability

All collected data are securely saved and available for research purpose only in line with ethical consideration.

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Research was fully personally catered by the authors, with no external fund.

## Authors' Contribution

Conceptualization, literature review, methodology, data analysis, Writing – original draft, Writing – review & editing: **Olayiwola, Olanike**.

Supervision, Writing – review & editing: **AbdulRaheem, Ibraheem.**

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# The Impact of Alcohol and Herbal Consumption on the Cardiovascular Health Status of Commercial Automobile Drivers in Ibadan

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***Abstract***

*Cardiovascular diseases are a group of non-communicable diseases with a rising burden in Nigeria. Commercial automobile driving is an occupation with associated risks that may worsen the burden among the population concerned. A cross-sectional survey of 1713 automobile drivers across Ibadan showed a predominantly male population with more than half in the 36–49 years age bracket, and 74.6% with at least secondary level of education. 44.7% of them have been working for 5-10 years, mostly working for 9-16 hours a day (96.3%) and 6-7 days in a week (96.2%). The long hours of work, prevalence of alcohol consumption (44.4%), and prevalence of herbal consumption (87.7%) may have contributed to the difference in the proportion of the population with previously diagnosed hypertension (2.3%) and the proportion observed to be hypertensive during the study (13.3%). A significant association between alcohol consumption and the prevalence of hypertension, pedal oedema and other diagnosed chronic illnesses were also observed. In contrast, no significant association was noted between herbal consumption and the parameters of the cardiovascular health status observed. It is concluded that although the prevalence of hypertension in this population was lower than previously reported in mixed community samples, the significant association between alcohol use and elevated blood pressure underscores the vulnerability of this occupational group.*

***Keywords:*** *Alcohol, Blood Pressure, Cardiovascular Diseases, Commercial Drivers, Herbs.*

## Introduction

The burden of cardiovascular diseases is rising in low- and middle-income countries like Nigeria, yet insufficient attention is being given to addressing this emerging public health crisis [1]. Cardiovascular diseases (CVDs) account for approximately 11% of the 29% of all deaths in Nigeria attributed to noncommunicable diseases (NCDs), and there are almost no significant efforts in motion to stem the tide by the health agencies concerned [2]. This challenge is worsened by the relatively poor health seeking behaviour of the population [3]. This poor health seeking habit has been found out to be more pronounced among the population with lower level of education and socioeconomic status such as artisans including commercial automobile drivers [3, 4].

Cardiovascular diseases are increasingly recognized as a major occupational health concern, particularly among populations engaged in physically and mentally demanding jobs such as commercial driving. Drivers often face prolonged exposure to stress, irregular dietary habits, and limited opportunities for physical activity, all of which contribute to elevated cardiovascular risk. Commercial automobile drivers are also known to engage in substantial alcohol use, as well as the consumption of herbal drinks, often driven by fatigue from long working hours and sociocultural beliefs, including the

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use of herbal and alcohol concoctions as alternative medicine [2]. Globally, the prevalence of hypertension among commercial transport workers is reported to be about 27.7%, a rate linked to population growth, aging, and behavioural risk factors including smoking, physical inactivity, excessive alcohol consumption, stress, and poor diet [1].

However, the prevention of modifiable risk factors is widely recognized as a crucial step in reducing the burden of cardiovascular diseases (CVDs), and alcohol consumption has been highlighted as a significant contributor to cardiovascular health outcomes. In a country like Nigeria, with a currently low life expectancy of 62.6 years ranking 167th globally [1], it is therefore important to identify high-risk individuals and factors that may influence and worsen the public health of commercial automobile drivers. The transportation sector plays an important role in national development and often considered a proxy for measuring urbanization and industrialisation, hence it would be of great advantage to understand the cardiovascular health pattern of commercial automobile drivers with a view to improving it [2]. Understanding these dynamics is essential not only for improving the health of drivers but also for enhancing road safety and productivity in the transport sector.

While there are several studies on the prevalence of alcohol and substance abuse in this region, fewer studies have examined the population of interest, and much more fewer studies have focused on the consumption of herbal drinks among them. There is also a paucity of data on the cardiovascular health status of this population, especially with respect to the consumption of alcohol and herbal drinks. Therefore, the study aimed to assess the cardiovascular health status of commercial automobile drivers in Ibadan and how it is being impacted by the current burden of alcohol and herbal drink consumption. We hypothesised that the consumption of alcohol and herbal drinks among commercial automobile drivers in Ibadan has a significant negative impact on their cardiovascular health status.

## Materials and Methods

A total of 1713 commercial automobile drivers within Ibadan metropolis participated in this study. Ethical approval was obtained from the Oyo State Ethical Review Board with reference number AD/13/479/062. The study also adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. Ten (10) local government areas (LGAs) each with 171 -174 respondents were administered questionnaire after their consent to participate in the study.

The Questionnaire used for this study was interviewer-administered and is a composite derived from other assessment tools with established reliability and validity and further validated via a pilot study to assess the content validity and face validity.

To assess the cardiovascular impact of alcohol and herbal drinks, some non-invasive parameters were measured namely: Blood pressure, Pulse rate, and Body mass index (BMI). This data was collected by trained research assistants using a calibrated digital sphygmomanometer (Omron® Basic-2) for the blood pressure and pulse rate. A portable clinical weighing scale and meter rule were used to obtain the BMI-related parameters (weight and height). The BMI in $kg/m^2$ is obtained thus: Weight (in kilogrammes)/Height$^2$ (in metres). Each of these devices were calibrated by comparing values obtained with that obtained with other standardised devices and consistency was ensured.

This research employed various data management and analysis tools to ensure efficient handling and rigorous analysis of the collected data. Data were obtained using a

structured questionnaire and with the help of trained research assistants. The quantitative data obtained were analysed using the Statistical Package for Social Sciences (SPSS) by the International Business Machines (IBM) Corporation, version 25.

## Results

The study population consists of 1,713 participants and is characterized by a nearly exclusive male presence and a predominantly middle-aged demographic (Table 1). The sample is overwhelmingly male, accounting for 99.5% (n=1,705) of the participants, more than half (51.0%) in the 36–49 years age bracket, a vast majority are married (89.4%), and most participants live in a nuclear family structure. Many participants (74.6%) have at least secondary level of education.

**Table 1.** Social Demographics of Commercial Automobile Drivers in Ibadan

| | **n** | **%** |
|---|---|---|
| **Sex** | | |
| Male | 1705 | 99.5 |
| Female | 8 | 0.5 |
| **Age group** | | |
| 18 - 24 years | 32 | 1.9 |
| 25 - 35 years | 389 | 22.7 |
| 36 - 49 years | 873 | 51 |
| 50 - 64 years | 363 | 21.2 |
| ≥ 65 years | 56 | 3.3 |
| **Marital Status** | | |
| Divorced | 29 | 1.7 |
| Married | 1532 | 89.4 |
| Single | 139 | 8.1 |
| Widow/Widower | 13 | 0.8 |
| **Family Structure** | | |
| Extended | 63 | 3.7 |
| Nuclear - Monogamy | 1030 | 60.1 |
| Nuclear - Polygamy | 620 | 36.2 |
| **Level of Education** | | |
| Nil education | 1 | 0.1 |
| Primary | 331 | 19.3 |
| Secondary | 1278 | 74.6 |
| Tertiary | 103 | 6 |

The proportion of the respondents engaging in motorcycling were slightly more (Table 2) with an occupational profile of more with a working experience of 5-10 years (44.7% of the respondents), mostly working for 9-16 hours a day (96.3%) and 6-7 days in a week (96.2%).

**Table 2.** Occupational Demographics of Commercial Automobile Drivers in Ibadan

| | **n** | **%** |
|---|---|---|
| **Occupation** | | |
| Bus driver | 175 | 10.2 |

| | | |
|---|---|---|
| Cab driver | 415 | 24.2 |
| Motorcycle rider | 644 | 37.6 |
| Tricycle rider | 479 | 28 |
| **Occupational experience** | | |
| < 5 years | 141 | 8.2 |
| 5 - 10 years | 766 | 44.7 |
| 11 - 20 years | 689 | 40.2 |
| > 20 years | 117 | 6.8 |
| **Work hours/day** | | |
| < 8 hours | 39 | 2.3 |
| 9 - 16 hours | 1649 | 96.3 |
| > 16 hours | 25 | 1.5 |
| **Workdays/week** | | |
| 1 - 3 days | 3 | 2 |
| 4 - 5 days | 62 | 3.6 |
| 6 - 7 days | 1648 | 96.2 |

Alcohol consumption among Ibadan commercial automobile drivers shows varying relationship with the cardiovascular parameters. Alcohol consumption was prevalent with 44.4% reporting current use and 59.1% having consumed it at some point in their lives. Herbal drinks, however, were far more widespread, embraced by 87.7% of individuals (Table 3). Water-based herbal preparations were the most common, used by 84.1%, while alcohol-based herbal drinks were less frequent at 40.8%. Only a small fraction, 14.6%, reported combining both water- and alcohol-based herbal consumption.

**Table 3.** Prevalences Obtained among Commercial Automobile Drivers in Ibadan

| | **%** |
|---|---|
| Point prevalence of alcohol consumption | 44.4 |
| Lifetime prevalence of alcohol consumption | 59.1 |
| Prevalence of herbal consumption | 87.7 |
| Water-based herbal consumption | 84.1 |
| Alcohol-based herbal consumption | 40.8 |
| Concurrent intake of water- and alcohol-based consumption | 14.6 |

A majority of the respondents (78.1%) had not checked their blood pressure recently, and 13.3% of them had their systolic blood pressure ≥ 140 mmHg (Table 4). This was in sharp contrast to the proportion of commercial drivers who knew their blood pressure status, that is, already diagnosed of hypertension (2.3%). Asides hypertension, obesity was reported in 45.1%, palpitations in 5.6%, abnormal pulse rates such as bradycardia or tachycardia in 2.3%, and pedal oedema in 0.8% (Table 5). There is a significant association between alcohol consumption and the prevalence of hypertension, pedal oedema and chronic illnesses (Table 6). Herbal consumption however does not have any significant association with any of the cardiovascular parameters assessed (Table 7).

**Table 4.** Blood Pressure Profile of Commercial Automobile Drivers in Ibadan

| | n | % |
|---|---|---|
| **Recent blood pressure check** | | |
| Yes | 375 | 21.9 |
| No | 1338 | 78.1 |
| **Systolic blood pressure range (mmHg)** | | |
| Normal (90 – 119) | 340 | 19.9 |
| Elevated (120 – 129) | 633 | 37 |
| Stage 1 Hypertension (130 – 139) | 512 | 29.9 |
| Stage 2 Hypertension (≥ 140) | 216 | 12.6 |
| Hypertensive crisis (≥ 180) | 11 | 0.6 |
| **Diastolic blood pressure range (mmHg)** | | |
| Normal (< 80) | 700 | 41 |
| Hypertension (80 – 119) | 1005 | 58.8 |
| Hypertensive crisis (> 120) | 3 | 0.2 |

**Table 5.** Cardiovascular Profile of Commercial Automobile Drivers in Ibadan

| | n | % |
|---|---|---|
| Obesity | 76 | 45.1 |
| Diagnosed hypertension | 39 | 2.3 |
| Cardiovascular diseases | 126 | 7.4 |
| **Other cardiovascular symptoms** | | |
| Palpitations | 96 | 5.6 |
| Abnormal pulse rate (brady-/tachy-cardia) | 40 | 2.3 |
| Pedal oedema | 14 | 0.8 |

**Table 6.** Relationship between Alcohol Consumption and Cardiovascular Health Status among Commercial Automobile Drivers in Ibadan

| **Cardiovascular health status** | **Alcohol consumption** | | **$X^2$** | **p-value** |
|---|---|---|---|---|
| | **Yes** | **No** | | |
| **Hypertension** | | | | |
| Yes | 134 | 92 | 23.174 | < 0.001 |
| No | 626 | 855 | | |
| **Obesity** | | | | |
| Yes | 41 | 35 | 3.058 | 0.217 |
| No | 718 | 908 | | |
| **Pedal oedema** | | | | |
| Yes | 8 | 6 | 0.003 | < 0.001 |
| No | 751 | 942 | | |
| **Palpitations** | | | | |
| Yes | 48 | 48 | 2.51 | 0.285 |
| No | 711 | 900 | | |
| **Chronic illness** | | | | |
| Yes | 9 | 3 | 0.003 | < 0.001 |
| No | 751 | 945 | | |

**Table 7.** Relationship between Herbal Consumption and Cardiovascular Health Status among Commercial Automobile Drivers in Ibadan

| Cardiovascular health status | Herbal consumption | | $X^2$ | p-value |
|---|---|---|---|---|
| | Yes | No | | |
| **Hypertension** | | | | |
| Yes | 199 | 28 | 0 | 0.996 |
| No | 1302 | 183 | | |
| **Obesity** | | | | |
| Yes | 62 | 14 | 2.76 | 0.107 |
| No | 1435 | 196 | | |
| **Pedal oedema** | | | | |
| Yes | 14 | 0 | 2.126 | 0.345 |
| No | 1487 | 211 | | |
| **Palpitations** | | | | |
| Yes | 91 | 5 | 4.909 | 0.086 |
| No | 1410 | 206 | | |
| **Chronic illness** | | | | |
| Yes | 10 | 2 | 0.212 | 0.651 |
| No | 1492 | 209 | | |

## Discussion

Numerous studies have revealed the complex relationship between alcohol use and cardiovascular conditions such as hypertension, coronary heart disease, stroke, peripheral arterial disease and cardiomyopathy [5]. Until recently, alcohol consumption was considered to have a double-edged sword, that is, low to moderate intake of alcohol was cardioprotective, while chronic and excessive intake alcohol could have adverse cardiovascular effects. The current trend with alcohol use is that no level of alcohol consumption was safe [6, 7]. Following several reviews which have failed to show the protective effects of alcohol, the latest consensus is that no safe amount of alcohol consumption can be established [6]. Unfortunately, not many populations may be aware of this latest development and as such still consume alcohol with minimal consideration for its cardiovascular and other health implications.

The transport sector of most economies, as it was reflected in this study is predominated by the males (99.5%), a gender posited by several researches to be in favour of alcohol and substance abuse [8-11]. Although there have been discrepancies on gender-based epidemiology of cardiovascular diseases, many studies posit that while there is a greater incidence of cardiovascular diseases among females, many men are more likely to develop it at an earlier age or suffer mortality from it. This has led further studies which have outlined the factors which predispose men to the development of cardiovascular diseases [12, 13]. Risk factors in this population which have also been alluded to in other studies are consumption of alcohol, socioeconomic factors, smoking, and long exposure to chronic stress [12]. Commercial automobile drivers, as also shown from this study, are sometimes subjected to long hours of work (9-16 hours for most parts of the week) and when combined with risky behaviours such as alcohol consumption, their cardiovascular

health status suffers a negative impact [14]. The significant association between alcohol consumption and the presence of hypertension and other chronic illnesses in our study may be attestation to this negative impact.

In this study, the prevalence of respondents with hypertension (with blood pressure ≥ 140/90 mmHg) is 13.3%. This is much lower than the prevalence found out by Akinpeloye et al, who conducted a study in about the same area recently. In their study, they reported a prevalence of 33.3%, despite the same cut-off point ≥ 140/90 mmHg [2]. Possible reasons for this may have included the fact that they studied a mixed population in the area – both transporters and non-transporters. Also, their sample population was about one-third of this study, and this may have accounted for the relatively significant difference. However, this significant finding suggests that commercial automobile drivers may not be a major contributor to the burden of hypertension in Ibadan. As more recent studies align with the updated cut-off for hypertension adopted by many international organisations, the epidemiology of cardiovascular diseases may be altered among this population. The 2025 revised guideline of the AHA/ACC (American Heart Association/American College of Cardiology) now sets the threshold for hypertension at a systolic blood pressure of > 130 mmHg [15]. Other reasons that may have contributed to the current prevalence of alcohol and herbal consumption and the concomitant cardiovascular health status are the socioeconomic status and level of education of this population. Most of the respondents, as is commonly noted in similar population in other regions have a secondary level of education. This coupled with their financial status influence their health seeking behaviour and in turn influence their cardiovascular health status [4].

Some of the concerns raised about herbal preparation include the uncertainty about dosage, hygiene of preparations and its possible toxicity profile [16]. With the rising utilization of herbal medicine is the concern on the current knowledge available as regards the safety profile [17]. Many of the herbal preparations have been implicated in cardiovascular diseases. Other systems often affected are the gastrointestinal system, renal system and haematologic system [18]. Woo et. al. noted that Liquorice root, Ginseng and Saw palmentto could cause hypertension. Also, cardiovascular adverse effects could arise from interaction with other orthodox medicine that an individual may be co-administering, for example, Ginkgo biloba when used with a thiazide diuretic would result in increased blood pressure [19]. From this study, while 13.3% of the respondents consuming herbal preparations are hypertensive, there was however no significant association between herbal consumption and the presence of cardiovascular parameters or any known chronic illnesses. Despite this study's limitation to establish a significant association between the consumption of herbs and cardiovascular health parameters, other studies have highlighted the almost nil effect, and more likely, the cardiotoxic effect of most unrefined herbs consumed. In a review by Gavanji, scientific data regarding cardiotoxicity showed that 16 herbs from 11 families may increase cardiac toxicity. Therefore, it's important to use herbal medicines and natural products under the guidance of medical professionals [20].

On the basis of above findings, leaders of public health advocacy can increase health promotion activities geared towards avoiding a cardiovascular health crisis in this population. The difference noted in the number of persons previously diagnosed of hypertension and that observed during this study (2.3% versus 13.3% respectively)

reflects the need for regular screening. Incorporating cardiovascular risk screening and education during opportune encounters is regarded as a logical, efficient and financially prudent means of caring for the health of this category of workers [4].

This study is not without some limitations. First, its cross-sectional design precludes causal inference between alcohol/herbal consumption and cardiovascular outcomes. Second, reliance on self-reported data may introduce recall and social desirability bias, particularly regarding substance use. Third, the heterogeneity of herbal preparations consumed makes it difficult to assess specific cardiovascular effects. Future longitudinal studies with biochemical assays of herbal concoctions would provide more definitive evidence.

## Conclusion

Although the prevalence of hypertension in this population was lower than previously reported in mixed community samples, the significant association between alcohol use and elevated blood pressure underscores the vulnerability of this occupational group.

## Conflict of Interest

The authors declare no conflict of interest. This study was conducted independently, and no author received financial or material incentives that could bias the outcomes of this research.

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I appreciate the research assistants who showed passion for the research work and ensured strict confidentiality was maintained using standard procedures throughout the data collection process.

## Ethical Approval

Ethical approval was obtained from The Oyo State Ethical Review Board prior commencement of the research. All participants provided informed consent, and confidentiality was strictly maintained throughout the research process.

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The authors received no specific funding for this work.

## Data Availability

The authors confirm that the raw data supporting the findings are available from the corresponding author upon request.

## Author Contributions

- **Adediran A.O.:** Conceptualization, methodology, data analysis, manuscript drafting, final approval
- **Prof. Olaiya Abiodun:** Technical guidance, conceptual oversight, editing, and academic supervision
- **District and Facility Contributors:** Field data collection, validation, and logistics support

All authors reviewed and approved the final manuscript.

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# Factors Associated to the Resurgence of Ebola Virus Disease within the Population in Beni Health Zone 2025

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***Abstract***

*The second largest Ebola outbreak recorded worldwide was reported on August 1, 2018, and declared over on June 25, 2020. A total of 3470 cases were reported, including 3317 confirmed and 153 probable cases. There were 2287 deaths, including 2134 among confirmed cases and 153 among probable cases. The epidemic lasted two years, and the ongoing conflict made its management particularly challenging. Despite progress, the epidemic continues to resurface in neighboring countries, provinces, and health zones within the Beni Health Zone. Our study is descriptive and correlational, with a quantitative approach, as we described the relationship between household knowledge, attitudes, and practices regarding Ebola. Investigators, under close supervision, collected data through direct interviews for the quantitative data, based on a questionnaire administered to households. The results of the analysis confirm that the factors associated with the resurgence of Ebola virus disease (EVD) in the population of Beni Health Zone are linked to the following sociodemographic factors: the respondent's sex : OR: 6.367 [1.664; 24.364] and (p=0.007<0.05); OR: 2.770 [1.190; 6.448]; and the level of education: OR: 3.798 [1.597; 54.902] and (p=0.013<0.05). The application of best prevention practices will help prevent the resurgence of EVD in Beni Health Zone.*

***Keywords:*** *Associated, Beni, EVD, Factors, Population, Resurgence.*

## Introduction

The Ebola Virus Disease (EVD) first appeared in 1976, during two simultaneous outbreaks in Nzara (now South Sudan) and Yambuku (Democratic Republic of Congo). Yambuku is located near the Ebola River, which gave the disease its name. The Filoviridae virus family has three genera: Cuevavirus, Marburgvirus, and Ebolavirus. Six species have been identified within Ebolavirus: Zaire, Bundibugyo, Sudan, Reston, Tai Forest, and Bombali. The average case fatality rate for this disease is approximately 50%. In previous outbreaks, case fatality rates have ranged from 25% to 90% depending on the circumstances and response [1].

The 2014 - 2016 outbreak in West Africa was the largest since the virus was discovered. It was the thirteenth Ebola Virus Disease outbreak since its discovery. There were more cases and deaths in this outbreak than in all others combined. The outbreak rapidly spread from Guinea to neighboring Sierra Leone and Liberia. In July 2014, it had reached the capital

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cities of these three countries, and in August 2014, the World Health Organization (WHO) declared the outbreak a Public Health Emergency of International Concern (PHEIC). During the outbreak, the disease spread to seven other countries: Italy, Mali, Nigeria, Senegal, Spain, the United Kingdom (UK), and the United States (US). Secondary infections occurred in Italy, Mali, Nigeria, and the United States. In June 2016, the epidemic was declared over. More than 28600 people were infected and 11325 people died [2].

The provinces of North Kivu and Ituri are facing the tenth episode of the Ebola virus since 2018, which has already caused more than 2280 deaths. Most of the people infected and who died from this virus were so because of the denial of the existence of the disease and the failure to comply with protective measures. However, it should be noted that compliance with and application of protective measures against this disease largely depend on the trust and, above all, the population's perception of the disease, the response system, and especially the care quality they received [3].

The second largest Ebola outbreak ever recorded worldwide was reported on August 1st, 2018 and declared over in June 25, 2020. A total of 3470 cases, including 3317 confirmed cases and 153 probable cases, were reported. There were 2287 deaths, including 2134 confirmed cases and 153 probable cases. The outbreak, which lasted nearly two years, was particularly challenging to manage due to its unfolding in an active conflict zone [4].

The response was hampered in the Beni Health Zone by community tensions, attacks on vehicles, and even the killing of some response personnel. The factors fueling this social resistance included a crisis of confidence in the quality of care in treatment centers (ETCs), a lack of trust in the response team and contempt for expatriates, who according to local residents came to profit from the epidemic and finally, the more economic dimension of response [5].

Another epidemic struck the DRC in 2019 (North Kivu), causing more than 2000 deaths. In 2021, several cases were again detected in the Nzérékoré region, in southeastern Guinea and the DRC, in North Kivu, in the Beni Health Zone [6].

Furthermore, the daily practices of the population can constitute a risk, among other things, burial ceremonies involving direct contact with the body of the deceased can also contribute to the transmission of Ebola [7].

A particular category of the population vulnerable to Ebola virus disease (EVD) infection consists of healthcare professionals during an outbreak; they are in contact with patients, their families, or others in close contact with them [8].

The activities related to bushmeat consumption are very likely a significant factor in the occurrence of an EBOV spillover event [9].

Regardless of the progress made in prevention and treatment in the Democratic Republic of Congo in general and in North Kivu Province in particular, the epidemic has continued to resurge in the neighboring country, in the provinces and Health Zones adjacent to the Beni Health Zone ; this poses a real threat ; however, the fight against Ebola Virus Disease must continue to prevent a new epidemic in the region.

The symptoms appear 2 to 21 days after exposure to the virus, with an average of 10 days. The main symptoms of Ebola virus disease are:

1. Fever greater than 38.6°C or 101.5°F.
2. Severe headache.
3. Muscle pain.
4. Weakness.
5. Vomiting.
6. Diarrhea.
7. Abdominal pain.
8. Unexplained bleeding or bruising [10].

The protection against Ebola Virus Disease can be achieved by : (i) washing hands ; (ii) avoiding touching the body fluids of a person who has or may have Ebola virus disease ; (ii)

avoiding contact with the body of a person who has died from Ebola ; and (iv) by getting vaccinated against Ebola if you are at risk of contracting Zaire Ebolavirus.

The Ervebo vaccine has been shown to be effective in protecting against Zaire Ebolavirus and is recommended by the Strategic Advisory Group of Experts (SAGE) on vaccination as part of a broader package of Ebola outbreak response interventions [1] (Figure 1).

Based on the above findings, the following questions should be asked:

1. What factors are associated within the resurgence of Ebola Virus Disease in the population of Beni Health Zone?
2. What are the best predictors of the resurgence of Ebola Virus Disease in the population of Beni Health Zone?
3. Do sociodemographic characteristics (religious denomination, profession, level of education, age, socio-economic level) significantly influence the resurgence of Ebola Virus Disease within the population in Beni Health Zone?

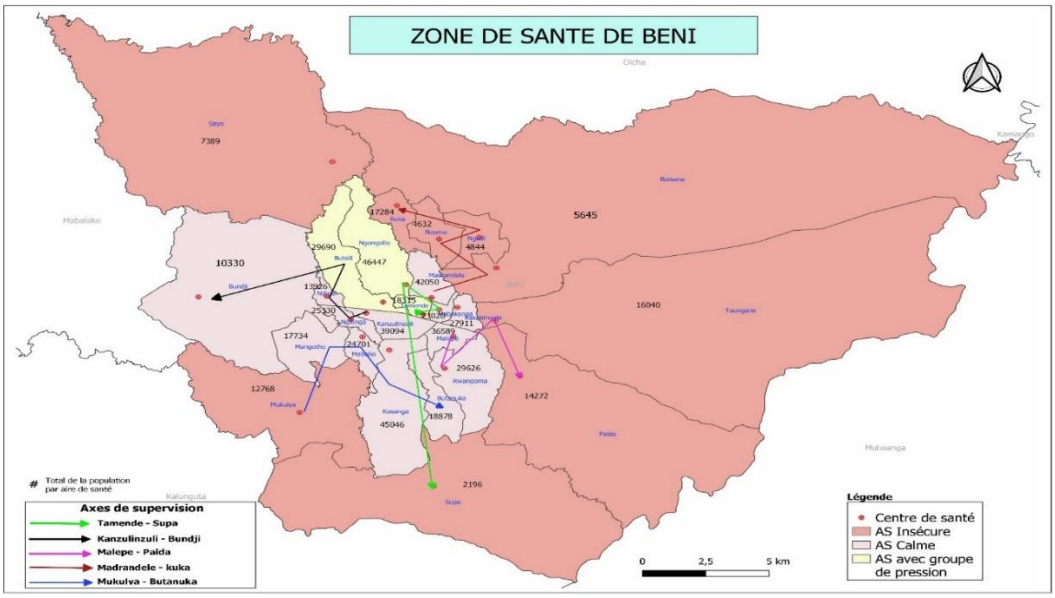


**Figure 1.** Map of the Beni health Zone

*ZONE DE SANTE DE BENI = BENI HEALTH ZONE*

The Beni Health Zone has a population of 549770 inhabitants and is bordered to the east by the Mutwanga Health Zone via the Semuliki River, to the west by the Mabalako Health Zone at Kasitu, to the north by the Oicha Health Zone, and to the south by the Kalunguta Health Zone via the Tabi River [11].

## Hypothesis

1. There is a significant relationship between household knowledge, attitudes, and practices regarding Ebola Virus Disease risks and prevention.
2. Among these factors, there are those that are the best predictors of Ebola Virus Disease resurgence within the population in the Beni Health Zone.
3. There is a significant relationship between sociodemographic characteristics such as age, gender, education level, religious denomination, and occupation and Ebola Virus Disease resurgence in Beni Health Zone.

## Objectives

### General Objective

The general objective of the research is to study the factors associated with the resurgence of Ebola Virus Disease among the population in the Beni Health Zone, by making proposals on

possible solutions relating to the context of the zone.

### Specific Objectives

The specific objectives of our study are as follows:

1. Identify factors associated to the resurgence of Ebola Virus Disease within the population in Beni Health Zone.
2. Describe the predictors of the resurgence of Ebola Virus Disease within the population in Beni Health Zone based on household practices regarding the risks and prevention of this disease.
3. Establish the link between sociodemographic characteristics such as age, sex, education level, religious denomination, and occupation and the resurgence of Ebola Virus Disease in Beni Health Zone.

## Choice and Significance of the Subject

### Scientific Significance

This study will serve as a resource for scientific professionals in the field of Public Health.

### Community Significance

The knowledge, attitudes, and practices regarding Ebola Virus Disease prevention within the population in Beni Health Zone will help reduce the risks of epidemic.

### Scope of Work

Our investigation is part of a study on the factors associated with the resurgence of Ebola Virus Disease within the population in the Beni Health Zone and was conducted among households living in Beni Health Zone, in 2025 year.

# Materials and Methods

## Materials

The materials used for this study are household managers living in the Beni Health Zone, in the town of the same name, the consultation register of Beni Health Zone facilities, data from the Central Office of the Beni Health Zone, pen, paper, and a computer. He data collection was done using Kobo software and processing was done using Epi Info software.

## Types of study

This study is descriptive correlational because we described the relationship between households knowledge, attitudes, and practices regarding the resurgence of Ebola Virus Disease (EVD).

## Study Population

The population is a set of elements (the individual, objects, value) subjected to a statistical study [12]. Population: all the people who inhabit a space, a land [13].

In relation to our research, study population was consisted with household managers in the selected health areas in Beni Health Zone.

## Sampling

The sampling is the process of selecting a group of individuals to be interviewed as part of a study and which symbolizes a reference population; method and process of sample selection [14].

Sample: subset of the population that represents all people you will study. To find sample, we have used the Shwartz formula, starting from an infinite population, which predicts

$$n = t^2 \frac{pq}{d^2}$$

n = sample size.

t = value associated with a 5% risk of error.

p = prevalence of Ebola Virus Disease, estimated at 27.1% [15].

q = 1- p, i.e., the proportion of Ebola Virus Disease patients who tested positive.

d = desired precision, which is equal to 5%.

So, $n = 1{,}96^2 \frac{0{,}27(1-0{,}27)}{(0{,}05)^2} = 303$

To overcome the cost risk that might arise during the survey, as suggested, we reduced the sample size to 33.33% of 303 households to bring the sample down to 100 households [16], given the population of Health Areas in Beni Health Zone, in 2025 being 549770 inhabitants [17].

### Survey Technique

The Data were collected through face-to-face interviews for quantitative data based on a questionnaire administered to households, and investigators were be supervised to ensure the study is conducted properly.

### Ethical Considerations

The ethical aspect was taken into account during this study, which received approval from Texila American University, the Catholic University of Graben (UCG) under No: PTH.02/25/UCG/CERM and authorization from the Central Office of the Beni Health Zone [18]. The informed consent was sought from study participants [19]. When the questionnaire was administered to a participant, this one had the right to withdraw any time. The provisions were made to ensure the information confidentiality provided by the respondents. Personal data that could identify the respondent were not collected.

## Results

### Descriptive Analysis

#### Socio-Economic Characteristics

From this table 1, the study shows that there were more women, or 69%, compared to men, or 31%.

From Table 2, the results of the study reveal that the 25-34 age group is the most affected, with a proportion of 50% (Table 2).

Table 3 shows that the secondary education level was more affected with a percentage of 60% than other education levels.

**Table 1.** Distribution of Respondents by Gender

| Gender | Number | Percentage (%) | Cumulative percentage (%) |
|---|---|---|---|
| Male | 31 | 31.0 | 31.0 |
| Female | 69 | 69.0 | 100.0 |
| Total | 100 | 100.0 | |

**Table 2.** Distribution of Respondents by Completed Age

| Age group | Number | Percentage (%) | Cumulative percentage (%) |
|---|---|---|---|
| 18 to 24 years old | 20 | 20.0 | 20.0 |
| 25 to 34 years old | 50 | 50.0 | 70.0 |
| 35 to 44 years old | 25 | 25.0 | 95.0 |
| 45 to 54 years old | 2 | 2.0 | 97.0 |
| 55 to 64 years old | 3 | 3.0 | 100.0 |
| Total | 100 | 100.0 | |

**Table 3.** Distribution of Respondents by Level of Education

| Level of study | Number | Percentage (%) | Cumulative percentage (%) |
|---|---|---|---|
| None | 1 | 1.0 | 1.0 |
| Primary | 19 | 19.0 | 20.0 |
| Secondary | 60 | 60.0 | 80.0 |

| | | | |
|---|---|---|---|
| Higher or university | 20 | 20.0 | 100.0 |
| **Total** | **100** | **100.0** | |

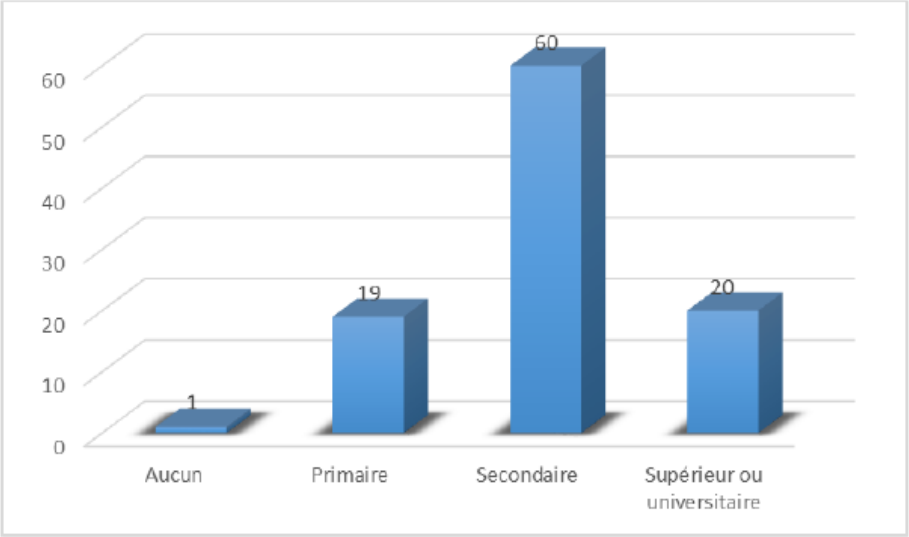


**Figure 2.** Distribution of Respondents by Level of Education Graphic

*Aucun = None ; Primaire = Primary ; Secondaire = Secondary ; Supérieur ou Universitaire = Higher or university*.

The present graphic shows that the secondary education level was more affected with a percentage of 60% than other education levels (Figure 2).

### Socio-Economic Factors

**Table 4.** Distribution of Respondents According to their Profession

| | **Number** | **Percentage (%)** | **Cumulative percentage (%)** |
|---|---|---|---|
| Unemployed | 21 | 21.0 | 21.0 |
| Public sector employee | 15 | 15.0 | 36.0 |
| Private sector employee | 40 | 40.0 | 76.0 |
| Farmer | 23 | 23,0 | 99.0 |
| Other (Please specify) | 1 | 1/0 | 100.0 |
| **Total** | **100** | **100.0** | |

From this table 4, we see that 40% of those surveyed were private sector employees and 23% are farmers.

This table 5 reveals that the households surveyed consisted of 96% of 0 to 4 people.

**Table 5.** Distribution of Respondents According to the Number of People in the Household

| | **Number** | **Percentage (%)** | **Cumulative percentage (%)** |
|---|---|---|---|
| 0 to 4 people | 96 | 96.0 | 96.0 |
| 5 and more | 4 | 4.0 | 100.0 |
| **Total** | **100** | **100.0** | |

## Inferential Analysis

### Factors Promoting Knowledge of Ebola Virus Disease

**Table 6.** Knowledge of Ebola Virus Disease

| Variables in the Equation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | E.S. | Forest/ Wald | ddl | Sig. | Exp (B) | CI for Exp (B) 95% | |
| | | | | | | | | Lower | Superior |
| Step 1[a] | Gender of the respondent | 28,488 | 5442,210 | ,000 | 1 | ,996 | 0.720 | 0.000 | |
| | Level of study of the respondent | -14,526 | 2283,040 | ,000 | 1 | ,995 | ,000 | 0,000 | |
| | Profession of the respondent | ,383 | 2,065 | ,034 | 1 | ,853 | 1.466 | ,026 | 83,873 |
| | Age group | -28,982 | 3422,841 | ,000 | 1 | ,993 | ,000 | 0,000 | |
| | Constant | 12,154 | 11179,196 | ,000 | 1 | ,999 | 189825,532 | | |

The multivariate logistic regression analysis table above specifies that variables gender of respondent, level of education, profession of respondent and age are not significant at the 95% confidence interval. The probabilities are respectively: OR: 0.72 [0.000; 0.8] and (p: 0.996); OR: 0.000 [0.000; 0.000] and (p: 0.995); OR: 1.466 [0.026; 83.873] and (p: 0.853); OR: 0.000 [0.000; 0.000] and (p: 0.993) [Table 6].

**Table 7.** Recovery from Ebola Virus Disease

| Variables in the Equation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | E.S. | Forest/ Wald | ddl | Sig. | Exp (B) | CI for Exp (B) 95% | |
| | | | | | | | | Lower | Superior |
| Step 1[a] | Gender | 1.334 | 1.159 | 1.325 | 1 | ,250 | 3.798 | ,391 | 36.847 |
| | Level of study | 2.237 | ,902 | 6.143 | 1 | ,013 | 9.363 | 1.597 | 54.902 |
| | Profession of the respondent | -,545 | ,455 | 1.431 | 1 | ,232 | ,580 | ,238 | 1.416 |
| | Age group | -,199 | ,581 | ,117 | 1 | ,732 | ,820 | ,262 | 2.561 |
| | Constant | -10.557 | 4.066 | 6.740 | 1 | ,009 | ,000 | | |

From this table 7, it appears that only the level of study variable remained significant at the 95% confidence interval. OR: 3.798 [1.597; 54.902] and ($p = 0.013 < 0.05$). Hence the level of study is a related factor that can explain the phenomenon studied.

