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Anti-inflammatory Effect of Salvia Miltiorrhiza is Mediated via IL-6, JAK, and STAT Pathway in a Dysfunctional Vascular Endothelial Cell

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Abstract

The vascular complication of diabetes mellitus is a problem for the patient, and the ability to cope with the disease and the associated inflammation is a critical aspect of diabetes. Cytokines-induced inflammation in vascular endothelial cells (VECs) plays an active role in chronic diseases such as atherosclerosis, diabetes mellitus, kidney injury, and stroke. We investigated the role of total salvianolic acids (TSA), total tanshinones (TTSN), and their combination (TSA/TTSN) on the activated vascular endothelial cell and its inhibitory effect on signal transduction and cytokines regulation. In the extracellular medium of the injury model of human umbilical vein endothelial cells (HUVECs) induced by thrombin, the human IL-6, VCAM-1, and ICAM-1 were significantly elevated ($p < 0.05$). However, suppression in the TSA, TTSN, and TSA/TTSN (100 µg/L)-treated groups ($p > 0.05$) were notable. TSA alone but not TTSN and TSA/TTSN combination, inhibited the expression of P-selectin ($p < 0.05$) and E-selectin ($p < 0.01$) respectively, in VECs. Western blot analysis showed JAK and STAT expression in VECs however, the protein expression was modest in the Salvia miltiorrhiza-treated groups, indicating the potential of TSA/TTSN in the inflammatory pathways of IL-6, JAK, and STAT signal transduction in endothelial cells (ECs). This study has made novel observations regarding the components of Salvia miltiorrhiza regulatory effect on cytokines in Vascular Biology.

Keywords*: Atherosclerosis; Cytokines; Diabetes mellitus; HUVECs; Inflammation; Salvia militiorrhiza.*

Introduction

The endothelial is the thinnest layer of the cell covering the conduit of the blood vessel, providing a surface by which blood circulates in the lumen. The endothelial cells play a role in the regulation of inflammation, platelet aggregation, and vascular smooth muscle proliferation [1, 2]. Endothelial cells also play special roles, including blood clotting, angiogenesis, blood pressure regulation, the selective barrier between the vessel and the surrounding bloodstream [3].

However, endothelial cells are first targets during dysregulation of cytokines production under chronic disease conditions owing to their important roles, including continuous contact with the immunological system, result in barrier dysfunction and monolayer permeability by triggering endothelial cell-shape change, and cytokines infiltration due to prolonged increase in permeability of the vascular endothelial barrier mechanism [4]. Vessel damage and inflammation, in most cases, give rise to angiogenesis and tumour development [5].

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Furthermore, inflammation and dysregulation of cytokine production are directly involved in the pathogenesis of atherosclerosis, diabetes mellitus, cardiovascular disease, and autoimmune disease [6].

Chronic cardiovascular diseases, coronary artery disease, atherosclerosis, and diabetes mellitus involve complex inflammatory mediators, including endothelial dysfunction right from the onset of the disease [7, 8] Researchers found that the endothelial cell is a critical pathological target in a chronic diabetes mellitus patient, as diabetes poses detrimental havoc to the vascular endothelial cell during disease progression [9].

Hyperglycemia is a pathological rise in blood sugar that occurs in people with diabetes. When the endothelium is exposed to hyperglycemia, including the high glucose-induced impaired antioxidant defence, an array of negative intracellular events promotes endothelial dysfunction and cardiovascular clinical manifestation in diabetes [10]. The loss of endothelial function could also trigger diabetes microvascular (retinopathy, nephropathy, neuropathy) and macrovascular diseases (ischemic heart disease, stroke, peripheral vascular disease) [11].

An enzyme, thrombin (coagulate factor II), is involved in the coagulation cascade and inflammation and exerts its effect on endothelium when there is an imbalance in the coagulation system, causing endothelial dysfunction and stimulating the release of inflammatory mediators and growth factors [12, 13]. Thrombin promotes platelet activation and aggregation, triggers a pro-inflammatory reaction, and has cell membrane receptors abundant in arterial vessel walls [13]. Consequently, thrombin induces leukocyte adhesion on the endothelial surface and subsequent penetration into the underlying tissue resulting in the disruption of the normal biochemical pathway [14]. The cellular effects of thrombin are known to be mediated by protease-activated receptors (PARs), and PAR-1 is involved in the initial platelet aggregation in response to thrombin, while PAR-4 is assumed to contribute to the stability of platelet aggregation [15].

Medicinal plants have numerous bioactive compounds and display various pharmacological activities such as potency, smoother actions, and tolerance, which are clinically relevant criteria for treating chronic conditions such as cardiovascular diseases; (hypertension, diabetes mellitus, atherosclerosis, myocardial infarction), and the accompanying detrimental inflammation [16]. However, the lack of in-depth knowledge of their therapeutic principles limits their application in the clinic and acceptance in the field of medical science.

Researchers in the field of natural medicine (NM) has made tremendous progress regarding the therapeutic use of the dry root of Salvia militiorrhiza, a popular herbal remedy for treating cardiocerebrovascular disease in China [17, 18]. Salvia militiorrhiza is known for promoting blood flow and resolve stasis [16]. The phytochemical report showed that Salvia militiorrhiza is made up of the abietane type-diterpene quinones pigment (lipid-soluble) Tanshinone I, IIA, IIB, Cryptotanshinone, and Dihydrotanshinone, etc. as well as the phenolic group (water-soluble) Danshensu, Salvianolic acids, lithospermic acid, etc. [19, 20]. Furthermore, diterpene quinones and the phenolic group have been shown to have an antiplatelet effect [21]. Research indicates that Salvia militiorrhiza could dissolve thrombosis and improve blood circulation to resolve inflammation [22], but the underlining mechanism involved in these actions is not entirely understood.

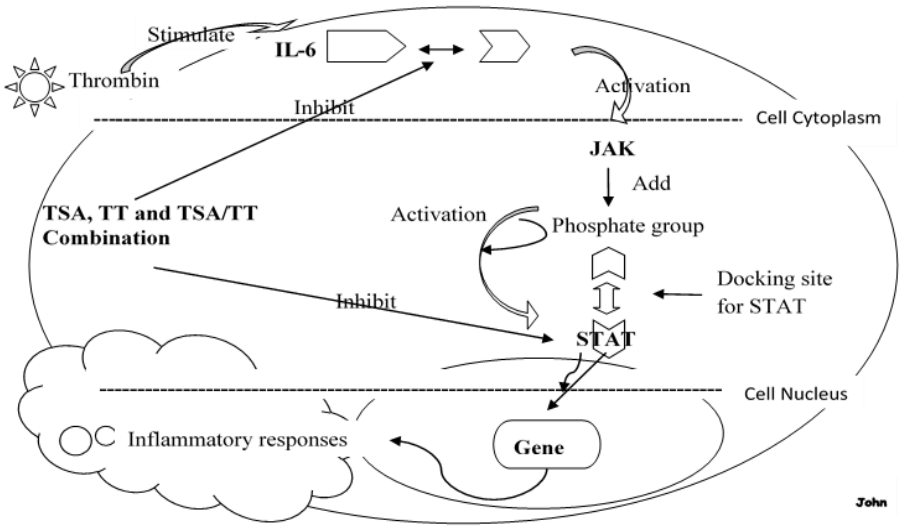

Figure 1. Signal Transduction Pathway of TSA, TT, and TSA/TT Combination Traced from the Activated IL-6, JAK, and STAT

Graphical Abstract

The signal transduction pathway of TSA, TT, and TSA/TT combination traced from the activated IL-6, JAK, and STAT.

TSA, TT, and their combination inhibited thrombin mediated inflammation and blocked the activation of IL-6 outside the cell to stop the binding and activation of the JAK/STAT signal transduction pathway in HUVECs.

The objective of this study is to establish a thrombin injury model of Endothelial Cells (ECs) from Human Umbilical Vein (HUV) in order to study the anti-inflammatory and mechanism of *Salvia militiorrhiza* components (total *Salvianolic acids* and total *Tanshinones*, by therapeutic targeting the pro-inflammatory cytokines.

We would like to state here that this work is original, and the results presented have not been submitted previously in whole or part for publication in another journal nor published in any form whatsoever.

Materials and Methods

Cell Culture

All reagents used for the experiment, including the cell, are bought from ScienCell Research Laboratory, USA. Based on the manufacturer's protocol, the HUVECs (Cat. No. 8000) were incubated with Endothelial Cell Medium (Cat. No.1001) containing 5% FBS (Cat. No. 0025), 1% Penicillin/Streptomycin solution, (Cat. No.0503), 1% Endothelial Cell Growth Supplement (Cat. No. 1052) and pH 7.4. Cells were plated and grown in a 75mm Corning tissue culture flask (Corning Costar Corp., Bedford USA), coated with human plasma fibronectin (Lot. No. NMM1701224, Millipore, USA). Cells were incubated (at 5% CO_2/95% humidified air and temperature of 37°C) and grown to 75 to 80% confluence within 3 to 4 days. At confluence (day 4), cells were trypsinized (Trypsin/EDTA, Cat. No.0103, ScienCell, USA) and the cell pellet were re-suspended in the full endothelial cell medium (ECM) containing 5% FBS and 1% growth factor, then seeded at $6x10^3$ cells in 96-well fibronectin-coated Corning tissue culture plate at an insert volume of 200 µl/well. HUVECs monolayer was used within 24 to 48h at passage 2 to 3 in all the experiments. All procedures were carried out under standard laboratory conditions and safety practices.

Drugs

Two chemical components of Total *Salvianolic acids* [TSA] and Total *Tanshinons*

[TT] were purchased from Xi'an Biotech Inc. P.R. China. A stock solution of *Salvianolic acids* was made using basal ECM (1mg/mL), whereas Tanshinones was dissolving in DMSO (0.1%) and then added to ECM to get the final stock concentration of 1mg/mL). Both were individually filtered through a sterile 0.22µm filter. Thrombin from Bovine plasma (1000U, Cat. No. T8021) was purchased from Solarbio.

Cell Viability Assay

To determine whether TSA, TT or TSA/TT combination is cytotoxic to HUVECs, we performed a modified 3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenyltetrazolium (MTT, Solarbio) assay was performed in order to ensure the therapeutic safety of the drug on the viability of the cell. Briefly, HUVECs were seeded at $1x10^4$ cells/well density and grown to confluence in 96-well culture plates then washed twice with PBS followed by incubation with different concentrations of TSA, TT, and TSA/TT (12.5µg/L, 25µg/L, 50µg/L, and 100µg/L) for 6 hrs without FBS, ECGS, and P/S. The endothelial cells were labelled with 0.5 mg/mL 3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenyl tetrazolium (MTT) in PBS for 4hrs, and the resultant formazan was dissolved in 0.04N HCL/isopropanol. The absorption was measured using a microplate reader at 570 nm. The endothelial cell viability was expressed as a percentage of the value of the control wells. There are six replicates in each treatment group. The experiment was repeated five times on different occasions.

Cytokine Secretion of the HUVECs Injury Model

HUVECs were grown to confluence in a fibronectin-coated 96-well tissue culture plate. It was washed twice with warm (37°C) PBS. Before thrombin addition, cells were fasted of FBS and ECGS for 15min and treated with 10u/mL thrombin. Based on the various groups, 100 µg/L TSA, 100 µg/L TT, and 100 µg/L TSA/TT combination was added and incubated for 6h at 37°C, 5% CO_2/95% humidify-air. Cells incubated with basal medium alone were taken as control. After 6h incubation with the various treatments, HUVECs culture supernatant was harvested and stored at -70°C. According to the Manufacturer's Instruction, human IL-6, VCAM-1, ICAM-1, P-Selectin, and E-Selectin levels in culture supernatants were measured using ELISA kits (R & R&D System), according to the manufacturer's instruction. Briefly, ten standard wells were set up separately on the ELISA micro-titter plate's wells coated with the corresponding antibodies to make a solid face antibody. Standards were constituted according to the manufacturer's instructions; two wells were set apart as blank. 40µL of sample diluent was pipetted into each well, containing 10µl of the sample, and carefully mixed to avoid bubbles, bringing the final dilution to 5-fold. The plate was covered and then incubated for 30 min at 37°C. Thereafter, 300µl of wash solution (30-fold dilution) was pipetted into each well after the content was discarded, then left for 30 s before draining. This step was repeated five times. After that, 50µL of HRP-Conjugate reagent was added to each well and incubated at 37°C for 30min, after covering with the lid. The washing steps were repeated, followed by the addition of a colorimetric solution (Chromogen A and B). We incubated the plate (37°C for 15min) in the dark. Finally, we added a stop solution (50 µL/well) to each well to stop further reactions. We then measured the absorbent at 450 nm, taken the blank wells as zero.