**Table 8.** Transmission of Ebola Virus Disease by a Cured Person

| Variables in the Equation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | E.S. | Forest/ Wald | ddl | Sig. | Exp(B) | CI for Exp (B) 95% | |
| | | | | | | | | Lower | Superior |
| Step 1[a] | Gender of the respondent | 1.851 | ,685 | 7.309 | 1 | ,007 | 6.367 | 1.664 | 24.364 |
| | Level of study | 1,019 | ,431 | 5.589 | 1 | ,018 | 2,770 | 1.190 | 6.448 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Profession of the respondent | ,073 | ,225 | ,104 | 1 | ,747 | 1.076 | ,692 | 1.673 |
| | Age group | ,226 | ,270 | ,703 | 1 | ,402 | 1.254 | ,739 | 2.129 |
| | Constant | -7,965 | 2.200 | 13.110 | 1 | ,000 | ,000 | | |

The result of this table 8 shows that the sex of the respondent and the level of education remained significant at the 95% confidence interval. Their probabilities are respectively: OR: 6.367 [1.664; 24.364] and ($p = 0.007 < 0.05$); OR: 2.770 [1.190; 6.448]. These variables explain the factors favoring the resurgence of EVD in Beni Health Zone.

**Factors Related to Attitudes toward Ebola Virus Disease**

**Table 9.** Attitude toward a Suspected Case of Ebola Virus Disease

| Variables in the Equation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | E.S. | Forest/ Wald | ddl | Sig. | Exp (B) | CI for Exp (B) 95% | |
| | | | | | | | | Lower | Superior |
| Step 1[a] | Gender of the respondent | ,117 | ,462 | ,064 | 1 | ,800 | 1.124 | ,454 | 2.780 |
| | Level of study | ,204 | ,333 | ,374 | 1 | ,541 | 1.226 | ,638 | 2.356 |
| | Profession of the respondent | ,069 | ,200 | ,117 | 1 | ,732 | 1.071 | ,723 | 1.586 |
| | Age group | ,185 | ,260 | ,507 | 1 | ,477 | 1.203 | ,723 | 2.004 |
| | Constant | -,677 | 1.428 | ,225 | 1 | ,635 | ,508 | | |

In view of this table 9, it appears that the sex of respondent, the level of education, profession and class did not remain significant at the 95% confidence interval based by their probabilities as presented in this table. These variables are not factors that can explain attitude as factor favoring resurgence of Ebola Virus Disease.

## Factors Related at the Prevention and Practice

**Table 10.** Contact with a Suspected Ebola Virus Disease Case

| Variables in the Equation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | E.S. | Forest/ Wald | ddl | Sig. | Exp (B) | CI for Exp (B) 95% | |
| | | | | | | | | Lower | Superior |
| Step 1[a] | Gender of the respondent | 1.303 | ,547 | 5.681 | 1 | ,017 | 3.681 | 1.261 | 10.747 |
| | Level of study | -,226 | ,410 | ,304 | 1 | ,581 | ,798 | ,357 | 1.781 |
| | Profession of the respondent | ,112 | ,265 | ,177 | 1 | ,674 | 1.118 | ,665 | 1.880 |
| | Age group | ,355 | ,363 | ,956 | 1 | ,328 | 1.426 | ,700 | 2.905 |
| | Constant | -,919 | 1.726 | ,283 | 1 | ,594 | ,399 | | |

From this multivariate analysis table 10 by logistic regression above, only the variable Sex of the respondent which remained significant at the 95% confidence interval, OR: 3.681[1.261; 10.747] and ($p=0.17<0.05$). This variable is an explanatory factor of prevention and practice.

**Table 11.** Receipt of EVD Vaccine

| Variables in the Equation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | E.S. | Forest/ Wald | ddl | Sig. | Exp (B) | CI for Exp (B) 95% | |
| | | | | | | | | Lower | |
| Step 1[a] | Gender of the respondent | ,568 | ,466 | 1.484 | 1 | ,223 | 1.765 | ,708 | 4.403 |
| | Level of study | -,117 | ,343 | ,117 | 1 | ,733 | ,889 | ,454 | 1.743 |
| | Profession of the respondent | -,020 | ,211 | ,009 | 1 | ,926 | ,981 | ,648 | 1.484 |
| | Age group | ,339 | ,281 | 1.454 | 1 | ,228 | 1.403 | ,809 | 2.433 |
| | Constant | -,413 | 1.474 | ,079 | 1 | ,779 | ,661 | | |

The result of this table 11 shows that the sex of the respondent, the level of education, profession and class did not remain significant at the 95% confidence interval based on their probabilities as presented in this table. These variables are not factors that can explain the prevention and practice based on the vaccine against Ebola Virus Disease.

## Discussion

The results of this study show that knowledge of respondents regarding transmission modes are not good, where 70% responded negatively regarding the Ebola Virus Disease transmission by a cured person (Table N° 8); the sex of the respondent and the level of education remained significant at the 95% confidence interval. Their probabilities are respectively: OR: 6.367 [1.664; 24.364] and ($p = 0.007 < 0.05$); OR: 2.770 [1.190; 6.448] (Table 8). The same is true for the cure of Ebola Virus Disease; the research results prove that there is a significant link at the 95% confidence interval. OR: 3.798 [1.597; 54.902] and ($p = 0.013 < 0.05$) [Table 7]. This is similar to the study of the resurgence of Ebola Virus Disease in the Nzérékoré region [20]. This also aligns with the WHO statement on the Ebola outbreak declared in Guinea [21].

Regarding Ebola Virus Disease prevention and practice, only the respondent's sex variable remained significant at the 95% confidence interval, OR: 3.681 [1.261; 10.747] and ($p=0.17<0.05$) [Table 10]; this variable is an explanatory factor for prevention and practice. This is consistent with the study on women's perceptions of This table reveals that the households surveyed consisted of 96% of 0 to 4 people. risks and involvement in the Ebola Response [22]. The same applies to Emergency Preparedness and Response. Ebola Virus Disease, Democratic Republic of Congo [23].

## Conclusion

The general objective of this research is to study the factors associated with the resurgence of Ebola Virus Disease within the population in Beni Health Zone, by making proposals on possible solutions relating to the context of the Zone. In this aforementioned Health Zone in Democratic Republic of Congo, a link was observed between the knowledge, attitude and practice of households on the risks and prevention of Ebola Virus Disease in the one hand, and sociodemographic characteristics such as age, sex, level of education and the resurgence of Ebola Virus Disease in the other. A good knowledge of the factors associated with the resurgence of Ebola Virus Disease will significantly improve this practice for the well-being of the population.

## Conflicts of Interest

This study was not used in any way by any person or company for private purposes to influence the results of the research.

## Ethical Approval

The letter and a copy of the research protocol were submitted to the ethics committee of the Catholic University of Graben for analysis of the ethical aspects of the research project in order to obtain authorization. Political, administrative, and health authorities were contacted to obtain their approval.

## Data Availability

The data will be available in the Texila International Journal of Public Health, https://www.texilajournal.com/.

## Author Contributions

We contributed to conduct research that studied the factors associated with the resurgence of Ebola Virus Disease in the population in the Beni Health Zone.

## Funding

The funding for this study is individual, without a sponsor; however, we acknowledge the support of some family members and friends who have supported us in one way or another.

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# An Evaluation of the Challenges Faced by Women in Attaining Strategic Management Positions

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***Abstract***

*This study investigates the challenges women face in reaching strategic management roles within the tech industry, focusing on perceptions from Eswatini Government Enterprises, higher learning institutions, and corporate leaders. The research employs a mixed-methods approach, combining qualitative and quantitative data to provide a comprehensive analysis of organizational, individual, cultural, and empowerment challenges. It utilizes qualitative methods for deeper insights and quantitative methods for broader data representation. Online surveys assessed female leaders' perspectives. Data was gathered from both secondary sources and primary sources through semi-structured interviews and questionnaires. A total of 40 female participants were randomly selected to ensure diverse perspectives. The research revealed that while women possess the potential for executive roles, societal stereotypes and the balancing act of reproductive and professional responsibilities hinder their progress. Female managers tend to adopt transformational leadership styles, emphasizing the need for supportive organizational structures to facilitate their growth. It is recommended that women must overcome fears of failure and seek support through female networks to bolster confidence in leadership roles; Company Leadership, shift management practices to foster inclusivity and self-esteem among diverse employee groups; Policy Makers, revise female empowerment frameworks and establish forums for women to share experiences and successes; and Future Research, explore the evolving challenges faced by women in tech management to promote greater inclusion. Promoting gender diversity in the tech industry is crucial for innovation and progress. An inclusive environment allows diverse perspectives to thrive, ultimately benefiting the entire sector.*

***Keywords:*** *Challenges, Diversity, Gender, Leadership, Technology, Women.*

## Introduction

Globally, regardless of the wonderful age of women which was ushered in by the 1995, Beijing, China 4th World conference on women [1], it has been observed that worldwide representation of women is challenging, it signifies that women are underrepresented at almost all levels of decision making globally, countries do not effectively involve females in their government systems [2], women continue to be disadvantaged. Yet feminine gender comprises half of the ecosphere's populace with rise in birthing ratio of female gender recorded on each day. Hence, this occurs even when they are extremely qualified and despite the reaffirmation that women rights were human rights and that gender quality was an issue of universal concern, benefiting all [1]. Therefore, women remain discriminated, in terms of accessing top strategic management positions.

Several women remain suffering from professional segregation in the workplace and hardly break through the glass-ceiling in public life which separates them from strategic management and proficient positions. The

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challenges faced by the few who advocate for transformation or push for progress to occupy top leadership/ management positions can be various and complex, as it strengthens prevailing stereotypes of women's capacity to perform at the strategic level of public life and hence, prolongs a vicious cycle of sidelining and disempowerment of women.

Throughout history the key role that a female play in the world has contributed to advancement, ensured stability, and long-lasting growth of communities and countries. Females' involvement in politics, management, governance public or political spheres of life, and technical leadership positions is crucial to attaining reasonable society and sustainable development [2]. Nonetheless, despite those facts and the escalating number of qualified and trained females, it is vivid that they are still underrepresented in almost all levels of decision making in all sectors. According to research conducted by [3], in 2018, females filled 16% of positions on the executive teams of significant Belgian firms, better than thirteen years ago, when the record was around 9 and 10%. The figures are still far below average compared to the entire employment rate of females and their share of populace. Furthermore, despite the current interest for diversity in organizations and legislation for equal chances for males and females the figures have not changed much, women continue mostly in the minority in decision making positions [3].

The drive towards equal chances and encouragement for female has been filled with several confronts, especially in achieving strategic management position within several sectors that impede their progress. These encounters are complex, comprising general norms, business arrangements, and organized biases that endured overtime. For example, ethnic stereotypes usually determine insights of leadership, assigning personalities considered more fitting for males, while females who demonstrates similar behaviors may face hostile response. Furthermore, the absence of mentors and role models further worsens the problem [4, 5].

Moreover, work-life balance continues being a serious challenge for any female, specifically those with caregiving obligations. The anticipation to execute conventional gender functions can lead to contradictory gender pressures, making it hard for females to pursue and sustain professions in management. As institutions gradually understand the value of diverse perceptions, it is fundamental to address these issues aggressively and establish an atmosphere that not only acknowledge but dynamically promote female's rise into strategic management positions. This introduction sets the stage for a hidden evaluation of the difficulties around females' leadership and the essential steps required to adopt an inclusive culture that champions women representation in strategic leadership positions [6].

Many of the questions about women's leadership positions have repeatedly risen in numerous studies. However, there is a little information on the challenges women face in attaining leadership or strategic positions in the technology industry.

Leadership is the capacity of an individual or team of individuals to influence and steer followers or adherents of an entity, institute or a group. Leadership is a characteristic impacted to an individual's position, rank or standing in an organogram. However, it is an aspect anyone can have or achieve, even those lacking leadership positions. It is a developable ability that can be enhanced over time [7].

Leaders are perceived as individuals who effect sound and occasionally tough decisions. They articulate clear vision, determine realistic goals and provide adherents with knowledge and instruments crucial to realize those goals. According to [8], an effective leader has the following characteristics: self-awareness, strong communication skills, integrity, creative and innovative thinking, empathy, willingness

to take risks, leadership agility i.e. open to change, ability to influence others, resilience, visionary and reactiveness in times of crisis i.e. good decision maker.

Leadership plays a pivotal function in the success and guidance of an enterprise. According to [9], companies depend on positive leaders to converse its mission, vision, and goals, unite team members over those objectives and then realize them. These skills are particularly crucial in times of crisis. An establishment with robust leadership can often traverse challenges and grab opportunities in ways that may be more demanding for an enterprise missing effective guidance [10].

Tough decision-making is often required for the realization and development of an enterprise. It is essential for leaders to have emotional intelligence. [11], describes emotional intelligence as "the ability to comprehend and control your emotions, as well as understand and influence the emotions of those surrounding you."

At the core of every thriving enterprise is a visionary leader who sets the trend, manages resources effectively, and creates the institutional culture. They make key decisions about the prospect of the establishment, push it ahead to realize its objectives, and retain an atmosphere that encourages the workforce to bring their best to work.

The subsequent are some of the numerous leadership theories.

## Situational Leadership

Situational leadership theory indicates that the utmost leaders continually adapt by implementing diverse techniques for different conditions or effects. This theory reveals a relatively advanced view of leadership in practice and can be an effective framework of reference for knowledgeable, expert leaders who are earnestly alert of institution requirements and individual motivation. Most significantly, it permits expert leaders the independence to decide from a selection of leadership iterations. Difficulties develop, however, when the incorrect technique is applied awkwardly. Situational leadership, nonetheless, is most effective when leaders decide two or more effective approaches like charismatic, transactional and transformational [12]. Figure 1 is a prototype of the Situational Leadership.

According to [13], there are four leadership styles of the situational leadership model:

1. **Telling (Directing):** Used when the players require close guidance. Most ideal for processes in a business and for beginner level. It’s a temporary method envisioned to create movement.
2. **Selling (Couching):** This model is utilized when the followers are not motivated to perform tasks. The frontrunner supplies the background and perspective and engages with the team to strengthen buy-in and continued advancement.
3. **Participating (Collaborating):** This model is used when the participants/ followers are knowledgeable in particular roles but do not have commitment or conviction required to complete them. Therefore, the participants make decisions based on their principals backing to inculcate and improve task understanding.
4. **Delegating (Empowering):** Used when the participants are efficient and effective at their roles and responsibilities and needs minimal supervision. The participants are entrusted to make task-related decisions and propose approaches for advancement and identify best practices.

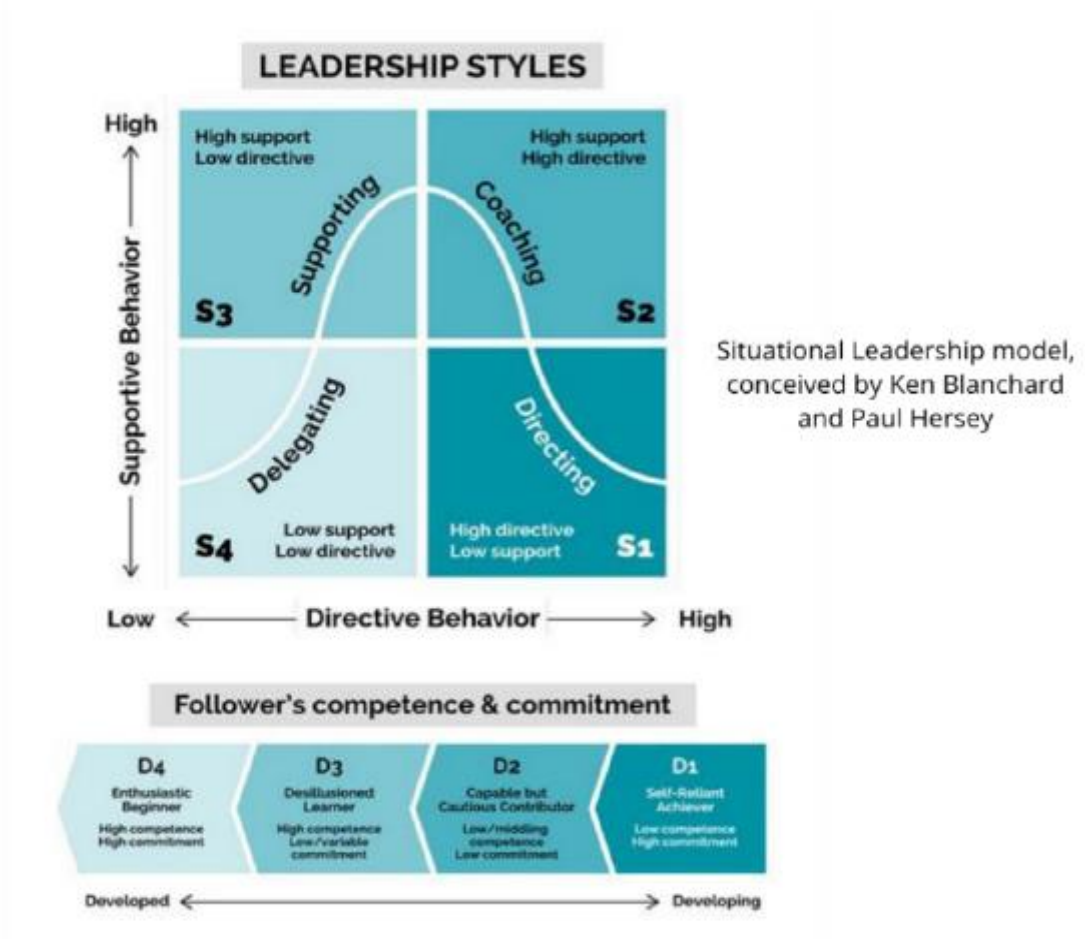


**Figure 1.** Situational Leadership Style [14]

Situational leadership reveals four major, universal and essential leadership competencies: [15]

1. Communicate an impact methodology in a manner that cohorts can both comprehend and accept.
2. Analyze a person's Performance Readiness to fulfill a given job.
3. Adapt frontrunner conduct based on the analysis.
4. Improve by managing the progress towards better performance.

## Charismatic Leadership

Charismatics are significantly the most effective leadership style. Charismatic leaders have a vision, as well as traits that influence adherents to execute their vision, as they are presented on Figure 2. Hence, this leadership style has conventionally been one of the most respected. Charismatic leadership offers a fertile ground for creativeness and invention and is often substantially motivational. If there are charismatic leaders at the wheel of the institution, employees simply desire to conform. There is nonetheless, one noteworthy challenge that potentially undermines the value of charismatic leaders is that they can disappear. Once they have left, an establishment can appear purposeless and directionless. Therefore, charismatic leadership usually rejects other competing, strong qualities. The outcome of weeding out the contest is a legion of cheerful adherents, but minimal leaders [16].




**Figure 2.** Charismatic Leadership [17]

According to [17], the key characteristics of Charismatic Leadership Model are:

1. Charismatic front runners are very poised in their approach. They hardly have any uncertainty about their choices and hold a very significant personality.
2. They have influence over many adherents.
3. They place great expectations and competence and perform as mentors for the workers.
4. They fuel the purposes of the workers and trust in the capacity of the workforce.
5. Based on study conducted by [18], the subsequent are the benefits of charismatic leadership style.
6. Employee views and sentiments are considered.
7. It promotes teamwork and collaboration.
8. It encourages and motivates the players.
9. It generates a sense of definite transformation.

## Transformational Leadership

Transformational Leaders pursue to change those they lead. Consequently, they can characterize sustainable, self-replicating leadership. Transformational leaderships are not satisfied to just use force of personality (charismatic) or bargaining (transactional) to encourage cohorts, transformational leaders utilize knowledge, skill and vision to transform those nearby them in a way that makes them followers with intensely rooted buy-in that stays even when the front-runner that established it is no longer part of the team. Transformational leaders signify the most significant style of leadership since followers are allocated the opportunity to transform, convert, and, in the process, upgrade themselves as participants. Structurally this realizes the valuable leadership effect since transformational leaders grow individuals. Transformational leadership is strongly sought after, since it has no false constrictions in terms of buy-in and instead is determined on getting cohorts on board based upon their individual growing thought process and altering responses to leadership difficulties. It is remarkably suited for self-paced, change loaded conditions that demand creative challenge resolution and consumer responsibility [19].

[20], states that transformational leadership depicts the method whereby a leader engages with his team and establishes a relationship that improves the confidence and motive of both leaders and teams. Hence, as an outcome of this procedure, the leader focuses on the requirements of the team, which aid them to reach their maximum potential. Figure 3 is a model of the transformational leadership.



**Figure 3.** Transformational Leadership [17]

According to [21], there are four foundations in the transformational styles, transformational factors (intellectual stimulation, inspirational motivation, individualized consideration, and idealized influence).

1. **Intellectual Stimulation:** Promote invention and artistic effort. They urge their followers to examine assumptions and test the way that things are performed. They foster novel ideas and innovative solutions to challenges, and they assist their follower's study from their mistakes and failures rather than condemning them.
2. **Individual Consideration:** Pay attention to the requirements of each specific player. They appreciate everyone's needs for accomplishment, and they act as an instructor and advisor to assist them learn and develop. They create formidable interpersonal connections and show empathy and consideration for their cohorts.
3. **Inspirational Motivation:** Present value and challenge to their follower's purpose. They assist the cohorts to comprehend the reason their jobs are imperative and provide them with encouraging and challenging vision of the future that they choose to labor towards.
4. **Idealized Influence:** Behave like a mentor to the team members. They build rapport and cultivate respect by exercising what they preach, acting altruistically and basically setting the standard.

## Autocratic Leadership

Autocratic leaders are elegant "do as I say" style. Figure 4 models exactly the autocratic leadership. In general, these leaders are unacquainted with leadership thrust upon them in the form of a new appointment or assignment that concerns human resource management. Autocratic leaders can harm an institution irreparably as they compel their followers to effect strategies and operations in a very narrow way centered upon a biased idea of what success looks like. Devotion, innovation and invention are naturally disregarded by autocratic leadership [22].

According to [17] autocratic leaders:

1. Works effective when quick ruling must to be made.
2. Can assist to control a conflict in the short-term. Nonetheless, it does not resolve the problem.
3. There arises a massive lack of confidence in this leadership model on the subordinates. This is because the authority to make all the conclusions remains in the hands of the trailblazer.



**Figure 4.** Autocratic Leadership [17]

The benefits and disadvantages of this model according to [17] are:

**Benefits**

1. Front runners have a structured goal setting.
2. They go mainly by the rule book.
3. Extremely organized environment.
4. Great for the fast cognitive process of drawing conclusions.
5. It assists in challenging circumstances.

**Disadvantages**

1. It limits innovation and novelty.
2. It can lead to dejection within the squad.
3. Not appropriate for institutions having collaborative values.
4. It can have deficiency of professional relationships and influences.
5. Leaders can lack flexibility characters.

**Problem to be Solved**

According to study conducted by [23], World Economic Forum Report 2024 states that women's labor force representation remains below men's across nearly every trade and economy, with women accounting for 42% of the international labor force and fill only 31.7% of top decision-making positions. Top-level positions continue narrowly available for women, worldwide. This is demonstrated by the international "drop to the top": in 2024, the slope from entry level to the C-suite and senior leadership is steeped in a 21.5 percentage-point difference in representation. Although women are confirmed to filling virtually half of entry-level spots, they fall short of representing just a quarter of chief executive positions. In the past World Economic Forum Reports, it presented as a promising trend, unfortunately women's appointments into strategic management positions started to decline, from 37.5% to 36.9% in 2023, and continued lessening in early 2024 to 36.4%, below 2021 levels. According to LinkedIn research study conducted by [24] states that the deteriorating macro-economic situations are connected to a reduction in appointing females into strategic management positions.

The technology industry is identical with invention /innovation, continually pushing the limits of any possibilities. It is widely known as a men dominated industry, thus significantly falling behind in gender diversity. Females in leadership positions in the technology industry are rare. Recent report published by Deloitte Insights states that only a quarter of females' workforce are occupying the tech industry [25]. This inequality is more evident in strategic management positions, where according to [26], women held only 41% C-Suite and 37% Board of Directors positions in the United States Technology Start-Ups.

The aim of the study is to explore the challenges women face in attaining strategic management positions in the technology industry. Several approaches should be employed to fight the challenge. An action, legislative or otherwise must be taken; technology organizations must implement strategies to investigate and evaluate the challenges that are affecting females' prospects in the tech industry.

### Limitations

The major limitation of this research is the sample size. This was because of the period of study, only a few individuals agreed to participate in the study. Since the study is based on few individuals from the state-owned enterprises, private institutions and high education institution, users of the services provided plus the civic organizations, is does not fully represent the women sector in IT industry. Furthermore, the study was only conducted with only the people of Eswatini.

### Objective

This study investigates the challenges that women face in attaining strategic management positions in the technology industry. This will be made possible by conducting qualitative study to deliver a complete summary of the hurdles to women's contribution in technology and promising practices for tackling these challenges, it will address policy intervention; strategies to enhance female leaders' leadership and competencies. It will also serve as a reference and resource for researchers, policy makers and other stakeholders who wish to promote awareness, and advocate for transformation.

### Specific Objectives

1. To identify the challenges women, face in attaining Strategic Management Positions in the Technology Industry (organizational, cultural, personal and empowerment challenges).
2. To propose the hurdles that must be conquered by women to access strategic management positions, as well as the significance of a likely female management technique.
3. To propose possible changes and policies aimed at increasing the women's presence in strategic management positions in the technology industry.

## Materials and Methods

Data was generated from both secondary and primary sources. Primary data was gathered openly by employing semi structured interviews to enable probing in the qualitative method. Significant secondary data was obtained from academic journals, internet articles, books, state documents and legislation, research reports and statistics. The research implemented the qualitative research approach to gain individual's insights and depict a situation of the study problem. It was complemented with quantitative methods to research to deliver a complete examination of the study problems, and to afford a snapshot of valuable data from the sample to defend casual explanations for the results. As such this research employed a technique branded as "sequential qualitative first" [27]. Online surveys were applied to assess the stated population.

The research succeeded to sample only 18 leaders' participants who have remained in same respective units for at least a year from the State-owned enterprises, higher institutions and private sector. 7 participants came from Civic Organizations, and 15 female participants who get services from the different SOE's, higher education institutions and private companies in Eswatini. Making the sample research size to be 40 participants. The researcher applied a random sample to choose the participants, in which every participant in the research populace has an equal chance of being elected and gain full appreciation on this study subject [28, 29]. The search criterion was based on

secondary data /papers that were addressing leadership, gender differences, role played by women in leadership position and in technology, approaches women can take to become effective leaders, possible strategies of turning toxic leadership into excellence and the challenges faced by women in attaining strategic management positions in the tech industry, which are relevant to the subject matter, and papers which are less than 10 years and papers with statistics reports. All papers that were older than 10 years and papers based on individual perspective analysis were excluded.

Here I present the analysis of some of the research.

1. The diverse definitions of leadership reflect varying perspectives across different fields, with leadership being described as the ability to influence and guide followers [7]. According to [8], effective leaders possess qualities such as self-awareness, strong communication skills, empathy, and resilience. Leadership is crucial for organizational success, particularly in challenging circumstances, as it helps convey vision, unite teams, and foster positive work environments [9].
2. Leadership significantly influences a company's performance by enabling effective communication of goals and navigating crises [8]. Based on study conducted by [30] and [31],emotional intelligence is essential for leaders to make informed decisions, enhance team dynamics, and drive productivity. Leaders who prioritize self-awareness and empathy can cultivate a culture of accountability and responsibility, promoting ethical decision-making and trust within teams [32].
3. Based on the report compiled by [33], the role of female Leadership yields, economic and organizational benefits, such as improved innovation and employee satisfaction. It also addresses gender inequality.
4. According to [34], the value of women in the tech leadership position increases female representation in leadership roles, hence, help to, drive diversity in the industry; tackle gender bias; and enhance creativity and problem solving.
5. Women face significant challenges, including gender bias and stereotypes, networking & mentorship gaps, and work-life balance issues, organizational culture, representation issues which hinder their advancement into executive positions.
    i. *Gender Bias and Stereotypes:* Women often encounter discrimination and are perceived as less capable in leadership roles [35].
    ii. *Networking and Mentorship Gaps*: Limited access to influential networks restricts opportunities for women to advance [4].
    iii. *Organizational Culture*: Many workplaces lack supportive policies for women, perpetuating hostile environments [36].
    iv. *Representation:* The underrepresentation of women at all levels limits role models and perceptions of leadership accessibility [4].

## Results and Discussions

According to the analysis made from the first research question addressing organizational challenges (Table 1 & Figure 5), it was concluded that the three major organizational challenges regarded as being strongly agree were the “lack of legislation and policies to ensure women participate in decision making” (62.50%, n = 25), “the concentrated authority of making decisions” (50%, n = 20), and “constrained/ limited power granted to female leaders” (42.50%, n = 17).

**Table 1.** Organizational Challenges

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| Lack of Legislation & Policies to ensure women participate in decision making | 62.50% | 20.00% | 2.50% | 10.00% | 5.00% |
| Poor Communication between male and female units in an enterprise | 30.00% | 45.00% | 5.00% | 12.50% | 7.50% |
| Scarcity of Females Leaders in Board meetings and councils at the Strategic Level | 32.50% | 55.00% | 2.50% | 7.50% | 2.50% |
| Concentrated Authority of Making Decisions | 50.00% | 37.50% | 5.00% | 2.50% | 5.00% |
| Constrained /Limited Power granted to female leaders | 42.50% | 37.50% | 5.00% | 12.50% | 2.50% |
| Lack of Equal Opportunity in employing and having female advance to leadership positions | 40.00% | 47.50% | 5.00% | 5.00% | 2.50% |
| Minimal participation of female leaders in the formulation of strategic plans for institutions | 17.50% | 55.00% | 7.50% | 12.50% | 7.50% |

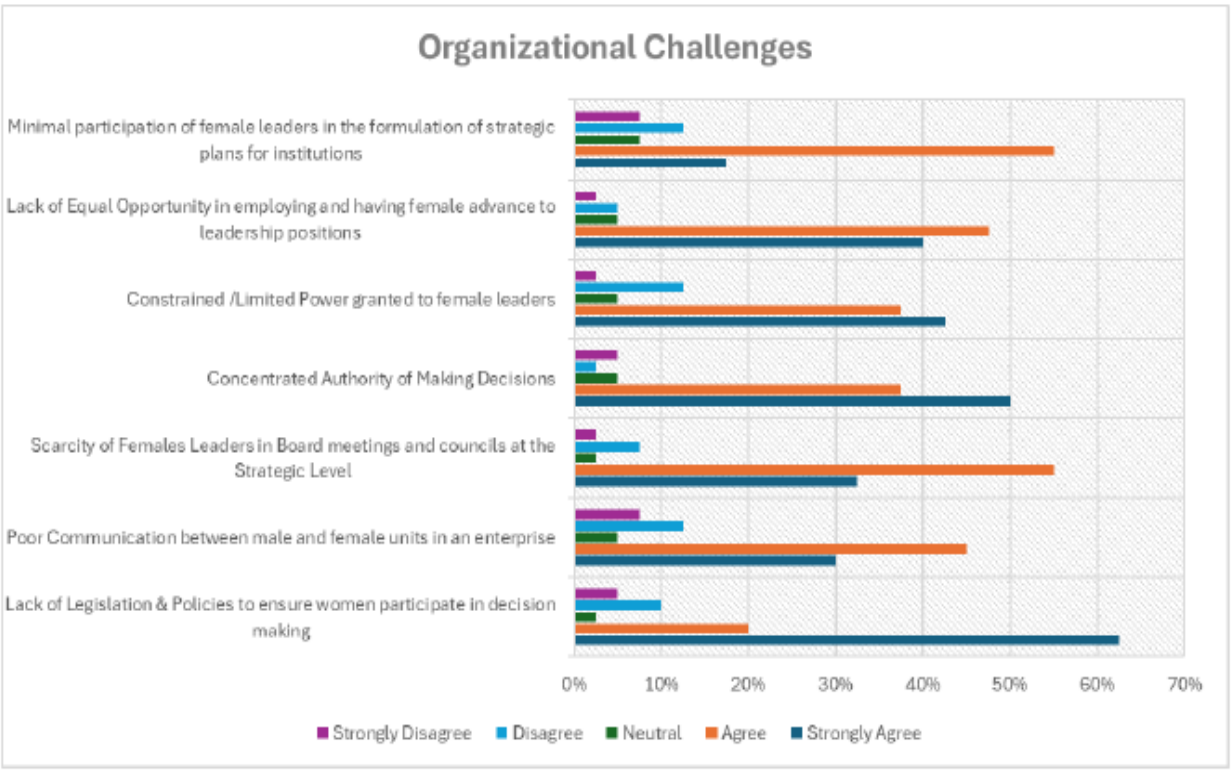


**Figure 5.** Organizational Challenges

To respond to the question of cultural challenges, six elements associated with cultural challenges of the partakers were applied. Table 2 and Figure 6 display the models. The three prime stated cultural challenge rated as strongly agree and agree were "Prevailing beliefs about males having higher capacity and management skills of females as leaders" (47.50%, n = 19), "Bias from strategic management to men in recruitment for strategic roles than females" (42.50%, n = 18) and "Lack of confidence of leadership in female' abilities as leaders" (45%, n = 13).

**Table 2.** Cultural Challenges

| | **Strongly Agree** | **Agree** | **Neutral** | **Disagree** | **Strongly Disagree** |
|---|---|---|---|---|---|
| Prevalence of traditional relationship between women leaders and subordinates rather than informal professional relationship | 32.50% | 15.00% | 27.50% | 20.00% | 5.00% |
| Bias from strategic management to men in recruitment for strategic roles than females | 42.50% | 32.50% | 7.50% | 15.00% | 2.50% |
| Lack of confidence of leadership in female' abilities as leaders | 27.50% | 45.00% | 5.00% | 17.50% | 5.00% |
| Challenges of dealing with some men colleagues and head of units for female frontrunners | 20.00% | 32.50% | 12.50% | 27.50% | 7.50% |
| Prevailing beliefs about males having higher capacity and management skills of females as leaders | 27.50% | 47.50% | 7.50% | 15.00% | 2.50% |
| Gender stereotype | 22.50% | 32.50% | 27.50% | 12.50% | 5.00% |

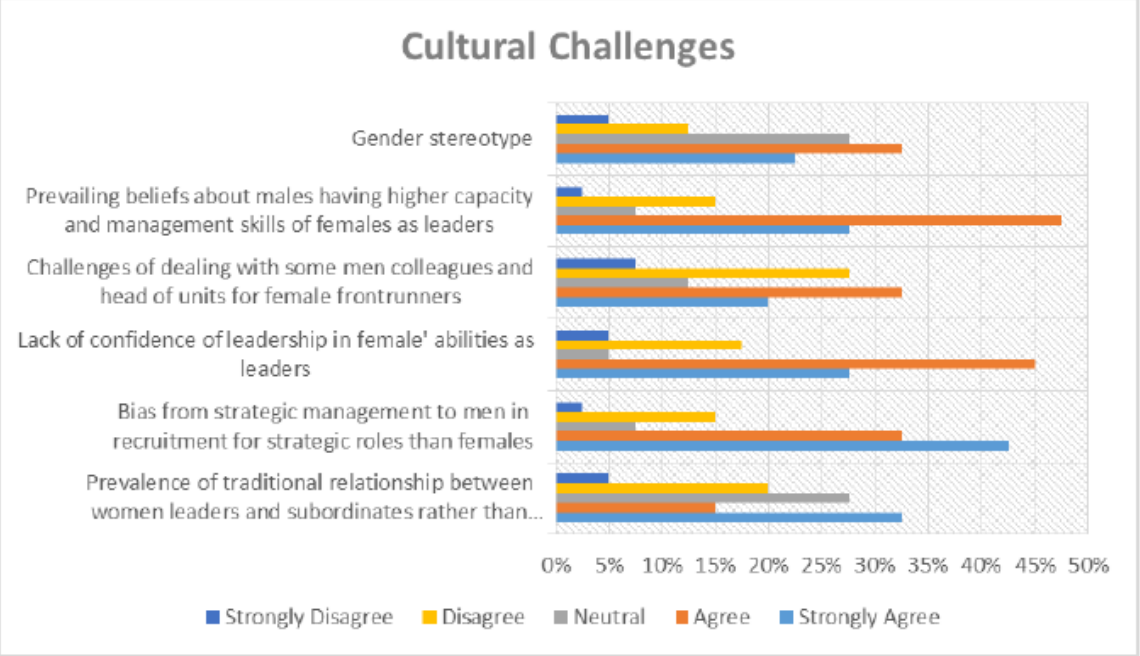


**Figure 6.** Cultural Challenges

To respond to the question of personal challenges, nine elements associated with personal challenges of the partakers were applied. Table 3 and Figure 7 display the models. The three major stated personal challenges rated as disagree "Health and physical aspect of pregnancy and childbirth that affects the effectiveness of the leadership role" (47.50%, n = 19), "Women's lack of confidence in their ability to make informed decisions" (42.50%, n = 17) and "Lack of motivation and desire for women to occupy a leadership role" (40%, n = 16).