Western Blotting Analysis

Western blot was performed to quantify the expression of JAK-2 and STAT-3 protein in HUVECs. Briefly, a confluence monolayer of HUVECs was assigned to experimental treatments (Control, Model, Inhibitor, and *Salvia militiorrhiza* group). Cells were incubated for 6h at 37°C, 5%CO_2 / 95% moisturized air with basal medium, basal medium /10units/mL thrombin, 25µM AG490

(AG490, Lot. No. 120M1985, Sigma-Aldrich), and 100µg/L TSA/TT + 10u/mL thrombin respectively for the Control, Model, Inhibitor, and Drugs groups. Protein was extracted from the cell for western blot 6hrs after incubation. According to the Manufacturer's Instruction, cells were washed and lysed using a cell lysis kit (Sangon Biological Engineering Technology & Service Co., Ltd., Shanghai, China). Lysates were sheered repeatedly and then centrifuged at 12,000xg for 5min at 4°C. BCA protein concentration assay was done according to the manufacturer's instruction (BCA protein assay kit, Product No. SK3021-500, Sangon Biological Engineering Technology & Service Co. Ltd., Shanghai, China), in order to verify the volume of protein to be loaded into the Gel. An equal volume of sample buffer (42% 0.5 mol/L Tris [pH 6.8], 42% glycerol, 55 bromophenol blue, and 1%SDS; Bio-Rad Laboratories, Inc. Hercules, CA, USA) was added to the sample. Test samples were loaded onto 5-8% (v/v) Sodium dodecyl sulfate-poly-acrylamide gel electrophoresis (SDS-PAGE) and run until the blue marker reached the end of the gel. Proteins are transferred to Immobilon®-P (PVDF membranes, Cat. No. IPVH00010, Millipore Corp., Billerica, USA). All membranes were blocked for non-specific binding by washing in Tris-buffer saline (25mM Tris, pH 6.8, TBST) containing 5% w/v skim milk and 0.1% v/v Tween-20 for 2h at room temperature. The membrane was incubated overnight at 4°C with primary antibodies, Anti-STAT3 (Cat. No. 44384G, Invitrogen), and Anti-JAK2 (Cat. No. 06-255, Millipore) at a dilution of 1:100 to 1: 1500 according to the manufacture's instruction. After three washed, the blot was incubated for 1h at room temperature with horseradish peroxidase-conjugated goat-anti-rabbit IgG (Beijing Biosynthesis Biotechnology Co., Ltd. China) at dilution of 1:1000 in TBST. Thereafter, the washing step was repeated, and the antigen-antibody complexes were detected using enhanced chemiluminescence (ECL, Lot. No. 4622841, GE Healthcare Bio-Sciences AB Sweden) reagent and visualized by scanning with the Bio-Rad Versa Doc (Bio-Rad, Richmond, CA USA) equipped with Nikon Imaging camera. We quantified the band density using Quantity One version 4.2.2 software (Bio-Rad, USA). β-actin (Rabbit polyclonal anti-β-actin, Santa Crus Biotechnology CA, USA) was used as a protein standard.

Statistical Analysis

We expressed all data as the mean ± SD of results obtained from at least three individual experiments performed in duplicate using SPSS version 11. A p-value < 0.05 was regarded statistically significant, while a p-value < 0.01 was considered highly significant.

Results and Discussion

Effect of TSA, TT, and TSA / TT on Cell Viability

Effect of TSA, TT, and TSA / TT on cell viability of HUVECs was determined using the modified MTT assay, which showed no cytotoxicity, indicating that the incubation at the range of 12.5 µg/L to 100 µg/L for 6hrs is suitable for the viability of the cell compared with the model, Figure 2 and 3.

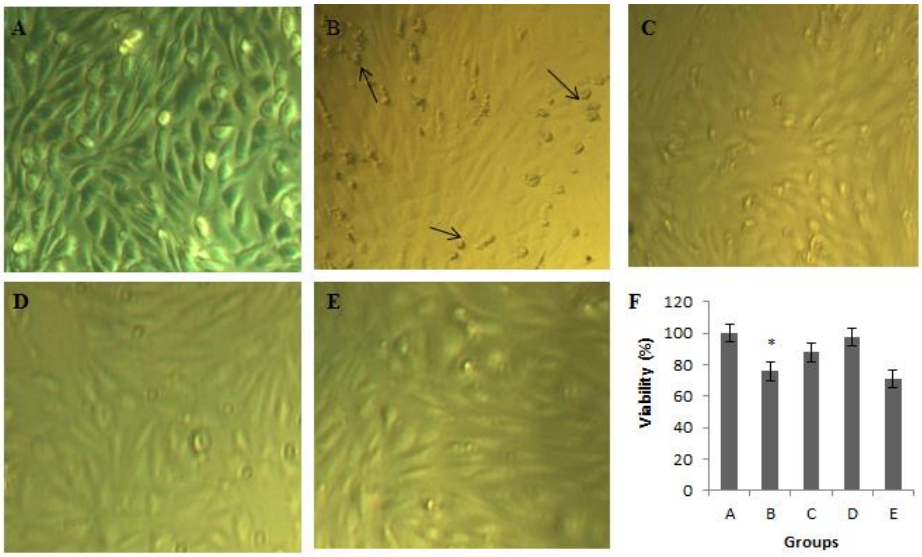

Figure 2. Micrographs of HUVECs taken using a Phase-Contrast Microscope Equipped with a Digital Camera (X100)

Micrographs of HUVECs taken using a phase-contrast microscope equipped with a digital camera (X100). A: Control, B: Model (incubated with basal medium only), C: incubated with thrombin + TSA, D: incubated with thrombin + TT, E: incubated with thrombin + TSA/TT, and F-panel represent viability chart of HUVECs, incubated with thrombin and Salvia militiorrhiza components for 6 hrs. Black arrows in panel B indicate cell injury. Notice the tumor-like swellings and distortion from the normal morphology of HUVECs 6 hrs after incubating with thrombin (Figure 2).

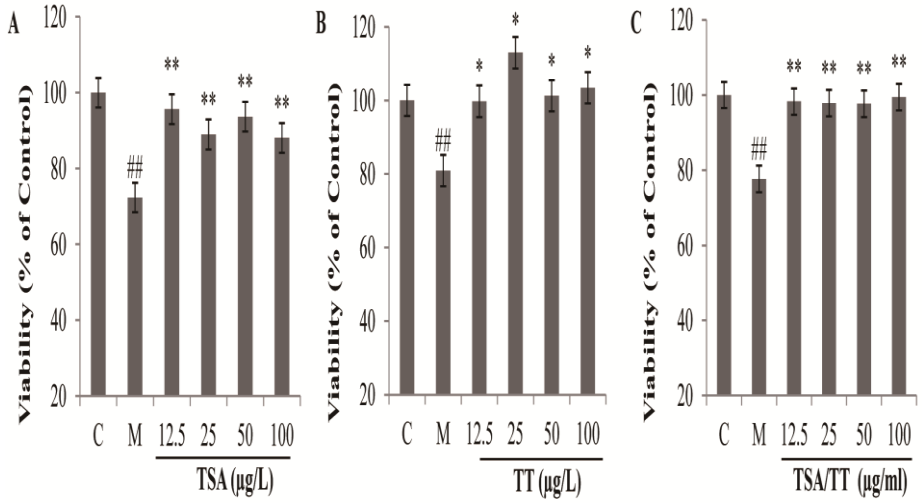

Figure. 3. The Viability of HUVECs after Incubation with TSA, TT, and TSA/TT for 6 hrs

The Viability of HUVECs after incubation with TSA, TT, and TSA/TT for 6 hrs. A: total salvianolic acids (TSA); B: total Tanshinone (TT); and C: total salvianolic acid/total tanshinone (TSA/TT). Lower panel: C represents Control, and M represents Model. A, B, and C are low to moderate doses of TSA, TT, and TSA/TT, respectively. Notice the trend in the low to moderate doses. TSA, TT, and TSA/TT at low to moderate doses enhanced the cell viability (Figure. 3).

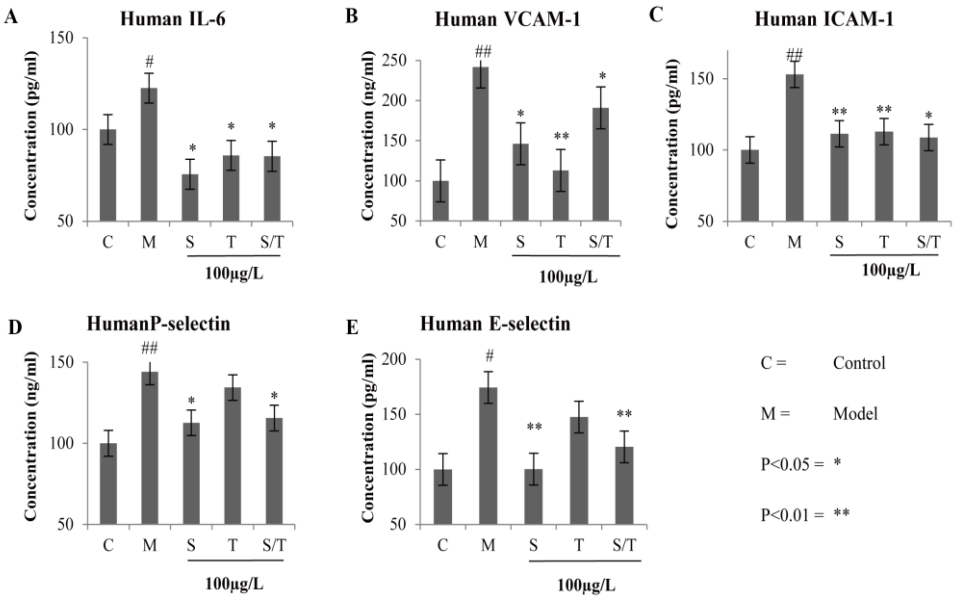

Figure 4. Effects of Salvia Militiorrhiza Components on Cytokines Secretion

Effect of TSA, TT, and TSA/TT Combination on Cytokine Secretion of HUVECs

Compared with the Control, marked significant differences were observed in cytokines secretion of HUVECs incubated with thrombin within 6 hrs of incubation; IL-6 (P<0.05), VCAM-1, and ICAM-1 (P < 0.01); P-selectin (P < 0.01), and E-selectin (P < 0.05) respectively. It is interesting to note that the inflammatory mechanism as related to atherosclerosis and diabetes mellitus is the activation of endothelial cell [23, 24]. Platelet activation cascade leads to cellular activation of P-selectin, and increase ICAM-1, VCAM-1, and E-selectin; and result in inflammatory progression, endothelial dysfunction, and the formation of the atherosclerotic lesion (Figure 4) [25-27].

S: Salvianolic acids, T: Tanshinones, S/T: the combination of Salvianolic acids and Tanshinones. S, T, and S/T significantly (p < 0.05 and p < 0.01) ameliorated human IL-6, human VCAM-1 and human ICAM-1, respectively, whereas S (p < 0.05) and S/T (p < 0.01) also significantly ameliorated human P-selectin and human E-selectin, respectively, contrary to the Tanshinones alone.

Interestingly, *Salvia militiorrhiza* components significantly ameliorated the expressions of IL-6 (p < 0.05), VCAM-1 (p < 0.05), (p < 0.01), (p < 0.05) and ICAM-1 (p < 0.01), (p < 0.01), (p < 0.05), across the groups for TSA, TT, and TSA/TT respectively, Figure 3. Furthermore, the expression of cell adhesion molecules, P- and E-selectin, in thrombin-induced HUVECs injury is an indication of leukocytes rolling on inflamed endothelium [28]. This was mitigated by the addition of *Salvia militiorrhiza* components. TSA (P-selecting, p > 0.05), TSA/TT (P-selectin, p > 0.05) and TSA (E-selectin, p > 0.01), TSA/TT (E-selecting, p > 0.01) levels respectively in thrombin-induced injury of HUVECs were greatly mitigate by *Salvia militiorrhiza* components at 100μg/L (raw dose), Table 1. TT alone have a modest effect on P- and E-selectin (p > 0.05) and (p > 0.05), respectively. Therefore, in view of this, there is a high probability that TSA alone or TSA/TT combinations are potent components of *Salvia militiorrhiza* in regard to cytokines regulation of endothelial cells if tested clinically as preventive or curative in patients vulnerable to diabetes mellitus or atherosclerosis.

Western Blotting

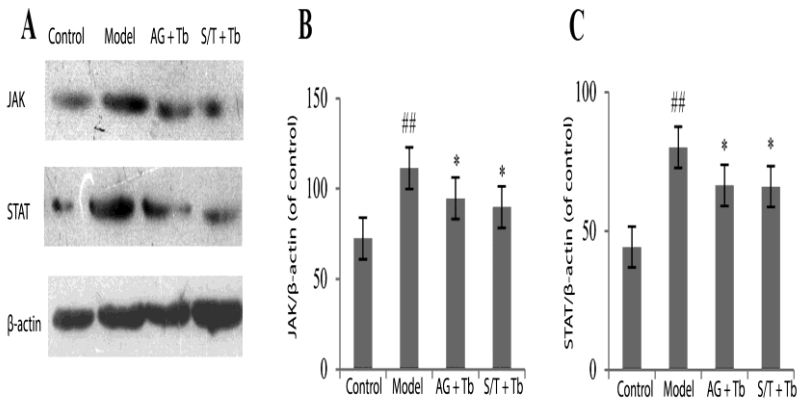

Figure 5. Effect of Salvia Militiorrhiza Components on the Expression of JAK and STAT-3 Proteins

A: Original blot images for JAK, STAT, and β-actin; B and C: Quantification of the blot image of panel A. Control (healthy HUVECs), Model: (HUVECs thrombin Injury Model), AG+Tb: (HUVECs incubated with AG490+Thrombin), S/T+Tb: (HUVECs incubated with Total Salvianolic acids + Total Tanshinons + Thrombin). n = 3, $p < 0.05$.

Thrombin initiated signal transduction in HUVECs as shown in Figure 5, model. AG 490 is a potent inhibitor of epidermal growth factor tyrosine kinase activity, JAK family tyrosine kinases, and guanylyl cyclase. Epidermal growth factor tyrosine kinase found in human platelets, macrophages, plasma, etc. act by binding to JAK on the cell surface to stimulate the tyrosine kinase activity protein of the receptor, which initiates a signal transduction cascade after binding, and results in a variety of biochemical changes within the cell. The addition of AG 490 to the cells significantly diminished JAK and STAT. This is comparable to TSA/TT as shown by the blot analysis, indicating that TSA/TT attenuated the Janus kinase/signal transducer and activator of transcription (JAK/STAT) signaling pathway in HUVECs to ameliorate the dysfunctional production of inflammatory cytokines [29, 30]. Thus represents one of the novel mechanisms by which TSA/TT acts to protect the cells against inflammatory progression in atherosclerotic and diabetes mellitus event, making *Salvia militiorrhiza* a versatile herbal drug in atherosclerosis and diabetes [31].

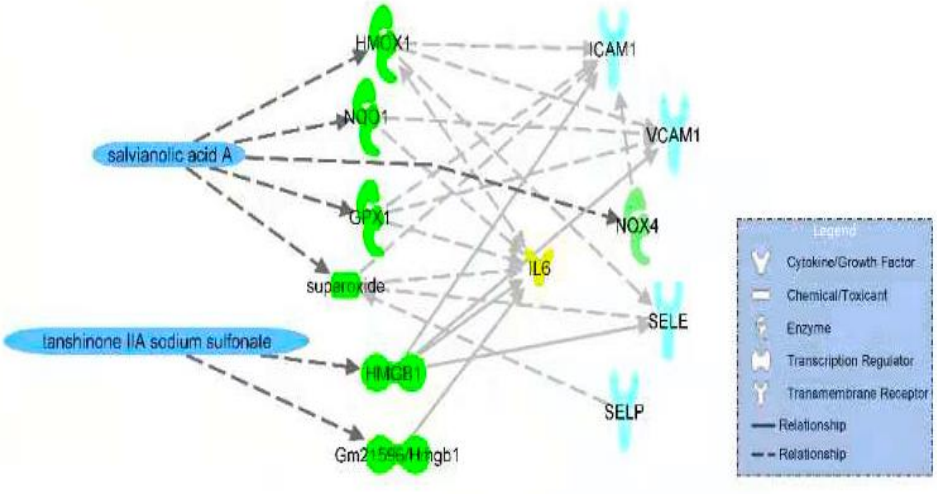

Figure 6. Ingenuity Pathway Analysis (IPA)

An updated view of biological pathways and functions connecting the active components of *Salvia militiorrhiza* and dysfunctional inflammatory signal transduction using ingenuity pathway analysis (IPA). Ingenuity Pathway Analysis (IPA; Ingenuity Systems, Redwood City, CA) was performed to trace connections of the cytokines with inflammation and to determine how the different cytokines expressed in HUVECs were regulated by *Salvia militiorrhiza* components. Salvianolic acid A have connections with IL-6; ICAM1, VCAM1 (leucocyte rolling and adhesion), SELE, and SELP (cell adhesion molecules and platelet activation) through Enzymes (HMOX1, NOO1, GPX1), and Superoxide (chemical/toxicant). Whereas Tanshinone IIA have connections with IL-6, ICAM1, VCAM1 (leucocyte rolling and adhesion), and SELE through transcription regulator (HMGB1 and Gm21596/Hmgb1) (Figure 6).

Conclusion

Dry root of *Salvia militiorrhiza* is one of the most important and widely used herbal medicine for hundreds of years in treating several ailments such as coronary artery disease, myocardial ischemia, and other cardiovascular diseases [16] in China and other countries, but the knowledge of the pharmacological targeting pro-inflammatory cytokines is poorly understood. We hypothesized that at certain doses, TSA, TT, and TSA/TT combination inhibits dysfunctional cytokines secretion to regulate inflammation in endothelial cells. The data demonstrate that TSA, TT, and TSA/TT, 2:1 combination (100 µg/L) inhibited thrombin in culture and blocked the increased expression of IL-6, JAK, STAT signal transduction pathway similar to tyrphostin AG 490 (AG490), and revised the high levels of IL-6, ICAM-1, VCAM-1, P-selectin, and E-selectin respectively, to protected HUVECs against thrombin-induced inflammatory injury and endothelial dysfunction. In this study, *Salvia militiorrhiza* components showed potential in regulating dysfunctional pro-inflammatory cytokines in vascular endothelial cells [16].

Inflammation is a sign of physical or systemic injury involving the signaling of inflammatory mediators, and chronic inflammatory as found in diabetes mellitus, could be harmful to the body [32]. Inflammation is one of the serious and major causes of endothelial dysfunction resulting in atherosclerotic vascular injury and remodeling in diabetes mellitus [32]. The activation of the JAK/STAT signal pathway in vascular endothelial cells results in inflammatory progression and endothelial dysfunction [34]. It was experimentally proven that soluble forms of IL-6, ICAM-1, VCAM-1, P-selectin, and E-selectin are found in the activated endothelial cells [35]; and predict the development of macrovascular disease in a diabetic patient [36]. It is scientifically reasonable to note that an herbal medicine targeted at regulating the pathogenic circulation of inflammatory cytokines is capable of ameliorating the detrimental effects of diabetes mellitus in the patient.

It was experimentally reported that the several components in combination in *Salvia militiorrhiza* ameliorate insulin resistance through the regulation of glucose and fat metabolism [37]. Furthermore, tanshinone IIA, which is a major component in *Salvia militiorrhiza*, is capable of attenuating renal damage in a diabetic model through the inhibition of oxidative stress and inflammatory pathway [38]. This is proof that the dry root of *Salvia militiorrhiza* possesses both anti-inflammatory and antioxidant properties as a relevant therapy in diabetes. From the experimental point of view, these claims are worth analyzing as related effects were observed in the current work. This study has made an observation regarding one of the pathways by which *Salvia militiorrhiza* regulates pro-inflammatory cytokines production in the pathophysiology of arterial disease.

Acknowledgements

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Declaration

We declare that this work is original and has not been submitted for publication in any journal nor published in any form whatsoever.

Conflict of Interest

The authors of this manuscript declare no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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Knowledge, Attitudes, and Behaviours of Adults (15-49 Years) towards HIV/AIDS in Ghana

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Abstract

The adult population (15-49 years) are the most productive and yet the most vulnerable to HIV infections in Ghana. A phenomenon that threatens the socio-economic growth of the country and the survival of its people. Poor knowledge, ill-informed attitudes, and risky lifestyles are the key factors that hinder the prevention of HIV spread among adults. The study's aim was to explore knowledge, attitudes, and risky behaviours among adults which hinder the prevention of HIV/AIDS in Ghana. A case-control study of 362 adults was conducted in the Ahafo and Northern regions of Ghana in 2020. Descriptive and inferential statistics were significant at 1% and 5%. Results indicated that the majority of adults in Ghana are sexually active with limited education but high knowledge of HIV/AIDS. The study revealed significant levels of association between HIV infections and age, sex, marital status, sex with multiple partners, use of the condom, sex for money, sexually transmitted infections, alcohol or drug abuse, personal income, access to places where sex is traded, and migration. The study concludes that both cases and controls generally had good knowledge regarding HIV/AIDS but show poor attitudes towards PLHIV and also engaged in risky behaviours that might predispose others to HIV infections. Findings also highlight the need for culturally adaptive and age-specific HIV education for adults across all regions. Identified misconceptions on HIV/AIDS, poor attitudes of adults towards PLHIV, and risky behaviours of adults regarding HIV/AIDS need specific and targeted education towards behavioural change.

Keywords*: Attitudes, Adults, Behaviours, HIV/AIDS, Knowledge.*

Introduction

Following the first report of HIV/AIDS in 1981, the disease has been one of the most dreaded global health challenges, affecting over 70 million people and claiming about 35 million lives [1]. Joint United Nations Programme on HIV/AIDS (UNAIDS) puts 2018 global estimates of people living with the virus at 37.9 million. Out of this number, 36.2 million are adults, while people who have died from HIV/AIDS-related illnesses since the beginning of the epidemic are 770,000 [2]. Developing countries have the highest number of HIV/AIDS infections in the whole world due to the poor state of their health facilities and limited specialization [1]. For example, Sub-Saharan Africa alone has 25.6 million infections. Though statistics indicate a declining rate of HIV/AIDS infections globally, the virus has disrupted many economies, with developing countries suffering the most impact [2]. In Sub-Saharan Africa, Ghana is among the first 20 countries with HIV/AIDS prevalence, with South Africa as the leading African country with HIV/AIDS virus.

Though new infections are sharply declining, a myriad of challenges still exists that make it difficult to control the spread of the virus [3].

HIV/IADS affects people mostly in their productive years (15-49 years), with several impacts on families, communities, and the infected individuals' economies. Apart from the health, the stigmatization of people living with the virus makes it difficult for infected persons to contribute substantially to the development of the economy of their countries.

Irrespective of the global decline in HIV/AIDS cases, Ghana's new infections rouse in 2018, with adult HIV/AIDS prevalent rate estimated at 1.69 percent [4]. While the Northern region has the lowest prevalence of HIV, the Ahafo region recorded the highest prevalence of HIV/AIDS. What remains uncertain are factors contributing to the spread of the disease in Ghana. This has raised concerns about male transmissions and how the country is responding to break the transmission chain of HIV/AIDS.

This study, therefore, examines in detail the factors accounting for the spread of the HIV/AIDS virus in Ghana. This is because HIV/AIDS continues to rise in developing countries with an increase in new infections [5]. This study is intended to uncover the factors responsible for the rising levels of HIV/AIDS in Ghana. The results are expected to inform the Ghana Health Service on nature and factors causing the rise in infections and tackle it.

The study further examines the risk factors associated with the continued HIV infections and accounts for the reasons in regional variations. It proposes appropriate intervention measures to curb the trend in Ghana. This study would help medical practitioners in tackling the root challenges leading to the spread of the virus. Therefore, it would impact the strategies adopted by the health professionals in dealing with the virus and serve as a springboard for further studies in HIV/AIDS incidence in the country.

The fact that in Ghana, many factors predispose adults to the risk of HIV/AIDS while others living with HIV infections do not have access to prevention, treatment, and care services [6]. Challenges of containing the HIV/AIDS virus continue to exist despite efforts to stop the virus. The emergence of Sustainable Development Goals, especially goal 3, has enjoined the world to promote global health and end HIV/AIDS by 2030. Ghana falls short of many targets [7] as new HIV infections remain high among adult populations. In spite of the advancement made to combat HIV/AIDS, poor knowledge, bad attitudes, and irresponsible behaviours continue to thwart efforts in national and global health promotion. This study, therefore, aims to explore the knowledge, attitudes, and behaviours of adults towards understanding the rising levels of new HIV/AIDS infections, causal factors, and the nature of spread in Ghana. It also aims to contribute to global health discourse by advancing knowledge in factors hindering the prevention of HIV/AIDS in Ghana.