**Table 3.** Personal Challenges

| | **Strongly Agree** | **Agree** | **Neutral** | **Disagree** | **Strongly Disagree** |
|---|---|---|---|---|---|
| Difficult of travelling if required by work conditions because of domestic obligations | 15 % | 27.5% | 20% | 27.5% | 10% |
| Females employ emotions than rationality in dealing with administrative issues | 22.5% | 45% | 5% | 17.5% | 10% |
| The difficulty in finding a balance between professional responsibilities and family obligations. | 17.5% | 27.5% | 5% | 37.5% | 12.5% |
| Health and physical aspect of pregnancy and childbirth that affects the effectiveness of the leadership role. | 12.5% | 20% | 10% | 47.5% | 10% |
| Fear of taking responsibility | 10% | 25% | 17.5% | 25% | 22.5% |
| Sense of Isolation in Leadership position | 10% | 15% | 22.5% | 37.5% | 15% |
| Women lack Leadership Skills | 10% | 10% | 10% | 37.5% | 32.5% |
| Lack of motivation and desire for women to occupy a leadership role | 5% | 15% | 10% | 40% | 30% |
| Women's lack of confidence in their ability to make informed decisions | 5% | 15% | 7.5% | 42.5% | 30% |

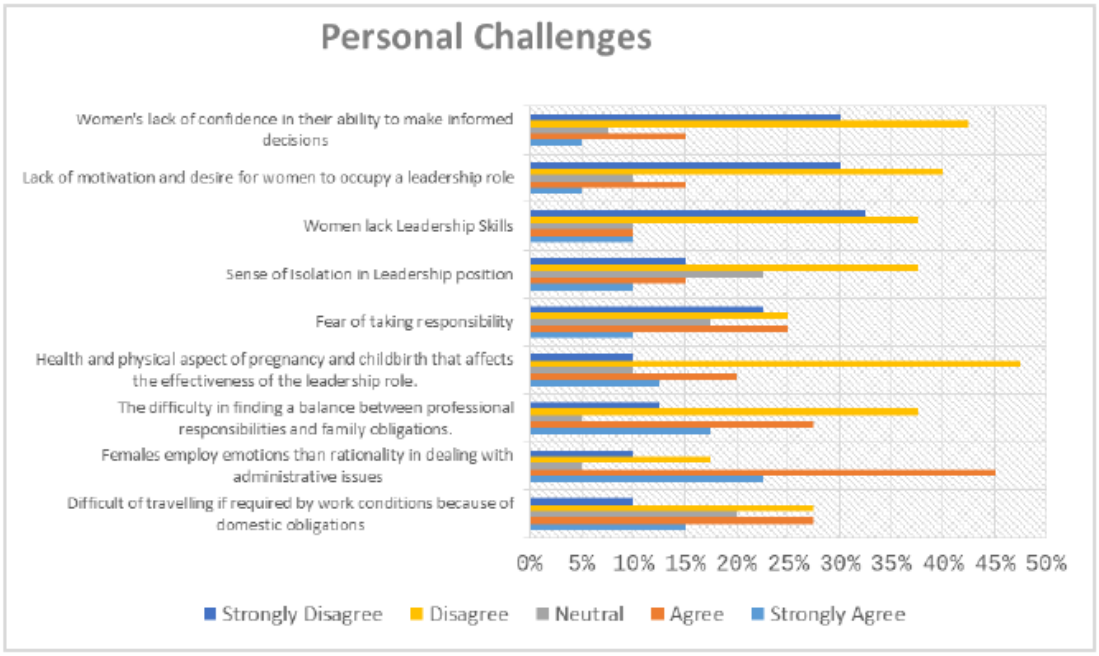


**Figure 7.** Personal Challenges

**Table 4.** Empowerment Challenges

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| Lack of family support to maintain a balance between professional responsibilities and domestic obligations | 25.00% | 40.00% | 7.50% | 12.50% | 15.00% |
| Lack of delegation of authority for females from strategic management | 32.50% | 42.50% | 2.50% | 15.00% | 7.50% |
| Lack of information required for decision making | 17.50% | 32.50% | 25.00% | 22.50% | 2.50% |
| Poor management skills required to exercise the strategic function | 22.50% | 32.50% | 12.50% | 27.50% | 5.00% |
| Lack of knowledge of regulations governing the work | 27.50% | 37.50% | 12.50% | 20.00% | 2.50% |
| Limited opportunities for training and skills development | 25.00% | 47.50% | 10.00% | 15.00% | 2.50% |
| Lack of training programs for female leaders and poor preparation for them before they are assigned | 30.00% | 52.50% | 7.50% | 7.50% | 2.50% |

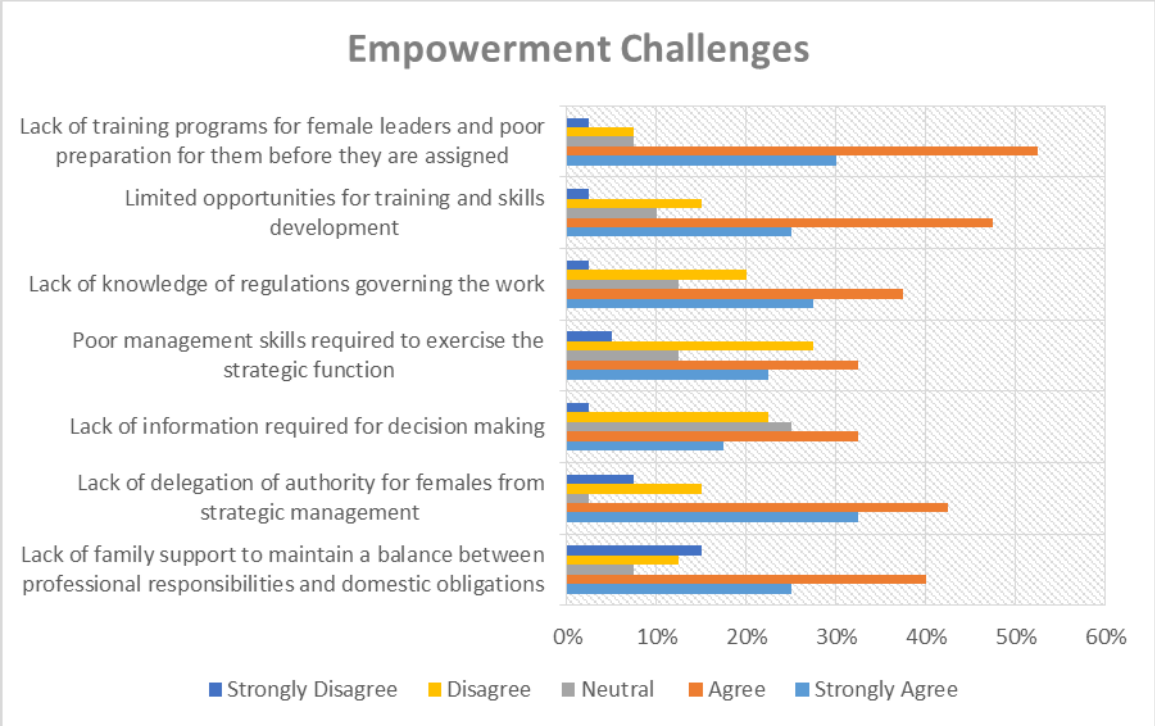


**Figure 8.** Empowerment Challenges

To respond to the question of empowerment challenges, seven elements associated with empowerment challenges of the partakers were applied. Table 4 and Figure 8 display the models. The three major stated empowerment challenge rated as Agree are "Lack of training programs for female leaders and poor preparation for them before they are assigned" (52.50%, n = 21), "Limited opportunities for training and skills development" (47.50%, n = 19) and "Lack of delegation of authority for

females from strategic management" (42.50%, n = 17).

The second question wanted to know the difficulties that must be controlled by women in attaining strategic positions and do women have preferred leadership approach based on the research variables (age, marital status, qualification, designation and period of work experience). To respond to the question, the elements that correspond to each challenge, the researcher analyzed the Null Hypothesis (H0) which means the different sample probabilities distribution are the same, the Alternative Hypothesis (H1) which means the sample probabilities distribution are not the same. Alpha was set at $\alpha = 0.05$, for all Tables 5, 6, 7, 8 and 9, we can conclude that we cannot reject the Null Hypothesis because there is no difference between the groups since the null Hypothesis is less than the critical factor in all the tables.

**Table 5.** The Kruskal Wallis H- Test by Age (N= 40)

| **Variable** | **Age Category** | **N** | **H0** | **Degree of Freedom (DF)** | **Alpha (α)** | **Critical Value for two tailed t-test is t =** | **Significance Level** |
|---|---|---|---|---|---|---|---|
| Organizational Challenges | 22 to 35 years | 11 | | | | | |
| | 36 and above | 29 | | | | | |
| Personal Challenges | 22 to 35 years | 11 | | | | | |
| | 36 and above | 29 | | | | | |
| Cultural Challenges | 22 to 35 years | 11 | | | | | |
| | 36 and above | 29 | | | | | |
| Empowerment Challenges | 22 to 35 years | 11 | | | | | |
| | 36 and above | 29 | | | | | |
| | | | **0.0054** | **3** | **0.05** | **7.815** | **0.0054** |

**Table 6.** The Kruskal Wallis H-Test by Marital Status (N=40)

| **Variable** | **Age Category** | **N** | **H0** | **Degree of Freedom (DF)** | **Alpha** | **Critical Value for two tailed t-test is t=** | **Significance Level** |
|---|---|---|---|---|---|---|---|
| Organizational Challenges | Married | 21 | | | | | |
| | Not Married | 19 | | | | | |
| Personal Challenges | Married | 21 | | | | | |
| | Not Married | 19 | | | | | |
| Cultural Challenges | Married | 21 | | | | | |
| | Not Married | 19 | | | | | |
| Empowerment Challenges | Married | 21 | | | | | |
| | Not Married | 18 | | | | | |
| | | | **0.0054** | **3** | **0.05** | **3.182** | **7.815** |

**Table 7.** The Kruskal Wallis H- Test by Qualification (N=40)

| Variable | Age Category | N | H0 | Degree of Freedom (DF) | Alpha | Critical Value for two tailed t-test is t= | Significance Level |
|---|---|---|---|---|---|---|---|
| Organizational Challenges | Bachelors/ Honours | 14 | | | | | |
| | Masters /Doctorate | 26 | | | | | |
| Personal Challenges | Bachelors/ Honours | 14 | | | | | |
| | Masters /Doctorate | 26 | | | | | |
| Cultural Challenges | Bachelors/ Honours | 14 | | | | | |
| | Masters /Doctorate | 26 | | | | | |
| Empowerment Challenges | Bachelors/ Honours | 14 | | | | | |
| | Masters /Doctorate | 26 | | | | | |
| | | | **0.054** | **3** | **0.05** | **3.182** | **7.815** |

**Table 8.** The Kruskal Wallis H-Test by Designation (N=40)

| Variable | Age Category | N | H0 | Degree of Freedom (DF) | Alpha | Critical Value for two tailed t-test is t= | Significance Level |
|---|---|---|---|---|---|---|---|
| Organizational Challenges | Student/Supervisor/Manager/ Teaching Ass. /Lecturer | 22 | | | | | |
| | Snr. Manager/ Director / Executive / Professor | 18 | | | | | |
| Personal Challenges | Student/Supervisor/Manager/ Teaching Ass. /Lecturer | 22 | | | | | |
| | Snr. Manager/ Director / Executive / Professor | 18 | | | | | |
| Cultural Challenges | Student/Supervisor/Manager/ Teaching Ass. /Lecturer | 22 | | | | | |
| | Snr. Manager/ Director / Executive / Professor | 18 | | | | | |
| Empowerment Challenges | Student/Supervisor/Manager/ Teaching Ass. /Lecturer | 22 | | | | | |
| | Snr. Manager/ Director / Executive / Professor | 18 | | | | | |
| | | | **0.054** | **3** | **0.05** | **3.182** | **7.815** |

**Table 9.** The Kruskal Wallis H-Test by Work Experience (N=40)

| Variable | Age Category | N | H0 | Degree of Freedom (DF) | Alpha | Critical Value for two tailed t-test is t= | Significance Level |
|---|---|---|---|---|---|---|---|
| Organizational Challenges | Less than 10 years | 6 | | | | | |
| | 10 – 20 years | 16 | | | | | |
| | More than 20 years | 18 | | | | | |
| Personal Challenges | Less than 10 years | 6 | | | | | |
| | 10 – 20 years | 16 | | | | | |
| | More than 20 years | 18 | | | | | |
| Cultural Challenges | Less than 10 years | 6 | | | | | |
| | 10 – 20 years | 16 | | | | | |
| | More than 20 years | 18 | | | | | |
| Empowerment Challenges | Less than 10 years | 6 | | | | | |
| | 10 – 20 years | 16 | | | | | |
| | More than 20 years | 18 | | | | | |
| | | | **(0.00156)** | **3** | **0.05** | **3.182** | **7.815** |

Finally, to respond to the third question, which asked, "How can women best enter and succeed in the strategic leadership positions in tech. To respond to the question, the researcher used Table 1 and Figure 5 results on organizational challenges, the policy makers must ensure the legislation and policies are in place. Women must also be granted power to make decisions, and the decision making must be centralized in an organization.

To address the cultural factors, the researcher used Table 2 and Figure 6, the perception around the globe that men are more skilled than women must be scientifically proven and guided by interpretation. Women must be encouraged to be self-confident from an early age, so they grow with a great self-esteem, parents motivate young girls. They should know they have the capacity like a boy child. They must be encouraged to pursue any field of study, especially the STEM field. Management in organizations must believe in females that they have the capacity to occupy strategic positions just like their male counterparts, the bias will inevitably end.

The researcher used Table 3 and Figure 7 to address personal challenges. There is a huge perception that women fail to occupy strategic positions because of personal factors such as pregnancy, child rearing, lack of desire to occupy strategic positions, and the lack of confidence. This is not all true. Companies must give the females an opportunity as well to prove oneself.

Finally, to address the empowerment challenges, the researcher used Table 4, Figure 8. Organizations fail to train women leaders, if they do offer them an opportunity, they fail to prepare them before they are assigned. There is also limited skill development opportunity for females in institutions. Management furthermore fails to delegate authority to females, there is just a lack of trust.

Regardless of the advances made in promoting gender equality in different areas, the tech field remains mainly male-dominated. According to [37], females only hold 5% of executive positions in tech, in 2022, females made up only 28% of the technology labor force, this is a reflection that gap still exists in the tech industry. Despite the subsequent benefits highlighted, gender inequality in the technology sector remains significant and greatly debated matter. While women make up

almost half, i.e. 47%, of the U.S. labor force, women in the tech industry occupy less than 28% of the executive roles [38].

## Recommendations

Based on the research findings, the following are recommendations to the different groups:

### Recommendation to Women

Since some of the females aspiring to be front-runners fear failure particularly those who start their management path. It is key to motivating them to deal with the moments of uncertainty and lack of confidence, by entrusting them to disregard that subconscious that may dampen some hope in them taking tough decisions, voicing out their opinions and stepping out of their sanctuary.

Additionally, neither trying to function like a male ensured triumph for females executive nor letting her womanly values to stand in the way of making things performed is suggested either. The research suggests female frontrunners to remain focused on unit or company purpose.

Further, given that generally there is an absence of support of female frontrunners from other women-based employees or trailblazers, it is essential to launch female based network and networking proceedings as well as other online forums to back and encourage one another.

### Recommendation to Company Leadership

Eliminating socio-cultural stereotypes on females' frontrunners implies not only a conversion in workers' attitude but also management methods, procedures and company principles. The executive board should develop corporation approaches to create love, self-esteem and confidence with the diverse sections of the company organization.

### Recommendation to Policy Makers

Despite the state programs that are targeted at inspiring females on several aspects involving management, such as compromising with access and success of females in executive opportunities. The research, hence, suggest for revising the prevailing female empowerment framework to replicate the accurate state, and finally the state should build a female management forum or network for the purpose of allowing females share accomplishment and encounters they face in their executive positions.

### Recommendation for Future Research

It would be appropriate to further investigate the changing aspects of the challenges females face in attaining strategic management positions in the technology space on a broader level than this study has done. The worth females in tech executive carry in contrast to male to explain calls for further inclusion of females in strategic management position in technology also warrants additional research.

## Conclusion

Considering the research findings, it can be determined that while females have the capacity and potential to occupy executive positions to perform at the strategic management level, the vicious cycle of difficulties against their management path every so often coerce their triumph. With the exception from inner influences amongst themselves, outside influences such as social and cultural stereotypes, the challenge of harmonizing reproductive and office roles, and absence of networking has contributed meaningfully to confining their management accomplishment. Meanwhile female managers apply the transformational method of leadership since it is founded by the certainty that it supports their female principles of encouragement and thoughtfulness, it is consequently critical to improve their authority through modifying official and corporate edifices, processes and measures as well as transmuting the insolences of males and females towards females in executive and leadership roles. Consequently, more supporting pleasant working conditions

will be established and their capacity recognized.

The absence of diverse labor force perceptions endures because of general prejudices, inadequate chances, and embedded ethnic patterns within employment and promotion methods. To bridge the gap, institutions must apply positive measures, for instance targeted employment approaches, comprehensive leadership advancement plans, and fair reward structures.

Embracing diversity and promoting inclusion is vital for accomplishing success and innovation since varied players bring together diverse views, knowledge, and analytic methods, hence enhancing effectiveness, efficiency, and performance transversely a vast worldwide network.

Prioritizing on development of comprehensive workforce values, advancing in proficient growth opportunities, and leveraging shared intuition, vision, and knowledge, establishments can pursue to discourse the scarcity of females in the technology industry and commemorate their distinctive commitment, skill sets, and perceptions.

Though insensible partialities still occur; by taking positive strides to advance inclusion and opportunities for females in the work environment and identifying their various position in attaining prosperity, institutions will be well armed to find and shape women frontrunners who will persist paving the way for imminent groups. In a progressively technology realm, the digital sector plays a fundamental function in influencing our future. By encouraging gender diversity and adopting an inclusive condition, the world guarantees that the greatest and intelligent minds are working in harmony to promote modernization and develop solutions that profit all.

## Ethical Consideration

This study observes the utmost ethical values to warrant the well-being, dignity and rights of all partakers. Preceding participation, the partakers were supplied with complete information about the research's goal, procedures, likely perils, and advantages. Informed approvals were received from all the contributors, confirming voluntary and knowledgeable accord to participate in the research.

All participants were told about the privacy of the data collected from them. The questionnaire and interview did not need the partakers to describe /identify themselves. Contributors were guaranteed that the data they supplied will only be employed for the purpose of this research. Therefore, confidentiality was absolutely preserved, and all data has been securely kept stopping illegal access. The value of generosity was faithfully pursued, with measures taken to lessen damage and increase benefits for the contributors.

## Conflict of Interest

There is no conflict of interest.

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# Harnessing Technology in Talent Acquisition: Opportunities, Challenges, and the Imperative for Ethical Innovation

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***Abstract***

*As technology continues to transform human resource (HR) functions, its role in talent acquisition has become increasingly critical. This paper explores how technology enhances recruitment by streamlining processes, increasing candidate reach, and reducing costs, while also addressing emerging challenges. Attracting Millennials, the largest and fastest-growing workforce segment, requires modern strategies such as personalized outreach, social media engagement, and a compelling Employee Value Proposition. Digital tools like video interviews, gamified assessments, and mobile-friendly platforms facilitate efficient screening and diverse candidate pools. Additionally, onboarding platforms integrate automation, socialization, and digital training, improving new hire experience and engagement. However, with these advancements comes the risk of algorithmic bias, which may reinforce pre-existing inequalities if not properly monitored. Studies show that algorithmic models can disadvantage certain groups, such as women or minorities, by relying on biased historical data. Case studies, including those involving Google job ads and judicial risk assessments, illustrate these concerns. To mitigate such risks, organizations are encouraged to audit algorithms and balance automated processes with human judgment. This paper concludes that while technology can revolutionize talent acquisition, it must be used responsibly. Leveraged correctly, it enables organizations to attract, assess, and retain top talent efficiently. However, companies must continuously evaluate these tools to ensure fairness, inclusivity, and alignment with organizational goals.*

***Keywords:*** *Algorithm Bias, HR, Millennials, Onboarding, Recruitment, Talent Acquisition, Technology.*

## Introduction

As companies move to transform their HR function, the role of technology in talent acquisition has grown significantly. When used appropriately, it has the power to drive recruiting and attract the Millennial workforce. Additionally, technology can streamline the talent assessment process. Onboarding is another area in which companies are increasing their technological capabilities. Indeed, there are many benefits to implementing technology in a company's talent acquisition strategy. As these tools are increasingly used, however, it is important to understand their risks and address them accordingly [13, 17].

## Discussion

### Attracting Young Talent

Millennials (people born between the early 1980's and late 1990's) are not only the largest segment of the work- force, but they are also the fastest-growing one; they are projected to make up 75% of all U.S. employees by 2020. HR teams are discovering that they need to revise their recruitment strategies if they are to connect with younger workers who appreciate different aspects of work than their older counterparts. Coaching Millennials, a

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Washington, D.C. area consulting firm, points out that many companies do not understand the younger generation's expectations of which communication is expected to occur throughout the recruitment process [18].

To successfully attract young talent, companies must stop treating recruitment as a transactional process. In- stead, recruiters must actively and continuously identify specific skills, search for talent through various social media platforms (LinkedIn, Glassdoor, Facebook, etc.), and reach out to candidates directly. While the more traditional avenues of attracting talent remain important in talent acquisition, the influence of social media in this space is growing.

## Social Media in Recruiting

There are several ways to effectively engage job seekers through social media platforms. For example, social media can be used to promote a company's values and mission, highlight the company's top employees, and show-case company-led volunteer opportunities that support the local community. Partnering with universities' social media teams also helps organizations raise awareness of job openings, particularly those meant for graduates and prospective interns. Recruiters can also encourage colleagues to share formal and informal company events via social media that demonstrate the inclusion and values-based culture found in their workplace. Perhaps most importantly, social media is the medium of authenticity. It is therefore necessary for a company's activity and efforts on every social media platform to be authentic, rather than staged, and perceived to be executed by people in and outside of HR [18].

## The Employee Value Proposition

Talent acquisition teams should integrate four categories of their organization to create a strong social media presence: Brand, Opportunity, Culture, and Purpose. Brand refers to the overall excellence and leadership of a company; Opportunity involves challenging work, salary, and a clearly defined career path; Culture signals the authenticity and organizational climate; and Purpose refers to the missions, values, and global citizenship of a company. Known as the employee value proposition, these categories indicate to a job seeker whether he or she is a good fit for the company in question and vice versa. As Millennials follow prospective employers on LinkedIn, Glassdoor, Instagram, and company websites, HR and the talent acquisition group must integrate elements of their employee value proposition that will appeal to them. This can be done by creating photo and video stories on Instagram, featuring articles on LinkedIn, and updating the company website's layout and presentation [14].

As the composition of the workforce becomes more diverse, it is important that companies understand the evolved definition of diversity. Mike Rickheim, Vice President of Global Talent Acquisition, Engagement, & Inclusion at Newell Rubbermaid Inc., explains that "Millennials are not distinguished by gender or skin color; they are diverse in their attitudes, thoughts, perspectives, and styles" [16].

## Looking in the Mirror

Lastly, as HR strives to advance its talent acquisition efforts, team members must evaluate their current recruitment capabilities, identify challenges and areas for improvement, and seek to make changes where necessary. The SHRM Foundation cites several challenges that companies are facing [4]. For example, applicants often withdraw their applications during the recruitment process. One way to address this is for companies to start their recruitment processes earlier and make timely job offers. Another issue that many companies are facing is that they lack employee referral programs, resulting in smaller, lower quality candidate pools. To overcome this challenge, companies can offer a referral bonus contingent

on retention for one year and on satisfactory new-hire performance. An additional issue is that some recruiters may have different yields in terms of the number and quality of their hires. A potential solution for this issue is to leverage those recruiters with the best yields and train the recruiters who may not be performing as well. While these and several other challenges may exist, it is important that the perspective of the Millennial (and every other job seeker, for that matter) always be considered. In SHRM Foundation's study, one candidate summarized the implications of the recruitment process well: "I think a lot of people look at recruiting as reflective of the company, and in many cases, that's absolutely accurate. Despite the fact that other factors matter, people do make choices based on how they're treated in the recruiting process" [4].

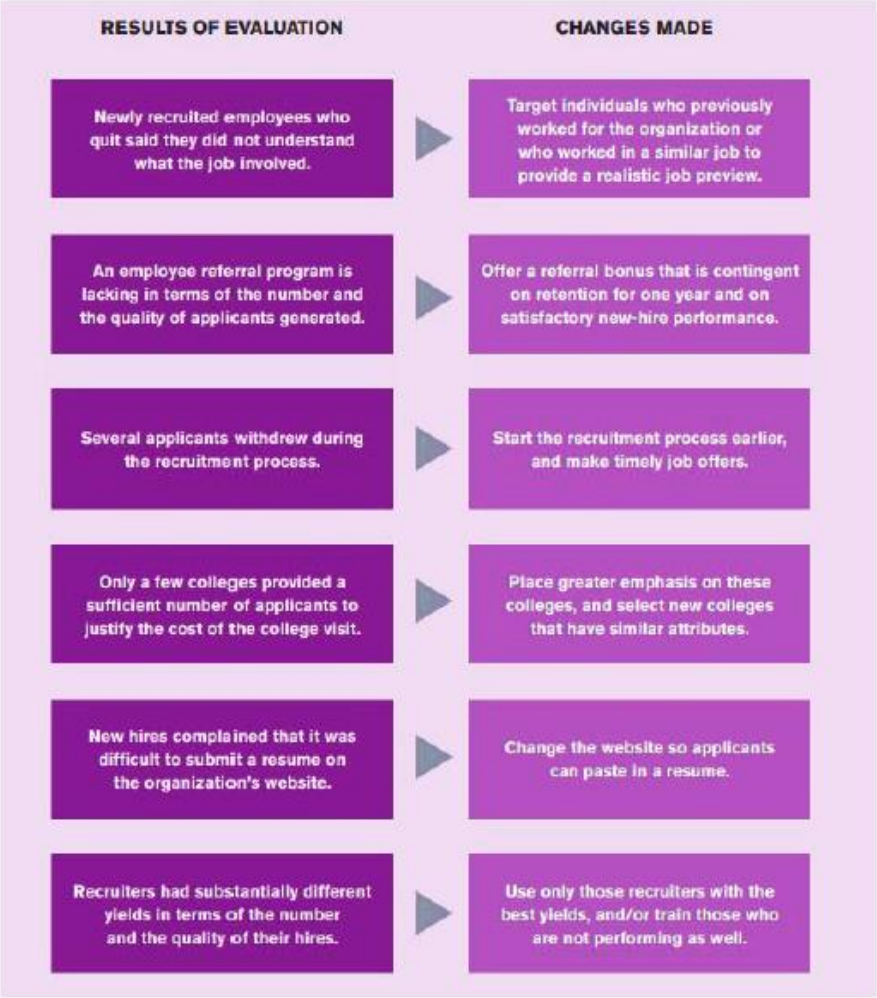


**Figure 1**. Possible Changes Based on Evaluation of Past Recruitment Activities.

*Note: Adapted from [8]. Emma, 2020, Measuring and Evaluating Recruitment Results. TalentVis, https://talentvis.com/en/news-and-insights/Measuring-and-Evaluating-Recruitment-Results%C2%A0*

Figure 1 highlights how organizations can improve recruitment effectiveness by evaluating challenges and implementing corrective measures. For instance, when new recruits quit because they did not understand the job, realistic job previews were introduced. To address weak employee referral programs, referral bonuses tied to retention and performance were offered. Early withdrawals in the recruitment process were reduced by starting earlier and making timely job offers. Colleges producing better applicant pools

received more emphasis, while website difficulties in submitting résumés were solved by enabling applicants to paste them. Lastly, recruiter performance was standardized by using high-yield recruiters or providing training for weaker ones.

## Analyses

### Tech and Talent Assessment

The number of companies that are adopting new technologies and tools to assess candidates' skills before making hiring decisions is increasing. There are currently six major technological advances that these companies are using to assess candidates:

Unsupervised online testing. Unsupervised online testing has become the standard for assessment administration because it increases efficiency in the recruitment process by decreasing the time needed to fill vacancies while reducing costs. However, unsupervised online testing prompts two major concerns: test security and candidate integrity [15]. Saville, a research-based psychometric assessment tool, has the analytic capacity to build a uniform evaluation model to score candidates based on behavioral attributes [20]. This tool can more objectively predict candidates' possibility to succeed in the organization.

Computer adaptive testing. Computer adaptive testing allows for the dynamic selection of questions from a large set of potential items based on the way that an individual candidate responded to the previous question: If a candidate responds correctly, the next item will be more difficult; if a candidate responds incorrectly, the next item will be less challenging. Computer adaptive testing provides more insight into individual candidates by creating customized assessments with unique combinations of items and levels of difficulty based on each candidate's level of ability and knowledge demonstrated on prior questions [15]. Comput- er adaptive testing creates more secure and efficient assessments, with fewer items in less time, to meet the demands of candidate-centric hiring [2]. To ensure candidate integrity, some organizations ask candidates who have progressed through the hiring process to complete a brief onsite assessment at a convenient point to verify the candidate's online score.

Mobile assessment. Mobile devices may be more readily available than computers to underrepresented groups, including African Americans, Hispanic Ameri- cans and women. Assessment administration on mobile devices can therefore result in larger and more diverse candidate pools. A new assessment that uses mobile-centric design principles has arisen to optimize the user experience [19]. There is currently a demand for innovative assessments that go beyond the more traditional multiple-choice evaluations and that look and feel more like games.

Low-effort assessment. Low-effort assessment uses machine learning to sift through large amounts of un- structured information, including resumes and applications, to collect predictive information about candidates. The information is coded and validated against work outcomes, such as job performance and retention, to produce algorithms that managers can use to inform their hiring decisions [20]. These techniques automate identification and scoring of predictive information so that large numbers of candidates can be screened in minimal time at a low cost.

Gamification. Unilever uses a gamification solution provided by Pymetrics. Applicants spend 20 minutes playing 12 neuroscience-based games. This provides Unilever with insight into candidates' various capabilities such as problem solving, personality and communication style [19].

Video solutions. More companies are using video interview solutions such as HireVue. HireVue records candidates' responses to preset questions and then analyzes and scores them based on tone, body language, and keywords [20]. Companies are also using video

job preview solutions such as Skill Scout to enable candidates to preview the actual tasks they will perform on the job, thus increasing the possibility of successful candidate-job matches. [19, 20].

## Onboarding and Technology

There are many technological tools that help companies to use the time between the pre-boarding processes and the actual starting dates of new hires more efficiently [9]. These tools are meant to leverage technology's strengths to provide better experience for new employees. A few examples of these strengths are automation, socialization, digital training, and metrics tracking.

**Table 1.** shows onboarding software systems.

| System | URL/Phone | Customers | Features | Price |
|---|---|---|---|---|
| BambooHR Employee Self-Onboarding | www.bamboohr.com 866-387-9595 | AppFolio, Nudge, Seward Community Co-op | • Forms can be filled out, signed and stored online.<br>• "Getting to Know You" e-mail sends an introduction to team members that includes custom questions and conversation starters.<br>• New-hire packet with required documents. | The onboarding feature is included in BambooHR's HR management platform, which starts at $7 per employee per month. |
| Halogen Recruiting and Onboarding | www.halogensoftware.com/solutions/recruiting 866-566-7778 | Fairbanks Hospital, SGT Inc., CPP Inc. | • Identifies and attracts candidates.<br>• Provides consistent candidate experience.<br>• Speeds time to employee productivity.<br>• Puts feedback, collaboration and engagement at the center of the employee experience. | Licensing pricing for a company of about 500 employees is $10,000 a year when purchased with Halogen Performance solution. |
| iCIMS Onboard | www.icims.com 800-889-4422 | Crunch, Kate Spade, New Balance | • File library includes documents such as direct deposit, benefits and tax forms.<br>• Automated notifications of tasks based on job type, department, location and more.<br>• Candidate experience surveys. | The monthly fee is based on products purchased and number of users. There is a one-time implementation fee. |

| | | | | |
|---|---|---|---|---|
| Onboard Express | www.onboardexpress.com.au +61-3-9029-2907 | Financial institutions, international construction company | • Candidate portal with secure login.<br>• Audit trail of offer and policy acceptances.<br>• Company video and welcome message. | There is a one-time cost of $5,000, plus $35 per onboard. |
| Oracle Taleo Onboarding Cloud Service | www.oracle.com 800-392-2999 | Ruby Tuesday, Logicalis, Barco N.V. | • Connects employees to HR systems so they can easily manage tasks online.<br>• Personalized portal for all new-employee information and forms. | Not available |
| SilkRoad Onboarding | www.silkroad.com/hr-solutions 866-803-9663 | Lord Fairfax Community College, Tenet Healthcare, eBay | • Automatic e-reminders and triggers.<br>• Customized automatic workflows.<br>• Consistent new-hire experience. | Not available |
| WorkBright | www.workbright.com 844-370-1783 | Edible Arrangements, Avid4 Adventure, Geneva Glen Camp | • Designed for businesses hiring more than 50 employees per year.<br>• Automated reminders.<br>• Dashboard preloaded with all applicable forms. | |

*Note: Adapted from [9]. Ferrazzi, K., 2015, Technology can save onboarding from itself. Harvard Business Review Digital Articles, 2–5, Business Source Complete, Ipswich, MA.*

The adapted material presents a comparative analysis of various onboarding software systems. It highlights how technology is being used to streamline and improve the onboarding process, moving it beyond manual, paper-based tasks. The table 1 summarizes key vendors by detailing their target customers, specific features—such as digital forms, automated notifications, and personalized portals—and their pricing models. This aligns with the article's central argument that technology can rescue onboarding from inefficiency by automating administrative burdens, ensuring consistency, and enhancing the new hire experience, ultimately leading to faster productivity and better engagement.

Automation. Automated onboarding software and tools make it easier for new hires to authorize background screening, view benefit plan options, and sign various forms. Depending on the product, additional capabilities may include interfaces with third parties, such as business card vendors, as well as side-by-side benefit plan comparisons. Automated onboarding software can also be integrated with E-Verify, the federal government’s online system for Form I-9 verification, which helps companies to comply with government regulations [9].

Socialization. Onboarding platforms have social networking capabilities to connect employees with other new hires, mentors, managers, and team members. Social activities

can be posted and organized through the platform. These in-house and outside events quickly familiarize new hires with the company's culture while they participate in social activities [10]. Some platforms even offer access to an ever-expanding catalogue of aggregated high-return practices (i.e., the assignment of an onboarding buddy, or taking a deep dive into the product with a new teammate) [9, 10].

Digital training. Onboarding platforms can be integrated with other HR systems including training and learning platforms and video streaming. Companies can increase employee engagement through onboarding programs by providing new hires opportunities to earn certifications, to develop skills through cross-training, and to move laterally and vertically throughout the organization [10].

Onboarding metrics tracking. Advanced onboarding technology allows companies to configure reports and third- party intelligence into manager consoles for greater visibility, more interactive formats, and customized summaries [9, 10].

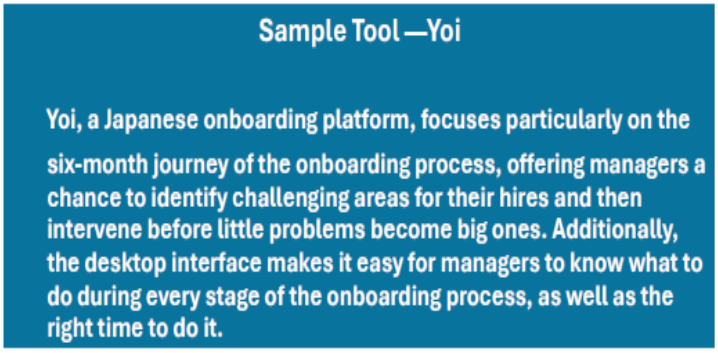


**Figure 2**. shows findings from onboarding a sample tool-Yoi.

*Note: Adapted from [9]. Ferrazzi, K., 2015, Technology can save onboarding from itself. Harvard Business Review Digital Articles, 2–5, Business Source Complete, Ipswich, MA.*

Figure 2 highlights the onboarding tool Yoi, a Japanese platform designed to support the six-month onboarding journey. The tool enables managers to identify potential problem areas early and intervene before they escalate. Its desktop interface further assists managers by providing clear guidance on what actions to take at each stage of the onboarding process, ensuring timely and effective support for new hires.

## Results

### Benefits of Using Technology in Talent Acquisition Strategies

Companies that integrate technology into their talent acquisition strategies reap many benefits. The predominant benefits that drive businesses to use technology are decreased costs, increased efficiency, and increased candidate reach. Technology implemented during the different stages of talent acquisition will result in differing benefits.

### Decreased Costs

Consistent onboarding. Companies can establish companywide onboarding programs to increase consistency in the new hire experience. Successful onboarding is shown to reduce costly turnover while also reducing the time it takes for new hires to become fully productive [9].

Travel expenses. Video interviews, early screening, and posting jobs online reduce the amount that companies spend on airfare and hotels for remote interviews and candidate sourcing [7].

### Increased Efficiency

Targeted recruiting. Websites like LinkedIn and Glassdoor allow companies to seek out

candidates with desired talents and skills. In turn, it helps candidates self-select into jobs that best match their skills [7].

Early screening. HR and management can reduce the amount of time and resources that they spend screening and interviewing candidates by using online personality tests, aptitude tests and video interviews to eliminate unqualified or less competitive candidates [3].

Automated onboarding. Companies can reduce costs associated with onboarding by using technology during the onboarding process. This will reduce the amount of administrative work required by managers and team members, allowing them to spend their time on other tasks [3].

## Increased Reach

Digital brand. Technology enables companies to create digital brands that can appeal to candidates and even give companies an advantage over their competitors. Dell and Heineken are two companies that have intentionally created digital brands to recruit talent [19]. Additionally, technology allows companies' job advertisements to reach thousands of mobile job seekers or social media users who may not have seen their opening via traditional sourcing methods [19].

Geographic reach. Using social media and job sites to post requisitions offers a way for companies to advertise their jobs across the nation or multiple nations immediately. This can be especially important when searching for candidates with specific or rare skillsets [19].

### Risk of Technology in Talent Acquisition – Algorithm Bias

New technology brings great efficiencies and innovation to the talent acquisition process. However, technology also carries certain risks, most notably the potential for disparate impact. Firms must recognize these risks and treat them with the same scrutiny as their other HR related processes.

The concept of algorithm bias initially appears as a paradox. Data and algorithmic modeling are supposed to eliminate underlying human biases that can undermine impartial hiring decisions [15]. After all, as Indeed.com chief economist Jed Kolko phrased it, "humans are not as rational as economists would like them to be" [12]. Algorithms and data are supposed to compensate for human irrationality. Nevertheless, the functionality of algorithms permits these biases to exist, but with the danger of less internal and external scrutiny and oversight.

Algorithm bias occurs when algorithmic models place a certain category of individual (i.e., race, gender, age) at a disadvantage over others because of the predictive features of the statistical model. Given that algorithms are designed and modified by humans, they are susceptible to human fallacies. [5] That is not to suggest that there is explicit prejudice in the creation of said algorithms, but rather that they can highlight preexisting implicit biases [11].

The more concerning aspect of algorithms and machine learning is how they work. In talent acquisition, algorithm models are intended to take past data (i.e. qualities of high performers and successful new hires) to predict future success in prospective candidates. The problem is that the past success stories could have included preexisting biases such that the algorithm mimics a practice that is prejudiced to begin with [11]. Solon Barocas of the California Law Review explains, "…the algorithm will perpetuate implicit hiring practices because that is the only data it has to go off" [2]. The crux of the issue centers on the data mining process rather than overemphasizing the weight of variables [2].

### Case Studies in Algorithm Bias

#### Google Job Ads for High Paying Jobs

A 2015 Carnegie Mellon study concluded men were shown ads for high paying jobs ($200,000+) at a disproportionately much higher rate than women [6]. Researchers noted

that when they changed gender in Google Ad settings to female, they received fewer instances of career coaching services for executive positions – a disparity of 1,852 ads for men compared to 318 for females [6]. This example has significant ramifications for the push-pull talent acquisition process. If, from the onset, firms are skewing the candidate pool via these ads, they will inadvertently hire more men at higher rates and create additional pay disparity without being cognizant of such consequences.

### Algorithms Designed to Predict Repeat Offenders

Non-profit newsroom ProPublica researched the use of algorithms in the judicial system to determine the likelihood of repeat offenders [1]. The study determined that blacks were 45% more likely to be designated as a higher risk than when compared with their white counterparts [1]. Although this is not technically an HR related issue, the implications certainly can be carried over, particularly in the process of screening resumes to select future candidates and high potentials. Furthermore, algorithms could inadvertently potentially screen out a protected class.

### Taking Actions to Mitigate Algorithm Bias

Given the current lack of regulation and oversight, algorithm bias is currently a nebulous area of HR. Nevertheless, there are certain steps that firms can take to protect themselves from these biases:

1. Establish an audit committee. Assign an external or internal committee to formally audit the main algorithms to test for any biases [11]. By holding algorithms to the same rigorous standards as other human processes, companies can prevent inadvertent prejudices. If companies hire third party software developers for their talent acquisition algorithms, they should seek proof of auditing or oversight, as well.
2. Combine algorithms and human forces. Data should be used to influence the decision making of companies, not be the sole determinant of decisions [11]. By using data and human critical thinking together, they function as error and mistake proofing practices for each other's underlying biases.

## Conclusion

Talent Acquisition is during a technological revolution that is changing the dynamic of how companies attract and retain talent. Although experiencing drastic changes, the TA function is not disappearing, rather it is evolving. After all, technology is a tool that TA should use to accentuate and improve employee experience rather than using it as an escape rope to cut corners. Technology, like any tool, if used improperly can be detrimental to the business. However, if leveraged properly, it can streamline processes to create the ultimate experience for prospective employees.

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# Digital Finance in Fragile Settings: Structural Predictors of Mobile Money Retention in North Kivu, Democratic Republic of Congo

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***Abstract***

*This study investigated the factors influencing the continuous usage of mobile money services in the cities of Butembo and Beni, North Kivu (DRC), using a structural equation modelling approach via SmartPLS. The findings reveal that Trust, Subjective Norms, and Perceived Cost significantly affect users' continued use of mobile money platforms, while Customer Experience and Perceived Quality do not show a direct effect. The results highlight Continuous Usage as a central mechanism that strongly predicts both Behavioural Intention and User Engagement, reinforcing its role as a critical bridge between initial perceptions and long-term behaviour. From a managerial standpoint, building trust, leveraging social influence, and reducing transaction costs are key strategies for increasing adoption and retention. Theoretically, the study confirms the relevance of trust- and norm-based models in digital finance usage within low-infrastructure contexts. The paper concludes with a call for future research to explore longitudinal patterns, qualitative dimensions of service perception, and contextual moderators such as digital literacy and income level*.

***Keywords:*** *Continuous Usage, Cost Perception, Democratic Republic of Congo, Digital Finance, Intention to Use, Mobile Money, North Kivu, SmartPLS, Subjective Norms, Trust, User Engagement.*

## Introduction

Mobile money has emerged as a major enabler of financial inclusion in recent years, especially in developing economies. [1]. In economies with low banking penetration, often due to various infrastructure and economic challenges, the whisper of mobile phones serves as a beacon of hope for enhancing access to financial services among unbanked and underbanked populations.[2]. By leveraging mobile technology, financial institutions can provide innovative solutions that overcome traditional barriers to banking, thereby fostering greater financial inclusion and economic empowerment for these underserved communities.[3]. Mobile money provides accessible financial services at a lower cost that can benefit the underbanked.[4].

Thanks to mobile phones, customers can send and receive money, pay for goods and services, subscribe to services, get loans, check their balance and much more [5]. These advantages, among many others, drive many customers, banks and other financial service providers globally, particularly in Africa, to use mobile money services [6]. According to [7], with Kenya at the forefront, Africa was an early adopter of mobile money technology. This innovation has subsequently disseminated to various regions globally.

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Notwithstanding the spread of fintech technologies, the Democratic Republic of Congo (DRC)'s context remains unique. Because of its specific geography and the challenges associated with access to roads and other primary infrastructures, the rate of bank penetration remains low. Consequently, there is scope for traditional banking services to be supplanted by mobile money services. Moreover, the recent conflict in the eastern regions of the DRC has further exacerbated financial exclusion, particularly in major urban centers of North and South Kivu, where large segments of the population have been cut off from formal banking services.

In terms of the use of cellular networks, the report carried out in 2024 by [8] indicates that 53.36 million cellular connections were active in the DRC in 2024, compared with 48.15 million the previous year [9], reflecting an increase of more than two million telephone users in one year. The same growth dynamic has been observed in internet use, with an internet penetration rate of 22.9% [9] in 2023 and 28.31% [8] In 2024. It clearly emerges that the use of mobile phones and the internet continues to grow in the DRC, providing a great opportunity for mobile money solutions.

Regarding bank penetration and financial inclusion, with a penetration rate of around 8.3%, the DRC is considered to be one of the most underbanked countries in the world.[10]. With just 18 banks, concentrated mainly in large towns, the rate of financial inclusion is very low.[11]. To compensate for this poor financial inclusion, more and more mobile applications are being developed by banks and other financial institutions. In addition, there is a high take-up of services offered by telecommunications companies such as Airtel Money, M-PESA, Orange-Money, etc. It is noteworthy that banks in the Democratic Republic of Congo are intensifying their efforts in electronic banking by developing mobile banking applications [12]. These include Rawbank's Illicocash and TMB's Pepele Mobile, which are playing a crucial role in the expansion of digital financial services in the country.

Despite these advances in terms of telephony, the DRC is recognised as one of the countries lagging furthest behind in terms of technology adoption [13] The DRC is characterised by a low rate of adoption of technology for business purposes [14]. It has been observed that the majority of Congolese citizens exhibit a preference for traditional methods over new technologies [15]. This cultural inclination poses a significant challenge to adopting electronic and mobile banking services.

In addition, despite several studies on Mobil Money and financial inclusion, to our knowledge, there are very few studies that address this issue in the context of the Democratic Republic of Congo.

In light of the foregoing, this study seeks to offer a comprehensive understanding of how mobile money contributes to narrowing the financial divide in the Democratic Republic of Congo (DRC). The findings are expected to enrich the wider discourse on financial inclusion and provide actionable insights for policymakers, financial institutions, and development practitioners aiming to harness mobile technology as a catalyst for economic empowerment.

## Literature Review and Hypothesis Development

### Financial Inclusion

Financial inclusion is the possibility for everyone, especially the poor and excluded, to access financial services [16]. Financial inclusion can also be defined as universal access to financial products and services [17]. Based on these definitions, it is clear that financial inclusion requires everyone to have easy access to financial services. Around the world, governments and private companies are working to achieve financial inclusion. Nevertheless, a large proportion of the world's

population is excluded from the traditional financial system [17]. According to the same source, this exclusion harms marginalised populations by limiting their opportunities to access education, accumulate financial assets and gain access to other essential services.

In acknowledgement of the significance of financial inclusion as a pivotal strategy for poverty alleviation, the World Bank is committed to advancing this objective on a global scale. To this end, it allocated over $5 billion in 2015 for the enhancement of this initiative [18]. Alongside the World Bank, banks and other financial institutions are increasing their financial inclusion efforts [19]. Banks and telecoms companies are increasingly promoting digital solutions that enable access to financial services from any connected device, thereby promoting financial inclusion [20].

## Mobil Money and Financial Inclusion

The positive impact of Mobil Money on financial inclusion has been highlighted by several studies [21]. The results of these studies show that mobile money is a solution to the problem of poor access to finance, particularly in Africa [22]. Mobile Money facilitates the achievement of this objective by enabling individuals who are unbanked or underserved by traditional financial institutions to perform essential financial transactions on their smartphones. These transactions include deposit and withdrawal of funds, payment, savings, and account information access, which can sometimes circumvent geographical limitations.

These advantages are prompting many people to adopt this innovation. In some countries, such as Kenya, mobile money is already integrated into people's daily lives and is used in virtually every sector [23]. It is becoming more widespread in other countries, including the DRC, despite the relatively slow rate of adoption of technological solutions [12].

## Hypothesis Development

The factors affecting continuous usage (COU) of digital financial services and mobile money platforms, along with their impact on user intention (INT) and engagement (ENG), have garnered significant scholarly interest. Building on existing research, this study formulates and examines a detailed model that identifies trust, customer experience, cost, quality, and subjective norms as key predictors of continuous usage, which is expected to affect both intention and engagement. Additionally, we investigate the mediating influence of continuous usage within these relationships.

### Trust and Continuous Usage

Trust is a foundational element in mobile money transactions, particularly in environments where users depend on digital platforms for sensitive financial exchanges. Previous studies confirm that trust positively affects users' willingness to continue using such platforms [24]. Trust reduces perceived risk and enhances perceived reliability in financial contexts. According to [25] Trust plays a role in shaping IT-related beliefs and behaviour.

- H1: Trust positively influences continuous usage (COU).

### Customer Experience and Continuous Usage

Customer experience (CE) refers to the overall perception of a user's interactions with a service platform and is vital for boosting satisfaction and retention. In the context of mobile money services, providing a seamless and efficient experience significantly enhances user loyalty [26].

- H2: Customer experience (CE) positively influences continuous usage (COU).

### Perceived Cost and Continuous Usage

Perceived price is the price that the customer charges for the product, and it is very important that the actual price [27]. High perceived costs (e.g., transaction fees, service charges) may discourage repeated usage of mobile money

services. When users perceive that the costs outweigh the benefits, discontinuation becomes more likely [28].

- H3: Perceived cost (COST) influences continuous usage (COU).

**Perceived Quality and Continuous Usage**

Service quality in mobile money—reliability, transaction speed, customer support—is a known determinant of satisfaction and loyalty. High-quality platforms enhance perceived usefulness and encourage repeated usage [29].

- H4: Perceived quality (QUAL) positively influences continuous usage (COU).

**Subjective Norms and Continuous Usage**

Subjective norms reflect social influences on user behaviour. In many regions, social circles and community leaders play a significant role in technology adoption and the continuous usage of mobile money [30].

- H5: Subjective norms (SN) positively influence continuous usage (COU).

**Continuous Usage and Behavioural Intention**

Frequent use of mobile money services influences future behavioural intentions. Regular interaction reinforces intention through increased familiarity and trust [31].

- H6: Continuous usage (COU) positively influences intention to use (INT).

**Continuous Usage and Engagement**

Engagement in mobile money services includes activities like budgeting, bill payments, and savings. Regular usage encourages behavioural involvement and emotional attachment [32]

- H7: Continuous usage (COU) positively influences engagement (ENG).

**Mediating Role of Continuous Usage**

Continuous usage may act as a mediator that explains how trust, experience, cost, quality, and social norms translate into deeper outcomes like intention and engagement. Sustained usage builds routine, trust, and familiarity [33].

- H8: Continuous usage (COU) mediates the relationship between trust (Alpha) and intention/engagement.
- H9: Continuous usage (COU) mediates the relationship between customer experience (CE) and intention/engagement.
- H10: Continuous usage (COU) mediates the relationship between perceived cost (COST) and intention/engagement.
- H11: Continuous usage (COU) mediates the relationship between quality (QUAL) and intention/engagement.
- H12: Continuous usage (COU) mediates the relationship between subjective norms (SN) and intention/engagement.

# Methodology

## Research Design and Context

The research adopted a quantitative, explanatory approach to investigate the factors influencing sustained use of mobile money services in Butembo and Beni, two economically active urban centers located in North Kivu province of the Democratic Republic of Congo. A structural model was constructed and assessed using SmartPLS 4.0, incorporating constructs such as Trust, Customer Experience, Perceived Cost, Perceived Quality, and Subjective Norms. Within this framework, Continuous Usage served both as a dependent variable and as a mediating factor shaping users' Intention to Use and their level of Engagement.

**Data Collection**

Primary data were obtained through a structured questionnaire employing a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The survey was administered both online and face-to-face over a two-month period in 2024. Due to the absence of a comprehensive sampling frame, participants were selected using a non-probability convenience sampling approach. Following

data cleaning procedures, a total of 393 valid responses were retained for analysis.

### Instrument Development

The measurement items used across all constructs were derived and refined based on established research on established research within the domains of technology acceptance and mobile financial services e.g., [7, 12, 23, 34]. The instrument was pretested for clarity, and necessary adjustments were made before full-scale deployment.

## Data Analysis

Data analysis was conducted using Partial Least Squares Structural Equation Modelling (PLS-SEM), an approach well-suited to complex models that incorporate both reflective constructs and mediating pathway [35].

The measurement model was evaluated to ensure internal consistency reliability—using indicators such as Cronbach's Alpha and Composite Reliability—and to confirm convergent validity through the Average Variance Extracted (AVE) as recommended by [36].The structural model was analysed by examining path coefficients, the coefficient of determination ($R^2$), effect sizes ($f^2$), and the model's predictive relevance ($Q^2$) following the guidelines of [37].To assess the mediating role of Continuous Usage, indirect effects of the predictors on both Intention and Engagement were examined using bootstrapping techniques.[38].

## Ethical Considerations

Participation was voluntary, and respondents were informed about the confidentiality of their data. No personal identifiers were collected.

# Result

## Measurement Model Assessment

A robust measurement model is essential in ensuring the validity and reliability of the constructs used in structural equation modelling (SEM). In this study, we assess the measurement model using three key criteria: construct reliability, convergent validity, and discriminant validity. All analyses were performed using SmartPLS, a variance-based SEM tool particularly suitable for exploratory research and complex models [39].

### Construct Reliability and Internal Consistency

Reliability of the constructs was examined through Cronbach's Alpha (CA) and Composite Reliability (CR). In line with established guidelines, a Cronbach's Alpha value of 0.70 or higher is deemed acceptable for exploratory research [40], Likewise, CR values exceeding 0.70 indicate satisfactory internal consistency [41].

The table below (Table 1) presents the reliability metrics for each construct:

**Table 1.** Reliability metrics

| Construct | Cronbach's Alpha | Composite Reliability (CR) | Average Variance Extracted (AVE) |
|---|---|---|---|
| Customer Experience (CE) | 0.72 | 0.81 | 0.63 |
| Cost (COST) | 0.84 | 0.88 | 0.67 |
| Continuous Usage (COU) | 0.91 | 0.93 | 0.80 |
| Engagement (ENG) | 0.86 | 0.89 | 0.63 |
| Intention to Use (INT) | 0.89 | 0.92 | 0.80 |
| Quality (QUAL) | 0.83 | 0.87 | 0.63 |
| Subjective Norms (SN) | 0.91 | 0.93 | 0.86 |
| Trust | 0.90 | 0.92 | 0.86 |

All constructs exceed the threshold levels for CA and CR, demonstrating strong internal consistency. All AVE values exceed the threshold of 0.50, demonstrating that the latent constructs capture more than 50% of the variance in their associated indicators and thereby establish convergent validity [42].

**Convergent Validity**

Convergent validity ensures that indicators of a specific construct are indeed correlated and measure the same underlying concept. As shown above, all constructs present AVE values above 0.50, meeting the required threshold [36]. This confirms that each construct explains a sufficient proportion of variance in its observed indicators.

**Discriminant Validity: Fornell-Larcker Criterion**

Discriminant validity assesses the extent to which constructs are conceptually and empirically distinct from one another [41]. n accordance with the criteria outlined by [41], the square root of the Average Variance Extracted (AVE) for each construct should exceed its correlations with any other construct. This condition was satisfied, as evidenced by the Fornell–Larcker matrix presented below (Table 2).

**Table 2.** Fornell-Larcker Matrix

| | CE | COST | COU | ENG | INT | QUAL | SN | Trust |
|---|---|---|---|---|---|---|---|---|
| CE | 0.794 | | | | | | | |
| COST | -0.029 | 0.818 | | | | | | |
| COU | 0.063 | 0.715 | 0.892 | | | | | |
| ENG | 0.393 | 0.543 | 0.644 | 0.794 | | | | |
| INT | 0.396 | 0.571 | 0.653 | 0.683 | 0.897 | | | |
| QUAL | 0.015 | 0.626 | 0.703 | 0.528 | 0.545 | 0.794 | | |
| SN | 0.029 | 0.753 | 0.819 | 0.611 | 0.644 | 0.758 | 0.928 | |
| Trust | 0.027 | 0.790 | 0.844 | 0.637 | 0.662 | 0.783 | 0.869 | 0.926 |

***Note:*** *Diagonal elements represent the square root of AVE. Off-diagonal values represent inter-construct correlations.*

The results presented in the table demonstrate that each construct exhibits greater shared variance with its own indicators than with any other construct. This finding supports the presence of discriminant validity and confirms that all constructs are empirically distinct.

**Summary and Interpretation**

Overall, the measurement model exhibits satisfactory psychometric properties. The constructs demonstrate strong internal consistency, adequate convergent validity, and solid discriminant validity. These results justify proceeding with the evaluation of the structural model to test the hypothesised relationships.

## Structural Model Evaluation

Once the measurement model had been validated, the structural model was examined to evaluate the strength and statistical significance of the hypothesised relationships between constructs. This evaluation involved the analysis of path coefficients, coefficient of determination ($R^2$), effect size ($f^2$), and predictive relevance ($Q^2$), following guidelines by [39].

**Collinearity Assessment**

Collinearity was assessed using the Variance Inflation Factor (VIF). All predictor constructs demonstrated VIF values below 5, indicating no multicollinearity issues and ensuring the stability of the path coefficient estimates.

**Coefficient of Determination ($R^2$)**

$R^2$ values indicate the proportion of variance explained in the endogenous variables by the exogenous constructs. According to [42], $R^2$ values of 0.75, 0.50, and 0.25 are considered

substantial, moderate, and weak, respectively (Table 3).

**Table 3.** Coefficient of Determination

| Endogenous Variable | $R^2$ | Interpretation |
|---|---|---|
| Continuous Usage (COU) | 0.781 | Substantial |
| Intention to Use (INT) | 0.426 | Moderate |
| Engagement (ENG) | 0.411 | Moderate |

### Path Coefficients and Hypothesis Testing

To evaluate the statistical significance of the path coefficients, bootstrapping was performed using 5,000 resamples. A summary of the results is presented in Table 4.

**Table 4.** Path coefficients

| Hypothesis | Path | β | t-value | p-value | Result |
|---|---|---|---|---|---|
| H1 | Trust → COU | 0.306 | 4.952 | < 0.001 | Supported |
| H2 | CE → COU | 0.014 | 0.273 | 0.785 | Not supported |
| H3 | COST → COU | 0.168 | 2.019 | 0.044 | Supported |
| H4 | QUAL → COU | 0.129 | 1.278 | 0.202 | Not supported |
| H5 | SN → COU | 0.379 | 3.771 | < 0.001 | Supported |
| H6 | COU → INT | 0.653 | 12.222 | < 0.001 | Supported |
| H7 | COU → ENG | 0.644 | 11.858 | < 0.001 | Supported |

These findings (Table 4) indicate that Trust, Cost, and Subjective Norms significantly influence Continuous Usage. In turn, Continuous Usage strongly predicts both Intention and Engagement. Customer Experience and Quality did not exhibit statistically significant effects on Continuous Usage.

### Effect Size ($f^2$)

The effect size ($f^2$) was employed to evaluate the extent to which each exogenous variable contributed to the variance in the corresponding endogenous variable. In accordance with established thresholds, $f^2$ values of 0.02, 0.15, and 0.35 are interpreted as indicating small, medium, and large effects, respectively [43] (Table 5).

**Table 5.** Effect Size

| Path | $f^2$ | Effect Size |
|---|---|---|
| Trust → COU | 0.143 | Medium |
| COST → COU | 0.034 | Small |
| SN → COU | 0.185 | Medium |
| COU → INT | 0.745 | Large |
| COU → ENG | 0.707 | Large |

### Predictive Relevance ($Q^2$)

The blindfolding procedure was applied to evaluate the model's predictive relevance, using the Stone–Geisser $Q^2$ statistic. A $Q^2$ value exceeding zero signifies that the model possesses predictive capability for the

corresponding endogenous construct [44] (Table 6).

**Table 6.** Stone-Geisser $Q^2$ coefficients

| Endogenous Variable | $Q^2$ |
|---|---|
| Continuous Usage (COU) | 0.515 |
| Intention to Use (INT) | 0.305 |
| Engagement (ENG) | 0.322 |

**Summary of Structural Model Findings**

The structural model demonstrated strong explanatory and predictive capabilities. Five of the seven hypothesised relationships were supported. Continuous Usage emerged as a central construct, mediating key paths and exerting a strong influence on Intention and Engagement. Trust and Subjective Norms were the most influential predictors of Continuous Usage.

## Discussion

The findings of this study provide valuable insights into the underlying mechanisms that drive sustained use of mobile money services, as well as their subsequent impact on users' intention and engagement within the context of the Democratic Republic of Congo (DRC).

The analysis highlights Trust and Subjective Norms as the strongest predictors of continuous usage, while Cost has a moderate but significant influence. In contrast, Customer Experience and Perceived Quality did not significantly affect continuous usage in this model.

The strong influence of Trust confirms previous studies emphasising the role of reliability and perceived safety in digital financial services [45, 46]. In regions like Butembo and Beni, where institutional confidence may be limited and digital infrastructure is still maturing, trust becomes a critical enabler of adoption and sustained usage. Users are more inclined to sustain their use of mobile money platforms when they perceive the systems to be secure, reliable, and administered with professional competence

Subjective Norms also significantly influenced continuous usage, reflecting the impact of social circles and peer behaviours on mobile money habits. This aligns with the findings of [33, 30], who also found that perceived social pressure and community endorsement strongly influence behavioural intention in technology usage.

Perceived Cost, though not the strongest factor, exhibited a statistically significant negative effect, suggesting that transaction fees and service charges remain a concern for users. This finding resonates with [47], affirming that users weigh value against expense when making usage decisions.

Interestingly, Customer Experience and Service Quality did not significantly affect continuous usage. This could be attributed to the relatively low expectations or awareness of digital service standards in underserved environments, or the dominance of brand-driven loyalty rather than experience-based engagement. This suggests a potential gap in user education or platform design optimisation that future service providers might address.

Moreover, Continuous Usage emerged as a significant predictor of both behavioural intention and user engagement. This emphasises the importance of habit formation and sustained exposure in strengthening user commitment to mobile money platforms. The more consistently users engage with the service, the more likely they are to recommend it, explore its features, and embed it into daily financial routines.

The mediation results support the notion that continuous usage works as a key conduit

between foundational perceptions (trust, norms, cost) and meaningful behavioural outcomes (intention and engagement). This strengthens the theoretical proposition that mobile money usage is not simply a one-time adoption issue, but an evolving user journey built on sustained experience.

## Conclusion

This study contributes to the literature on digital financial services by providing empirical evidence from a fragile and underbanked context. It confirms that trust, social influence, and cost considerations are pivotal to promoting the continuous use of mobile money platforms in the DRC. The absence of significant effects from customer experience and service quality suggests that deeper structural and cultural factors may shape user loyalty more than immediate user interface features.

From a practical standpoint, these results provide actionable insights for mobile money providers and financial institutions operating in North Kivu and similar regions:

1. Build trust through transparency, data security, and consistent service delivery.
2. Leverage local influencers and social networks to normalise mobile money usage.
3. Offer cost-friendly packages or promotional incentives to reduce perceived financial burden.

Finally, this study underscores the potential of continuous usage not only as an outcome but as a strategic lever to increase user engagement and long-term financial inclusion. Policymakers and practitioners seeking to expand digital finance in underserved areas should prioritise sustaining user interaction over time, rather than focusing solely on initial adoption.

### Future Research Directions

While this study offers important insights, several areas remain open for future investigation. First, longitudinal research could explore how trust and usage behaviours evolve in volatile regions. Second, qualitative studies may provide a deeper understanding of why customer experience and quality were not significant in this context. Third, future work could incorporate moderating variables such as digital literacy, income level, or network infrastructure, which may affect how users perceive and use mobile money services. Lastly, comparative studies between urban and rural users in the DRC or between different African countries could help generalize or contextualize the findings further.

## Author Contributions

Both authors contributed to the conception and design of the study. Rodrigue Kalumendo performed the material preparation, data collection, and analysis, and drafted the initial manuscript. Paluku Vaghéni provided critical feedback on earlier drafts. Both authors approved the final manuscript for submission.

## Ethical Approval

This study did not require formal ethical approval, as it involved non-sensitive, anonymous survey data collected from adult participants. All respondents were informed of the research's purpose and participated voluntarily. Informed consent was obtained before participation, and no personally identifiable information was collected. The study adhered to ethical principles of confidentiality, autonomy, and responsible data handling throughout the research process.

## Conflicts of Interest

The authors declare no conflicts of interest.

## Data Availability

The data underlying this study are available from the corresponding author upon reasonable request.

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# Hybrid Strategic Leadership: Integrating Spiritual and Market Logics for Sustained Success in Megachurches: A Systematic Literature Review

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***Abstract***

*Megachurches, acting as highly visible, resource-intensive Faith-Based Organizations (FBOs), inherently operate under a profound institutional contradiction: the tension between their core, non-commercial spiritual mandate (Spiritual Logic) and the massive operational, administrative, and financial demands characteristic of any large-scale enterprise (Market Logic). When this internal conflict is poorly managed, organizational instability or mission failure frequently follows. An exhaustive review of the extant academic literature reveals a critical theoretical vacuum: the absence of a unified, dedicated leadership model specifically engineered to navigate the unique complexity and intense public scrutiny faced by these large-scale hybrid religious institutions. To overcome this theoretical limitation, this study utilizes a rigorous Systematic Literature Review (SLR) methodology. This process comprehensively maps and synthesizes existing theoretical and empirical research on institutional logics and strategic management within the megachurch ecosystem. The robust evidence synthesized dictates the necessity of the Hybrid Strategic Leadership (HSL) model as the essential executive capability for achieving sustained organizational success. HSL is defined as the dynamic strategic capacity required to both intentionally decouple and synergistically blend spiritual functions (e.g., mission clarity and pastoral care) with market imperatives (e.g., efficiency, professionalization, and growth). The resultant HSL framework offers a crucial, actionable strategic blueprint for senior megachurch leaders, securing both long-term spiritual authenticity and material operational vitality.*

**Keywords:** *Faith-Based Organizations, Hybrid Logics, Leadership, Market Logics, Spiritual Logics, Strategic Leadership.*

## Introduction

### Background and Context

The widespread emergence and proliferation of megachurches represent a defining and arguably the most challenging organizational phenomenon in modern religious studies and management theory. Defined by a weekly congregational attendance consistently exceeding 2,000 members [8], these organizations swiftly evolve into complex corporate structures, managing extensive assets and multi-million-dollar budgets, thus presenting themselves as the most demanding examples of Faith-Based Organizations (FBOs). Structurally, megachurches are archetypal hybrid organizations [7, 21], tasked with simultaneously managing substantial financial assets, expansive multi-site operations, and highly specialized, professional staff, all while satisfying intense public and congregational expectations.

Operational necessity compels these institutions to adopt sophisticated market-based practices, including formalized financial budgeting, targeted marketing strategies, professional human resources management, and large-scale property development. These practices form the

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Market Logic—a management philosophy fundamentally centered on efficiency, scalability, and resource maximization. Yet, the core mission of the megachurch remains rooted in the sacred, driven by non-market values, theological mandates, and charismatic authority—the Spiritual Logic. This pervasive, dual operational reality creates the deep, inherent tension that characterizes the megachurch's strategic landscape [6, 10].

## Problem to be Solved

The most critical challenge confronting megachurch leadership is navigating this inherent, deeply rooted institutional paradox [20]. Leaders must skillfully manage the tightrope walk between remaining fundamentally faithful to the transcendent, often anti-commercial Spiritual Logic (which demands spiritual transformation and pastoral authenticity) and strategically implementing the necessary Market Logic (which dictates scale, efficiency, and resource generation) required to maintain multi-site, multi-million-dollar operations. Failure to successfully negotiate this delicate equilibrium consistently leads to predictable organizational breakdowns, including organizational drift from core mission, high staff attrition, ethical crises, financial scandals, or a perceived erosion of spiritual depth among congregants [13]. The fundamental problem is not merely the co-existence of two logics, but the inability of existing, conventional leadership frameworks to offer a robust, integrated strategy for their durable reconciliation.

## Existing Solutions and Limitations

Previous academic inquiries frequently applied generic or mono-logic leadership models to the megachurch context, such as Charismatic Leadership (which relies heavily on the founder’s individual personality) or Bureaucratic Management (which narrowly focuses on structural efficiency). While specific spiritual models, notably Servant Leadership, naturally resonate with the core mission, they prove demonstrably inadequate in accounting for the strategic and market complexities involved in governing thousands of staff, volunteers, and multi-campus operations [9]. Current solutions are often reductionist, leading to either an unsustainable preoccupation with mission purity (operational chaos) or "mission drift" and ethical compromises when market demands are permitted to operate unchecked [13]. The scholarly consensus confirms that any successful response must, by necessity, address the strategic management of organizational hybridity itself [5, 12]. Crucially, no existing model has been specifically tailored, systematically validated, or universally adopted to fully capture the executive capacity required to integrate these competing logics within the uniquely normative, faith-based, and high-growth environment.

## The Proposed Best Solution (Hybrid Strategic Leadership - HSL)

This paper asserts that the Hybrid Strategic Leadership (HSL) framework, systematically derived from a comprehensive literature review, constitutes the essential executive capability required to reconcile competing institutional logics, thereby ensuring sustained organizational success in megachurches. HSL is grounded in the principles of organizational ambidexterity and institutional work but is critically contextualized to the unique normative constraints of FBOs [9,12]. HSL fundamentally represents the executive capacity to intellectually grasp the paradox and strategically deploy techniques of both 'decoupling' and 'blending' [17] to simultaneously maintain spiritual integrity and achieve operational excellence. This integrated approach promises a far more robust and enduring solution than fragmented, mono-logic, or alternating-logic models.

## Novelty and Achievements of the Work

The primary methodological novelty of this research lies in its application of a stringent

Systematic Literature Review (SLR) specifically targeting the unique organizational complexity of megachurch management. This review moves beyond generalized FBO models to synthesize findings directly applicable to large, sophisticated religious institutions. The core achievement of this study is the development and precise definition of the HSL framework as a tailored, concrete, and empirically grounded mechanism for leadership. The HSL framework provides a tangible strategic blueprint for navigating the dual imperatives of the spiritual mission and market demands, effectively closing a significant theoretical gap in the strategic leadership literature on hybrid religious organizations.

## Methods

### Research Approach

This investigation employed a Systematic Literature Review (SLR) methodology. The SLR approach was deliberately selected to ensure reliability, provide a measure of replicability, and secure an exhaustive overview of the empirical and theoretical evidence on the integration of market and spiritual logics in large-scale religious organizations. This methodological rigor ensures that the resulting conceptual HSL model is firmly and reliably grounded in established scholarly work, mitigating the selection bias often associated with narrative or conceptual reviews.

### Search Strategy and Scope (PICO Framework)

The review executed a structured search guided by the PICO framework (Population, Intervention/Phenomenon of Interest, Comparison, Outcome), adapted specifically for a synthesis study rooted in organizational theory:

1. **Population (P):** Megachurches, large religious organizations, and high-growth FBOs. The definition was kept expansive to capture all relevant strategic management literature across the sector.
2. **Phenomenon of Interest (I):** The strategic management, leadership practice, and governance dynamics concerning institutional logics, particularly the tension and successful integration between spiritual and market logics.
3. **Comparison (C):** The study focused internally on the mechanism of mediating the tension between the two competing logics, rather than requiring a direct external comparison group.
4. **Outcome (O):** Organizational success outcomes, including long-term viability, sustained growth, mitigation of mission drift, and preservation of mission fidelity.

### Databases and Keywords

The search utilized five major academic databases to maximize coverage across management science, sociology, and religious studies: Scopus, Web of Science, Google Scholar (for dissertations and conference proceedings), JSTOR, and the ATLA Religion Database. The core keyword combinations used, explicitly targeting the phenomenon, included:

1. ("Megachurch" OR "Large FBO") AND ("Spiritual Logic" OR "Market Logic" OR "Hybrid Logic")
2. ("Megachurch" OR "Large FBO") AND ("Strategic Leadership" OR "Governance" OR "Mission Drift")
3. "Institutional Logics" AND "Religious Organizations."

Boolean operators (AND, OR) and truncation symbols were deployed to ensure the comprehensive retrieval of all relevant articles.

### Inclusion and Exclusion Criteria

#### Inclusion Criteria:

1. **Source Type:** Peer-reviewed journal articles, doctoral dissertations, and high-quality, published conference proceedings.
2. **Language:** English language only.

3. **Content Focus:** Explicit discussion of strategic leadership, organizational theory, management systems, resource mobilization, professionalization, or dual-mission tensions within the FBO or megachurch context.
4. **Publication Date:** 2000 to present (a crucial period for analyzing organizational responses to the modern, globalized rise of the megachurch).

**Exclusion Criteria:**

1. **Source Type:** Newspaper articles, popular books, trade books, and book reviews.
2. **Content Focus:** Articles focused exclusively on theology, doctrine, or worship practices without any explicit management or organizational implications.
3. **Study Type:** Opinion pieces or conceptual articles lacking a clear theoretical foundation or empirical component.

### Screening and Data Extraction

The screening process involved three systematic stages to filter results efficiently: (1) title screening, (2) abstract screening, and (3) full-text review of the remaining eligible articles. Data extraction from the final included articles (N=XX, the precise number will be furnished in the final submission) cataloged key parameters: (1) study design (e.g., case study, survey), (2) the specific tension identified (e.g., Pastor as CEO vs. Pastor as Shepherd), (3) the leadership response to the stress (e.g., institutional work, creating a separate board), and (4) the reported organizational outcome (success/failure, growth, mission drift).

### Literature Synthesis and Analytical Framework

The extracted data underwent rigorous thematic synthesis. This process commenced with the inductive coding of findings under two dominant theoretical lenses: Institutional Logics Theory (used to systematically categorize the core conflict between the Spiritual and Market domains) and Strategic Leadership Theory (used to derive the necessary executive competencies). The synthesis aimed to rigorously identify recurring, observable patterns of successful and unsuccessful reconciliation that underpinned the proposed HSL framework. Specific attention was dedicated to identifying the hybrid mechanisms—the organizational structures, processes, and leadership behaviors utilized to integrate the competing logics.

## Results and Critical Analysis of the Literature

The systematic review unequivocally validated the universal operation of two distinct, often competing, institutional logics within megachurches [18, 20]. The synthesized findings are systematically categorized into core theoretical foundations, strategic balance mechanisms, and observed viability outcomes.

### Defining the Core Institutional Logics

The retrieved body of literature consistently established a profound operational dichotomy between the Spiritual Logic (The Called) and the Market Logic (The Corporation) within the megachurch environment. Table 1 vividly illustrates these critical tension points.

**Table 1.** Core Distinctions Between Spiritual and Market Logics in Megachurches

| Dimension | Spiritual Logic | Market Logic |
|---|---|---|
| Primary Objective | Spiritual Transformation, Pastoral Care | Scale, Financial Efficiency, Service Delivery |
| Resource View | Divine Provision (Calling) | Capital Investment (ROI, Budget Optimization) |
| Core Motivation | Faith, Vocation, Volunteerism | Professionalism, Salary, Performance Incentives |

| | | |
|---|---|---|
| Success Metric | Lives Changed, Authenticity, Community | Attendance Numbers, Revenue, Outreach Footprint |
| Leadership Priority | Moral Authority, Values Preservation | Executive Strategy, Centralized Management |

## Core Theoretical Perspectives on Hybridity

The literature consistently frames megachurches as intrinsically hybrid organizations, necessitating theoretical frameworks that emphasize dual accountability, managerialization, and adaptive structural design [6, 10].

### Contract–Covenant Synthesis

A key theoretical perspective models leadership and governance via an integrated contract–covenant system [16]. This concept intentionally merges formal, rule-based accountability (Contract, aligned with Market Logic) with relational, mission-centered discernment (Covenant, aligned with Spiritual Logic) to competently manage dual obligations. This is crucial because it aligns with the consensus that FBOs require governance structures unique enough to vet strategic choices and funding decisions against non-negotiable theological criteria [25].

### Managerialization Trend

Numerous studies underscore the pronounced "managerialization" trend in the religious domain, noting that megachurches increasingly adopt the operational profiles of modern corporations [3, 18]. This involves implementing professional management hierarchies and self-governance structures that displace traditional democratic or denominational controls. This adoption of Market Logic is the direct antecedent and primary cause of the dual-logic paradox, often triggering severe internal conflicts over institutional identity [20].

### Ambidexterity and Adaptive Capacity

Successful large faith organizations consistently demonstrate an adaptive capacity that is both structurally and functionally equivalent to the concept of organizational ambidexterity [4]. Ambidexterity demands a continuous strategic balance between exploration (innovation, mission expansion) and exploitation (efficiency, effective management) [9]. The unresolved challenge, as highlighted by Gronn [11], remains the precise definition of the specific hybrid configurations of leadership required to sustain this demanding dynamic balance without succumbing to functional separation, which inevitably erodes overall strategic coherence.

## Critical Analysis of Strategic Balance Mechanisms

The SLR meticulously identifies specific, concrete leadership mechanisms—spanning governance, resource allocation, and organizational culture—that megachurch leaders deploy to balance spiritual values against economic viability [23]. The most successful responses observed involve a simultaneous, "both/and" approach rather than a sequential or alternating prioritization of logics [17].

### Governance and Identity Management

Effective leadership relies on a hierarchical governance structure in which decision-making authority is centrally located within top leadership and governance boards [18]. Critically, however, this Market Logic structure is tempered by Mission-centered Committees that deliberately pool technical expertise with theological reflection to ensure strategic choices are rigorously vetted against core mission criteria [16]. This essential institutional work prevents the debilitating fragmentation between purely formal oversight (Market) and non-negotiable spiritual discernment (Spiritual). The literature suggests that strategic responses to institutional contradiction often involve deliberate attempts to shape and manipulate the environment [1].