Materials and methods

This study used a case-control study design to compare how frequently the exposure to risk factors are present in each group. This helps to determine the relationship between the risk factors and HIV infections (status) in Ghana. Quantitative methods were used for data collection and analysis to determine the prevalence of risk factors of HIV amongst the adult population of 15 to 49 years old in the Ahafo and Northern regions of Ghana.

The choice of the Ahafo region and Northern region as study areas was because the two regions recorded the highest (2.66%) and lowest (0.40%) HIV prevalence rates respectively in 2018 [8]. The Ahafo and Northern regions are part of the 16 administrative regions of Ghana. Estimates in 2018 put new HIV infections for all ages at 20,000, with about 14,000 HIV-related deaths in Ghana. These statistics supported the choice of the two regions as case and control for studying HIV infections in Ghana.

The design comprised of comparable case (adult HIV positive persons) and control (adult HIV negative persons) determined by the inclusion and exclusion criteria. A total of 362 participants from both the Ahafo region (155

cases, 155 controls) and Northern region (26 cases, controls 26) were randomly selected using a simple random selection approach given regional HIV differences in the prevalence. The sample size of the study was determined using the following formula.

$$n = (\frac{r+1}{r}) \frac{(\bar{p})(1-\bar{p})(Z_{\beta} + Z_{\alpha/2})^2}{(p_1 - p_2)^2}$$

The sample size of n=362 (181 cases, 181 controls) is determined at 80% power, ($Z\beta$ = 0.84), 0.05 significance level ($Z\alpha$=1.96), an equal number of cases and controls (r=1), odds of 2 or greater, and take the proportion of cases exposed in the control group at 20%. The average proportion exposed was taken at (0.33 + 0.20)/2 = 0.265.

The sources of cases were identified from Tano South district in the Ahafo region and Karaga district in the Northern region, where sampling frame was provided by the Ghana Health Service from Anti-Retroviral Treatment (ART) centres upon fulfilling all the ethical requirements. Only cases which met inclusion criteria were allowed to participate in the research. The inclusion criteria for this research were being a client at a selected ART centre within the age range of 15–49 years and a resident of the study region in the last three months to the date of enrolment on the study. Cases were persons who became HIV positive and have been recorded at selected hospitals (ART centres), while controls were randomly selected from among persons who remained HIV negative evidenced at the same selected health facilities. Data were then collected within this population, which was cleaned, analysed, and interpreted using SPSS.Statistics. v21.

Results and Discussion

This section analyses and discusses the results of the study. The results are presented in tables. The investigators provide comparisons and juxtaposition to draw meaning from the results presented for the sake of advancement in knowledge, societal transformation, and human progress in the HIV/AIDS pandemic. The findings of the study are presented in light of literature and the contemporary health situation in Ghana. The aim is to provide relevant knowledge in understanding the spread of HIV/AIDS among adults. The thoughts generated in this discussion will help draw conclusions for the study.

Demographic Characteristics

Results from Table 1 indicate that the largest age group of respondents that were HIV positive were in the middle age adult groups (25-39 years). This group represents 45.2 percent of the respondents, followed by the older adults (aged 40-49 years, representing 43% of respondents) infected with HIV. Also, the largest age group of respondents without HIV were in middle-aged adults of (25-39 years, representing 63.6%), while the younger age group of 15-24 years were the second among HIV-negative respondents (21.5%). Sadly, the majority of the respondents, HIV carriers (66.3%), were unemployed. Again, about 67.4% of the respondents were HIV-negative who were in full-time employment. The majority of HIV carriers (60.2%) were urban residents, while 39.8% of HIV carriers were rural residents. Table 1 shows the results of the demographic and socio-cultural dynamics of the respondents, which could influence their knowledge level in HIV awareness and or safe sex practice. The study estimated the association between each demographic and HIV Status of respondents and found some variables to be statistically significant at levels 1% and 5%. These variables are age group, occupational status, educational status, and marital status of respondents. Again, respondent's place of residence, the first source of HIV information, sex with multiple partners, condom usage at all times, sex for money, alcohol and drugs status, and awareness of places where sex is traded were assessed and reported (Table 2).

The study asserts that a relationship exists between the age group of respondents and HIV infection at 1% significant level. This implies

that the older one gets, the high the risk of HIV. This is established by the increase in the significant level of association with an increase in age (Table 2). The occupational status of the respondents was also significant at 1% level relating to HIV Status. The analysis further revealed a significant positive level at 1%, estimating the relationship between the educational status of the respondents, marital status, and place of residence with HIV Status.

Table 1. Respondents Demographic Information

Respondents Demographic Information	**Responses**	**HIV Status**			
		Negative		**Positive**	
		N	**%**	**N**	**%**
Respondent's District	Bechem	155	85.6%	155	85.6%
	Karaga	26	14.4%	26	14.4%
Age Group of Adults Respondents	15 -24 years (Young)	39	21.5%	20	11.1%
	25 - 39 years (Middle)	115	63.6%	83	45.9%
	40 - 49 years (Older)	27	14.9%	78	43.0%
Sex of Respondent	Female	125	69.1%	136	75.1%
	Male	56	30.9%	45	24.9%
Category of Respondent (Cases)	Bechem (Ahafo)				
	Old	-	-	123	79.4%
	New	-	-	32	20.6%
	Karaga (Northern)				
	Old	-	-	25	96.2%
	New	-	-	1	3.8%
Occupational Status of Respondent	Full – Time	122	67.4%	25	13.8%
	Part – Time	42	23.2%	36	19.9%
	Unemployed	17	9.3%	120	66.3%
Educational Status of Respondent	University	30	16.60%	10	5.50%
	Senior high school	44	24.30%	16	8.80%
	Junior high school	56	30.90%	48	26.50%
	Primary school Education	28	15.50%	47	26.00%
	No formal Education	23	12.7%	60	33.10%
Marital Status of Respondents	Cohabiting	2	1.1%	13	7.2%
	Divorced	1	.6%	19	10.5%
	Married	114	63.0%	77	42.5%
	Never married	12	6.6%	3	1.7%
	Separated	1	.6%	2	1.1%
	Single	51	28.2%	53	29.3%
	Widow	0	0.0%	14	7.7%
Respondents Place of Residence	Urban	75	41.4%	109	60.2%
	Rural	1106	58.6%	72	39.8%

Source**:** Author's Field Survey, 2020

HIV Knowledge, Attitude and Behaviours

This section discusses the results of the investigation on knowledge, attitudes, and behaviours of respondents towards HIV/AIDS in Ghana. The findings revealed a plethora of factors that contribute to knowledge, attitudes,

and behaviours on HIV/AIDS. From the study, the key sources of information on HIV remain principally the traditional sources of information such as; Radio (51.9% with HIV; 34.3% without HIV), Television (23.2% with HIV; 19.3% without HIV), Health care systems (15.5 % with HIV; 7.7 % without HIV) and friends (30.4% with HIV; 1.97% without HIV). Albeit these factors vary between groups, sources of information on HIV remain traditional. It appears as though social media, which is trending and easy to reach, is not being utilized in the dissemination of information on HIV/AIDS.

The findings of this study corroborate the findings of [9], who argued that HIV/AIDS information sharing is strictly through the main media. The implications for this trend could be linked to the volatility nature of social media, such that information usually exists without controls. This could expose some HIV/AIDS patients with the consequences of stigmatization and stereotyping. This finding, however contradicts [10], which reported adaptation of social media to the reportage of HIV/AIDS information. According to them, users of social media for HIV information have found the system useful though efforts need to be kept in place to overcome undue exposure of the patients to the general public. Generally, this study also posits that there exists an association between access to a health facility and HIV infections. Indicatively, one's risks of infection reduce with access to health facilities. Findings also revealed high percentages (over 90%) of both infected persons and non-infected persons have knowledge of HIV/AIDS. Though this trend indicates efforts being made under HIV sensitizations programmes, respondents with HIV infection appear to have detailed knowledge on the virus than those without infections. On the whole, many of persons without infections only indicated general knowledge and awareness without a deeper understanding of how to protect themselves adequately from the virus. Table 2 confirms the assertions by [11, 12] that sensitization programmes must target some behavioural change with efforts to contain HIV/AIDS virus. While acknowledging that such behavioural change does not come in handy, efforts need to be made to dispel prejudices about HIV/AIDS. This will pave the way for proper education, targeting HIV information sharing and general behavioural change towards HIV/AIDS and advancing all people's progress.

Like many traditional medical types of research, the current study found that unprotected sexual intercourse is the main cause of HIV infections. Apart from this, the use of infected objects and blood transfusion with infected persons were identified as causes of the spread of HIV infections. Besides, respondents also identified the following symptoms associated with HIV infections; diarrhoea, fever, headache, rash, and weight loss. About 91% of HIV carriers and 82.3% of respondents without HIV indicated that there is HIV treatment available in Ghana. Although this does not mean a cure for the disease, the spread of fake information has become a daunting task to deal with in the current dispensation where social media is much patronized, and the proliferation of spiritual herbalists and healers remained unchecked in Ghana.

Table 2. Relationship/Association between Demographics and HIV Status

Respondents Demographic Information	Responses	HIV Status				χ2	P-value
		Negative		Positive			
		N	%	N	%		
District	Bechem	155	85.60%	155	85.60%	0.00	1.000
	Karaga	26	14.40%	26	14.40%		
Age group (Years)	15 – 24 (Younger)	39	21.60%	20	11.10%	23.24	0.015**
	25 - 39 (Middle)	115	63.60%	83	45.90%	55.70	0.000***
	40 - 49 (Older)	27	14.80%	78	43.10%	49.10	0.000***
Sex	Female	125	69.10%	136	75.10%	1.66	0.197
	Male	56	30.90%	45	24.90%		
Occupational Status	Full – Time	122	67.40%	115	63.50%	23.75	0.000***
	Part – Time	2	1.10%	26	14.40%		
	Unemployed	57	31.50%	40	22.10%		
Educational Status	University	30	16.60%	10	5.50%	45.93	0.000***
	Senior high school	44	24.30%	16	8.80%		
	Junior high school	56	30.90%	48	26.50%		
	Primary school	28	15.50%	47	26.00%		
	No formal Education	23	12.70%	60	33.10%		
Marital Status	Cohabiting	2	1.10%	13	7.20%	51.21	0.000***
	Divorced	1	0.60%	19	10.50%		
	Married	114	63.00%	77	42.50%		
	Never married	12	6.60%	3	1.70%		
	Separated	1	0.60%	2	1.10%		
	Single	51	28.20%	53	29.30%		
	Widow	0	0.00%	14	7.70%		
Residence type	Rural	75	41.40%	109	60.20%	12.78	0.000***
	Urban	106	58.60%	72	39.80%		

Source**:** Author's Field Survey, 2020, Significant level; 1% (***), 5% (**)

Factors Accounting for Regional Variations in HIV Prevalence and Spread in Ghana

Thirteen (13) out of 21 independent variables were reported by multiple logistics regression models to be statistically significant at 1% and 5%, influencing HIV spread among adults in Ghana (See Table 3). These 13 variables significantly contribute to variations in the likelihood of spreading HIV among adults in Ghana. These variables are listed as; the age of respondents, sex of respondents, marital status, having sex with multiple partners, condom usage at all times, sex for money, infected with sexually transmitted infection (STI), alcohol or drug addiction, awareness of places where sex is traded, awareness of drugs selling places, income level, access to places where sex is traded and migration status of respondents.

Though many studies exist on the causes of HIV, these variables have also been under-reported. This study contributes to the ongoing debate in global health by outlining the principal factors responsible for the spread and regional variations in HIV/AIDS in Ghana. The implication is that there is the likelihood of reducing the spread of HIV if these variables are targeted and brought under control. On the other hand, ineffective handling of these factors will expose populations to infections and retard efforts to combating HIV/AIDS in Ghana.