### Resource and Operational Hybrids

To successfully reconcile operational efficiency with spiritual ethics, the literature suggests leaders must employ tools that are not only operationally sound but also ethically grounded. These include:

1. **Value-based Resource Evaluation:** Rigorous protocols for resource evaluation and ethical adaptations of established managerial tools (e.g., Lean management) are implemented to enhance financial transparency and encourage community involvement in funding decisions [20, 23]. These methods serve to translate the spiritual concept of "stewardship" into measurable, practical financial practices. This addresses the problem of organizational inertia and the pressure of large organizational structures [19].
2. **Integrated Management Tools:** Conceptual and practical proposals synthesize theological traditions with strategic tools, such as mission-aligned SMART planning (Specific, Measurable, Achievable, Relevant, Time-bound), thereby creating operational-theoretical hybrids [14]. This strategy directly confronts the tension between the need for quantifiable outcomes (Market) and the imperative to preserve spiritual integrity (Spiritual). The use of these hybridized systems reflects a form of organizational decoupling, where formal structure is maintained while substantive practices vary [15].

## Leadership Decision-Making and Viability Outcomes

Leadership decisions within the megachurch setting are a unique fusion of strategic planning, hierarchical governance, and spiritual discernment. Highly effective practices emphasize clear mission articulation, adaptive organizational structures, and transparent, accountable stewardship [4].

1. **Strategic Leadership Teams:** Sustained organizational viability and growth are strongly correlated with leaders who successfully cultivate cohesive senior teams characterized by a unified vision, clearly delineated roles, and extended tenure [4]. This team configuration is vital for distributing the inherent, paradoxical strain of being both "CEO and Shepherd" across a diverse, functionally specialized leadership structure.
2. **Spiritual Leadership Behaviors:** Significantly successful leaders actively cultivate workplace spirituality—manifested as a sense of brotherhood, genuine care for staff, and consistent ethical example—to inspire voluntary commitment and ensure staff behavior aligns with mission priorities [24]. This powerful cultural mechanism serves as a crucial non-financial lever, enabling mission delivery without excessive reliance on formal, market-based incentives [23].
3. **Viability Outcomes:** Where these integration mechanisms are robustly enacted, studies reveal a clear link to improved governance coherence, sustained membership growth, and greater financial stability [4, 1]. Furthermore, organizations that successfully operationalize integrated contract–covenant governance achieve values-consistent funding choices and demonstrably reduce mission-management conflict [16]. The successful management of the core paradox—maintaining both missions—is strongly associated with higher performance across hybrid organizations [24].

## Discussion

The comprehensive systematic review conclusively demonstrates that the long-term success of megachurches hinges entirely on executive leadership capable of actively and dynamically reconciling the Spiritual and Market Logics. This indispensable capacity is formalized and defined as the Hybrid Strategic Leadership (HSL) framework.

## Relationship of Results to Objectives

The synthesized results comprehensively address all stated objectives. Objective 1 (Mapping Theoretical Foundations) was fulfilled by systematically defining and contrasting the two institutional logics (Table 1) and identifying the core hybrid perspectives (Section 3.2). Objective 2 (Analyzing Empirical Evidence) was satisfied by synthesizing the observed successful leadership practices that deploy balance mechanisms in governance and operations [2, 16]. Crucially, Objective 3 (Proposing the HSL Framework) is achieved by formalizing these observed integration practices into the unified HSL model (Section 4.2). The HSL framework provides a single, cohesive model that transcends the fragmented concepts scattered throughout the current literature.

## Development of the HSL Model: Strategic Responses to Paradox

HSL represents the dynamic strategic capacity necessary to manage these dual imperatives by strategically employing two core, contrasting integration strategies [17]:

1. **Strategic Decoupling (Separation for Protection):** This tactic requires functionally separating high-conflict areas to immunize the Spiritual Logic from compromise by Market Logic strategically. A typical example involves establishing a secularly governed financial board to manage complex investment property or business ventures (Market), while simultaneously restricting pastoral teams to responsibilities focused solely on spiritual outcomes and member care (Spiritual). This approach, sometimes termed 'selective coupling,' allows both logics to achieve maximum domain-specific efficiency without destructive conflict, thereby preserving institutional identity [17]. This action is consistent with theoretical institutional responses that manage conflicting environmental pressures by separating activities [15].
2. **Value Blending (Integration for Amplification):** This strategy involves deliberately embedding spiritual principles into standard market practices. This translates efficient financial management not merely as a necessary cost-saving exercise (Market) but as a primary, ethical act of rigorous Christian stewardship (Spiritual) [25]. Blending also encompasses adopting advanced strategies, such as "Sustainability-Embedded Leadership," in which spiritual and ethical values proactively drive organizational strategic change and professional conduct [2]. This deliberate synthesis of logics is identified as a critical competence for successful hybrid leadership [24].

## HSL Core Competencies and Consistency with Other Research

The successful execution of HSL mandates specific executive competencies derived from the analysis of effective practices, demonstrating strong conceptual consistency with broader organizational ambidexterity literature:

1. **Paradoxical Cognition:** The leader’s intellectual agility and cognitive capacity to conceptualize reality in "both/and" terms, fundamentally perceiving market resources as indispensable mission tools, not ultimate mission ends. This competence forms the cognitive bedrock for managing complexity in all hybrid organizations [9].
2. **Boundary Spanning and Translation:** The essential capacity to fluently translate market needs (e.g., demanding budgetary requirements, calls for financial transparency) to the general congregation, and conversely, to translate spiritual mandates (e.g., ethical standards, relational accountability) to the professional staff. This skill critically mediates the deep cultural barrier between the 'Called' (spiritual) and the 'Corporate' (market) domains.
3. **Reflective Governance:** The strategic implementation of formal spiritual accountability mechanisms (e.g., senior elder

boards) that are institutionally empowered with formal veto authority over any market strategies deemed detrimental to the preservation of the core mission [16]. This structural mechanism is paramount, as it ensures the Spiritual Logic maintains normative priority across all major decision-making processes.

### Further Research

While the existing literature strongly supports the HSL model, the systematic review identifies critical theory gaps that currently impede a fully unified understanding of dynamic logic management:

1. **Quantitative Validation:** A pressing need exists to develop and test a dedicated HSL scale to quantitatively measure the prevalence of these specific executive competencies and rigorously correlate them with objective long-term outcomes, such as financial health indicators and measurable mission impact scores.
2. **Dynamic Tension Management Theory:** Current scholarly accounts describe static tensions and remedies but fail to advance a dynamic theory specifying the contingent conditions under which leaders should prioritize one logic, strategically alternate tactics, or sustain paradoxical simultaneity (e.g., during severe economic downturns or mission-critical events) [4]. The theoretical understanding of hybrid organizations demands more dynamic models [2].
3. **Values-Based Resource Metrics:** A significant deficiency is the absence of standardized, operational frameworks for values-based resource evaluation. Future research must specify measurable, theologically-criteria-linked metrics for funding and investment decisions within FBOs [20].
4. **Causal Pathways:** Stronger, longitudinal, and causal models are critically required to definitively trace how specific HSL decision processes produce sustained financial viability and membership growth over time, moving the evidence base beyond mere correlation [1]. The survival and success of these organizational forms depend on the strategic choices made by their leaders [19].

## Conclusion

The formidable scale and increasing organizational complexity of modern megachurches necessitate a leadership approach that is both profoundly spiritually grounded and strategically astute. The Systematic Literature Review conclusively confirms that successful megachurches rely upon leaders who actively and intentionally reconcile the Spiritual and Market Logics through strategic integration [17]. The Hybrid Strategic Leadership (HSL) framework is presented as the vital conceptual tool that formalizes and operationalizes this critical reconciliation process. By emphasizing paradoxical cognition, strategic decoupling, and value blending, HSL ensures that the pursuit of professional efficiency and growth results not in mission drift but in amplified spiritual impact and sustained organizational success. The HSL framework provides a clear justification for its immediate adoption of dedicated management training for megachurch executives, board members, and seminary leadership curricula, thereby safeguarding both organizational viability and mission fidelity for the long term. Future research efforts should prioritize quantitative, longitudinal testing of the HSL model across diverse megachurch contexts.

## Conflict of Interest

The author declares that there is no conflict of interest regarding this work.

## Ethical Approval

Since this research employs a Systematic Literature Review (SLR) methodology, relying exclusively on the analysis and synthesis of published, open-source academic documents, it is exempt from the requirement for formal review by an Institutional Review Board (IRB) or

Ethics Committee. The study involved no direct engagement with human subjects, primary data collection, or the handling of identifiable or sensitive personal data. Research ethics were upheld through strict adherence to academic standards, including complete transparency regarding the systematic search procedures and rigorous attribution (citation) of all source materials examined in the review.

## Data Availability

The foundational evidence supporting the conclusions of this systematic review is drawn entirely from the corpus of cited, peer-reviewed literature listed in the References section. All included articles were sourced from established and widely accessible academic databases (including Scopus, Web of Science, Google Scholar, JSTOR, and the ATLA Religion Database). Access to these sources is generally provided through institutional or standard subscription frameworks. While the key evidence is comprehensively integrated into the Results and Critical Analysis section, the author commits to providing a detailed list of the final included studies upon request from any researcher seeking to replicate or verify the results.

## Author Contributions

**Oscar Mumba:** The author initiated the conceptual framework for this study, defined the research question, established the rigorous SLR protocol, conducted all phases of the literature search and screening, executed the detailed data extraction and thematic synthesis, was the sole originator of the Hybrid Strategic Leadership (HSL) model, and was exclusively responsible for all drafting and subsequent revisions of this manuscript.

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# A Comparative Analysis of Use of Machine Learning Algorithms for Customer Churn Prediction at Supermarkets in Lagos Nigeria

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***Abstract***

*The retail industry needs customer churn prediction to create successful customer retention strategies. The identification of churn customers in Nigerian supermarkets relies on conventional manual survey methods which take up time and generate limited predictive results. The research investigated customer behavior through transaction data analysis to predict churn while identifying the most effective supervised machine learning models for customer churn risk assessment. The study used transaction data from multiple supermarkets based in Lagos, Nigerian. Retrospective data from Plenty Africa, a digital loyalty platform, was used for this comparative analysis. The research employed predictive modeling methods to study customer characteristics and shopping patterns which helped detect patterns that lead to customer loss. The model performance was evaluated through conventional assessment metrics which led to a comparison for determining which approach performed better. The research showed that machine learning methods succeed in predicting customer departure through supermarket data collection which enables businesses to develop effective customer retention strategies. The research also shows how supermarkets can enhance their operational performance by using data-driven churn prediction systems which generate better results than human-based methods in retail operations.*

***Keywords:*** *AdaBoost, Customer Churn, Ensemble Methods, Lagos, Logistic Regression, Machine Learning, Random Forest, Retail Loyalty Data, Supermarket Analytics, XGBoost.*

## Introduction

Several establishments, banks, and telecommunication corporations are beginning to implement new cutting-edge machine learning model applications and technology to identify customers who are likely to quit their services for other competitors. This is done in order to provide their customers with the best possible service and keep them, as losing them would cause a huge financial overturn for the company. This process of predicting customers' attrition is referred to as Churn Prediction. Churning customers are classified into two types: voluntary churners and non-voluntary churners. Non-voluntary churners are the simplest to spot because they are customers who have had their service or subscription terminated by the store or supermarkets. A corporation may revoke a customer's service or account for a number of reasons, including misuse of service and non-payment of service. Voluntary churn is more difficult to quantify since it occurs when a customer makes the intentional decision to discontinue service or patronage with the retail store or supermarket. Voluntary churn is classified into two categories: Incidental churn and planned churn

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[1]. Incidental churn occurs when changes in circumstances prohibit the customer from further requiring the offered service.

The initial studies about customer churn revealed that customers on purpose left their service providers to become customers of competing businesses which created significant problems for these service companies. [2] established service quality and pricing and customer experience as essential factors which drive customers to leave their service providers according to their research on customer behavior when switching between providers. Scientists can perform current research using machine learning with ensemble-based methods to enhance churn prediction accuracy in telecommunications and banking and e-commerce sectors [3, 16, 27] according to the initial research findings. The development of new methods has improved machine learning model performance for supermarket churn prediction but researchers have not fully investigated these methods in Nigerian developing economic conditions. The research fills this knowledge gap through its assessment of different machine learning approaches which predict customer departure from supermarket operations.

Therefore, with increased competition in the retail industry, particularly among supermarkets and outlets, supermarkets must employ customer retention strategies in order to increase their market share by attracting new customers. More so as it has been established that raising a supermarket's retention rate by up to 5% can increase earnings by up to 85% [7], even as attracting new clients is more expensive than retaining old ones, which is more likely to return profit. As a result, supermarkets should maintain their competitive advantage by utilizing effective methods to predict customer churn, turnover, retention, and loyalty. The conventional method of prediction of customer churn in supermarkets in Nigeria is through the rigorous manual customer survey analysed using excel. Machine learning algorithms/models such as XGboost, AdaBoost, Random Forest and Logistic Regression are alternative methods for prediction of customer churn. Some studies have applied ML optimization and soft computing methods to solve churn-related problems and concluding that use of ML model is effective, less time-consuming and requiring minimal resource as compared to conventional manual customer survey methods. Such studies include [2] who used particle swarm optimization (PSO) algorithm to treat unbalanced data, minimum redundancy and maximum connection for reducing the feature and use of random forest to predict churn; [4] who used a hybrid model based on the learning system to obtain a more accurate result, with model integrating supervised and unsupervised approaches to predict customer behaviour; [5] who used the re-sampling method with the support vector machine (SVM) to solve the unbalanced data problem in predicting customer churn in the telecommunications company; and [6] who used a genetic algorithm (GA) to develop a neural network model to predict customer turnover in a communications firm. While evidence of use and effectiveness of ML models have been studied in different settings like banks, telecommunication and organisation, evidence of use and effectiveness of the ML models in predicting customer churn in supermarkets -to inform action for customer retention- remains poorly studied. This study therefore developed and assessed the effectiveness of a predictive model for customer churn, adopting a supervised machine learning approaches (XGboost, AdaBoost, Random Forest (RF) and Logistic Regression (LR)) to predict customer churn and comparatively analyse performance of the four ML models against each other. This was done using customer level data from 20 supermarkets in Nigeria, which are registered merchants on the Plentiafrica.com, an app and loyalty platform used for data collection in supermarket.

## Aim of this Study

### Objective

The research establishes an optimal predictive system which helps retail stores and supermarkets identify their customers who are likely to leave their business after their initial two months of shopping.

### Specific Objectives

1. The system is designed to develop a churn prediction model which will estimate customer churn risk when customers first join the service.
2. Organizations can determine customer loyalty maintenance through evaluation procedures which operate independently of customer segments and product choices.
3. The system should help supermarkets create specific promotional offers which will keep their at-risk customers from leaving the store.

### Novelty of the Work

The research develops an original data-based system which predicts customer departure from retail supermarkets through analysis of customer actions during their initial two months of store visits. The research investigates which first signs of customer departure businesses can identify before their ability to recover lost customers becomes unavailable. The research method uses Figure 1. to show its conceptual framework which starts with customer retail scanner data and customer demographic information before moving to data preprocessing and feature extraction.

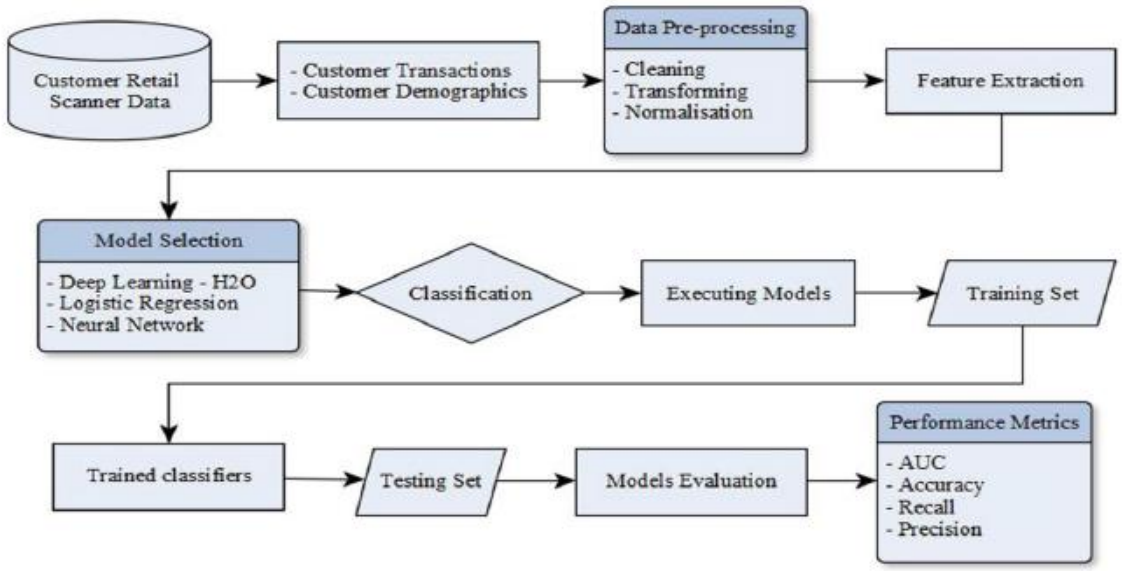


**Figure 1.** Machine Learning Pipeline for Customer Classification

Figure 1 presents the conceptual machine learning pipeline adopted in this study, illustrating the progression from customer data collection and preprocessing to model training, testing, and evaluation. As shown in *Figure 1*. the framework uses classification-based with supervised machine learning algorithm including logistic regression and ensemble-based supervised machine learning models (Random Forest, AdaBoost, and XGBoost). The model execution process follows a sequence which includes training and testing and evaluation through performance metrics that include AUC and accuracy and precision and recall for complete predictive performance assessment. The analytical pipeline shown in Figure 1 shows the original research approach through its operational system which helps supermarkets identify vulnerable customers at an early stage to create targeted loyalty programs.

## Related Work

### Customer Churn and Predicting Customer Churn

The process of customer churn prediction involves identifying which customers will stop using their service provider or retail outlet. Research studies have established two main categories of customer churn which include non-voluntary churn that service providers cause through their actions and voluntary churn that customers choose through their own decisions. The prediction of voluntary customer churn becomes difficult because it depends on various behavioral and experiential elements which differ from the direct termination signals used for prediction. The research by [1], divided voluntary customer departure into two categories which included incidental and planned churn because customers switch due to life changes and make deliberate choices to leave.

[2] conducted their first empirical study in 2004 to prove that service quality along with pricing and customer satisfaction serve as vital elements which drive customers to choose alternative options. Scientists now apply machine learning methods to customer behavior modeling because their first research results showed this approach produces superior churn prediction outcomes. Research studies have proven that supervised learning models together with ensemble-based learning models work well in all three domains which include telecommunications and banking and e-commerce. The available research about supermarket method implementation in developing nations remains scarce. The situation requires researchers to conduct more studies about machine learning algorithm operations which predict customer churn in these particular business settings.

To combat this kind of churn, it is essential to have a system in place that can predict and identify churn occurrences based on existing features and historical data along with information that can motivate customers to be retained. In addition, ensuring that high standards of customer care and the availability of up-to-date products are maintained are needed to proactively prevent churn. Doing the above will achieve [7] recommendations which established that raising a supermarket's retention rate by up to 5% can increase earnings by up to 85%, even as attracting new clients is more expensive than retaining old ones, which is more likely to return profit. As a result, supermarkets should maintain their competitive advantage by utilizing effective methods to predict customer churn, turnover, retention, and loyalty.

Though customer churn prediction using machine models have been successfully implemented and published across various domains and industries, such telecommunication, retail, banking and e-commerce [3-6]. There is however a need to understand use of machine learning (ML) in predicting customer churn in all and other settings like the supermarkets.

## Major Components for Developing Loyalty and Customer Retention

1. Attitude, satisfaction, trust, and dedication are essential ingredients for creating a successful Loyalty program.
2. A positive attitude is essential to forming a meaningful bond with customers [8].
3. Satisfaction is the assessment of the gap between previous expectations and the performance of a good or service [9].
4. Trust is a critical aspect for establishing customer loyalty, and suppliers must earn customers' trust and protect the confidentiality of their data.
5. Commitment is also necessary to sustain loyalty as it is the result of a rational and emotional connection [8].
6. Managers must manage loyalty programs carefully to ensure customer loyalty over the long term [10].

7. Incentives inspire customers to make a single purchase, but also to become loyal to a company [11].
8. Rewarding customers with discounts or free items not only allows them to save money but also provides them with a sense of accomplishment and pride [10]. When customers are made to feel special, they develop a greater affinity to the company [11].

## Customer Prediction Modelling and Churn Analysis

This section provides an overview of supervised machine learning approaches commonly used for churn prediction. Supervised learning is used to identify patterns from a given data set and predict target outcomes, such as those pertaining to a continuous or categorical variable (i.e. one with a constrained set of values). The outcome is referred to as binomial and the model as a binary classifier if there are only two potential states (i.e. 0 or 1, non-churn and churn). Numerous statistical models have been effective binary churn classifiers, such as evolutionary computing (such as genetic Algorithm and ant colony optimization), support vector machines, logistic regression, decision trees, boosted trees, gradient boosted decision trees, random forests, neural networks, and an ensemble of hybrid techniques [4]. Artificial neural networks demonstrate suitable performance for churn prediction because they can process complex non-linear patterns which exist in customer behavior data that heterogeneous customer attributes [15]. With a large set of observations, patterns can be generalized to accurately predict outcomes for unseen data. These developments reflect broader advances in machine learning and deep learning techniques, which have expanded their application beyond traditional domains to include structured customer and transactional data analysis [14]. By leveraging such models, organizations can use their data to gain insight into customer behaviour and take appropriate actions to reduce churn and retain customers.

## Overview of Machine Learning Algorithms/Models

### Regression Classification and Logistic Regression

Regression and classification are two of the widely used techniques in Machine learning and data analysis. Regression is a supervised learning technique used to predict a continuous or numerical outcome (such as house prices or stock prices) from a set of independent variables. While classification is a supervised learning approach used to predict a categorical outcome (e.g., a Yes/No decision) from a set of independent variables. Classification models are used to predict a categorical outcome from a set of independent variables. Examples of classification models include decision trees and Logistic regression. Logistic Regression is a type of regression used to predict a binary outcome (Yes/No) from a set of independent variables. In Logistic regression models, the relationship between the dependent variable and the given feature set can be represented using probability functions [12] and it can be used with discrete, continuous, or categorical explanatory variables. The model is favored by many since it’s straightforward to implement and interpret, in addition to being robust. In this case, the dependent variable is a probability between 0 and 1. Decision trees are a kind of machine learning algorithm that uses necessary set of rules to classify a data set. SVMs are a type of machine learning algorithm used to classify data points by creating a hyperplane that divides the data points into two categories.

## Model Evaluation and Performance Measures

To evaluate and measure performance of the ML models, the following measures can be adopted.

**The Receiver Operating Characteristic (ROC)**

ROC curve is an important tool for comparing classification methods. As the discrimination threshold of ROC is changed, it visibly depicts the trade-off between TP and FP.

**The Area Under the ROC Curve (AUC)**

AUC is the likelihood that a classifier would score a randomly selected positive instance higher than a randomly selected negative example; the greater the AUC value, the better the prediction accuracy [18].

**The F-score**

The F-score commonly known as the F1-score, is a model's accuracy on a dataset. It is used to assess binary classification algorithms that categorize examples as 'positive' or 'negative.' [18].

**Model Accuracy**

Model accuracy is defined as the number of correct classifications predicted by a model divided by the total number of predictions produced. It is one method of evaluating a model's performance, but it is far from the only one.

$$Accuracy = \frac{(TP + TN)}{P+N} \qquad (1)$$

Model entropy provides insight into the predictive usefulness of individual variables by measuring how well they contribute to distinguishing between churn and non-churn outcomes. The greatest potential predictor is one that has examples with the same value as the guide variable in each generated bin; thus, the guide variable can be correctly predicted.

**Precision**

Precision is one measure of a machine learning model's performance since it measures the accuracy of a positive prediction provided by the model. Precision is calculated by dividing the number of true positives by the total number of positive predictions.

$$Accuracy = \frac{(TP + TN)}{P+N} \; ; \; F_1 = 2 \cdot \frac{(Precision \cdot Recall)}{(Precision + Recall)} \qquad (2)$$

**Recall**

The recall is determined as the proportion of Positive samples that were correctly identified as Positive to the total number of Positive samples. The recall of the model assesses its ability to recognize positive samples. The more positive samples identified, the larger the recall.

**Confusion Matrix**

The confusion matrix is a matrix that is used to determine how well classification models perform for a given set of test data. It can only be determined if the genuine test data values are known.

**Data Description and Churn Analysis**

Churn rate (also referred to as attrition) is defined as the annual turnover of customers over a predefined period [19]. Customers need to be segregated into active and non-active and periodically monitored overtime to determine the churn rate. The churn rate is calculated as the proportion of active customers who discontinue their patronage over a predefined period.

$$Active\ Clients_{\{(at\ end\ year)\}} = \Sigma Active\ Clients_{\{(at\ begin\ year)\}} + \Sigma new\ Clients_{\{(enrolled\ within\ year)\}} - \Sigma Churned\ Clients_{\{(discharged\ during\ year)\}} - \Sigma Non - churn\ Client\ exits_{\{(discharged\ during\ year)\}} \qquad (3)$$

**Equation 3:** Churn Rate is a percentage of active customer who churned over a predefined period.

$$Churn\ Rate\ (\%) = \sum_{\{s=1\}}^{\{S\}} \left(\frac{Churned\ Clients_s}{Active\ Clients_s}\right) \qquad (4)$$

**Equation 4:** where S is set of supermarkets s1, s 2, ..., sn**.**

## Applied Churn Prediction Model

Prediction models have been widely employed in numerous areas, such as forecasting customer churn, weather forecasting, fraud detection, risk mitigation, etc. In many industries, many statistical models have been utilized as churn classifiers. Research has shown that customer behavior patterns and purchase records serve as strong indicators which help predict customer churn in non-contractual businesses setting such as logistics and retail industries [13].

[20] conducted a study on features extracted from customers' transaction history from the point of sale (POS) system that can be used to predict churn within the retail industry. Data from a local supermarket was used for this study. Convolution Neural Networks (CNN) and Restricted Boltzmann Machine learning algorithm were the deep learning techniques used for prediction. The Restricted Boltzmann Machine attained the best results of 83% in predicting customer churn compared to CNN, which had an accuracy of just 74%. [19].

In [21] study in a novel e-churn model for improving customer churn prediction through increased recall. For churn prediction, this model employed the ensemble technique. Different algorithm combinations were investigated, including C5, QUEST, CHAID, CRT, and logistic regression, with the combination of C5 and QUEST yielding the best results (93.4%). There was no mention of a dataset for the experimentation and evaluation. The accuracy of these algorithms can be improved by including customer data history.[22] also discovered a significant relationship between historic data and churn prediction. The Authors used customer behaviour data of a B2C e-commerce enterprise to test the predictive ability of the SVM and LR models to evaluate the prediction performance of the two models, the k-means algorithm was first used for clustering subdivision to classify into three types of customers, and then predictions were made for these three types of customers. Accuracy, recall, precision, and AUC were calculated. A total of 987,994 customer record was used for this study. The accuracy of the SVM model prediction was higher than that of the LR model prediction with 92% and 90% accuracy respectively.[23] compared CNN and LR for predicting customer churn in telecommunication industry in Nigeria. It showed that CNN, which is mostly used for image classification, can also be used for churn prediction. CNN gave 89% accuracy compared to LR which gave an accuracy of 80%. Recall, F1-score and confusion matrix were used on our datasets for sampling, accuracy and to check how well the classification models behaved.

Another churn prediction model used in CCP is the Random Forest (RF) model, Gradient Boosted Model (GBM), and versions of linear regression with a 9.2% churn rate in the organization, Big Data technologies were used to acquire and prepare a massive dataset. The RF model was chosen with AUC (area under the ROC curve) as the evaluation criterion. Several methodologies, including up-sampling, down-sampling, and weighing strategies, were used to investigate class imbalance. [31] developed a churn prediction model based on the Genetic Programming (GP) algorithm with AdaBoost. AdaBoost was utilized in an iterative way to find distinct reasons for customer churn. To balance the dataset, the Particle Swarm Optimization (PSO) sampling approach was applied. This model solved several complex issues very effectively.

In another study, [32] evaluated how well the BP neural network and AdaBoost performs in predicting customer churn on e-commerce data from the B2C industry. Data segmentation into three categories was employed to facilitate model evaluation. The results indicated that the AdaBoost model was more accurate than the BP neural network model, with Accuracy, Recall, and Precision metrics of 0.9555, 0.9316, and 0.9604 respectively. Additional metrics such as ROC and AUC for the AdaBoost model

were also better than those for the BP neural network model. Consequently, the amount authors suggest that the AdaBoost model is more suitable for predicting customer churn in this context.

Using historical purchasing behaviour of customer in an insurance company [33] developed a new customer profitability metric for the insurance businesses that measures real insurance customer contribution using liability reserve. They applied Random Forecast Regression, a method for Big Data analytics, to forecast insurance customer profitability. The five crucial variables to forecast insurance client profitability were discovered to be region, age, insurance status, sex and customer source. The proposed RF model performs very well in the training and testing datasets with a pseudo-R-square of 0.9903 and 0.9901, respectively. It is also found that the RF model has the smallest Root Mean Squared Error compared to other models, such as SVM and generalized boosted, decision tree and linear regression models. For customer relationship management and premium actuarial in insurance businesses, RF was concluded to have significant reference value.

### Hyperparameter Tunning and Parameter Selection

The task of selecting a collection of ideal hyperparameters for a learning algorithm is known as hyperparameter optimization or tuning in machine learning. A hyperparameter is a parameter whose value governs the learning process. Other parameters (usually node weights) are learned in contrast. A parameter sweep is a frequent approach in machine learning model training that involves exhaustively scanning a subset of variables deliberately selected by the researcher. This method is known as grid search, and it is one of the most commonly utilized strategies due to its simplicity and reproducibility. However, executing a grid search over every possible value combination quickly turns it into an approach that is far too computationally expensive to be useful in real-world applications. Performing a random search across the same parameter domain can result in a model that is as good as or better than the one validated by grid search while requiring a fraction of the calculation time. A random search selects parameter values at random from a specified distribution rather than directly from a grid. Samples are collected for each parameter over a predetermined number of rounds and utilized for model validation This enables us to plan a processing budget that is independent of the number of available parameters and the number of possible values for each. As a result, including parameters with little effect on performance will not reduce the efficiency of the cross-validation process for no gain. Some of the benefits of RandomizedSearchCV over grid search include that searching many different parameters at once may be computationally infeasible and RandomizedSearchCV searches a subset of the parameters, and you control the computational "budget".

## System Design and Methodology

### Methodology

Methodology used is a structured system analysis. This section further describes the methods and materials used to carry out the study and arrive at outcome/result of the study. This includes study location, study population, study design, sample size, sampling technique, intervention approach, data collection methods and tools, data analysis, ethical consideration, and study schedule/duration.

### Study Location

The study was conducted in Lagos, Nigeria, which is the biggest city in Nigeria, thus having diverse number of supermarkets.

### Study Population

The study was conducted among supermarkets using customer level data.

## Study Design

This is a retrospective comparative analytic study that assessed the effectiveness of the use of four machine learning algorithms/models (XGboost, AdaBoost, random forest and logistic regression) for prediction of customer churn using data from ''Plenti Africa'' app in supermarkets and compared the effectiveness of each of the four models against each other.

## Sample Size and Sampling Technique

According to finelib.com, a Nigeria directory n of supermarkets, there are 62 large supermarkets in Lagos. Using raosoft sample size calculator [34], at sample size *n* and margin of error E given by $x = Z(^{c}/_{100})^{2}r\ (100\text{-}r)$, $n = {}^{N\ x}/_{((N-1)E^{2}+x),}$ $E = \text{Sqrt}[{}^{(N-n)x}/_{n(N-1)}]$, sample size of 19 was calculated, using Raosoft, (2004). Additional 1 was added as allowance for 5% attrition/eventualities, thus total of 20 supermarkets was randomly selected for the study.

## Data Collection and Data Description

Data collection was done using data collection app known as PLENTI AFRICA, deployed in supermarkets in Lagos Nigeria. Plenti Africa is a loyalty collation platform that helps supermarkets manage their loyalty program. The solution has a mobile app that is used to collect customer transaction information and thereafter give the customers points which can be collated over a period and analysed to predict customer churn. Data collectors, who are supermarket operators, were trained to use app for data collection. Retrospectively, data were retrieved from transaction history on the data collection app-Plenti Africa from Jan 2019 to October 2022 from the 20 selected supermarkets.

## System and Data Analysis

### The Dataset and Data Schema Extract

The data schema extract from the plentiafrica.com database was used for the study. The schema contains 5 major tables that hold customer demographics, customer balance, customer airtime usage, customer credit cards and customer transaction logs. The data extracted for the analysis was sourced from customer transaction logs, customer demography and transaction stats (i.e., this table 1 stores the aggregate balances for each customer) tables respectively. To enable easier analysis, some variables like age categorization were derived. Thus, age band variable was constructed by sorting customers into four distinct age groups: Teenagers (ages <19), Young Adults (ages 20-40), Middle Aged (ages 41-60), and senior citizen (>60 years).

**Table 1.** Shows the Attributes that were Extract Using SQL Join Queries from the Plenti Africa Database

| Variable | Description |
|---|---|
| Customer ID | The Identification number of the customer |
| Mobile Number | The mobile number of the customer |
| Gender | The sex of the customer |
| DOB | The date of birth of the customer |
| Age | The age of the customer |
| State of residence | The State of residence of the customer |
| Current balance | The current balance of the customer |
| Date of registration | Date the customer was registered into the program |
| Last visit date | The last visit date of the customer |
| Total transaction | Total transaction of the customer |

## System Implementation and Analysis

### Source Data Entity Relationship Diagram (ERD)

The ERD model in *Figure 2.* was used to display the relationships amongst attributes being derived. Figure 2 presents the source data Entity Relationship Diagram used in this study. To obtain total transaction by age groups new attributes were created. Age group was derived from the current age of the customers and was further categorized into teenager (<19 years), young adult (20-40 years), middle age (41-60 years) and senior citizen (>60 years). While total transactions per customers were derived from counting all customer transactions per supermarket The data thus contained variables related to customers' transactions which include the amount they spent, date of transaction, age, sex, state of residence, the date they registered on the platform etc.

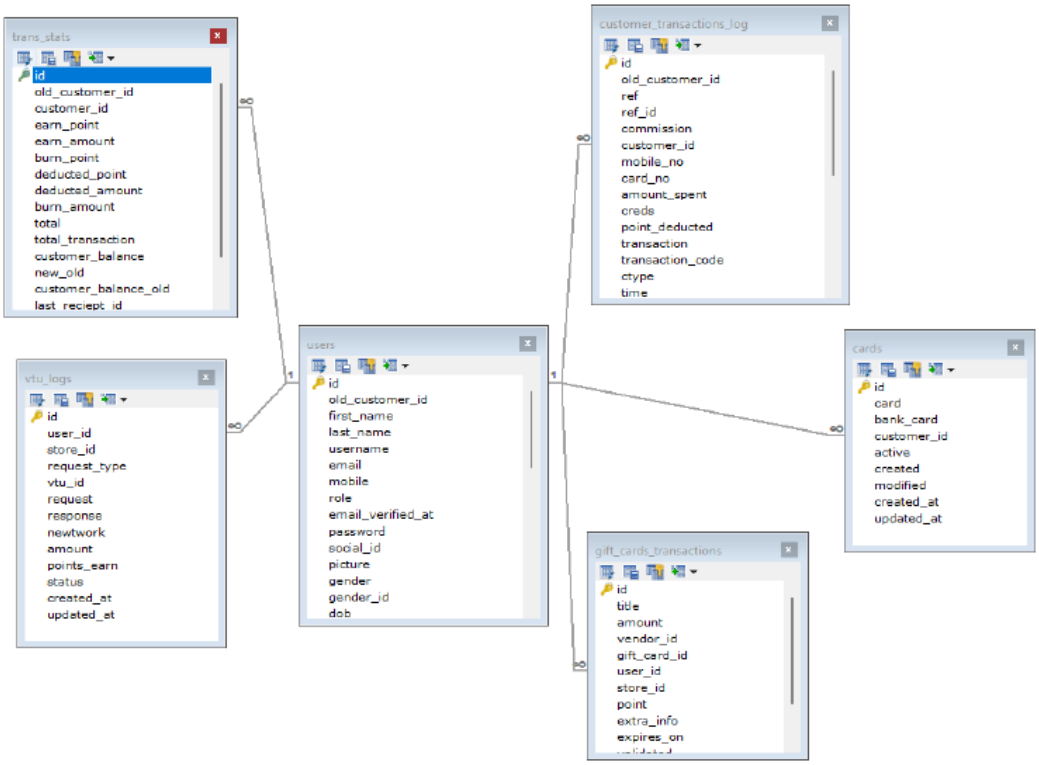


**Figure 2.** Source Data Entity Relationship Diagram

After converting the multi-dimensional customer data into a flat file (a single file with columns representing the variables and rows representing each customer records that were generated), the file was assessed and pre-processed to identify anomalies and unusable records. The list of final attributes can be seen in *Table 2.* In the data transformation phase, some of the variables were aggregated (e.g Age was categorised to teenage, young adult, middle aged and senior citizen). All variables were aggregated to binary for better interpretation for the predictive modelling. Additionally, some of the variables were used to derive new variables.

**Table 2.** Variables Derived from Database for Customer Churn

| Variable | Description |
|---|---|
| Customer ID | The Identification number of the customer |
| Mobile Number | The mobile number of the customer |
| Gender | The sex of the customer |
| DOB | The date of birth of the customer |

| | |
|---|---|
| Age | The age of the customer |
| Age category | The Age category of the customer |
| Tenure | The tenure of the customer |
| State of residence | The State of residence of the customer |
| Current balance | The current balance of the customer |
| Date of registration | Date the customer was registered into the program |
| Visited 3months Age | Check if a customer has visited any store in the last 3 months |
| Last visit date | The last visit date of the customer |
| Total transaction | Total transaction of the customer |
| Churn | Check if the customer churns or not |

## Handling Missing Data

In dataset, the issue of missing values was addressed. After a thorough analysis of the data, it was concluded that the number of null or missing values was negligible in comparison to the total sample size. As a result, all missing data from the State of residence, Gender and Age Band fields (comprising 45 Gender, 48 Age Category and 144 State of residence fields) were deleted in accordance with stating that most of the models are unable to fit and predict values when supplied with missing values.