Table 3. Factors Accounting for HIV Spread among Adults in Ghana

Variables	**AOR**	**P>z**	**[95% Conf. Interval]**
Age Group	1.795	0.002***	1.24321 - 2.59137
Sex	4.443	0.027**	1.189168 - 16.59735
Occupational Status	0.410	0.207	0.1024159 - 1.639884
Educational Status	0.515	0.203	0.1851685 - 1.430976
Marital Status	0.210	0.003***	0.0753018 - 0.5871516
Respondents Place of Residence	0.405	0.083	0.1459216 - 1.123671
Age group first time of sex	0.665	0.479	0.2140524 - 2.062923
Having sex with multiple partner	4.269	0.009***	1.448189 - 12.58322
Condom usage at all time	0.069	0.016**	0.007898 - 0.6095435
Ever had sex with a partner 15 years older	1.581	0.492	0 .4272804 - 5.853243
Sex for money	21.404	0.000***	6.098537 - 75.12323
Infected with sexually transmitted infection	7.135	0.000***	2.491865 - 20.42966
Alcohol or Drug addiction	0.082	0.000***	0.0240381 - 0.2818849
Awareness of places where sex is traded	6.792	0.007**	1.68661 - 27.34769
Awareness of drugs/alcohol selling places	0.123	0.006**	0.0278064 - 0.544935
Income level	0.201	0.008**	0.0609327 - 0.6613691
Access to place of sex trade	12.708	0.011**	1.791786 - 90.13664
Used to traveling to other parts of the country	0.664	0.480	0.2127659 - 2.069773
Migration Status	10.616	0.000***	2.881842 - 39.10868
Practice polygamy marriage	1.157	0.867	0 .2110345 - 6.34252
Entertainment	0.529	0.415	0.1145077 - 2.446815
Number of obs = 362		Prob > chi2 = 0.0000	
LR chi2(21) =356		Pseudo R2 = 0.7094	

Source: Author's Field Survey, 2020, Significant level; 1% (***) and 5% (**)

The Level of Implementation of National HIV/AIDS Control Strategies

Among respondents, the use of condoms during sexual intercourse is a sure strategy to reducing the spread of HIV/AIDS (50.3% of HIV carriers and 52.1% of persons without HIV). Staying faithful to one partner was the next strategy recommended by the respondents (30.2% of HIV carriers 16.6% of persons without HIV). These responses align with the national HIV/AIDS strategy of reducing the spread of AIDS through education and sensitization. The realization to practice safe sex, test for HIV, being faithful to only one sexual partner and avoiding unsafe sex with multiple partners help to reduce the chances of new infections HIV/AIDS.

Furthermore, the study suggests that many people will ordinarily not test for HIV/AIDS except they are asked by medical experts to do so. As the study indicates, 54.7% of HIV carriers tested on the demands of medical experts, while only 22.7% of HIV carriers tested upon seeing the symptoms of HIV/AIDS in them. Findings indicate that only a few people test for HIV/AIDS due to PMTCT and the desire to know their status (Table 3). These findings corroborate the findings of [11, 12] that many Ghanaians do not like to check up or test for HIV unless there is expect the request to do so. This implies that HIV/AIDS education needs to do more on attitudinal change and the need to embrace the scientific world in response to combating HIV/AIDS.

Recommendations to Address Knowledge, Attitudes and Behaviour towards HIV Persons

Generally, the study found that there was good knowledge on HIV/AIDS in both cases and controls but poor attitudes and behaviours towards persons living with HIV. It is therefore recommended for the purpose of safety and combating HIV/AIDS for health experts to organize periodic HIV/AIDS awareness campaigns all across Ghana. Such educational campaigns should be targeted at correcting the misconceptions in HIV/AIDS, teaching people on safe sex and how to avoid the spread of HIV/AIDS through behavioural adaptations. Again, there should be increased access to health facilities as this reduces the risks of exposure to HIV infections.

Again, stigmatization and poor attitudes towards persons with HIV/AIDS were found to be significant among the reasons why the virus spreads. This study proffers that people should be educated on how to live with infected persons. The education should also target reducing stigmatization and embracing infected persons as part of the larger community. It is as well recommended that educational campaigns should target specific age groups in different regions as age and geographical region were significant variables for the spread of the HIV/AIDS virus.

Table 4. Multiple Logistic Regression Analysis of Risk Factors associated with Spread of HIV across Regions in Ghana

Variables	Ahafo Region			Northern Region		
	AOR	**P>z**	**(95% Conf.Interval)**	**AOR**	**P>z**	**(95% Conf.Interval)**
Age Group	1.58	0.002***	1.081 - 1.631	1.581	0.138	1.081 - 2.081
Sex	1.48	0.001***	1.091 - 1.622	1.452	0.004***	1.092 – 1.822
Occupation	0.623	0.488	0.123 - 0.673	1.969	0.674	1.469 - 2.469
Educational Status	0.415	0.061	0.011 - 0.465	0.103	0.143	0.003 - 0.603
Marital Status	0.148	0.000***	0.001 - 0.198	0.138	0.129	0.008 - 0.638
Age at first time of sex	0.631	0.357	0.131 - 0.681	0.616	0.754	0.116 - 1.116
Having sex with multiple partner	4.678	0.001***	4.178 - 4.728	3.494	0.036**	2.994 -3.994
Sex for money	29.826	0.000***	29.326 - 29.876	6.519	0.337	6.019 -7.019
Infected with sexually transmitted infection (STI)	22.963	0.000***	20.123 - 23.013	0.061	0.032**	0.001 - 0.561
Used to traveling to other parts of the country	0.215	0.003***	0.015 - 0.265	8.944	0.025**	8.444 - 9.444
Migration Status	16.331	0.000***	15.831 - 16.381	10.184	0.039**	9.684 - 10.684
Practice polygamy marriage	2.521	0.671	2.021 - 2.571	1.947	0.009***	1.447 - 2.447

Source**:** Author's Field Survey, (2020), Significant level; 1% (***) and 5% (**)

Conclusion

This study investigated the knowledge, attitudes, and behaviours of adults in Ahafo and Northern regions of Ghana towards HIV/AIDS. The study used a case-control study comprising of 362 adults was conducted in the Ahafo and Northern regions of Ghana in 2020. All 381 participants were cases (181) and controls (181) who were individually interviewed in a private setting by HIV/AIDS trained counsellors using a structured questionnaire Both cases and controls generally had good knowledge regarding HIV/AIDS but show poor attitudes towards PLHIV and as well engage in risky behaviours

that might predispose others to HIV infections. The findings highlight the need for culturally adaptive and age-specific HIV education for adults across all regions on misconceptions about HIV transmission and prevention, poor attitudes of adults towards PLHIV as well as the risky behaviours of adults regarding HIV/AIDS.

Conflict of Interest

The authors declare that they have no competing interests.

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Prevalence of PFHRP2 and PFHRP3 Gene Deletions in Plasmodium Falciparum Isolates and their Performance of HRP2 Based Malaria Rapid Diagnostic Tests in Three Districts of Ghana

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Abstract

Malaria rapid diagnostic tests (MRDTs) are important for malaria disease management. However, the performance of the RDTs is affected when the targeted antigens in the parasite have a variation or are altogether absent. The most common parasite target antigen in RDTs, Plasmodium falciparum histidine-rich protein 2 (HRP2), has been reported to be absent in some P. falciparum parasites. 371 patient samples, from Akuapem North (58.5%), Atiwa East (21.3%), and from New Juaben (20.2%), were used in the study. PCR provided the highest number, 14.8% (55/371), of positive detections for falciparum infections. Microscopy detected parasites in 20/261 (7.7%) samples, and the minimum parasite density by microscopy was 430 parasites/µL. Out of the 371 samples, 27 (7.3%) were positive by RDT. The highest RDT positivity rate, 13.3% (10/75), was observed at New Juaben. False-negative RDT results were obtained in 43/55 (78.2%) of the negative branded RDT kits. Only two microscopies positive sample were RDT positive. Using 18SrDNA PCR, 55 (14.8%) samples were positive for P. falciparum. In Akuapem North, 79.2 % (19/24) of the PCR positive samples had P. falciparum parasites that lacked exon 2 of PFHRP2. An overall RDT positivity rate of 7.3% (27/371) and false-negative rate of 78.2% (43/55) were observed for the study sites. Plasmodium falciparum parasite populations with deletions of the PFHRP2 and PFHRP3 genes are present in Ghana. There is an urgent need to investigate the prevalence and geographic distribution of these parasites.

Keywords*: Histidine Rich Protien (HRP), Malaria Rapid Diagnostic Test (MRDT), Malaria, Rapid Diagnostic Test (RDT).*

Introduction

Malaria is one of the life-threatening parasitic diseases transmitted to people through the bites of infected adult female Anopheles mosquitoes. It is caused by Plasmodium parasites [1]. Currently, five parasite species are known to human malaria, and 2 of these species – P. falciparum and P. vivax – present the highest threat. Plasmodium falciparum, which is the most common malaria parasite in Africa, causes most malaria-related deaths worldwide. Plasmodium vivax, on the other hand, is the main malaria parasite in countries outside sub-Saharan Africa [2].

According to the World Health Organisation (WHO), there was a decline in malaria-related mortality globally by 37% in 2016. Additionally, the African region persists in having an unduly high proportion of the global burden of malaria. In 2017, the region recorded 92% of malaria cases and 93% of malaria mortality [2]. Globally, the WHO approach to malaria control efforts is based on vector control and improved diagnosis and treatment of patients with clinical malaria [3]. However, to a very large extent,

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accurate and early diagnosis of malaria is the main determinant of the management and treatment of malaria.

In Ghana and in all of Africa as well, RDTs are now the first-choice diagnostic tools for malaria diagnosis. Various malaria RDTs available capture at least four target antigens which include P. falciparum histidine-rich protein 2 (HRP2) and lactate dehydrogenase (LDH), and the pan-plasmodial aldolase and LDH [4].

The most widely used RDT is PFHRP2. Histidine-rich protein 2 (HRP2) is an antigen-specific to P. falciparum. Though it is highly abundant and heat stable, it is still detectable in the blood for up to a month after malaria parasites clearance [5]. In addition, PFHRP3, which is structurally similar to PFHRP2, has been shown to cross-react with certain monoclonal antibodies directed against PFHRP2 [6]. It has further been demonstrated that PFHRP2 based RDTs can produce false-positive results when the circulating HRP2 antigen persists even after antimalarial treatment and false-negative results when parasitaemia levels fall below around 200 parasites/µL, which is the detection limit for most RDTs which are commercially available [7].

The performance of MRDTs largely depends on the product quality, the conditions under which they are stored, parasite or operator factors, and concentrations of parasite/antigen. One critical factor is the variations that can occur in the parasite antigens targeted by the RDTs, such as the presence or absence of the target epitopes and changes in the number of epitopes in a specific parasite isolate [6, 8]. Genetic variability may be especially critical for RDTs based PFHRP2, as the majority of the RDTs make use of this antigen [9]. Understanding the distribution and evolution of these mutant parasites is a priority for the WHO, which recently hosted a technical consultation on P. falciparum hrp2/3 gene deletions and drafted interim guidance for investigating false-negative RDT [10]. It is also unknown whether reliance on PFHRP2 based RDTs to guide treatment is exerting evolutionary pressure favoring the spread of this mutation. Monitoring the accurateness of MRDT outcomes in addition to identifying issues affecting the diagnostic ability of MRDT is vital.

Materials and Methods

Study Design

A cross-sectional study design was used. This was a facility-based study in which patients reporting to selected District health facilities in the Eastern region with fever and a referral to the laboratory for malaria test were enrolled after seeking their consent.

Study Sites

Samples were collected from sites in three districts in the Eastern part of Ghana: Akuapem North District, New Juaben Municipality, Atiwa East District.

The Eastern Region lies between latitudes 6o and 7o North and between longitudes 1o30’West and 0o30’ East. The Region has a land area of 19,323 square kilometres (which constitutes 8.1% of the total land area of Ghana). Koforidua is the administrative capital. The 2017 projected population for the Eastern Region based on the 2010 population census figure of 2,633,154 and an annual growth rate of 2.5% was 2,952,399. The population is 49% male and 51% female, with an Urban-Rural split of 43.3 to 56.6, respectively. About 41.3% of the population is below age 15 years. Agriculture is the main economic activity in the region and employs about 53% of the population, 10.7% of the population is in industry, and about 22% in the services sub-sector [11].

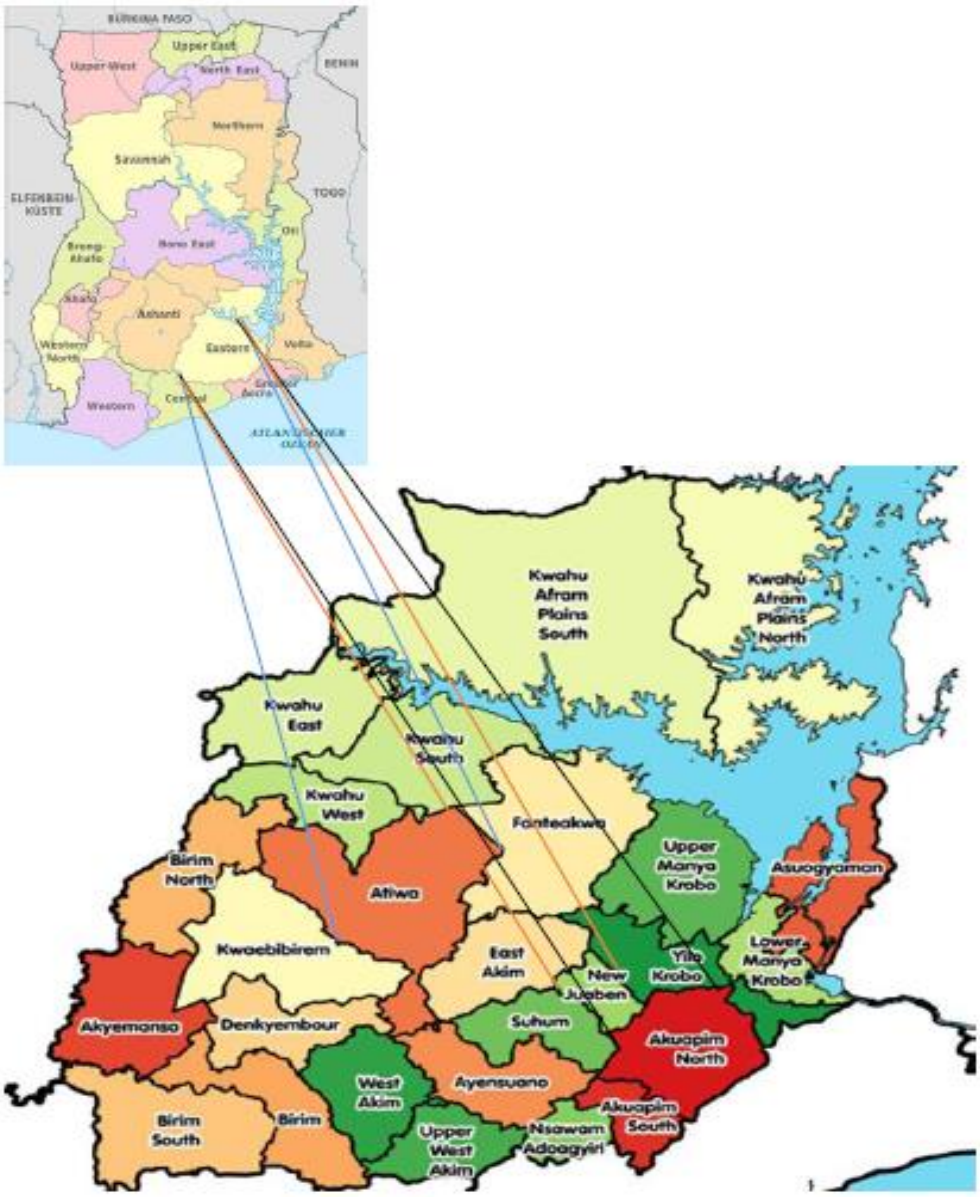

Figure 1. Map of Ghana showing the Eastern Region and the three Districts (enlarged)

Sample Size Calculation

The sample size was centered on the need to obtain relatively precise estimates of false-negative HRP2 RDT outcomes due to PFHRP2/3 deletions at each study site. Estimates for sample size were considered for obtaining proportions as a result of simple random sampling, using a sampling design effect (deft) = 1.5 (to account for observations correlated within clinics vis-à-vis PFHRP2/3 deletions) and a probability of committing a type-1 error = 95% (1-sided test), such that the 95% confidence interval does not overlap with the threshold of 5%. Thus:

$$n \geq \frac{deft[Z^2(P)(1-P)]}{D^2}$$

$$n \geq \frac{deft[1.92^2(0.33)(1-0.33)]}{0.05^2}$$

$$n \geq 57.6$$

Where:

Z = z-score of the confidence level (95%) =1.96

P = expected population prevalence of PFHRP2/3 gene deletions = 3.9% [18]
D = margin of error = 5% = 0.05

As a minimum, therefore, a sample of 58 individuals with a P. falciparum infection per site was collected.

Study Population

Blood samples were collected from a patient who came to the selected health facilities showing symptoms consistent with uncomplicated malaria and had a referral to the outpatient laboratory for blood smears in line with national malaria treatment guidelines.

Sample Collection

At the time of enrolment, demographic and clinical information was collected, and a finger-prick blood sample was obtained for thick and thin blood smears, an RDT. In addition, filter paper dried blood spots (DBS) were prepared, air-dried, and stored in plastic transparent zip lock bags with desiccant for DNA extraction.

Data Analysis

Crosstab descriptive analysis was performed using IBM SPSS Statistics (version 24). Microsoft Excel was used to draw the graphs.

Results and Discussions

Detection of P. Falciparum Malaria

A total of 371 patient samples, 217 (58.5%) from Akuapem North, 79 (21.3%) Atiwa East, and 75 (20.2%) from New Juaben Municipality, were used in the study. PCR provided the highest number, 14.8% (55/371) of positive detections (Figure 1) for P. falciparum.

Microscopy

Microscopy detected parasites in 20/261 (7.7%) samples. The 20 positive samples were obtained in Akuapem North (45.0%, n = 9), Atiwa East (20.0%, n = 4) and New Juaben Municipality (35.0%, n = 7). Only two microscopy-positive sample were RDT positive. The minimum parasite density reported by microscopy was 430 parasites/µL of blood.

Rapid Diagnostic Test

Out of the 371 samples, 27 (7.3%) were positive by RDT. Of these 27 RDT positive samples, 10 (37.0%), 7 (26.0%), and 10 (37.0%), were obtained from Akuapem North, Atiwa East, and New Juaben, respectively. The highest RDT positivity rate, 13.3% (10/75), was observed at Atiwa East (Figure 2). False-negative RDT results were obtained in 43/55 (78.2%) of the negative branded RDT kits. Twenty-two (51.2%) of the false-negative RDT results were obtained from Atiwa East, 18 (41.9%) from Akuapem North, and 3 (6.9%) from New Juaben.

PCR

Using 18SrDNA PCR, 55 (14.8%) samples were positive for P. falciparum (Fig. 1). Of these 55 PCR positive samples, 24 (43.6%), 4 (7.3%), and 27 (49.1%) were obtained from Akuapem North, Atiwa East, and New Juaben, respectively. For each of the P. falciparum PCR positive samples, the expected 205 bp fragment of the 18S rRNA gene was seen (Figure.3).

PCR Detection of PFHRP2 and PFHRP3

In Akuapem North, 79.2% (19/24) of the PCR positive samples had P. falciparum parasites that lacked exon 2 of PFHRP2. In New Juaben, on the other hand, only 7.4% (2/27) of the PCR positive samples had P. falciparum parasites that lacked exon 2 of PFHRP2. None of PCR positive samples had P. falciparum parasites that lacked exon 2 of PFHRP2 in Atiwa East. Only 33.3% (8/24) samples, all from Akuapem North, lacked exon 2 of PFHRP3. In total, 38.1% (8/21) of the samples contained parasites that lacked exon 2 of both PFHRP2 and PFHRP3.

Contributions of PFHRP2 and PFHRP3 to Malaria Diagnosis by PfHRP-2 RDT

When genomic DNA from positive and negative branded PFHRP2 RDT kits, confirmed

to carry P. falciparum parasite by PCR genotyping, were subjected to PFHRP2 and PFHRP3 gene PCR amplification, fourteen negative- branded PFHRP2 RDT isolates, consisting of 13 (92.9%) samples from Akuapem North and 1 (7.1%) from New Juaben, were negative for the PFHRP2 gene (PFHRP2-). Two samples, both negative- branded PFHRP2 RDT, were lacking the PFHRP3 gene (PFHRP3-). Both samples were from Akuapem North.

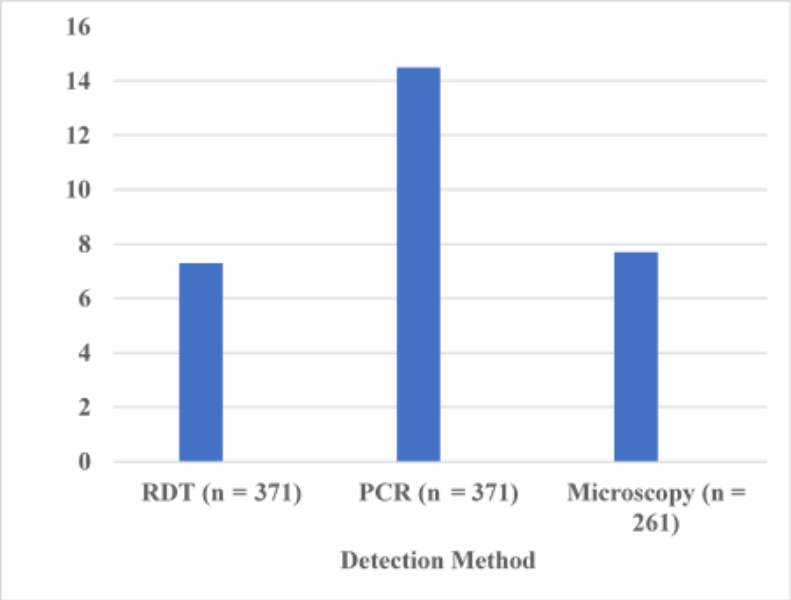

Figure 1. Proportion of Different Detection Methods Positive for Malaria

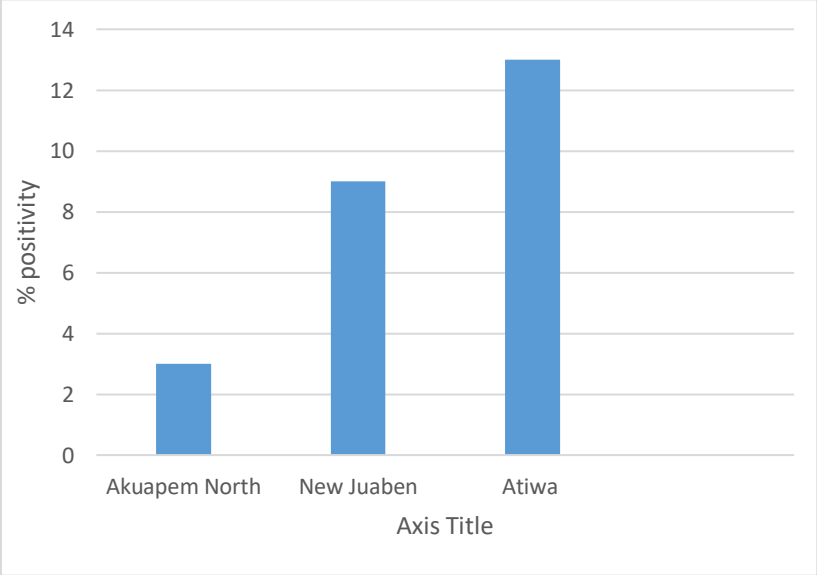

Figure 2. The Frequencies of Positivity (obtaining a Positive Test Results) obtained by - RDT in the Samples Collected from the Three Sites

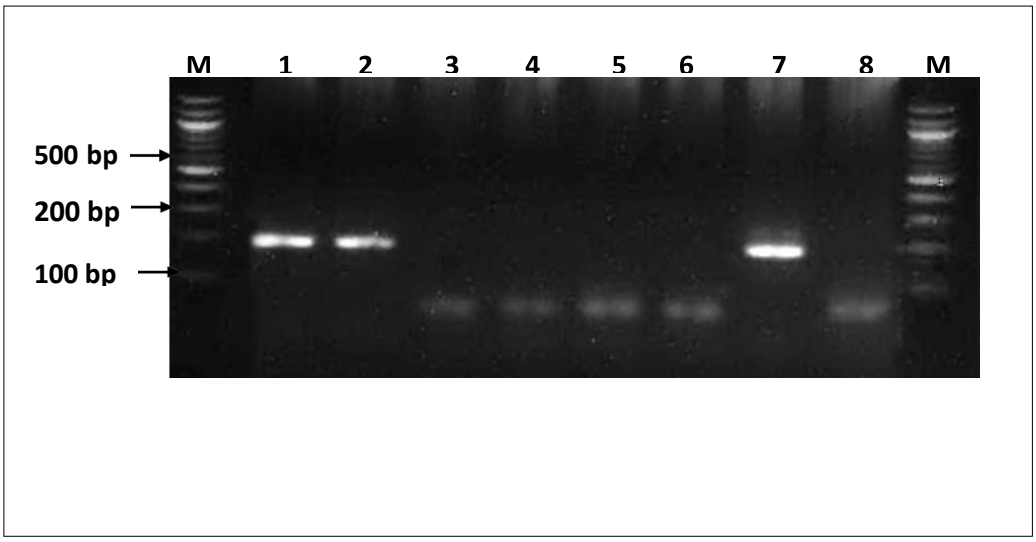

Figure 3. Ethidium Bromide-Stained 2.0% Agarose Gel Electrophoregram of Amplified P. Falciparum 18S rRNA Gene Fragments using the Primers rFAL1/rFAL2

Lane M = 100 bp DNA Ladder (NEB); Lanes 1 and 2 = Samples positive for P. falciparum infection; Lanes 3-6 = Samples negative for P. falciparum infection; Lane 7= positive control; Lane 8 = negative control as shown in Figure 3.