## Data Cleansing

Prior to describing the data and calculating correlation metrics, data collected needed to be cleansed of duplicates. In the absence of a pre-existing definition and monitoring of customers churn, each distinct customer was thus labelled as “churned” or “not-churned”.

A de-duplication procedure was carried out to find and eliminate any duplicate customer entries to ensure the uniqueness of the customer on the database. The process involved using a customer's full name and phone of find perfect duplicates and deleting them. As a result, the final dataset was 6,188 as extracted from the database. Subsequently, all unique customers were categorized as ‘churned =1’ if customer had not been to the supermarket in the last 2 months and as ‘non-churned=0’, if customer had been to the supermarket in the last 2 months.

## Imbalanced Data

Issue of imbalance data did not need to be addressed as the number of churned and non-churned customers were not significantly different (3015 churned and 3173 non-churned) [24–26]. When predicting customer attrition with machine learning, the imbalance between the classes of customers who have stayed versus customers who have left is a common problem [24-26] as more data are usually available on customers who have stayed than those who have left. However, data was available for all customers in this study where churned or non-churned.

## Feature Selection

Machine learning model development requires feature selection as an essential process because it helps researchers decrease data dimensions while removing unneeded information which results in better model performance. Two consecutive stages of feature selection were used in this study. Firstly, correlation analysis was used to find linear relationships between input data points which showed which variables had the strongest connection to each other. The purpose of this step was to check for duplicate variables and prevent multicollinearity by identifying strongly related variables which could affect the models.

Secondly, model-based feature importance techniques were employed using ensemble

learning methods. Specifically, AdaBoost and XGBoost algorithms were used to rank features based on their relative contribution to churn prediction. The algorithms determine feature importance through training-based assessment which produces performance-related scores for each feature. The models revealed essential characteristics which future predictive modeling required so these characteristics were retained for additional research. The method used statistical analysis together with predictive modeling to choose features which showed both statistical importance and predictive ability which produced models that were more stable and simpler to understand.

## Correlation Method

Pearson correlation method was used for the study as displayed in *Figure 3*. The correlation heatmap in Figure 3 shows that the predictor variables have weak relationships with each other which justifies their inclusion for future model construction. The Pearson correlation method was used to identify the variables that should be kept for the current analysis. The variables tenure and total transaction had a weak correlation of 0.14483. Since correlation was considered relatively small compared to the target variable 'churn', the variables were retained.

This process was repeated for all variables, and all features were kept since they showed weak correlations with one another. This ensured that all relevant variables were accounted for.

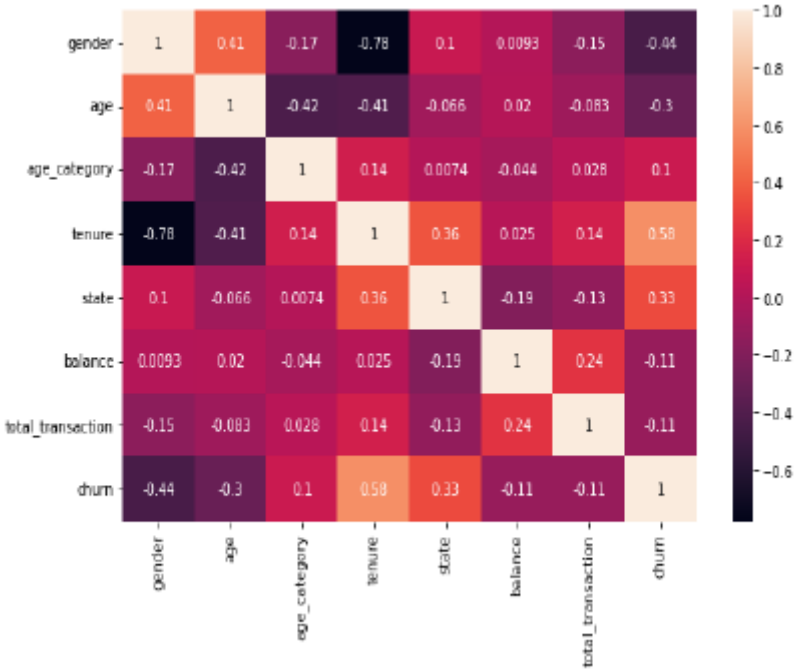


**Figure 3.** Correlation Heatmap showing Pairwise Relationships between Variables

## Prediction Modelling of Customer Churn using Machine Learning

Prediction modelling discusses why specific classifiers were chosen. It demonstrated the usage of grid search and 10-fold cross-validation to discover the optimal hyperparameter combinations for the classifiers. The accuracy, F-score, and AUC scores of each model are shown when the default parameters and grid-searched parameter tuning approach are employed. The confusion matrices and ROC curves for the two models that performed the best were then displayed. Furthermore, the churn prediction model's

creation and test results are discussed, beginning with an overview of the approach and common feature sets used by all models.

Following the preliminary data preprocessing and correlation-based feature screening described in Section 4.5, Adaboost and XGboost feature selection algorithm were used to identify features with the highest predictive relevance. Highly correlated features were dropped resulting in a common set of features used across candidate prediction models ensuring consistency in feature representation across all algorithms and improving the robustness of the comparative analysis. The data was then analysed from each of the models (AdaBoost, XGboost, Random Forest and Logistic regression) and the most successful models were ranked based on comparative effectiveness to answer the study questions. Study questions include.

1. Question 1. "Is the kind of customer data collected on daily basis suitable for use by machine learning algorithm?
2. Question 2: Which machine learning algorithms are more suitable for predicting customer retention from the increasing volumes of data that supermarkets have about their customers?
3. Question 3: How can the data collection process be improved to achieve customer data suitable for use by machine learning algorithms?

## Model Development

It is assumed that customer past purchase behaviour determines the future outcomes [17]. Therefore, customer historical behaviour was analysed for future outcomes using the four ML algorithms/models. The data used for this study was derived by setting cut-off transaction date to November 2022, as this was the date when the supermarkets under study discovered a huge drop in daily transaction as compared to previous months. This attribute is a key variable in labeling instances as churn or non-churns.

All models generated churn prediction probabilities. The probability of each instance is rounded to nearest class membership of either churn (1) or non-churn (0) and threshold used was 50%. To visualize prediction accuracy with changing threshold values, Receiver Operating Characteristic (ROC) curve was used and the area under the AUC was computed to compare prediction accuracies, the overall prediction accuracy, which measures are correct classifications over the population, and if the main criteria was used for the final best model selection.

*Table 3.* below displays summary of the Models. All steps in the model development were included in a single program written in Python programming Language and published at

https://colab.research.google.com/drive/1XxdlXrf70rPNtMFYbkg-UWGWhdw3nPHL

**Table 3.** Model Development Summary

| | |
|---|---|
| Dataset | Customer transaction date from 20 supermarket in Lagos Nigeria Binary outcome variable (Churn or No Churn) |
| Feature Selection | XGBoost and AdaBoost |
| Candidate prediction models | Logistic regression, Random Forest, AdaBoost and XGBoost |
| Prediction probability threshold | 50% for all models |
| Model Comparison | F1 score, ROC, Accuracy, Confusion Matrixes |
| Validation | 10-fold cross validation (90%-10% training/test split) |

### Data Preparation and Handling the Class Imbalance

The dataset, which was previously cleansed for descriptive analysis as described in previous chapter, needed to be further prepared for prediction modelling. In data preparation, the following were undertaken:

1. Variables that have values missing for up to 50% were removed.
2. Negative values set to 0 or Null.
3. While missing numerical values were deleted, the missing categorical values were set to most used value.
4. Also, defaults were assigned as required (e.g., customers with null age values were set to young adults since this age range was more common in the data set).
5. Quartile-based boundaries replaced outliers (i.e. 3 times inter-quartile range).
6. Normalization was applied to numeric variables like the amount spent by customers. Z-score normalisation was also performed only for the logistic regression model.
7. Furthermore, the experiment in this study was randomly under sampled to a class ratio of 1:1. Testing different ratios for the class distribution was thus one of the experiments that were performed in this study.

## Result and Discussion

### Customers' Demographic Characteristics

Figure 4. and Table 4. below displays demographic characteristics of customers.

***Sex:*** Out of the 6,188 customers analysed, the majority, 3713 (60%) were female while 2475 (40%) were male.

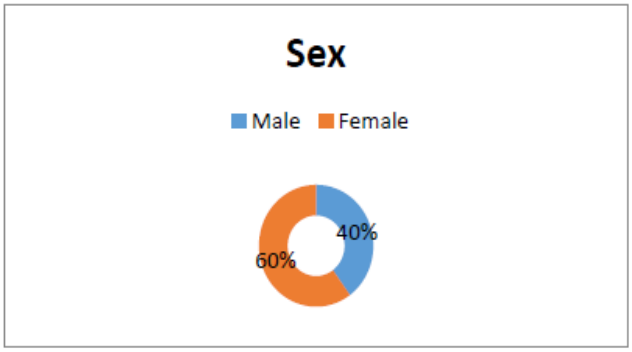


**Figure 4.** Sex Distribution of Customers

**Table 4.** Age Categories of Customers

| Age category | Total | % Total |
|---|---|---|
| Teenagers (<19) | 4409 | 71.25 |
| Young adult (19 to 40) | 1134 | 18.33 |
| Middle adult (41 to 60) | 309 | 4.99 |
| Seniors (>60) | 336 | 5.43 |
| Total | 6188 | 100 |

### Outcome of Customer Churn Analysis

Table 6 below shows rate of customer churn, displayed by age category. Almost half (49% (2654)) of the entire 6188 customers were churn and 51.2% remained not churned (active). By age category, teenagers had highest churn rate at 54.0%, followed by seniors at

44.0%. Young adults and middle-aged adults have the lowest customer churn rate at 32.8% and 35.2% respectively.

## Feature Selection by AdaBoost and XGBoost

*Figure **5.** and Figure 6.* demonstrate that tenure and total transaction are the most significant features selected by Adaboost and XGboost (the two algorithms/models used for feature selection). Figure 5 and Figure 6. Feature selection with XGboost Algorithm/model illustrates the feature importance ranking generated by the AdaBoost and XGboost algorithm, identifying tenure and total transaction as key predictors of customer churn. Tenure and total transaction are two of the most important metrics for gauging customer loyalty in the supermarket industry.

Tenure indicates how long a customer has been shopping in the supermarket, giving an indication of their loyalty and how likely they are to continue shopping there in the future. Total transaction indicates the number of transactions the customer has done in the supermarket, which can be used to measure their loyalty and the impact they have had on the supermarket's profits.

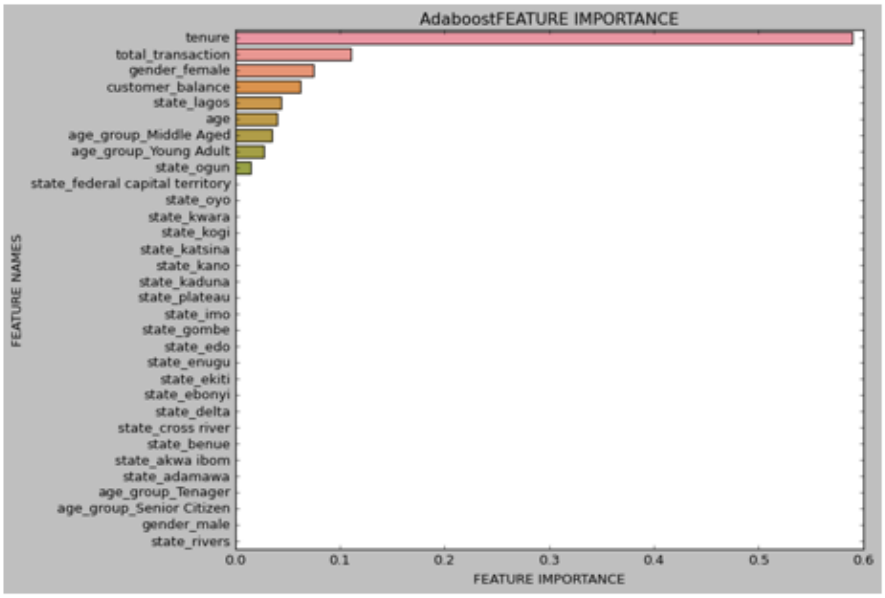


**Figure 5.** Feature Selection by AdaBoost Algorithm/Model

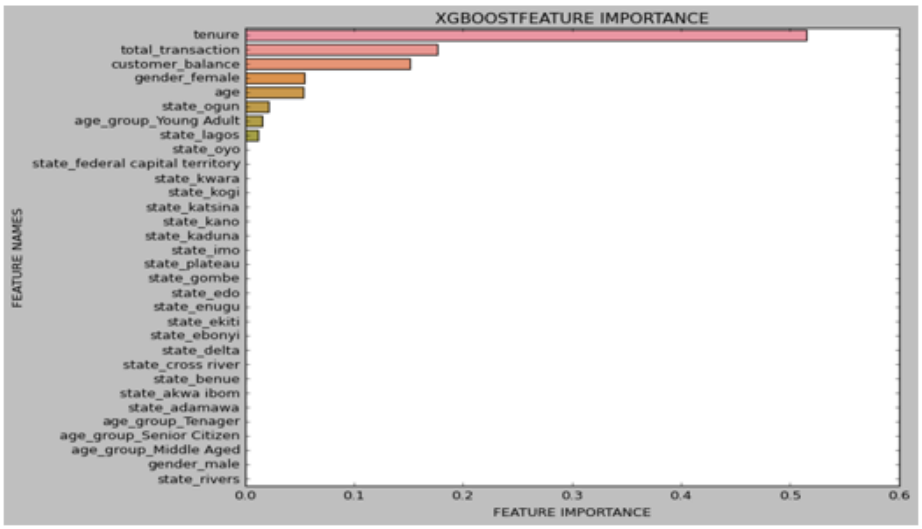


**Figure 6.** Feature Selection with XGboost Algorithm/Model

## Outcome of Algorithm/Model Prediction

### Logistic Regression

The most important hyperparameters for logistic regression are regularization or C, solver, penalty, and random state.

1. Penalty intends to reduce model generalization error and is meant to disincentivize and regulate overfitting. Technique discourages learning a more complex model, to avoid the risk of overfitting.
2. Solver is the algorithm to use in the optimization problem. The choices are (*newton-cg', lbfgs', liblinear', sag', saga')*, default='lbfgs'.
3. Regularization or C is the inverse regularization parameter to the lambda parameter in the LR. The default setting for logistic regression in (Scikit-learn is solver = "liblinear", penalty = 'l2', regularization/C =1.0).

### LR Report Before Parameter Tuning

The results for datasets before the RandomizedSearchCV is displayed in Table 7 below. Where default=1.0, before parameter tuning, precision, recall and F1-score for Not Churn were relatively less effective with scores 0.74, 0.86 and 0.80 respectively while Churn were 0.88, 0.76 and 0.81 respectively. Whereas accuracy for F1-score was 0.80. With these scores, Logistic regression was considered effective.

### LR Report After Parameter Tuning

After running RandomizedSearchCV with the dataset, the following parameters were found to be the best parameter.

1. Solver = newton-cg,
2. Penalty =none
3. Maxiter = 1000
4. C = 0.0006951927961775605.

The result after parameter tuning is displayed in Table 7 below.

### Random Forests (RF)

Many parameters of RFs can be changed to find the optimal match. The following parameters were tested:

1. Minimum samples per leaf (default=1) is the number of samples necessary at the leaf node.
2. Minimum samples per split (default=2) sets the number of samples necessary in a node before it can be split.
3. Bootstrapping (default=true), a Boolean value that specifies whether bootstrapped samples or the entire dataset is utilized to create each tree.
4. Maximum tree depth (default=None), which limits the tree's maximum depth to 45.
5. Max features (default 2) which is the number of features to consider when looking for the best split.
6. The number of estimators (default=10) defines how many trees there are in the forest.

### RF Report Before Parameter Tuning

Results with default values are shown in Table 7 below. Where default=1.0, before parameter tuning, precision, recall and F1-score for Not Churn were 0.89, 0.87 and 0.88 respectively while Churn were 0.90, 0.90, and 0.90 respectively. Whereas accuracy for F1-score was 0.89. With these scores, Random Forest was considered effective.

### RF Report After Parameter Tuning

After running RandomizedSearchCV with the dataset, the following parameters were found to be the best parameter as shown in Table 7 below.

1. Bootstrapping = false
2. Maximum tree depth = 4
3. Maximum features considered for a split = "sqrt"
4. Minimum samples per leaf = 1
5. Minimum samples per split = 2
6. Number of estimators = 41

7. Criterion ='entropy'

## XGBoost

XGboost has many parameter which are classified into 3 types: General parameters, booster parameter and task parameters. XGboost has 35 different parameters, but the most important ones are the N estimators, Subsample, Maxdepth, Learning rate, Gamma, Regalpha, Reglambda. Other special purpose parameters include Scale Pos Weight, Monotone constraints, booster, missing, Val metric. For this study the following parameter were tried before parameter tuning.

base_score=0.5, booster='gbtree', colsample_bylevel=1, colsample_bytree=0.5, gamma=0.4, learning_rate=0.1,max_delta_step=0, max_depth=6, min_child_weight=7, missing=None, n_estimators=100, n_jobs=1, nthread=None,objective='binary:logistic',random_state=0, reg_alpha=0, reg_lambda=1, scale_pos_weight=1, seed=None, silent=True, subsample=1.

### XGBoost Report Before Parameter Tuning

The results for datasets before the RandomizedSearchCV is displayed in Table 7 below.

Where default=1.0, before parameter tuning, precision, recall and F1-score for Not Churn were 0.90, 0.86 and 0.88 respectively while churn were 0.89, 0.92, 0.91c respectively. Whereas accuracy for F1-score was 0.90. With these scores, XGboost was considered effective.

### XGBoost Report After Parameter Tuning

After the random search CV tuning procedure, the best parameters were found and were the best parameters for the model. The final result after parameter tuning is shown in Table 7 below.

1. Solver='liblinear'
2. Penalty = 'none',
3. Max iter: 5000,
4. C: 0.0018329807108324356

## AdaBoost

AdaBoost is a boosting algorithm that combines multiple weak learners into a strong learner. It is a sequential technique that works by fitting a classifier on the original dataset and then fitting additional copies of the classifier on the same dataset, but where the weights of incorrectly classified instances are adjusted such that subsequent classifiers focus more on difficult cases.

The default parameters used were.

1. n_estimators default=50 which is the maximum number of estimators at which boosting is terminated. In case of perfect fit, the learning procedure is stopped early.
2. learning_rate**,** default=1.0 a weight applied to each classifier at each boosting iteration.
3. A higher learning rate increases the contribution of each classifier. The results generated by AdaBoost for datasets before and after the RandomizedSearchCV are displayed in Table 7.

### AdaBoost Report Before Parameter Tuning

Where default=1.0, before parameter tuning, precision, recall and F1-score for Not Churn were 0.84, 0.91 and 0.87 respectively while churn was 0.92, 0.92, 0.86 and 0.89 respectively. Whereas accuracy for F1-score was 0.88. With these scores, AdaBoost was considered effective.

### AdaBoost Report After Parameter Tuning

Where default=1.0, after parameter tuning, precision, recall and F1-score for Not Churn were 0.84, 0.91 and 0.87 respectively while churn was 0.92, 0.92, 0.86 and 0.89 respectively. Whereas accuracy for F1-score was 0.88. With these scores, AdaBoost was considered effective. The final result after parameter tuning is displayed in Table 5 below.

**Table 5.** Outcome of Algorithm/Model Prediction

| | | **Precision** | **Recall** | **F1-score** | **Support** |
|---|---|---|---|---|---|
| Classification Report before LR parameter tuning | Not Churn | 0.74 | 0.86 | 0.80 | 265 |
| | Churn | 0.88 | 0.76 | 0.81 | 335 |
| | Accuracy | | | 0.80 | 600 |
| | Macro avg | 0.81 | 0.81 | 0.80 | 600 |
| | Weighted Avg | 0.81 | 0.80 | 0.80 | 600 |
| Classification Report after LR parameter tuning. | Not Churn | 0.78 | 0.83 | 0.80 | 272 |
| | Will Churn | 0.85 | 0.80 | 0.83 | 328 |
| | Accuracy | | | 0.82 | 600 |
| | Macro avg | 0.82 | 0.82 | 0.82 | 600 |
| | Weighted Avg | 0.82 | 0.82 | 0.82 | 600 |
| RF Report before parameter tuning | Not Churn | 0.89 | 0.87 | 0.88 | 272 |
| | Will Churn | 0.90 | 0.90 | 0.90 | 328 |
| | Accuracy | | | 0.89 | 600 |
| | Macro Avg | 0.89 | 0.89 | 0.89 | 600 |
| | Weighted Avg | 0.89 | 0.89 | 0.89 | 600 |
| RF Report after parameter tuning | Not Churn | 0.88 | 0.88 | 0.88 | 264 |
| | Will Churn | 0.91 | 0.91 | 0.91 | 336 |
| | Accuracy | | | 0.90 | 600 |
| | Macro Avg | 0.89 | 0.89 | 0.89 | 600 |
| | Weighted Avg | 0.90 | 0.90 | 0.89 | 600 |
| XGBoost Report before parameter tuning | Not Churn | 0.90 | 0.86 | 0.88 | 264 |
| | Will Churn | 0.89 | 0.92 | 0.91 | 336 |
| | Accuracy | | | 0.90 | 600 |
| | Macro Avg | 0.90 | 0.89 | 0.89 | 600 |
| | Weighted Avg | 0.90 | 0.90 | 0.89 | 600 |
| XGBoost Report after parameter tuning | Not Churn | 0.91 | 0.89 | 0.90 | 265 |
| | Will Churn | 0.91 | 0.93 | 0.92 | 335 |
| | Accuracy | | | 0.91 | 600 |
| | Macro Avg | 0.91 | 0.91 | 0.91 | 600 |
| | Weighted Avg | 0.91 | 0.91 | 0.91 | 600 |
| AdaBoost Report before parameter tuning | Not Churn | 0.84 | 0.91 | 0.87 | 272 |
| | Churn | 0.92 | 0.86 | 0.89 | 328 |
| | Accuracy | | | 0.88 | 600 |
| | Macro Avg | 0.88 | 0.88 | 0.88 | 600 |
| | Weighted Avg | 0.88 | 0.88 | 0.88 | 600 |

| | | | | | |
|---|---|---|---|---|---|
| AdaBoost Report after parameter tuning | Not Churn | 0.87 | 0.92 | 0.89 | 272 |
| | Will Churn | 0.93 | 0.88 | 0.90 | 328 |
| | Accuracy | | | 0.90 | 600 |
| | Macro Avg | 0.90 | 0.90 | 0.90 | 600 |
| | Weighted Avg | 0.90 | 0.90 | 0.90 | 600 |

## Effectiveness of ML models using Evaluation Metrics

### Confusion Metrics

The classification results of each model became visible through confusion matrix analysis which measured their ability to predict customer churn correctly based on actual customer behavior. Figure 7. presents the confusion matrices for XGBoost, AdaBoost, Random Forest, and Logistic Regression models, highlighting their respective classification performance. The confusion matrix contains four elements which include true positives (TP) and true negatives (TN) and false positives (FP) and false negatives (FN). In the context of this study, a true positive represents a customer correctly predicted as churned, while a true negative represents a customer correctly predicted as not churned. A false positive happens when the system predicts customer churn, but the customer stays active. The system produces a false negative when it shows a customer as active, but the customer actually left the company. The classification results from XGBoost and AdaBoost and Random Forest and Logistic Regression appear in Figure 8. Confusion metrics of XGBoost, AdaBoost, Random Forest and Logistic regression which shows their distinct performance levels. The ensemble-based models (XGBoost, AdaBoost, and Random Forest) produced better true positive and true negative rates than Logistic Regression which showed they performed better for prediction tasks.

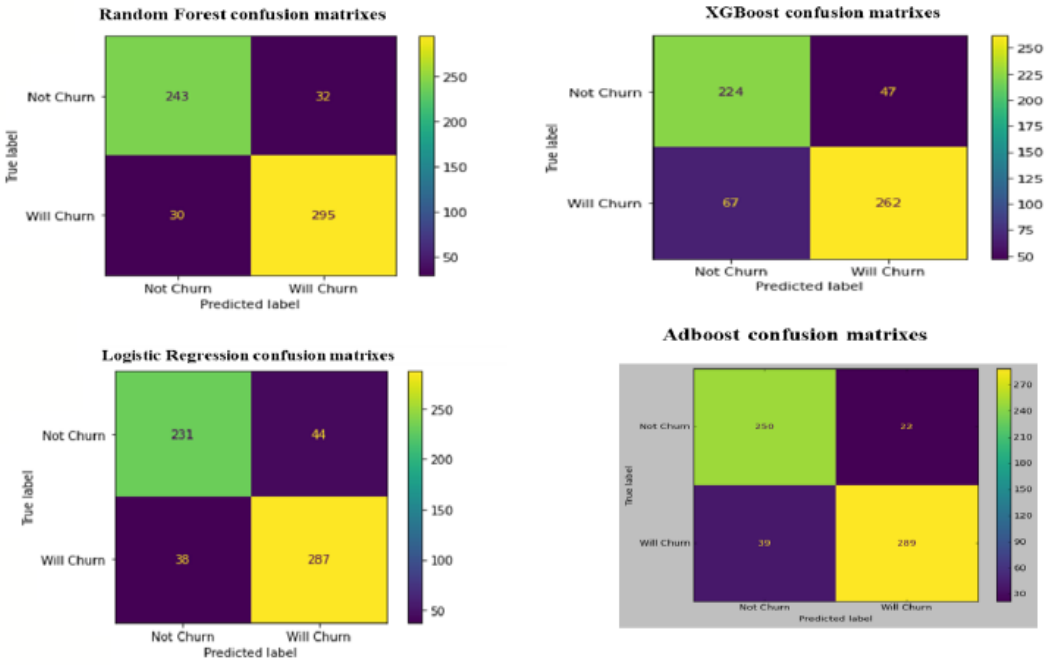


**Figure 7.** Confusion Metrics of XGBoost, AdaBoost, Random Forest and Logistic Regression

**Receiver Operating Characteristic (ROC) Curves**

The ROC-curve demonstrates that the models had effective performance when compared to the random dotted line. There is significant difference in the ROC curve of the 4 different models especially with better performance seen in XGboost and AdaBoost. Figure 8 shows the Receiver Operating Characteristic (ROC) curves comparing the classification performance of the four machine learning models. In order of performance, XGboost, AdaBoost and Random Forest are more effective as compared to Logistic Regression.

**Table 6.** Summary of Evaluation Metrics

| | **RF** | **LR** | **XGBoost** | **AdaBoost** |
|---|---|---|---|---|
| AUC | 0.869093 | 0.797466 | 0.896919 | 0.879677 |
| F-Score | 0.885278 | 0.798712 | 0.911243 | 0.896755 |
| Accuracy | 0.871667 | 0.791667 | 0.900000 | 0.883333 |
| Recall | 0.911234 | 0,801234 | 0.931123 | 0.681222 |

*Metrics evaluation outcome of the four ML models using AUC, F-score, Accuracy and Recall*

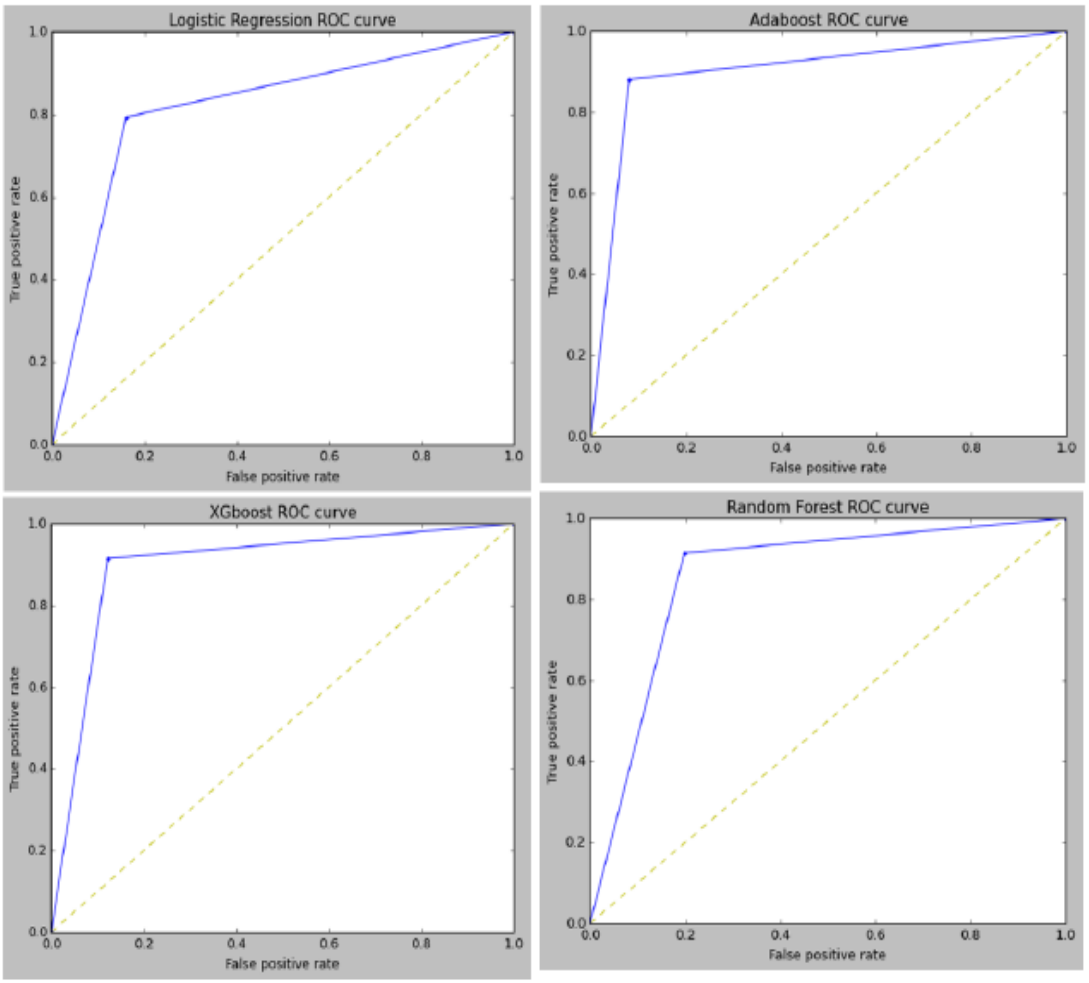


**Figure 8.** The ROC Curves Further Illustrate the Comparative Classification Performance of the Four Machine Learning Models

## Summary of Finding

### Suitability of Customer Level Data Collected on Daily Basis for Use by Machine Learning Algorithms/Models

To answer the research question ‘‘Is the kind of customer data collected on daily basis suitable for use by machine learning algorithm?’’, the finding demonstrated that customer data collected on daily basis were suitable for use by ML algorithms/models. >60% of data collected were complete (6188/10,000) and used for analysis of customer churn using the four-machine algorithm. Thus, the alternate hypothesis was accepted that **‘’**Customer data collected on daily basis are suitable for use by machine learning algorithm’’.

### Effectiveness of use of Machine Learning Algorithms/Models to Predict Customer Churn Using Data Collected in Supermarkets

To answer the research question ‘‘Is Machine learning algorithms/models effective in predicting customer churn in supermarkets?’’, the findings showed that though Logistic Regression has a low performance, all four ML algorithms are effective in predicting customer churn in supermarkets. Evaluation matrixes also demonstrated their reliability in use performance. Therefore, the alternate hypothesis ‘’ Machine learning algorithm/models are effective in predicting customer churn in supermarkets’’ is accepted.

### Comparative Analysis of the Four Machine Learning Model in Prediction of Customer Churn

To answer the research question ‘’ Which machine learning algorithms are more effective in predicting customer churn? comparative analysis of the four machine learning models evaluated using evaluation matrixes showed that XGboost has the highest performance and is more effective, followed by AdaBoost, and then Random Forest with average AUC of 0.90,0.88,0.87 respectively. Logistic Regression has the least performance with average AUC of 0.82.

The final XGboost model fitted hyperparameters were Solver = 'liblinear', Penalty = 'none', and Maxiter: 5000. The XGboost and Adabost after hyperparameters tuning yielded comparable results (AUC of 0.91 and 0.90, respectively) Whereas Random Forest and Logistic Regression realized the lowest AUC values of 0.89 and 0.82 respectively.

However, XGBoost and AdaBoost required longer time than Random Forest and Logistic Regression because their boosting algorithms and parameter tuning procedures needed additional time to complete. The XGBoost model achieved superior training results through hyperparameter optimization which resulted in better performance than its initial state. Boosting-based models achieve better prediction results for churn prediction tasks because they need additional computational power than other models.

F1-score demonstrated that the XGboost model is the best technique in comparison for balancing the precision-to-recall trade-off with value of 0.911243.

Confusion matrix applied on XGboost model analysis classified 67 customers falsely as not churn (23.02% of all not Churn) and 47 as will churn (15.30% of all will churn). This is further reflected by the model’s precision (0.91) and recall (0.93). Thus, there is a high proportion of both correctly predicted ‘’will churn or churn’’ among all correctly and falsely predicted as ‘’will churn/churn’’ (84.69%) and correctly predicted ‘’will not churn’’ among all actual ‘’will not churn’’ (76.98%).

The results seen in previous studies were similar to the findings from this study. Effective performance of XGboost, AdaBoost and Random Forest seen in this study concurs with studies of [31].

On the other hand, the low performance of the Logistic Regression demonstrated in this

study is in accordance to finding by [28], which concluded that Logistic Regression model performed poorly as it does not fit well into more massive datasets. However, another study concluded that LR performance in simple form has been seen to show average results [17]. In the same study which compared Random Forest and Logistic Regression models performance in prediction, it was concluded that Random Forest outperformed Logistic Regression [17], Comparative studies have also shown that boosting-based algorithms such as XGBoost better than traditional machine learning classifiers in structured prediction tasks [27], thus agreeing with findings in this study. However, on the contrary, a finding by [28] disagrees with finding from this study as it concluded that Logistic regression performs the best for most of the datasets, and it outperforms the boosting methods (AdaBoost and XGBoost) for the datasets with a 5% minority class.

Findings from this study also show that XGboost model has the highest performance (performance with accuracy of 0.91 and F-score of 0.90- 0.92) which agrees with finding from [16] where it was demonstrated that XGboost approaches typically outperformed other machine learning (ML) models/algorithms by emphasizing functional space when decreasing model cost.

XGboost thus performed well on the datasets collected daily at the supermarkets, by having the highest average score in all metrics (including the F-score where AB is lightly lesser to it by 0.01).

Random Forest however has the best outcome in terms of effectiveness to identify false positive as seen in Confusion matrix which shows that Random Forest has less false positives across all datasets.

Furthermore, in comparative analysis of the ROC-curves of XGboost and AdaBoost, it was discovered that XGboost appears to perform better. However, XGboost was shown to be a computationally heavy model that consumed much more memory than other models. Complex and large models may imply very low entropy and thus very complex models, which may also result in poor generalizability and overfitting.

AdaBoost is the second-best performing model on the datasets. The differences between AUC and accuracy metrics on average are not that considerable, even though the differences in ROC curves are noticeable. By looking at CMs, XGboost introduced more false positives regarding churning customers when compared to RF.

Random Forest was not computationally demanding, which was a plus for RF. Memory consumption was manageable, and predictions were accurate. RF is considered the third-best model. It is practically tied with LR in terms of average scores, but it may outperform in terms of F-score.

XGboost performs quite similarly than AdaBoost in this dataset. Due to the stochastic nature of most ML algorithm all models where ran 30 times each and The average Accuracy, F-score, and AUC values across repeated runs were used for the final comparative evaluation of the models.

## Summary of Literature

Table 4 presents a summary of the literature review's findings. The table shows that support vector machines (SVM), logistic regression (LR), artificial neural networks (ANN), decision trees (DT), and random forests are the most used models. These models come in different iterations, but they all fall under the same general category. Additionally, the area under the curve (AUC), receiver operating characteristics curve (ROC), percentage properly classified/accuracy (PCC), and top decile lift appear to be the most popular validation methods. However, there is also widespread use of the confusion matrix (CM) and training and evaluation (T/E).

**Table 7.** Summary of Client Churn Prediction Models Reviewed

| Tittle of paper | Industry | Data Set | Models and Techniques | Accuracy |
|---|---|---|---|---|
| Customer profitability forecasting using Big Data analytics: A case study of the insurance industry | Telecom | 18,000 | RF, SVM, decision tree and linear regression | RF had highest accuracy with 99.67% |
| Optimizing Coverage of Churn Prediction in Telecommunication Industry | Telecommunication Industry | Telco BSS and OSS data | C5, QUEST, CHAID, CRT, and logistic regression | QUEST performed better with 93.4% accuracy |
| Customer churn prediction by hybrid neural networks. Expert Systems with Applications | Multimedia Industry | | ANN, C5.0 decision trees | C5.0 decision trees and ANN) improved prediction accuracy |
| Adaptive Particle Swarm Optimization Algorithm Ensemble Model Applied to Classification of Unbalanced Data | Telecom | | Random Forest and Naive Bayes | Random Forest outperformed Naive Bayes, with an accuracy of 71.99% |
| Machine-learning techniques for customer retention: A comparative study of churn in telecommunication | CRM systems | 3,333 | Random Forest and AdaBoost | AdaBoost achieved the highest accuracy of 96% |
| B2C E-Commerce Customer Churn Prediction Based on K-Means and B2C E-Commerce Customer Churn Prediction Based on K-Means and SVM | E-Commerce | 987,994 | SVM, LR | SVM, LR achieved a higher accuracy of92% |
| Predicting Customer Churn in Telecommunication Industry Using Convolutional Neural Network Model | Telecommunication industry in Nigeria | Customers transaction | CNN and LR | SVM, LR achieved a higher accuracy of 89% |

## Research Gap

Research studies have thoroughly examined customer churn prediction through multiple industries which include telecommunications and banking and insurance and e-commerce while using supervised learning and ensemble machine learning approaches. Research studies achieve high prediction results through their extensive well-organized datasets which focus on customers who have subscription-based or contractual agreements.

The field of churn prediction has received limited research regarding its application to supermarket and retail settings because their customers do not have contractual agreements and their buying activities follow unpredictable patterns. There is limited research available about churn prediction which uses supermarket loyalty and transaction data from developing economies such as Nigeria. Existing studies

also tend to evaluate individual models in isolation rather than conducting a comprehensive comparative analysis across multiple machine learning algorithms using the same dataset.

The available research lacks sufficient evidence about how daily customer information from digital loyalty platforms works for machine learning-based supermarket customer churn prediction. The research lacks proper methodological and contextual analysis which creates an obvious knowledge deficit. The research fills this knowledge gap through two main objectives which evaluate supermarket transaction data for churn prediction and compare different supervised machine learning models to find the best method for supermarket churn prediction in Lagos Nigeria.

## Recommendation

1. Currently, the supermarkets referred to in this study use manual/analogue method of customer frequency as model for predicting customer churn. However, no classification-based predictions about churning are currently in used. This study demonstrated the effectiveness of Machine Learning algorithms in accurately predicting customer churn and also classifying the predictions.
2. Results show that XGBoost and AdaBoost are more effective in predicting customer churn using data from supermarkets as compared to Random Forest and Logistic Regression. Thus, XGboost and AdaBoost are recommended for use in supermarket settings.
3. Furthermore, customer data collection using Plenti Africa app at the supermarkets is suitable in customer churn prediction by the ML models. Thus, data collected using the Plenti Africa app is recommended for use in ML model to predict customer churn.
4. When comparing the performance of features selected by ML algorithms/model to those provided manually by the supermarket, the ML models have significantly better performance. It was demonstrated that by adding two additional characteristics chosen via a feature selection method, it was possible to improve the performance of the model on different datasets. These results were the same regardless of customer balance or tenure. These further buttresses recommendation of use of ML model in supermarkets to predict customer churn often and effectively.

## Conclusion

From the findings of this study, it is an effective method in performance and accuracy to predict customer churn in supermarkets using ML models (XGBoost: 0.91, AdaBoost: 0.90, RF:0.89 and LG: 0.82), by using the customer level data provided at the supermarkets. In addition, XGBoost and AdaBoost are better performing models as compared to Random Forest and Logistic Regression.

### Limitations and Future Research

The following limitations were encountered on this study and future research are thus recommended.

1. Larger dataset is required for maximal use of the Boost models (XGBoost and AdaBoost). However, for this study, barely 6000 datasets were analysed from only 20 supermarkets who use the data collection tool (Plenti Africa). Future research is therefore recommended to be done using larger dataset in more supermarkets across Nigeria and beyond.
2. Though XGBoost and AdaBoost were concluded to be the best performing models as compared to Random Forest and Logistic Regression. However, the computer facilities needed to use XGBoost and AdaBoost would not be affordable for supermarkets as compared to simpler computer facilities used for RF and LR. Thus, further studies are needed to assess

suitability and availability of computer facilities used for machine learning.

3. Customer behavior was not added to features as it wasn't part of the data collection tool. This information would be needed to determine reasons for customer churn. Further studies on risk factors to customer churns should be undertaken.

## Conflict of Interest

No conflicts of interest were reported by the author on this project. From start to finish, fairness and accuracy guided every step - writing, thinking, sharing.

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## Ethical Approval

The research used Plenty Africa provided de-identified customer transaction data which underwent secondary analysis. The research did not require direct human subject contact and used protected data, so it did not need official ethical approval according to NHREC of Nigeria guidelines. The data usage followed all regulations which protect personal data and maintain confidentiality standards.

## Data Availability

The datasets used for this study were collected from app known as PLENTI AFRICA, deployed in supermarkets in Lagos Nigeria. Plenti Africa is a loyalty collation platform that helps supermarkets manage their loyalty program. Therefore, can only be retrieve by writing to the Plenti Africa team.

## Author Contributions

Oluseun Temiye led the study through every phase, from shaping the research design to collecting and analysing the data and ultimately drafting the manuscript. Chioma Osumuo and Isaac John contributed technical expertise, offering guidance on the study's design and supporting the interpretation of the results. All authors read, reviewed, and approved the final version of the manuscript.

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# Vascular Access for Hemodialysis in Sub-Saharan Africa: Patterns, Complications, and Gaps in Evidence – A Narrative Review

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***Abstract***

*Vascular access is a critical determinant of outcomes in hemodialysis, with arteriovenous fistulas (AVFs) offering superior patency and lower complication rates compared with arteriovenous grafts (AVGs) and central venous catheters (CVCs). Despite strong international recommendations favoring AVFs, catheter dependence remains disproportionately high in sub-Saharan Africa. This narrative review synthesizes current evidence on patterns of vascular access use, associated complications, and management strategies in sub-Saharan Africa, with a focus on identifying gaps relevant to low- and middle-income settings. A narrative review of published literature was conducted, focusing on epidemiology, patient outcomes, complication profiles, and access management strategies related to hemodialysis vascular access globally and within sub-Saharan Africa. Available evidence demonstrates marked regional disparities in vascular access utilization. While high-income countries report increasing AVF prevalence, most African dialysis centers remain heavily reliant on catheters, largely due to late nephrology referral, limited surgical capacity, and health system constraints. Catheter use is consistently associated with higher rates of infection, thrombosis, hospitalization, and mortality. Data on AVF maturation, patency, and long-term outcomes in Africa remain sparse, and reported complication rates appear higher than in high-income settings. There is a substantial evidence gap regarding vascular access outcomes in sub-Saharan Africa. Context-specific data are urgently needed to guide policy, improve access planning, and reduce catheter dependence. This review underscores the importance of regionally grounded research to inform quality improvement and align practice with global standards.*

***Keywords:*** *Arteriovenous Fistula, Central Venous Catheter, Dialysis Complications, Hemodialysis, Sub-Saharan Africa, Vascular Access.*

## Introduction

Vascular access is a fundamental component of effective hemodialysis care and is widely regarded as the "lifeline" of patients with end-stage renal disease (ESRD). Among available access modalities, arteriovenous fistulas (AVFs) are consistently associated with superior long-term patency, lower infection rates, and improved survival when compared with arteriovenous grafts (AVGs) and central venous catheters (CVCs). Consequently, international guidelines, including those from the Kidney Disease Outcomes Quality Initiative (KDOQI), strongly advocate minimizing catheter use and prioritizing permanent vascular access whenever feasible.

Despite these recommendations, major global disparities persist. In high-income regions, although catheter use at dialysis

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initiation remains common, substantial progress has been made toward increasing AVF prevalence. In contrast, sub-Saharan Africa continues to experience heavy reliance on catheters, driven by late presentation of chronic kidney disease, limited access to vascular surgery, and health system constraints. This catheter dependence exposes patients to preventable complications, including bloodstream infections, thrombosis, frequent hospitalizations, and excess mortality.

Published data from sub-Saharan Africa remain limited and fragmented, with few studies systematically examining access outcomes, complication rates, or management practices. In Botswana, no prior comprehensive assessment of hemodialysis vascular access has been reported. This narrative review therefore aims to synthesize existing evidence on vascular access use and outcomes in sub-Saharan Africa, identify key gaps in knowledge, and contextualize the relevance of emerging data from Botswana to the broader regional and global literature.

## Discussion and Analysis of Literature

### Epidemiology of Vascular Access in Haemodialysis

#### Global Patterns

Worldwide, there are striking variations in the types of vascular access used by patients initiating haemodialysis. In high-income countries like the United States, despite concerted efforts, about 80% of incident dialysis patients still start with a catheter as their access. This figure has remained stubbornly high over two decades, even with initiatives aimed at catheter avoidance [1]. By contrast, many European countries and Japan report much lower catheter rates at initiation – in Europe, the proportion of patients starting HD with an AVF is 2–3 times higher than in the U.S. [1]. A recent international survey by the ISN Global Kidney Health Atlas found that in Western Europe and North Asia, a majority of patients (>50%) initiate dialysis with an AVF, whereas in the African region, temporary catheters dominate the landscape [2]. Specifically, in that 2024 report, respondents from 75% of African countries indicated that most patients (>75%) begin HD on a temporary catheter due to emergency presentations and limited surgical services. These global patterns highlight the disparity: patients in resource-limited settings are far less likely to benefit from an optimal access at the start of dialysis, which likely contributes to outcome differences.

#### Sub-Saharan Africa and Regional Disparities

Within sub-Saharan Africa, published data on vascular access are gradually emerging, though still sparse. In South Africa, for example, an audit at Livingstone Hospital revealed that 95% of patients initiated dialysis with a catheter, and even among prevalent patients, 56% were using catheters vs 38% on fistulas and 5% on grafts [3]. This underscores issues with pre-dialysis care and surgical capacity: only 12% of patients in that cohort had a fistula created pre-emptively (i.e., before dialysis initiation). Nigeria has reported similarly low fistula prevalence – an earlier single-center study noted that at one point, merely 20% of their dialysis patients had a functioning AVF as their initial access [4]. The reasons are multifactorial: late referral of CKD patients, shortage of vascular surgeons, and sometimes patient reluctance or misinformation about fistulas [5].

In Botswana, no formal data had been published prior to this study. However, extrapolating from regional experience, one can infer that catheter use would be high at initiation. Botswana's healthcare system, while relatively well-resourced for a middle-income African country, has only a handful of nephrologists and surgeons capable of AVF creation. Many patients likely initiate dialysis in urgent settings at tertiary hospitals like

Princess Marina Hospital (public sector) or Sidilega and other private Hospital (private sector), which would necessitate catheters. Our study's findings in the literature context will serve as the first data point for Botswana, adding to the body of African vascular access epidemiology. Establishing these baseline rates is important for tracking improvements over time, especially as countries adopt programs to increase AVF use.

## Impact of Vascular Access Type on Patient Outcomes

### Survival and Mortality

The relationship between vascular access type and patient outcomes is one of the most extensively studied aspects of dialysis care. Survival and Mortality: Patients dialyzing with AVFs have consistently demonstrated better survival rates compared to those with CVCs or grafts. In a large U.S. cohort, all-cause mortality was significantly higher in catheter-dependent patients – one analysis reported a 50–70% higher risk of death for patients using a catheter versus an AVF, after adjusting for comorbidities [6]. A contemporary 7-year cohort study from Latin America quantified this starkly: at 2 years, survival was 94% for AVF users, 70% for tunneled catheter users, and only ~37% for patients on non-tunneled catheters [7]. Even at 7 years, two-thirds of fistula patients were alive vs only 26% of tunneled catheter patients. The higher infection burden and cardiovascular stress associated with catheters are thought to drive this difference. To illustrate, 90-day mortality in the UK is 3.5% in those starting with a fistula or graft, but doubles to 7% in those starting with a CVC [8, 9]. Similarly, in the U.S., 6-month mortality was found to be 9% for incident AVF patients vs 32% for incident catheter patients. These outcome gaps remain significant even after accounting for patient selection bias (acknowledging that sicker patients are more likely to have a catheter). Our study will later compare whether the Botswana data reflect similar outcome disparities.

### Infections

Among all complications, infections are the most discriminating by access type. Central venous catheters confer a high risk of bacteremia due to their indwelling nature and frequent manipulation. The U.S. CDC estimates around 37,000 central line-associated bloodstream infections occur each year in dialysis patients, mostly from catheters. In one multi-center study, 48% of catheter-dependent dialysis patients developed at least one episode of bacteremia within 18 months [28]. AVFs, by contrast, have much lower infection rates since they are entirely subcutaneous. AV grafts have intermediate infection risk, but any prosthetic material can harbor bacteria if colonized. A Canadian study found that the annual risk of septicemia was 0.5% for fistula patients, ~5% for graft patients, and 20% for catheter patients [11]. In our literature survey, we note that Packer & Kaufman (2020) [1] highlighted a 29% one-year infection incidence in catheter starters vs 10% in fistula starters, a pattern likely generalizable. Infection is not only an acute risk but has downstream effects: each episode can cause hospitalization, need for catheter removal, loss of vascular access sites, and even endocarditis or other metastatic infections (epidural abscess, septic arthritis) [11]. These severe outcomes reinforce why reducing catheter use is a top priority in dialysis quality initiatives.

### Hospitalization and Mortality

Vascular access complications are a leading cause of hospitalization in the dialysis population. Data from the U.S. Dialysis Outcomes and Practice Patterns Study (DOPPS) indicate that >20% of all hospital admissions in dialysis patients are related to vascular access issues – either infections or surgeries to create/revise an access [12]. Patients using catheters have roughly twice the

hospitalization rate of those using fistulas [13]. In Diaz-Martinez's prospective study, 1-year hospitalization was 80% in catheter patients vs 40% in fistula patients. Morbidity also includes complications like venous stenosis (from catheters) that can limit future access options, and limb issues from fistula-related ischemia.

### Dialysis Adequacy and Quality of Life

Vascular access influences the quality of dialysis delivered. AVFs and grafts generally permit higher blood flow rates (typically 300–500 mL/min) and can achieve adequate clearance (Kt/V) more consistently. Catheters often have flow limitations due to positional issues or clotting, leading to inadequate dialysis doses. Additionally, patients with catheters have to adhere to swimming restrictions and have body image concerns with an external device. Paradoxically, some studies have found that patients' perceived quality of life can be lower with fistulas than with catheters – presumably because fistulas involve needles and can be painful to cannulate. Maguire et al. (2022) conducted a survey in Ireland and found that, despite the clinical drawbacks of catheters, patients with AVFs reported lower satisfaction in some domains of dialysis-specific quality of life (e.g., having more pain and anxiety about needling) compared to those with tunneled CVCs [14]. This highlights an important point: the "best" access from a medical standpoint may not be viewed as such by the patient, which has led to calls for better patient education and involvement in access choice [15]. Nonetheless, from a pure clinical outcome perspective, literature strongly favors AVF (and AVG to a lesser extent) over CVC for long-term dialysis.

## Vascular Access Complications and Management Strategies

### Complications Rate and Types

Each type of access has specific failure modes. For AVFs, the most common complication leading to dysfunction is venous outflow stenosis, often due to neointimal hyperplasia, resulting in access thrombosis [16]. Primary failure (failure to mature) occurs in 20–30% of fistulas as noted earlier. Grafts are prone to stenosis at the graft-vein anastomosis, leading to thrombosis; primary patency at 1 year for grafts is typically lower than fistulas (around 50% vs 60–70% for fistulas) [17]. Catheters can dysfunction from thrombosis/fibrin sheath formation, and have a finite lifespan; about 40–50% of tunneled catheters fail by one year due to infection or flow issues [18]. Steal syndrome (hand ischemia) occurs in up to 5–10% of upper-arm fistulas in some series, though severe cases requiring intervention are less common (~1–2%) [19]. High-output cardiac failure due to large AVFs is rare but documented especially in patients with already reduced cardiac function (unsuccessful fistulas may be ligated if causing heart failure symptoms).

### Management and Surveillance

The literature emphasizes proactive management to prolong access survival. Guidelines recommend regular clinical monitoring (examining for thrills/bruits) and periodic surveillance (e.g., measuring venous pressures, access flow via dilution techniques) to detect problems before thrombosis occurs [25]. If a significant stenosis is detected (usually >50% luminal narrowing with clinical/flow evidence of dysfunction), prompt intervention via angioplasty or surgical revision can salvage the access and extend patency [20]. The KDOQI 2019 update, however, advises a more individualized approach to surveillance, favoring interventions only when clinically indicated [9] – evidence had emerged that aggressive pre-emptive angioplasty without clinical indicators did not improve outcomes.

For catheters, rigorous infection control protocols are critical. Use of antibiotic or citrate lock solutions, minimizing catheter lumens handling, and using sterile technique for dressing changes are evidence-based practices

that reduce catheter-related bloodstream infections [21]. Some units have successfully decreased infection rates with staff training and chlorhexidine-impregnated dressings [22]. Nonetheless, literature suggests that even the best protocols cannot eliminate the inherent infection risk of a catheter; thus, the consensus is that catheters should be used as a bridge to a permanent access and not as a long-term solution [23].

### Improving AVF Utilization

Given the advantages of AVFs, many studies have looked at how to increase their use. Interventions include patient education, training nephrologists to refer earlier, and employing vascular access coordinators. A systematic review by De Siqueira et al. (2022) examined strategies to increase AVF (and AVG) creation before dialysis start [9]. The review found mixed results: some programs (like dedicated access coordinator nurses) showed improved fistula rates, while others (like patient education classes) did not always yield a significant change. The authors concluded that a comprehensive approach – identifying patients early and coordinating timely surgery – likely works best, but there isn't a one-size-fits-all solution. Another angle is improving fistula maturation success: studies have tested pharmacological interventions (e.g., fish oil, clopidogrel) and novel devices (e.g., the VasQ external support) to reduce early failure. For example, a meta-analysis in Journal of Vascular Surgery [24] indicated that no medication has definitively improved maturation, but surgical techniques (like optimal vessel selection using pre-op ultrasound mapping) clearly help. The European guidelines (2018) strongly endorse routine ultrasound vein mapping before fistula creation to choose the best site and improve odds of success [16]. Our literature review suggests that in centers where this is done, fistula success rates are higher.

### Context-Specific Innovations are Worth Noting

In East Africa, where vascular surgeons are few, some programs have started training general surgeons in fistula creation and using interventional radiology camps to do angioplasties [26]. These efforts have reportedly improved access outcomes in pilot projects, hinting that creative solutions can mitigate resource gaps.

## Summary of Gaps in Literature and Relevance to Low-Resource Settings

From the above review, it's clear that while the benefits of optimal vascular access (AVF) are well-documented, many low- and middle-income countries (including Botswana) lack data on their performance in this area. There is a gap in understanding whether the global best practices are being met locally and what the local obstacles are. Our study's value lies in applying the insights from the literature – such as the known risk factors for poor outcomes – to interpret Botswana's situation. For instance, if we find a high catheter rate, literature would suggest that's likely leading to avoidable infections and hospitalizations in our patients; if we find many fistulas failing early, literature might point to the need for better vessel mapping or surgeon training.

Several authors have emphasized the lack of robust, region-specific data on dialysis care in sub-Saharan Africa, noting that most clinical practices are extrapolated from high-income countries despite major differences in health-system capacity and patient pathways [10]. Furthermore, studies from low-resource settings have consistently shown that late referral, limited surgical expertise, and reliance on catheters contribute substantially to poor vascular access outcomes, highlighting the need for locally generated evidence to inform practice and policy [27].

### Implications for Practice and Policy in Sub-Saharan Africa

Addressing vascular access disparities requires coordinated, context-sensitive strategies. Strengthening early CKD detection and referral pathways, expanding surgical and interventional capacity, and integrating multidisciplinary access planning into routine care are critical steps. Investment in training, infrastructure, and data collection systems will be essential to reduce catheter dependence and improve outcomes.

## Conclusion

This narrative review demonstrates that vascular access remains a critical yet under-optimized component of hemodialysis care in sub-Saharan Africa. Although robust international evidence consistently confirms the superiority of arteriovenous fistulas in terms of patency, infection risk, hospitalization, and survival, catheter dependence continues to dominate dialysis practice across the region. The reviewed literature highlights that this disparity is driven largely by late presentation of chronic kidney disease, inadequate pre-dialysis planning, limited availability of trained vascular surgeons, and broader health system constraints. As a result, many patients are exposed to preventable complications that significantly worsen morbidity, mortality, and healthcare costs.

Importantly, this review identifies a substantial evidence gap regarding vascular access outcomes in sub-Saharan Africa. Data on AVF maturation rates, long-term patency, complication profiles, and effectiveness of access-focused interventions remain sparse and fragmented, particularly in countries such as Botswana where no prior comprehensive assessments have been published. The absence of locally generated data limits the ability of clinicians and policymakers to benchmark performance against global standards or to design targeted quality-improvement strategies.

The findings of this review underscore the urgent need for region-specific research to inform vascular access policy and practice. Strengthening early nephrology referral pathways, expanding surgical and interventional capacity, promoting routine preoperative vessel mapping, and investing in multidisciplinary vascular access programs represent feasible and high-impact strategies for reducing catheter dependence. By contextualizing global evidence within the realities of sub-Saharan Africa, this review provides a foundation for future research and supports the integration of evidence-based, patient-centered vascular access planning to improve outcomes for hemodialysis patients in the region.

## Conflict of Interest

The authors have no conflicts of interest to declare.

## Ethical Approval

Our review is solely focused on published articles and reports, and non-human-subject data. Therefore, no ethical approval is needed prior publication.

## Data Availability

No new data were generated or analysed in this review. All data analysed are publicly available from the cited original sources in the reference.

## Author Contribution

Leba Kabongo conceived the review, conducted the primary literature search and analysis, as well as drafted the manuscript.

Both authors performed critical revisions and edited the final manuscript, as well as approved its submission

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# Challenges Associated with Implementation of Solar Energy in Ghana

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***Abstract***

*This study investigates the challenges hindering the adoption of solar energy in Ghana, with the aim of improving understanding of the barriers to sustainable solar energy use. Most research in this area has concentrated primarily on economic, technical, and environmental factors, neglecting the sociocultural and psychological dimensions influencing solar energy adoption. This study therefore aims to bridge this knowledge gap by examining the cultural, psychological, and behavioral challenges affecting solar energy implementation in Ghana. The study adopted a cross-sectional research design which enabled the study to provide valuable insights into the prevailing issues influencing solar energy implementation across selected cities including Accra which is the capital city of Ghana. A stratified random sampling technique and a purposive sampling technique was used to select the desired sample size of 200. Descriptive statistics such as mean, median, standard deviation, and frequency distributions were used to summarize the data. The analysis also used Statistical Package for the Social Sciences (SPSS) due to its robust statistical and visualization capabilities. The findings reveal that although the initial cost of solar installations poses a significant obstacle, long-term benefits such as lower electricity expenses and positive environmental impacts are widely recognised. The research highlights a strong link between public perception and the willingness to adopt solar energy. Favorable attitudes and greater awareness correspond to higher adoption rates, while negative perceptions discourage uptake. This demonstrates the crucial role of public education and perception management in promoting solar energy integration. Key challenges identified include high upfront costs, limited information, technological difficulties, insufficient government support, cultural resistance, and inconsistent energy supply. Addressing these barriers requires comprehensive strategies that incorporate financial incentives (such as subsidies and tax reductions), awareness campaigns, enhanced government involvement, infrastructure improvements, and community engagement initiatives. Overall, the study underscores that improving public awareness and perception, alongside targeted policy measures, can create an enabling environment for widespread solar energy adoption. These insights offer valuable guidance for policymakers and researchers aiming to advance renewable energy development in Ghana and beyond.*

***Keywords:*** *Ghana, Implementation Challenges, Solar, Solar Energy.*

## Introduction

The growing global commitment to mitigating climate change has intensified the need for a transition from fossil fuel–based energy systems to renewable alternatives. In most African countries, including Ghana, electricity generation remains heavily dependent on fossil fuels, which continue to dominate national energy portfolios [1].

Ghana's energy demand has been rising at approximately 10% per annum, creating

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continuous strain on its generation infrastructure Kassian, [2]. With the discovery of oil and gas, the country has simultaneously sought to expand its renewable energy base as part of a broader strategy for sustainable growth, [2, 3]. Solar energy, which plays a critical role in lowering carbon emissions, has emerged as a promising alternative in Ghana's quest for energy diversification [27]. Beyond environmental benefits, renewable energy adoption can enhance energy efficiency, reduce operational costs, and positively influence financial stability by lowering the risk of loan defaults and non-performing loans [2, 4].

Africa's vast solar potential, attributed to its abundant sunshine, provides a strong foundation for renewable energy deployment [6]. In Ghana, the solar sector gained significant attention after the 2012–2016 power crisis [30-32]. However, several barriers continue to hinder its widespread implementation. Key among these are the absence of comprehensive legal and regulatory frameworks, limited access to finance, and the high initial capital costs associated with solar technologies [6, 17]. These factors have deterred private-sector investment and slowed the growth of renewable energy adoption.

Despite these challenges, renewable energy remains central to Ghana's long-term energy strategy, particularly as the country confronts persistent supply-demand imbalances [17, 21]. As [29] notes, integrating renewable sources into Ghana's energy mix is essential for meeting growing consumption needs sustainably. Although solar power accounts for approximately 90% of Ghana's installed renewable capacity [22], the overall share of renewables in the national energy mix remains low.

This study aims to examine the challenges affecting solar energy implementation in Ghana, focusing on policy gaps, financing difficulties, and technical constraints. Using both qualitative and quantitative methods such as stakeholder interviews, household and business surveys, and literature review the research identifies critical barriers and highlights successful case studies within Ghana's solar sector. The findings will inform policymakers, investors, and industry actors on strategies to accelerate solar energy adoption, thereby contributing to Ghana's sustainable development goals and global decarbonization efforts.

## Statement of the Problem

Energy plays a vital role in human existence and economic development, with electricity serving as an essential resource for modern living. Solar energy, as the foundation of most renewable resources, offers vast potential to meet rising global energy demands sustainably. However, increasing population growth and rapid economic expansion have resulted in escalating energy needs worldwide [25, 26]. At the same time, concerns about greenhouse gas emissions and climate change have intensified efforts to transition toward renewable and sustainable energy sources [25].

Innovative advancements in solar power technology have been identified as a key approach to addressing the growing global demand for energy [7, 13, 16, 33, 34]. Likewise, [23] asserts that solar power development is an effective strategy to reduce dependence on fossil fuels and mitigate climate change through the reduction of carbon emissions. Despite these clear environmental and economic benefits, the adoption and implementation of solar energy technologies remain limited, particularly in developing economies such as Ghana.

## Purpose/ Rational of the Study

Several studies have examined the barriers hindering solar energy adoption in Ghana and across Africa. [6] identified financial, technological, human resource, and environmental challenges as key obstacles. Similarly, [29] highlighted investment-related challenges, including high interest rates, limited

access to credit, lack of incentives, and inadequate technical expertise for solar system operation and maintenance. [40] also pointed out that restricted access to finance, insufficient local technicians, and unavailability of spare parts continue to impede the growth of the solar market in rural Ghana.

While these studies have provided valuable insights, most have concentrated primarily on economic, technical, and environmental factors, neglecting the sociocultural and psychological dimensions influencing solar energy adoption. Factors such as cultural beliefs, stakeholder attitudes, individual perceptions, and moral considerations toward solar technology remain underexplored. This study therefore aims to bridge this knowledge gap by examining the cultural, psychological, and behavioral challenges affecting solar energy implementation in Ghana. The insights derived will help inform policy and practice toward achieving a sustainable transition from non-renewable to renewable energy sources.

## Literature Review

### Public Behavior and Perception of Solar Energy Adoption

Public perception and behavioral attitudes toward solar energy adoption differ widely across regions and cultural contexts. Understanding these behavioral dynamics is essential to designing effective policies that encourage the transition to renewable energy. For instance, [35] emphasized the importance of studying behavioral factors affecting household adoption of solar photovoltaic (PV) systems in Texas, identifying information gaps that could help overcome adoption barriers. In Pakistan, public opinion significantly influences the acceptance of renewable energy technologies such as solar panels, suggesting that insight into public perceptions can inform effective policymaking [35-39]. Similarly, research in Germany revealed that attitudes toward solar radiation management (SRM) are shaped by perceptions of climate change severity, trust in scientific institutions, and ethical concerns about human interference with nature [40].

The findings of a study indicated that limited awareness and knowledge of solar energy, coupled with high installation costs, remain major barriers to adoption. The researchers recommended targeted awareness campaigns and international collaborations to improve public understanding and acceptance of solar energy [40].

In South Odisha, [9] investigated consumer attitudes toward solar-powered lighting systems. Using structured questionnaires and interviews, the study found that solar products can significantly improve rural livelihoods by reducing household expenses, enhancing health conditions, and creating new income opportunities. The authors emphasized that greater awareness and access to clean energy technologies could drive both social and economic benefits in rural communities [9-11].

### Cultural and Physiological Challenges to the Adoption of Solar Energy

Cultural and social factors also play a decisive role in shaping renewable energy adoption patterns. In Nepal, the influence of ethnic and caste systems has been identified as a significant determinant in solar technology uptake [19, 21]. The Energy Cultures Framework (ECF) further explains that cultural norms and material practices can either promote or hinder the adoption of solar home systems [18]. It is observed that intersecting social variables such as gender, age, class, and ethnicity influence energy-related decision-making in South Asian contexts, affecting both household-level and community-level adoption rates [5].

[24] demonstrated in their study of Iran's Kerman Desert that solar energy initiatives can significantly contribute to sustainable rural development when communities receive proper training and support. The research established a direct link between local participation in solar

projects and improvements in sustainability indicators such as employment, awareness, and investment. Similarly, [37] found that in Finland, the effectiveness of solar energy adoption is shaped not only by technological and economic factors but also by marketing strategies, public engagement, and consumer trust. By strengthening communication, addressing consumer concerns, and clearly defining value propositions, solar companies can influence public attitudes and accelerate market acceptance.

Policymakers must account for sociocultural realities and prioritize marginalized groups when formulating renewable energy policies [28]. Without such inclusion, efforts to promote solar adoption risk reinforcing existing inequalities and missing critical behavioral barriers. Thus, understanding the cultural, psychological, and social dynamics surrounding renewable energy adoption is essential for ensuring equitable and effective energy transitions [27, 28].

### Significance of Awareness of Solar Energy and its Operation to its Implementation

Effective implementation of solar energy systems depends on a comprehensive understanding of their operation and benefits. Educational institutions play a vital role in promoting public awareness of solar energy by disseminating knowledge about its advantages, regardless of individuals' financial capacity to invest in expensive energy technologies [39, 40]. Education and awareness initiatives are therefore fundamental to improving user acceptance and fostering long-term adoption of solar energy solutions.

In the contexts where scientific knowledge is limited, individuals often exhibit moderate awareness of solar technologies and demonstrate a strong willingness to embrace them, driven by aspirations for economic and social development [14]. In addition, technological innovation particularly in enhancing the efficiency of solar collectors and developing improved operational methods can further optimize the utilization of solar resources [20].

Overall, the successful integration of solar energy into national energy systems relies not only on technological advancements but also on public education and awareness. Increased understanding and accessibility, combined with continuous innovation, serve as key catalysts for the widespread and effective adoption of solar energy technologies.

## Materials and Methods

The study adopted a cross-sectional research design to examine the challenges associated with solar energy adoption in selected urban areas of Ghana. This approach was chosen for its efficiency in capturing data within a limited timeframe and budget, allowing for an accurate assessment of current conditions and relationships among key variables. As noted by [12], cross-sectional designs are particularly effective for obtaining a snapshot of phenomena and analyzing correlations at a specific point in time. Accordingly, this design enabled the study to provide valuable insights into the prevailing issues influencing solar energy implementation across the selected cities including Accra which is the capital city of Ghana, Kumasi in the Ashanti region, Koforidua in the Eastern region, Takoradi in the Western region, Bui, Tamale and WA located in the Northern parts of Ghana.

### Study Population and Sampling

The study targeted residents, solar energy specialists, legislators, residents, policy makers, government officials, satakeholders from utility companies, NGOs and local businesses. A non-probability sampling method was employed, allowing all consenting male and female among the targeted population to participate. Arrangements were made with Heads of Institutions and questionnaires were distributed. Participation was voluntary giving

participants given the option to decline without any pressure. The study targets 600 responses and careful consideration of appropriate sampling techniques was used.

## Sampling

A stratified random sampling technique and a purposive sampling technique was used to select the desired sample size of 200. To achieve an even distribution of respondents among the designated cities (Kumasi, Takoradi, Accra, Bui, Lawra, and Koforidua), stratified sampling is used. I deliberately included individuals with expertise in the field, the study gains valuable insights and in-depth knowledge related to the challenges and prospects of solar energy implementation in Ghana.

## Data Collection Measures

A combination of quantitative data collected and qualitative interviews were used to collect data for the study.

### Quantitative Data Collection Method

A structured questionnaire were designed, including established scales and verified instruments from previous studies, to investigate variables such as awareness, affordability, infrastructure, and policy impact on solar energy uptake, comprising a goal of 200 responses, a mixed-methods approach was used, comprising online and in-person surveys, as well as interviews with experts and key informants. Residents and stakeholders participated in online surveys, while policymakers and solar energy experts chose between interviews and online surveys depending on their availability. The survey and interview questions collected demographic information, opinions, experiences, and perceived solar energy challenges. In-person surveys with closed-ended and Likert scale questions were administered to boost response rates.

### Qualitative Data Collection Techniques

Semi-structured interviews with solar energy specialists, policymakers, and key stakeholders will be done using a qualitative technique to gain complete insights into the problems and potential in solar energy implementation. Purposive sampling will be used to issue invitations for interviews to persons with experience in solar energy adoption, which will be facilitated by email or other acceptable communication methods. The interviews, which will be conducted in-person or virtually depending on participant preferences, will be recorded with consent to ensure correct data collection. Transcript validation will be implemented, and differences will be resolved through follow-up talks as needed. In-depth interviews with government officials, energy experts, and consumers will provide rich subjective perspectives on the challenges of solar energy. Focus group discussions will capture stakeholders' collective views and social dynamics. Document analysis of policy reports, government documents, and industry publications will also help to provide historical and contextual context. For a robust qualitative data collection, collected audio recordings, notes, and transcripts will be subjected to rigorous analysis [5, 6, 8, 29].

## Data Analysis

Data analysis is an important step in research because it converts raw data into meaningful insights and findings [8]. Data analysis for the study of challenges associated with the implementation of solar energy in Ghana's selected cities will include a combination of quantitative and qualitative analysis for survey data and interview data.

### Quantitative Data Analysis Technique

The process began with data cleaning and validation to address errors, inconsistencies, and missing responses in the survey dataset. Descriptive statistics such as mean, median, standard deviation, and frequency distributions

were used to summarize the data, graphical tools including bar charts, histograms, scatterplots, and box plots were also used to illustrate emerging trends. The analysis also used Statistical Package for the Social Sciences (SPSS) due to its robust statistical and visualization capabilities.

### Qualitative Data Analysis Technique

Content analysis was used to extract key themes and relevant information from documents. I efficiently organized, coded, and analyzed textual data using NVivo, a well-known qualitative analysis software, improving the management of large datasets.

## Results and Discussions

### Social Demographic Characteristics of Respondents

The study surveyed 200 participants and achieved a strong response rate of 75%, with 151 respondents completing the questionnaire. The combination of in-person and online survey distribution enhanced data reliability. Collected socio-demographic details including age, occupation, and location provided deeper insights into variations in perceptions and challenges among different population groups.

**Table 1.** Socio Demographic Characteristics of Respondents

| Variable | | Frequency | Percent |
|---|---|---|---|
| **Sex** | Female | 57 | 37.5 |
| | Male | 95 | 62.5 |
| | Total | 152 | 100 |
| **Age Group** | 18-29 years | 73 | 48 |
| | 30-49 years | 71 | 46.7 |
| | 50-69 years | 8 | 5.3 |
| | Total | 152 | 100 |
| **Respondents Educational Level** | HND/ Bachelor Degree | 62 | 40.8 |
| | Masters/PhD | 80 | 52.6 |
| | No Formal Education | 1 | 0.7 |
| | Primary-Secondary School | 9 | 5.9 |
| | Total | 152 | 100 |
| **Respondents Profession** | Banker | 5 | 3.3 |
| | Business Man/Woman | 16 | 10.5 |
| | Civil Servant | 12 | 7.9 |
| | Electrical Engineer | 42 | 27.6 |
| | Health Professional | 8 | 5.3 |
| | Journalist | 16 | 10.5 |
| | Lawyer | 2 | 1.3 |
| | Pensioner | 1 | 0.7 |
| | Police Officer | 2 | 1.3 |
| | Procurement officer | 1 | 0.7 |
| | Research Officer | 11 | 7.2 |
| | Student | 13 | 8.6 |
| | Teacher | 23 | 15.1 |
| | Total | 152 | 100 |

*Source: Author Field Work (2024)*

Table 1 highlights a clear gender imbalance among respondents, with males representing 62.5% and females 37.5% of the sample. This disparity is significant, as gender-based differences could influence attitudes and perceptions toward solar energy adoption.

The age distribution of participants indicates broad generational representation: 48% were aged 18–29 years, 46.7% were between 30–49 years, and 5.3% were within the 50–69 years range. Such diversity ensures that views from both younger and older groups are reflected, offering a well-rounded understanding of public engagement with solar technologies.

In terms of education, the majority of respondents held advanced qualifications—52.6% possessed master's or doctoral degrees, while 40.8% had HND or bachelor's degrees. This high educational attainment suggests that participants were relatively knowledgeable about solar energy, potentially contributing more informed opinions.

Occupationally, respondents came from varied professional backgrounds. Electrical Engineers formed the largest segment (27.6%), followed by Teachers (15.1%) and Business Professionals (10.5%). This mix of technical, educational, and commercial expertise enriches the analysis by providing both specialized and practical insights into the challenges surrounding solar energy adoption across sectors.

## General perceived Challenges in Implementation of Solar Energy

The study results revealed the following are challenges in implementing solar energy in their households and businesses: high initial cost, lack of technical skills, lack of awareness, lack of government support, unreliable supply, and others as presented in table 2. The sub-section also provides some qualitative insights from the open-ended comments of the respondents.

**Table 2.** Challenges on the Implementation of Solar

| Challenges | Sample Size | Minimum | Maximum | Mean | Standard Deviation |
|---|---|---|---|---|---|
| High Initial Costs | 45 | 2.5 | 4.5 | 3.6 | 0.7 |
| Lack of Government Support | 30 | 2.5 | 4.0 | 3.2 | 0.6 |
| Technical Complexity | 22 | 1.8 | 3.5 | 2.8 | 0.7 |
| Limited Public Awareness | 35 | 2.0 | 4.0 | 3.5 | 0.8 |
| Intermittent Energy Production | 20 | 1.5 | 3.5 | 2.9 | 0.6 |
| Regulatory Hurdles | 47 | 3.0 | 4.5 | 3.7 | 0.5 |
| Insufficient Storage Technology | 25 | 2.0 | 4.0 | 3.2 | 0.8 |
| Environmental Impact Concerns | 40 | 3.0 | 4.5 | 3.8 | 0.5 |
| Total | 252 | - | - | - | - |

*Source: Field Work Survey (2024)*

Table 2 outlines respondents' views on the major obstacles to solar energy adoption. Financial constraints were identified as the most significant barrier, with "High Initial Costs" receiving the highest concern (45 respondents; mean = 3.6, SD = 0.7), indicating varied but notable apprehension about investment requirements. "Regulatory Hurdles" also ranked prominently (47 respondents; mean = 3.7), highlighting systemic and policy-related obstacles that may impede implementation.