At present, PFHRP2 based RDTs are central to malaria control programs. Besides they allow malaria diagnosis even in the absence of a microscope. However, continues usage of these tests in areas of high malaria transmission is under threat by parasites that do not express PFHRP2 [12,13]. Due to the fact that the majority of the RDTs sold to the public target PFHRP2 expressed exclusively by P. falciparum, pfhp2/3 genetic diversity analysis of great interest to public health.

Until recently, the relatively few earlier studies on the PFHRP-2 based RDT kits in Ghana concentrated on finding the sensitivity and specificity of PF-HRP2 RDT kits [14, 15]. A study by [18] conducted Cape Coast provided further evidence for the existence of parasites carrying PFHRP2− in addition to how these parasites affect the accuracy of malaria diagnosis by RDTs based on this antigen in Ghana. The current study adds to those findings by analysing samples collected from Akuapem North, in addition to Atiwa East and New Juaben.

Ghana is hyperendemic to malaria; thus, RDTs are used for malaria diagnosis on a daily basis and throughout the year. Though microscopy is the gold standard for malaria diagnosis, it is not performed to confirm the absence of parasitaemia in most hospital or clinic laboratories. What rather happens is that when RDTs are negative, it is assumed that the patient is not having malaria. As a consequence of this, it is critical that malaria diagnosis using RDT kits have high accuracy as this is indispensable if malaria is to be controlled [16, 17].

The overall RDT positivity rate of 7.3% (27/371) was relatively lower as compared to those of other studies carried out in the country [18]. The highest RDT positivity rate of 13.3% (10/75) was obtained at Atiwa East, which although is a populous settlement in the country, has a population density far lower than both Akuapem North and New Juaben, the other two sites of the study. Compared with PCR, diagnosis of malaria infection by both microscopy and RDT were found to be lower, which was in agreement with other studies carried out in other places [19, 20, 21]. However, the quality of malaria diagnosis is imperative in all situations, as misdiagnosis can result in substantial morbidity and mortality.

A false negative RDT result was indicated when PCR detected the presence of malaria parasites, although the RDT kit test result was

negative for a particular sample. In this study, false-negative RDT results were obtained in 43/55 (78.2%) of the negative branded RDT kits, and this was higher than previously detected by [18]. Because malaria is endemic in this country, this can have serious aftermaths in the study areas in the absence of any confirmatory diagnostic tests, such as PCR, for such negative RDT results [22]. False-negative RDT results delay malaria treatment, potentially endangering life, in addition to the fact that the patient will serve as a source for uninterrupted transmission of malaria. Factors other than PFHRP2 deletion or variation, such as very low parasite density or concentration of the target antigen and hyperparasitaemia might have accounted for the false-negative RDT results [13].

The findings from this study confirm that P. falciparum parasite populations with deletions of the PFHRP2 and PFHRP3 genes are present in the country. The omissions of the PFHRP2 and PFHRP3 genes were seen in Akuapem North as well as Atiwa East but not in New Juaben. The samples from Akuapem North also showed the lowest RDT negative results (6.9%). Thus, the absence of the deletions in the samples from New Juaben was not surprising though considering the fact that it is a populous city similar and outcomes to that in Akuapem North were expected.

The deletions of the PFHRP2 and PFHRP3 genes agree with the study in [18]. In this study, PFHRP2 deletions were more prevalent than PFHRP3 deletions. Studies have shown that PFHRP3 deletions are more prevalent than PFHRP2 deletions in Colombia, which also has been found to be the case in Peru [23] and Honduras [24, 18]. Remarkably, this is not the case in Surinam, where PFHRP2-negative parasites were detected in higher numbers than PFHRP3- negative isolates [25].

The presence of parasites carrying both PFHRP2 – and PFHRP3 − have been reported. In some countries in South America, particularly those in the Amazon, a percentage as high as 25.7% has been observed [18, 23]. In this study, the prevalence of parasites with PFHRP2 −/PFHRP3 − was 38.1% (8/21), and this was only in the samples from Akuapem North. Previously, in 2016, a prevalence of double PFHRP2 −/PFHRP3 − parasites obtained in Akuapem North over the months of February to May was 4.3 %, similar to the 3% that was obtained in samples collected in April [18]. Plasmodium falciparum parasites that lack part or the entire PFHRP2 gene do not express the PFHRP2 protein and were therefore not detectable by the PFHRP2 detecting RDT kits. It is likely that HRP2-detecting RDTs may have limited reliability for detecting P. falciparum in some parts of Ghana. Consequently, RDTs that target other parasite antigens (pLDH and aldolase) and quality microscopy should be used for malaria diagnosis [13, 2] in such settings.

The potential impact of P. falciparum parasites lacking PFHRP2 on malaria case management and on procurement decisions regarding the type of RDTs is significant, and as such, it is imperative that the presence and prevalence of these parasites are properly identified along a larger population to obtain substantive evidence for the costly change of an RDT kit [26]. These may go a long way to help in the fight to eliminate malaria.

Despite the significance of the study, certain limitations were faced. Due to limited funding, time, and resources, other assays such as MSP gene PCR analysis could not be performed for parasite identification.

Conclusions

An overall RDT positivity rate of 7.3% (27/371) was observed. Plasmodium falciparum parasites that lack PFHRP2 genes alone or in addition to PFHRP3 genes were identified at two sites, Akuapem North and Atiwa East, but not New Juaben. In this study, 14 negative- branded PFHRP2 RDT isolates, consisting of 13 (92.9%) samples from Akuapem North and 1 (7.1%) from Atiwa East, were negative for the PFHRP2 gene (PFHRP2-). Only two samples from Akuapem North, both negative-branded

PFHRP2 RDT, were lacking the PFHRP3 gene (PFHRP3-).

Recommendation

The study should be extended to other districts in the region as well as other regions in the country.

Decisions regarding the choice of malaria diagnosing test kits could be reviewed to suit the genetically dynamic species of P. falciparum malaria parasites in the nation as a whole.

Aldolase and pLDH enzymes, which are utilized by the parasite for its metabolism and survival, could be assayed, and their genetic bases amplified and compared to the PFHRP2 / PFHRP3 genes if significant results are obtained in this study. RDT kits for our sub-region could be engineered with antibodies to target these proteins so that genetic deletions resulting in false-negative diagnosis would be reduced or totally prevented.

Conflict of interest.

There is no conflict of interest.

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Rural-Urban Disparities in the Acceptance and Adoption of Family Planning among Couples in Oyo State, Nigeria

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Abstract

Modern contraceptive use can enhance the living standard and reduce mortality among people living in rural and urban areas. However, contraceptive use tends to be low in the rural than the urban populace. A descriptive, cross-sectional study of systematic sampling technique was used to select 570 persons of reproductive age in the rural and urban communities of Oyo State. A semi-structured questionnaire on socio-demographic characteristics, knowledge, attitude and factors influencing uptake of modern contraceptives was administered to respondents. of the 570 respondents, the mean age was 34.3 ±8.4 years. The majority (63.3%) were female compared to 36.7% male respondents. Most (97.0%) of respondents had heard of family planning in the past. The result shows significant differences in location, gender, marital status, occupation, ethnicity, and a number of children (P<0.001). The majority (33.3%) of the respondents sourced family planning information from health care providers, while 31.3% sourced theirs from mass media – Radio, TV, or newspapers. Respondents in urban areas were currently using family planning methods than respondents in rural areas (61.8% vs. 38.2%). People in the urban area are 2.344 times the odds of utilizing any family planning compared to people in rural area (95% CI 1.495, 3.676). Urban and rural disposition to modern contraception services is influenced by economic, socio-cultural, environmental factors, location, age, educational, traditional beliefs, religion, family type, and level of knowledge. Although some signs of progress have been made in family planning at the communities, more work needs to be done. Men need to be actively involved, and other fears about family planning addressed.

Keywords*: Acceptance, Disparity, Family Planning, Rural, Urban.*

Introduction

One of the goals of the Sustainable Development Goals (SDGs) is promoting universal access to Sexual and Reproductive Health (SRH) services. Particularly, SDGs 3.7 and 5.6 is to promote family planning utilization among women and men of reproductive age [1, 2, 3]. Also, timely achievement of family planning targets is expected to hasten achievement across 5 SDG themes of People, Planet, Prosperity, Peace, and Partnership [2]. Current reports on the global contraceptive prevalence rates and unmet needs for family planning indicate overall gains across countries [1]. However, some low-income countries are yet to set priorities on investing in Family planning.

Nigeria's population continues to increase despite huge investments in family planning programs by government and development partners. The rapidly increasing population of

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Nigeria over the past 50 years is of great concern as it has an impact on both the growth and development of the nation. Currently, Nigeria's population is estimated to be 198 million people [4], thereby maintaining her position as the most populous country in Africa and the seventh globally [5].

Nigeria is overwhelmed with a high growth rate resulting from the desire for more children, with a Total Fertility Rate of 5.3 children born by a woman throughout her reproductive years. Despite high contraceptive knowledge, contraceptive uptake remains poor [4]. The slow pace of family planning utilization also has disparities across the region while there remain high unmet needs for contraceptives- 19% among Women of Reproductive Age. Consequently, it is projected that with the continued rapid growth in population, the country is set to becoming the 3rd most populous country in the world by 2050 [6].

Nigeria has one of the world's worst health indices largely due to uncontrolled population. The maternal mortality ratio (MMR), which is an indicator of the overall health of the population, is 576 maternal deaths per 100,000 live births in Nigeria [4]. This places Nigeria as the country with the 2nd highest burden of maternal deaths worldwide. Evidence has shown a direct link between maternal and child health, as child survival depends on the mother's health and nutritional status. Key indicators of childhood mortality such as infant and under 5 mortality rates are 69 deaths/1000 live births and 128 deaths/1000 live births, respectively [4].

Additionally, a UNICEF report ranked Nigeria as 11th highest in newborn deaths with a neonatal mortality rate of 37 deaths per 1000 live births [7]. A causal link between infant (and child) mortality and fertility has been documented, which suggests that these childhood mortality indicators are significant impediments to fertility decline, particularly in Sub-Saharan Africa. Similarly, when fertility decreases, this results in reductions in infant mortality, allowing parents to channel more resources to their children and an oval improvement in health and standard of living.

Problem Statement

Oyo State is in the South Western part of Nigeria, and it is one of the 36 states in the country. It has a long-standing history of family planning with ample donor support for family planning programs. However, the modern Contraceptive Prevalent Rate (mCPR) continues to dwindle from 18.8% in 2008, 24.4% in 2013, and 22.2% in 2018%. This comparably is lower than the average CPR of other states in the western region, which is 24.3%. Again, Oyo state has a high unmet need for family planning (30.6) compared with a national average of 19% [4]. Reasons for poor contraceptive uptake have been reported by many researchers ranging from poor access, cost, spousal disapproval side effect, amongst others [8, 9, 10].

Apart from socio-cultural barriers, access to contraceptive methods is extremely poor, particularly among the rural populace. Public and private health facilities mostly provide modern FP services and, in some cases, mission health facilities, while some access FP services from patent medicine vendors, traditional pharmacist providers [4]. Improving access to modern contraceptives prevents unwanted pregnancies, some of which lead to unsafe abortion a major cause of maternal mortality in Nigeria.

In Oyo state, more than two-thirds (89.3%) of currently married women reported that they decided jointly with their partners to use family planning. In addition, among currently married women who are non-users, almost three-quarters of them (70.9%) decided jointly with their partner not to use family planning [4]. Thus, the decision-making input of the male partners cannot be over-emphasized. Despite this report, mCPR remains poor in Oyo sate at just 22.6% for all methods compared to other South Western states of Nigeria. Among women age 15-49 who are not using contraception, the percentage of women who did not discuss family

planning either with a fieldworker or at a health facility was very high (78.7%), with only 5% of women being visited by a fieldworker who discussed family planning in Oyo State [4], this obviously shows a gap in reaching women with information and services at the community level by the health care provider. Again, there is a disparity in rural acceptance and adoption of family planning or childbirth spacing practices in Nigeria.