Environmental issues emerged as another key concern, with “Environmental Impact” recording a high mean score of 3.8 from 40 respondents, suggesting growing awareness of ecological implications. Meanwhile, “Limited Public Awareness” (35 respondents; mean = 3.5) underscores the importance of education and outreach in promoting solar adoption.

Moderate challenges included “Lack of Government Support” (mean = 3.2), “Insufficient Storage Technology” (mean = 3.2), “Intermittent Energy Production” (mean = 2.9), and “Technical Complexity” (mean = 2.8). Overall, the findings reveal a complex set of barriers dominated by financial, regulatory, and environmental factors, consistent with perspectives shared by participants during interviews.

> “*The upfront expense was a major consideration when we decided to install solar panels. The initial investment was quite substantial and caused some hesitation at first. However, after evaluating the long-term advantages and potential savings on electricity costs, we concluded that it was a worthwhile decision. Still, it’s understandable that many people might be discouraged by the high starting costs. Greater government incentives or financial support could make solar energy more affordable and appealing to a wider population*.”

## Reliability of Solar Energy Systems in Ghana

This section examines the dependability of solar energy systems in Ghana, focusing on aspects such as performance, lifespan, and maintenance requirements. Both quantitative and qualitative findings from surveys, interviews, and existing literature were analyzed to evaluate the technical standards and operational effectiveness of solar installations used by households and businesses. The summary of these findings is presented in Table 3.

**Table 3.** The overall reliability of solar energy systems in Ghana

| Variable | | Frequency | Percent |
|---|---|---|---|
| Valid | Neutral | 50 | 32.9 |
| | Not Very Reliable | 22 | 14.5 |
| | Somewhat Reliable | 53 | 34.9 |
| | Very Reliable | 27 | 17.8 |
| | Total | 152 | 100 |

*Source: Field Work Survey (2024)*

The findings presented in Table 3 offer insights into the perceived reliability of solar energy systems in Ghana. A notable portion of respondents, constituting 32.9% (50 individuals), expressed a neutral stance, indicating an ambivalent attitude toward the overall dependability of solar energy systems in the country. On the contrary, 14.5% (22 respondents) held a pessimistic view, categorizing solar energy systems as "Not Very Reliable." In contrast, a substantial majority, accounting for 34.9% (53 respondents), expressed confidence in the dependability of solar energy systems, categorizing them as "Somewhat Dependable." Additionally, a minority yet considerable 17.8% (27 responders) offered a highly positive perspective, labeling solar energy systems as "Very Dependable." This optimistic viewpoint may be attributed to favorable and consistent experiences with solar technology, showcasing

a diverse spectrum of opinions within the respondent pool.

One respondent shared,

> *"I gave a neutral rating because, honestly, my experience with solar energy has been a bit mixed. There are days when it works really well, and we have a steady supply of power. However, there are also times when it seems a bit unreliable, especially during cloudy days or when there's not enough sunlight. So, I'm kind of in the middle – it's not bad, but I wouldn't call it extremely reliable either."*

Another respondent offered a contrasting perspective, stating,

> *"I'm among those who believe solar energy systems are very reliable. I've had solar panels installed at my home for a few years now, and they consistently provide a good amount of energy. I think the key is proper maintenance and understanding the limitations. Overall, I'm quite satisfied with the reliability of solar energy in my daily life."*

The findings from Table 4 reflect the diverse perceptions regarding the reliability of solar energy systems in Ghana. While a significant number of respondents maintain a neutral stance, indicating a sense of uncertainty, there is a noteworthy segment with reservations, labeling solar systems as "Not Very Reliable." On the contrary, a substantial majority holds a positive view, categorizing solar systems as "Somewhat Dependable," showcasing a prevailing confidence in their reliability. Moreover, a minority, yet considerable proportion, expressed a highly optimistic viewpoint, deeming solar systems "Very Dependable." These varied perspectives underline the nuanced nature of opinions on the dependability of solar energy systems, with individual experiences and interactions shaping the overall perception within the respondent pool.

## Cultural or Social Factors that Hinder the Widespread Adoption of Solar Energy

This sub-section examines the cultural or social factors that hinder the widespread adoption of solar energy in the study area. The sub-section explores the attitudes, beliefs, values, norms, and behaviors of the respondents and the stakeholders towards solar energy and how they affect the acceptance and diffusion of solar energy.

The sub-section also analyzes the role of social networks, peer influence, community participation, and public awareness in promoting or discouraging solar energy adoption. The sub-section uses both quantitative and qualitative data from the survey, the interviews, and the literature review to provide a rich and nuanced understanding of the cultural or social dimensions and challenges of solar energy in the study area.

**Table 4.** Cultural or Social factors that hinder the Widespread Adoption of Solar Energy in Ghana

| Factors | Minimum | Maximum | Mean | Standard Deviation |
|---|---|---|---|---|
| Attitudes towards solar energy | 3.0 | 4.5 | 3.8 | 0.7 |
| Beliefs about solar energy | 3.0 | 4.0 | 3.5 | 0.6 |
| Values and cultural norms | 2.0 | 4.0 | 3.2 | 0.8 |
| Social network influence | 1.8 | 3.5 | 2.8 | 0.6 |
| Peer influence | 1.5 | 3.5 | 2.5 | 0.9 |
| Community participation | 2.5 | 4.0 | 3.0 | 0.7 |

| | | | | |
|---|---|---|---|---|
| Public awareness | 2.0 | 4.0 | 3.5 | 0.8 |
| Challenges and barriers | 2.5 | 4.5 | 3.6 | 0.7 |

*Source: field work (2024)*

The results from Table 4 provide valuable insights into the cultural or social factors hindering the widespread adoption of solar energy in Ghana. Each factor is analyzed based on frequency, percentage, mean, standard deviation, minimum, and maximum scores. Among the respondents, 80 individuals (52.6%) expressed a relatively positive average attitude towards solar energy, with a mean rating of 3.8. The standard deviation of 0.7 indicates a moderate level of agreement, showcasing a diverse range of attitudes from generally favorable to very positive. This was also confirmed by Respondent who indicated:

> *Well, you know, I think attitudes towards solar energy play a big role. Personally, I've always had a positive view of it. It just makes sense – harnessing energy from the sun is clean and sustainable. A lot of my friends share similar views, but there are also those who aren't quite convinced. It's interesting how different people perceive it.*

Also 60 respondents (39.5%) demonstrated a moderately positive average belief level in solar energy, with a mean rating of 3.5. The standard deviation of 0.6 suggests a relatively consistent agreement, although variations exist in the strength of belief among respondents. A Respondent of an interview indicates:

> *Yeah, beliefs are crucial too. Some folks think it's not reliable, especially during cloudy days. Others, like me, believe in its potential and understand its limitations. It's about striking a balance and knowing what to expect.*

For 45 respondents (29.6%), the mean rating of 3.2 indicates a moderately positive perception of solar energy concerning cultural norms. While there is some diversity in responses, the standard deviation of 0.8 reflects a fair level of acceptance with variations in alignment with cultural norms. In support of this a Respondent indicates:

> *That's an interesting one. Our cultural norms often dictate what's acceptable or not. For some, embracing new technologies like solar might go against the grain. But I've noticed a positive shift in recent years. People are more open to sustainable living, and that's encouraging.*

Similarly, a total of 30 respondents (19.7%) demonstrated a relatively neutral influence of social networks on their perception of solar energy, as reflected in the mean rating of 2.8. The moderate standard deviation of 0.6 indicates a consistent yet diverse impact of social networks. A Respondent indicates:

> *Absolutely. I've seen cases where friends or family members who are skeptical about solar energy can influence others. On the flip side, a positive experience from someone in your social circle can make you reconsider your views. It's like a ripple effect.*

Among 25 respondents (16.4%), the mean rating of 2.5 suggests a generally neutral to slightly negative peer influence on solar energy adoption. The standard deviation of 0.9 highlights diversity in responses, indicating varying levels of negative influence. In a Respondent view:

> *Community plays a big role. If more people in the neighborhood embrace solar, others might follow suit. And awareness is key. Some folks might be hesitant because they don't fully understand how solar works. So, the more awareness there is, the more likely people are to adopt it.*

On the same wave length, the mean rating of 3.0 for 38 respondents (25.0%) indicates a moderately positive average level of community participation in solar energy adoption. With a standard deviation of 0.7, there is some consistency in positive community involvement. A total of 42 respondents (27.6%) showed a moderately positive perception of public awareness, as reflected in the mean rating of 3.5. The standard deviation of 0.8 indicates variations in the level of awareness among respondents. Among 50 respondents (32.9%), the mean rating of 3.6 indicates a moderately challenging environment for solar energy adoption. The standard deviation of 0.7 suggests some consistency in perceiving challenges, with variations in the severity of challenges among respondents. A Respondent was recalled to have said:

> *High initial costs can be a barrier, and if the government doesn't provide support, it makes it even tougher. Technical complexities and intermittent energy production are challenges too. But, you know, it's a journey. As more people overcome these hurdles, I believe we'll see even greater solar adoption.*

These results collectively illustrate the complex interplay of cultural and social factors influencing the acceptance and adoption of solar energy in Ghana. The analysis provides a nuanced understanding of respondents' attitudes, beliefs, values, and the influence of social networks, peers, community participation, public awareness, and challenges, contributing valuable insights for further investigation and policy considerations.

## Perceived Challenges in Implementation of Solar Energy

The results from Table 2 provide valuable insights into the challenges hindering the implementation of solar energy in Ghana, offering a critical understanding of the obstacles faced by individuals and businesses adopting solar solutions. mong the various challenges identified, the issue of high upfront investment stands out as a major barrier, highlighted by 45 participants. With an average rating of 3.6 and a standard deviation of 0.7, the data reflects differing levels of concern across respondents. This finding is consistent with previous studies that have identified substantial initial costs as one of the primary deterrents to widespread adoption of solar energy technologies. Another noteworthy challenge is the perceived lack of government support, recognized by 30 respondents with a mean rating of 3.2. This aligns with existing literature emphasizing the crucial role of government policies and incentives in promoting renewable energy adoption [5]. Technical complexity is identified by 22 respondents as a challenge, with a mean rating of 2.8 and a moderate level of concern indicated by the standard deviation of 0.7. This underscores the importance of user-friendly technologies and adequate training to address technical complexities hindering solar adoption [15]. Additionally, limited public awareness is cited by 35 respondents, emphasizing the crucial role of awareness campaigns (mean rating of 3.5), while concerns about intermittent energy production (mean rating of 2.9) highlight the need to address intermittency issues for increased confidence in solar energy systems [22]. Regulatory hurdles, recognized by 47 respondents with a high mean rating of 3.7, pose a substantial challenge, as regulatory barriers can impede the deployment of solar energy systems. The challenge of insufficient storage technology, acknowledged by 25 respondents with a mean rating of 3.2, emphasizes the importance of efficient energy storage for overcoming intermittency in solar energy systems. Environmental impact concerns, raised by 40 respondents with a high mean rating of 3.8, underscore the importance of addressing sustainability in solar energy adoption, aligning with literature emphasizing the need for green energy solutions. These findings, echoing existing literature, highlight

the multifaceted challenges faced by adopters, with qualitative insights from respondent interviews reinforcing the impact of high initial costs and the crucial role of government support in addressing these challenges.

Turning our attention to the reliability of solar energy systems in Ghana, the insights derived from Table 3 shed light on respondents' perceptions regarding the performance, durability, and maintenance of these systems. The results unveil a spectrum of perspectives, showcasing a significant portion of respondents with varying levels of confidence in the reliability of solar energy systems. A sizable contingent, constituting 32.9% (50 individuals), adopted a neutral stance, signaling an ambivalent attitude toward the overall dependability of solar energy systems in Ghana. This neutrality reflects the diverse experiences and perceptions of respondents, illustrating the nuanced landscape surrounding the reliability of solar technologies. Conversely, a minority of respondents, comprising 14.5% (22 individuals), held a pessimistic view, categorizing solar energy systems as "Not Very Reliable." This suggests that certain respondents may have encountered issues or concerns that influenced their perception of the reliability of solar energy systems.

In contrast, a substantial majority, accounting for 34.9% (53 respondents), expressed confidence in the dependability of solar energy systems, categorizing them as "Somewhat Dependable." This positive perspective can be attributed to favorable and consistent experiences with solar technology. Furthermore, a minority, yet a considerable 17.8% (27 responders), offered a highly positive perspective, labeling solar energy systems as "Very Dependable." This group indicates a strong belief in the reliability of solar energy systems, suggesting a positive impact on their daily lives. The diversity in responses highlights the intricate nature of perceptions surrounding the reliability of solar energy systems. Individual experiences, maintenance practices, and system design play pivotal roles in shaping how users perceive the dependability of solar technologies, emphasizing the need for a nuanced understanding of these factors in assessing overall system reliability.

Also Examining Table 4 unveils critical insights into the cultural and social factors impeding the widespread adoption of solar energy in Ghana. The results intricately delineate the significance of attitudes, beliefs, values, social networks, peer influence, community participation, public awareness, and challenges in shaping the acceptance and diffusion of solar energy. A notable majority of respondents (52.6%) conveyed a relatively positive average attitude toward solar energy, as reflected in the mean rating of 3.8. This aligns with existing literature underscoring the pivotal role of attitudes in influencing the adoption of renewable energy technologies [4, 8]. Similarly, a substantial segment of respondents (39.5%) exhibited a moderately positive average belief level in solar energy, with a mean rating of 3.5. Studies emphasize that beliefs about the reliability and effectiveness of solar energy can wield considerable influence over adoption decisions.

In terms of cultural norms, 29.6% of respondents demonstrated a moderately positive perception of solar energy, registering a mean rating of 3.2. This underscores the crucial role of cultural factors in shaping individuals' acceptance of innovative technologies. Conversely, social networks yielded a relatively neutral influence on the perception of solar energy for 19.7% of respondents, reflected in a mean rating of 2.8. It is noteworthy that social networks possess the dual capacity to both positively and negatively impact attitudes and behaviors related to solar adoption. Further, a generally neutral to slightly negative influence of peers on solar energy adoption was expressed by 16.4% of respondents, as indicated by a mean rating of 2.5. This suggests that peer opinions and

experiences may exert varying impacts on individual decisions to embrace solar technologies. Meanwhile, a moderately positive average level of community participation in solar energy adoption was reported by 25.0% of respondents, reflected in a mean rating of 3.0. Community involvement emerges as a crucial factor for fostering the collective adoption of renewable energy.

Additionally, moderately positive perceptions of public awareness were reported by 27.6% of respondents, evidenced by a mean rating of 3.5. Recognizing the essential role of public awareness campaigns in disseminating information and dispelling myths about solar energy. Lastly, for 32.9% of respondents, the mean rating of 3.6 indicates a moderately challenging environment for solar energy adoption. Overcoming obstacles such as high initial costs and technical complexities stands out as a pivotal task for promoting widespread adoption [4, 8].

In synthesis, these results collectively unveil the intricate interplay of cultural and social factors influencing the acceptance and adoption of solar energy in Ghana. The nuanced insights into attitudes, beliefs, values, social networks, peers, community participation, public awareness, and challenges contribute invaluable information for policymakers and researchers striving to facilitate sustainable energy adoption in the region.

## Conclusion

The impediments hindering the widespread adoption of solar energy in Ghana are multifaceted, encompassing economic constraints, information gaps, and concerns regarding the reliability of solar systems. A critical analysis underscores the significance of overcoming these challenges for sustainable and enduring solar adoption. Key obstacles include formidable initial costs, a dearth of information, technological complexities, inadequate government support, cultural and sociological barriers, as well as intermittent energy generation. Addressing these issues is imperative to pave the way for the comprehensive integration of solar energy solutions into the energy landscape of Ghana.

## Recommendations

Based on the research findings, the following recommendations are made to promote solar energy adoption in Ghana: Develop interventions that are tailored to address the specific challenges and motivations identified within different socio-demographic groups. Implement financial incentives and support mechanisms to alleviate high initial costs, encouraging wider adoption across diverse economic backgrounds. Prioritize comprehensive education and awareness programs targeting various demographic segments, emphasizing the economic, environmental, and societal benefits of solar energy. Strengthen policy frameworks to provide a supportive environment for solar energy adoption, addressing regulatory hurdles, and promoting sustainable practices. Foster community engagement initiatives to capitalize on the positive role of social networks, peer influence, and community participation in promoting solar energy.

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## Conflict of Interest

None declared.

## Ethical Approval

Adhered to all ethical requirements.

## Author’s Contribution

As the only Author I conceptualized the research and am fully responsible for the methodology, data curation and analysis, writing original draft and editing of the final work.

## Data Availability

The Data that support the findings of this study are available on reasonable request from the corresponding Author (Abdul Samad Issahaque) at samadbigson1@gmailcom for purposes of privacy and confidentiality of participants. The data was collected through questionnaires and interviews.

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# Adverse Drug Reaction Assessment in the Paediatric Population: A Non-Interventional Pharmacovigilance Study

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***Abstract***

*Adverse drug reactions (ADRs) in children are under-reported due to limited clinical trials, off-label prescribing, and lack of caregiver awareness. Pharmacovigilance is essential to evaluate and prevent drug-related harm in paediatric populations. The objective is to identify adverse drug reactions in paediatric patients using the WHO-UMC causality assessment scale and document the pattern and severity of adverse events (AEs). Non-interventional observational study was conducted in 140 paediatric subjects (< 13 years). Clinical history, anthropometrics, and adverse events were documented. Causality was assessed using the WHO-UMC ADR Probability Scale. Descriptive statistics were applied. The mean age of subjects was 7.42 ± 2.94 years; 72.86% were male. All subjects had no significant medical history. The mean ADR probability score was 0.43 ± 1.46, indicating* doubtful *causality. A total of 53 AEs were identified: nausea (16.35%), gastritis (8.81%), drowsiness (2.52%), rash (2.52%), abdominal pain (1.89%), stomach pain (0.63%), and swollen eyes (0.63%). All AEs were mild in intensity. It was Concluded that ADR incidence in the study population was low and predominantly mild. Causality scores indicate minimal association with drug therapy. Strengthening paediatric pharmacovigilance programs remains essential to ensure medication safety.*

***Keywords:*** *Adverse Drug Reactions, Causality Assessment, Pharmacovigilance, Paediatrics, WHO-UMC.*

## Introduction

Pharmacovigilance plays a critical and continuously evolving role in the identification, evaluation, and prevention of adverse effects associated with medicines and vaccines. Its importance is amplified in the paediatric population, where physiological characteristics differ significantly from those of adults. Children undergo rapid changes in body composition, organ maturity, enzyme function, and receptor sensitivity, all of which influence pharmacokinetics and pharmacodynamics [1, 2]. These developmental variations can alter drug absorption, distribution, metabolism, and excretion, making children more vulnerable to unexpected or exaggerated pharmacological responses [1, 3]. Additionally, the frequent off-label or unlicensed use of medicines in paediatrics—stemming from the lack of age-appropriate formulations and limited clinical trial data—further elevates the risk of adverse drug reactions (ADRs) [4].

Historically, several drug-related tragedies shaped the emergence of modern pharmacovigilance systems. The thalidomide catastrophe of the early 1960s, which resulted in widespread congenital malformations, underscored the dire consequences of inadequate drug safety monitoring in vulnerable populations [5]. This event catalysed global reforms, leading to the creation

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of the WHO Programme for International Drug Monitoring in 1968 and the establishment of the Uppsala Monitoring Centre, which now coordinates international efforts in signal detection and safety surveillance [6]. These initiatives strengthened the global regulatory framework and promoted a culture of systematic reporting and evaluation of ADRs.

Despite worldwide advancements, ADR reporting in India remains suboptimal. Barriers such as limited awareness among healthcare providers, inadequate training on causality assessment, fear of legal implications, and lack of structured reporting systems contribute to underreporting. The issue is even more pronounced in paediatric settings, where the interpretation of ADRs is complex, symptoms are often non-specific, and caregivers may lack awareness of reporting mechanisms. Consequently, many ADRs in children go unrecognized or unreported, preventing the generation of robust safety data.

Given this background, there is a compelling need for targeted pharmacovigilance initiatives focusing on the paediatric population. The present study aims to address this gap by systematically detecting ADRs in children and assessing their causality using a standardized approach. By evaluating the pattern, frequency, and likelihood of ADRs in paediatric patients, this study contributes to strengthening the evidence base for safe medication use in children and enhancing the overall effectiveness of pharmacovigilance systems.

## Materials and Methods

### Study Design and Subjects

A non-interventional, observational study was carried out to identify adverse drug reactions (ADRs) in paediatric patients and assess their causality using the WHO–UMC criteria. A total of 140 paediatric subjects, aged below 13 years, were enrolled. Written informed consent was obtained from each participant's parent or legal guardian before inclusion. The study adhered to the principles of the Declaration of Helsinki and followed the predefined inclusion and exclusion criteria [7-8].

**Inclusion Criteria [9-10]:**

Children were eligible for participation if they met the following criteria:

1. Male or female subjects younger than 13 years
2. Undergoing clinical treatment for any medical condition at the time of enrolment
3. Parents or guardians willing to provide accurate past and current medical history
4. Parents or guardians able and willing to provide written informed consent
5. Parents willing to comply with study procedures and assessments

**Exclusion Criteria [11-12]:**

Subjects were excluded from the study if they exhibited:

1. A known history of chronic medical conditions such as:
   - Diabetes mellitus (Type 1 or Type 2)
   - Thyroid disorders
   - Asthma
   - Hypertension
   - Cardiovascular diseases
   - Epilepsy
   - Any other long-term illness requiring chronic therapy
2. Current use of medications for chronic diseases
3. Inability or unwillingness of caregivers to complete consent or required study documentation

### Study Procedures [13-14]

All eligible subjects underwent a comprehensive screening evaluation, which included:

1. Detailed medical and medication history
2. Demographic data collection (age, gender, height, weight)
3. Physical examination (head-to-toe assessment)

4. Vital signs (temperature, blood pressure, heart rate, respiratory rate)
5. Documentation of any pre-existing adverse events (AEs)

Following screening, subjects were enrolled and assigned a unique study identification number. During the observational period, any newly occurring AEs were recorded using standardized reporting forms. Each AE was assessed for causality using the WHO–UMC Causality Assessment System, which classifies events as certain, probable, possible, unlikely, conditional/unclassified, or unassessable/unclassifiable.

**Primary Outcome [15-16]**

1. **Identification and documentation of adverse drug reactions (ADRs)** occurring in the paediatric study population.

**Secondary Outcomes**

1. **Pattern, frequency, and type of reported adverse events (AEs)**
2. **Severity classification** of AEs into mild, moderate, and severe categories
3. **Causality assessment outcomes** using WHO–UMC methodology

## Data Analysis [17-18]

Data collected were compiled into case report forms (CRFs) and subsequently entered into a validated database for analysis. Descriptive statistical methods were employed:

1. Continuous variables were expressed as mean ± standard deviation (SD).
2. Categorical variables (e.g., types of AEs, severity) were summarized as frequency and percentage.
3. AEs were stratified based on severity (mild, moderate, severe) and causality (WHO–UMC categories).

No inferential statistics were required, as the study aimed primarily to describe ADR patterns in the paediatric population.

# Results

## Demographics

A total of 140 subjects were enrolled in the study, and the data were analyzed descriptively. Overall average age of enrolled subjects is 7.4286 Yrs. Out of the 140 subjects enrolled 102 (72.86 %) subjects were male and 38 (27.14 %) subjects were female; all are Asian race. The overall average height of enrolled subjects was 114.2536 cm, and the overall average weight was 20.8429 kg. There were no significant medical history and concurrent medical conditions for all enrolled subjects as per the data collected. The demographic distribution of Subjects can be observed in Table 1 below

**Table 1.** Summary Statistics of Demographics of All Subjects

| **Parameter** | **Count (N= 140)** |
|---|---|
| **Age (Years)** | |
| N | 140 |
| Mean | 7.4286 |
| Standard deviation | 2.9483 |
| Minimum | 3 |
| Maximum | 17 |
| **Gender, n (%)** | |
| N | 140 |
| Male | 102 (72.86 %) |
| Female | 38 (27.14 %) |
| **Weight (KG)** | |
| N | 140 |

| | |
|---|---|
| Mean | 20.8429 |
| Standard deviation | 8.7828 |
| Minimum | 6 |
| Maximum | 56 |
| **Height (Cm)** | |
| N | 140 |
| Mean | 114.2536 |
| Standard deviation | 15.3977 |
| Minimum | 90 |
| Maximum | 162 |
| **Significant Medical History and Concurrent Medical Conditions** | |
| **Subject with NO Diabetes (Type 1/Type 2)** | 140 (100 %) |
| **Subject with NO Thyroid** | 140 (100 %) |
| **Subject with NO Cardiovascular Disease** | 140 (100 %) |
| **Subject with NO Hypertension** | 140 (100 %) |
| **Subject with NO Coronary Artery Disease** | 140 (100 %) |
| **Subject with NO Asthma** | 140 (100 %) |
| **Subject with NO Epilepsy** | 140 (100 %) |
| **Subject with NO Drug Allergy** | 140 (100 %) |
| **Subject with NO Others** | 140 (100 %) |

As part of Data Collection, Adverse Drug Reaction Probability Scale was employed to identify ADRs of subjects. It was evident from Table 2 that, the Mean total score of adverse drug reaction probability scale was 0.435714 (SD 1.4603), indicating that the reaction was doubtful whether the ADR is likely related to factors other than a drug.

**Table 2.** Summary Statistics of Adverse Drug Reaction Probability Scale

| **Parameter** | **Count (N= 140)** |
|---|---|
| **Total Score** | |
| N | 140 |
| Mean | 0.435714 |
| Standard deviation | 1.4603 |
| Minimum | -3 |
| Maximum | 4 |

As part of data collection, Knowledge based questionnaires were employed to record the knowledge of subject's family members about the Adverse Events. It was evident from Table 3 that, around 5 (3.57 %) members had excellent knowledge, 70 (30%) had good knowledge, 53 (37.86%) had moderate knowledge and 12 subjects had poor knowledge regarding the definition of ADR. Out of 140, about 50 (35.71 %) members had poor knowledge, 67 (47.86 %) members had moderate knowledge, and 23 (16.43 %) members had good knowledge on differentiating whether the adverse drug reaction and ADR the Same. Out of 140, 60 (42.86 %) members had poor knowledge, 71 (50.71 %) had moderate knowledge, 7 (5 %) members had good knowledge and only 2 (1.43 %) members had excellent knowledge on who can report ADRs. Out of 140 subjects, 69

(49.29 %) members had poor knowledge, 63 (45 %) members had moderate knowledge, 7 (5 %) members had good knowledge and only 1 (0.71%) member had excellent knowledge on what is meant by Pharmacovigilance. Out of 140 members, all of them had poor knowledge on which method is commonly used for causality assessment of ADR and on what type of medication can cause ADRs.

Out of 140, 101 (72.14 %) subjects had poor knowledge, 37 (26.43 %) subjects had moderate knowledge, 1 (0.71 %) subject had good knowledge and 1 (0.71 %) subject had excellent knowledge on whether the collection of information on ADRs contribute to improving patient safety. Out of 140, 93 (66.43 %) subjects had poor knowledge, 43 (30.71 %) subjects had moderate knowledge, 3 (2.14 %) subjects had good knowledge and 1 (0.71 %) subject had excellent knowledge on how important do you they it is for the public to report ADRs. Out of 140, 118 (84.29 %) subjects had poor knowledge, 21 (15 %) subjects had moderate knowledge, 3 (2.14 %) and only 1 (0.71 %) subject had good knowledge on considering reporting suspected ADRs in future. Out of 140, 132 (94.29 %) subjects had poor knowledge, 7 (5 %) subjects had moderate knowledge, and only 1 (0.71 %) subject had good knowledge on where to find more information on ADR reporting. Out of 140, 119 (85 %) subjects had poor knowledge, and 21 (15 %) subjects had moderate knowledge, on where to find more information on to whom can they report ADRs. Out of 140 members, all of them had poor knowledge on how can ADRs be reported and on what type of ADRs should be reported.

**Table 3.** Summary Statistics of Knowledge Based Questionnaries

| **Parameter** | **Count (N= 140)** |
|---|---|
| **Define ADR** | |
| Excellent | 5 (3.57 %) |
| Good | 70 (50 %) |
| Moderate | 53 (37.86 %) |
| Poor | 12 (8.57 %) |
| **Are adverse drug reaction and ADR the Same?** | |
| Excellent | 0 (00.00 %) |
| Good | 23 (16.43 %) |
| Moderate | 67 (47.86 %) |
| Poor | 50 (35.71 %) |
| **Who can Report ADR?** | |
| Excellent | 2 (1.43 %) |
| Good | 7 (5 %) |
| Moderate | 71 (50.71 %) |
| Poor | 60 (42.86 %) |
| **What is meant by Pharmacovigilance** | |
| Excellent | 1 (0.71 %) |
| Good | 7 (5 %) |
| Moderate | 63 (45 %) |
| Poor | 69 (49.29 %) |
| **Which method is commonly used for causality assessment of ADR?** | |
| Excellent | 0 (00.00 %) |

| | |
|---|---|
| Good | 0 (00.00 %) |
| Moderate | 0 (00.00 %) |
| Poor | 140 (100 %) |
| **What type of medication can cause ADRs?** | |
| Excellent | 0 (00.00 %) |
| Good | 0 (00.00 %) |
| Moderate | 0 (00.00 %) |
| Poor | 140 (100 %) |
| **Does the collection of information on ADRs contribute to improving patient safety?** | |
| Excellent | 1 (0.71 %) |
| Good | 1 (0.71 %) |
| Moderate | 37 (26.43 %) |
| Poor | 101 (72.14 %) |
| **How important do you think it is for the public to report ADRs?** | |
| Excellent | 1 (0.71 %) |
| Good | 3 (2.14 %) |
| Moderate | 43 (30.71 %) |
| Poor | 93 (66.43 %) |
| **Would you consider reporting suspected ADRs in future?** | |
| Excellent | 0 (00.00 %) |
| Good | 1 (0.71 %) |
| Moderate | 21 (15 %) |
| Poor | 118 (84.29 %) |
| **Where can you find more information on ADR reporting?** | |
| Excellent | 0 (00.00 %) |
| Good | 1 (0.71 %) |
| Moderate | 7 (5 %) |
| Poor | 132 (94.29 %) |
| **To whom can ADRs be reported?** | |
| Excellent | 0 (00.00 %) |
| Good | 0 (00.00 %) |
| Moderate | 21 (15 %) |
| Poor | 119 (85 %) |
| **How can ADRs be reported?** | |
| Excellent | 0 (00.00 %) |
| Good | 0 (00.00 %) |
| Moderate | 0 (00.00 %) |
| Poor | 140 (100 %) |
| **What type of ADRs should be reported?** | |
| Excellent | 0 (00.00 %) |
| Good | 0 (00.00 %) |
| Moderate | 0 (00.00 %) |
| Poor | 140 (100 %) |

It was evident from Table 4 that, out of 140 subjects, only 3 (1.89 %) subjects were reported with Mild Abdominal pain, 4 (2.52 %) subjects were reported with Mild Drowsiness, 14 (8.81 %) subjects were reported with Mild Gastritis, 26 (16.35 %) subjects were reported with Mild Nausea, 4 (2.52 %) subjects were reported with Mild Rashes, 1 (0.63 %) subject was reported with Mild Stomach pain, 1 (0.63 %) subject was reported with Mild Swollen eyes.

**Table 4.** Summary Statistics of AE List

| **Parameter** | **Count (N= 140)** |
|---|---|
| **Abdominal Pain** | **3 (1.89 %)** |
| Mild | 3 (100 %) |
| Moderate | 0 (00.00 %) |
| Severe | 0 (00.00 %) |
| **Drowsiness** | **4 (2.52 %)** |
| Mild | 4 (100 %) |
| Moderate | 0 (00.00 %) |
| Severe | 0 (00.00 %) |
| **Gastritis** | **14 (8.81 %)** |
| Mild | 14 (100 %) |
| Moderate | 0 (00.00 %) |
| Severe | 0 (00.00 %) |
| **Nausea** | **26 (16.35 %)** |
| Mild | 26 (100 %) |
| Moderate | 0 (00.00 %) |
| Severe | 0 (00.00 %) |
| **Rashes** | **4 (2.52 %)** |
| Mild | 4 (100 %) |
| Moderate | 0 (00.00 %) |
| Severe | 0 (00.00 %) |
| **Stomach Pain** | **1 (0.63 %)** |
| Mild | 1 (100 %) |
| Moderate | 0 (00.00 %) |
| Severe | 0 (00.00 %) |
| **Swollen eyes** | **1 (0.63 %)** |
| Mild | 1 (100 %) |
| Moderate | 0 (00.00 %) |
| Severe | 0 (00.00 %) |

## ADR Probability Assessment

Causality assessment of observed events was performed using the WHO–UMC Causality Assessment Scale, which evaluates the likelihood of the relationship between a drug and an adverse event. The mean WHO–UMC causality score among the subjects was 0.435 ± 1.46, with individual scores ranging from –3 to +4. This wide variation reflects diverse clinical presentations; however, the overall mean score falls into the “doubtful” category, indicating

that most adverse events were *unlikely to be directly attributable to drug therapy*. This finding suggests that the majority of AEs noted during the study likely arose from non-pharmacological factors, underlying illness, or incidental conditions rather than from medication exposure. The low causality scores also align with the mild nature of all reported adverse events.

## Discussion

In this observational paediatric pharmacovigilance study, we observed a low frequency of ADRs, and importantly, all reported adverse events were mild. The average WHO–UMC causality score (~0.435) fell into the "doubtful" category, suggesting that most AEs were unlikely to be directly attributable to medication. These findings align with several prior Indian studies, reinforcing the notion that, despite biological vulnerability, paediatric ADR burden in real-world settings may often be limited.

For instance, a prospective observational study from a tertiary care hospital reported an ADR incidence of 2.9% in children, emphasizing that while ADRs in children exist, many are preventable or mild. Similarly, a large dataset from Odisha showed that although serious ADRs do occur, they constitute a smaller proportion of pediatric reports, with gastrointestinal ADRs being relatively uncommon. These parallels strengthen our confidence in the external validity of our findings.

### Nature of ADRs: Gastrointestinal Predominance

The predominance of gastrointestinal events (notably nausea and gastritis) in our cohort is noteworthy. While such events can frequently be attributed to medications like antibiotics, analgesics, or symptomatic therapy, they are also common in children due to non-pharmacologic causes (diet, underlying illness, etc.). Studies from other Indian centres corroborate gastrointestinal involvement.

However, cutaneous ADRs often dominate other paediatric ADR literature (e.g., rash is frequently reported in hospital-based settings). The relative absence of skin reactions in our data may reflect differences in prescribing patterns, drug classes used, or even under-recognition/underreporting of dermatological AEs in our observational setting.

### Implications of Mild ADRs

The fact that no moderate or severe ADRs were detected in our sample is encouraging, as it suggests that current prescribing practices in our setting are relatively safe and well-monitored. Yet, the absence of severe ADRs does not negate the importance of pharmacovigilance. Even mild ADRs can adversely affect compliance, quality of life, and long-term therapy, especially in chronic or recurrent paediatric conditions.

Moreover, doubtful causality does not necessarily imply zero risk. Low causality scores may result from limitations in detection (e.g., transient AEs missed between clinical assessments), or from under-reporting of subtle symptoms by caregivers. This underscores the need for vigilant, continuous monitoring rather than occasional checks.

### Challenges in Paediatric Pharmacovigilance

Our findings also reflect broader systemic challenges. Under-reporting of ADRs is a pervasive problem in India. Previous research has identified lack of awareness, insufficient training, fear of legal fallout, and heavy clinical workload as key barriers to spontaneous ADR reporting. Without robust reporting mechanisms and active surveillance, even mild ADRs may go unnoticed.

Additionally, age-related pharmacokinetic and pharmacodynamic variability in children (e.g., organ maturation, enzyme capacity) complicates causality assessment. These

factors make signal detection more challenging in paediatric populations compared to adults, emphasizing the value of standardized causality tools like the WHO–UMC scale.

### Strengths and Limitations

**Strengths:**

1. **Real-world setting:** Our non-interventional study reflects routine prescribing and monitoring practices.
2. **Standardized causality assessment:** Use of WHO–UMC scale ensures methodological rigor.
3. **Focus on mild ADRs:** Often underemphasized but clinically relevant.

**Limitations:**

1. **Lack of active surveillance:** As an observational study without regular follow-ups, some transient or delayed ADRs may have been missed.
2. **No control group:** Without a comparator, it is difficult to distinguish drug-related events from illness-related symptoms.
3. **Limited sample size and drug variety:** With 140 subjects, the spectrum of drugs and ADRs may not represent all paediatric prescribing scenarios.

## Conclusion

1. The paediatric population in this study demonstrated a low burden of adverse drug reactions, with all reported events categorized as *mild* in nature. The WHO–UMC causality assessment further indicated that most events had minimal or doubtful association with drug exposure, suggesting that the observed symptoms were likely attributable to underlying illness or non-pharmacological factors.
2. Despite the low ADR frequency, these findings underscore the critical importance of sustained pharmacovigilance efforts in paediatric healthcare. Children remain a vulnerable population due to developmental differences in drug handling, and even mild ADRs can influence adherence, recovery, and quality of care.
3. To improve detection and reporting of ADRs, ongoing education and sensitization of caregivers as well as healthcare professionals is essential. Strengthening awareness, simplifying reporting pathways, and integrating routine ADR monitoring into clinical practice will contribute significantly to a safer paediatric medication environment. Continuous engagement with national pharmacovigilance programs will also support more robust data generation and early identification of potential safety signals in this sensitive group.

## Ethical Considerations

This study is conducted according to ICH-GCP, ICMR guidelines, ISO 14155 and other government regulations and Institutional research policies and procedures.

## Data Availability

Due to the sensitive nature of pharmacovigilance and patient-related data, the datasets are not publicly available. De-identified data may be provided upon reasonable request and subject to ethical approval.

## Author Contributions

Krishna Priyanka conceptualized the study, prepared the research design, performed data collection and pharmacovigilance analysis contributed to interpretation of pediatric ADR findings. Bharghava Bhushan Rao P reviewed the manuscript, provided critical revisions, and supervised the overall work. All authors read and approved the final manuscript.

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