Although there has been a steady but slow increase in the use of modern contraceptives over the past decade from about 10% in 2013 to 12% in 2018, with the use of implants increasing from 0% to 3%, the modern method-mix in Nigeria is predominantly implants, injectable, condoms, and Locational Amenorrhea Method (LAM). It is also important to note that 35% of currently married women who are not currently using contraception have the intention of using it in the future [4]. The use of contraception by men makes up a relatively small subset of the above prevalence rates. The modern contraceptive methods for men are limited to male condoms and sterilization (vasectomy) [11].

Literature Review

According to the World Health Organization (WHO), family planning is defined as "the ability of individuals and couples to anticipate and attain their desired number of children and the spacing and timing of their births. It is achieved through the use of contraceptive methods, and the treatment of involuntary infertility" [11]. Family planning has been defined differently from many authors' perspectives. However common phenomena are the ability of an individual to voluntarily determine the spacing and timing of their birth. Emphasis is on voluntarism, based on comprehensive, unbiased information received by potential users. Accessibility to contraceptives is also imperative to family planning uptake. Family planning may involve consideration of the number of children a woman wishes to have, including the choice to have no children, as well as the age at which she wishes to have them. These matters are influenced by external factors such as marital situation, career considerations, financial position, and any disabilities that may affect their ability to have children and raise them. For people who are sexually active, family planning may involve the use of contraception and other techniques to control the timing of reproduction.

Abortion is not considered a component of family planning, as access to contraception reduces the need for abortion [12, 13]. Family planning allows spacing of pregnancies and can delay pregnancies in young women who may have an increased risk of health problems and death from early or late childbearing. Evidence suggests that women who have more than 4 children are at increased risk of maternal mortality. Family planning enables women who wish to limit the size of their families to do so. Other aspects of family planning include sex education, prevention, and management of sexually transmitted infections, pre-conception counseling and management, and infertility management [4].

Family planning is sometimes used as a replacement for contraception. However, it often involves methods and practices in addition to contraception. Additionally, there are many who might wish to use contraception but are not necessarily, planning a family (e.g., unmarried adolescents, young married couples delaying childbearing while building a career); family planning has become a household phrase for most people in this category. Contemporary notions of family planning tend to place a woman and her childbearing decisions at the center of the discussion, as women's empowerment and reproductive independence have gained significance in many parts of the world. It is most usually applied to a female-male couple who wish to delay child bearing or limit the number of children they have and/or to control the timing of pregnancy (also known as spacing children). Family planning has been

shown to reduce teenage pregnancies and high birth rates for unmarried women [14, 15]. The study examined the disparities between urban and rural acceptance and adoption among couples in Oyo state.

Methods

Study Design

This study is a descriptive cross-sectional study design. This type of study design is used to assess the prevalence of variables of interest in a defined population at a specific period of time. We can measure factors influencing the variable of interest and use data obtained for researches and programs.

Study Population

Description of the Study Area

Oyo State is one of the 36 states of Nigeria, and it was carved out of the old western state inn1996. It is bounded by Osun, on the East and Kwara state by the North, Ogun on the south, and Benin republic on the West. It is occupied mainly by the Yoruba people who also speak the Yoruba language and has a population of about 8 million people, and its main occupation is farming. There are 33 Local Government Areas (LGAs) in the state; 11 are in the urban while 22 are in the rural areas.

The study was conducted in 4 LGAs, 2 urban and two rural, these are:

Ibadan North-West Local Government Area

Ibadan North-West is an urban LGA with headquarter located in Dugbe/Onireke, Ibadan It was carved out of the defunct Ibadan Municipal Government (IMG) on August 27, 1991, during the regime of former military President, retired General Ibrahim Babaginda. Its landmass extends to about 244.55km^2. This feature makes it one of the largest LGAs in Oyo State. It is bounded by Ibadan Northwest and Ido LGA in the North, by Oluyole LGA in the South, by Ido Local Government in the West, and by Ibadan North and South East LGA in the East. It has a population figure of 283,098 according to the results of the 2006 census released by the National Population Commission. The LGA has a total estimated population of 250,543, and the estimated population for people of the reproductive age is 55119 [16, 17].

Ibadan South-East Local Government Area

Ibadan South-East is also an urban LGA in Oyo State, Nigeria. It was created on 27th August 1991 by the Federal Government and was carved out of the defunct Ibadan Municipal Government. The LGA covers an area of about 80.537 hectares of land. According to the 2006 census, Ibadan South-East LGA has a population of 266,457 2020 is 436,133 while the estimated population for people of reproductive age is 95949. The LGA has a total of 12 wards [16, 17].

Kajola Local Government Area

The LGA located in the northern part of Oyo State covers an area of 609 km², and it is bounded in the south by Ibarapa LGA and Ogun State, in the east by Iseyin LGA, in the west by Iwajowa LGA and Republic of Benin, and in the northwest by Itesiwaju LGA. The 2006 census puts the LGA population figure as 200,528 while the project population for 2016 is 281,700. The total estimated population is 329,497, with reproductive age put at 72,489, and comprises 11 wards [16, 17].

Oyo West Local Government Area

Oyo West LGA is in the central of Oyo State. It bounds Atiba by the north, bounds Afijio by the south, bounds Iseyin by the west, and Oyo east LGA. It covers an area of 505 km², and the headquarters of the LGA is Ojongbodu. Based on the 2006 census, the population census of the LGA is 136,457, and the projected population for 2016 is 191,700. The estimated population of the LGA for 2020 is 223,334, while the estimated population for people of reproductive age is 49133. The LGAs has ten (10) wards [16, 17].

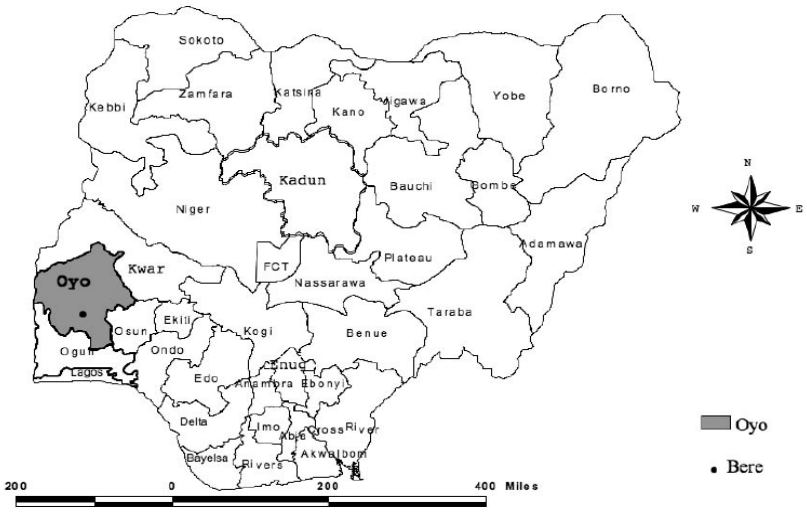

Figure 1. Map of Nigeria showing Oyo state (City Map, 2020)

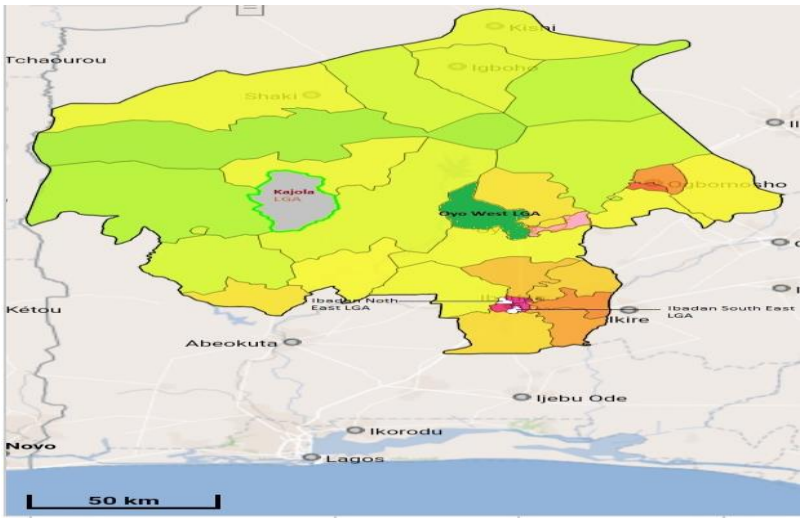

Figure 2. Study LGAs highlighted in Oyo state Map (City Map, 2020)

The study population consists of men and women of reproductive age between 18 to 49 years, including married adolescents and adults who have lived in the community for more than 2 years.

Inclusion Criteria

Men and women of reproductive age between 18 to 49 years who have lived in their communities for more than 2 years at the time of the study.

Exclusion Criteria

Men and women of reproductive age who are less than 18 years or older than 50 years, who have not lived in their communities for more than 2 years at the time of the study, or persons who are not clinically stable or not within the enumerated area were not considered.

Sample Size

Sample Size Determination

N=DZ2Pq

d2

Where:

N = sample size
D = design effect = 2
Z = a constant at 95% precision =1.96
d = desired precision at 5 %
q = 1 – p (1- 0.219 = 0.781)
P = Contraceptive Prevalence Rate (CPR) in Oyo state = 22.6% (NDHS, 2018)

Therefore,

N= (2 x 1.96 x 1.96 x 0.226 x 0.774)/ (0.05 x 0.05)

N~ 543

543+(5/10 x 543) = 570.

Results

Of the Five hundred and seventy (570) participants across urban and rural communities (each accounted for 50%) were sampled for the study. Table 1 confirms that majority of the study population were males 53.7% in the rural and 46.3% in urban area while more female respondents in the urban area, there was however, significant difference by location (P<0.0001). The study indicated that majority of the respondents were in their youthful age as 47.2% and 25-30 years, and 23.8% and 50.3% of the sampled population were between ages 31-40 years and 25-30 years in rural and urban, respectively.

Majority (48%) of the respondents were married less than 5% of the respondents practice traditional religious, majority from the rural and urban were Christian (47.4% and 52.6%) and Muslim (52.6% and 47.4%) respectively. In terms of education, commonly, the respondents both in the rural and urban have secondary school education with 49.9% and 50.2% respectively. Both in the rural and urban area, majority of the respondents were traders, closely followed by government workers and self-employed (Table 1). The study also shows clearly that there is significant difference between location and gender, marital status, occupation, ethnicity, and number of children (P<0.001).

Table 1. Socio-Demographic Characteristics

Variable	Rural (n=285)	Urban (n=285)	p-value
Gender			
Male	194 (53.7%)	167 (46.3%)	0.019
Female	91 (43.5%)	118 (56.5%)	
Age			
18-25	61 (60.4%)	40 (50.3%)	0.120
25-30	88 (49.7%)	89 (50.3%)	
31-40	93 (47.2%)	104 (52.8%)	
41-49	43 (45.3%)	52 (54.7%)	
Religion			
None	0 (0.0%)	1 (100.0%)	0.378
Christianity	119 (47.4%)	132 (52.6%)	
Islam	164 (52.6%)	148 (47.4%)	
Traditional religious	2 (33.3%)	4 (66.7%)	
Marital status			
Divorced	0 (0.0%)	3 (100.0%)	0.039
Married	245 (51.4%)	232 (48.6%)	
Separated	0 (0.0%)	6 (100.0%)	
Single	38 (48.7%)	40 (51.3%)	
Widowed	2 (33.3%)	4 (66.7%)	
Occupation			
Artisan	57 (57.6%)	42 (42.4%)	0.032
Farming	4 (66.7%)	2 (33.3%)	
Government work	14 (44.4%)	20 (55.6%)	
Housewife	3 (42.9%)	4 (57.1%)	

Other	0 (0%)	9 (100.0%)	
Self-employed	49 (42.6%)	66 (57.1%)	
Skilled job	38 (57.6%)	28 (42.4%)	
Trading	116 (51.1%)	111 (48.9%)	
Unemployed	2 (40.0%)	3 (60.0%)	
Education			
None	4 (66.7%)	2 (33.3%)	0.010
Other	1 (20.0%)	4 (80.0%)	
Primary	68 (61.8%)	42 (38.2%)	
Quranic	3 (60.0%)	2 (40.0%)	
Secondary	171 (49.9%)	172 (50.2%)	
Tertiary	38 (37.6%)	63 (62.4%)	
Ethnicity			
Hausa	0 (0.0%)	5 (100.0%)	0.003
Igbo	3 (18.8%)	13 (81.3%)	
Yoruba	280 (51.2%)	267 (48.8%)	
Other	2 (100.0%)	0 (0.0%)	
Number of Children			
1 – 2	79 (41.2%)	113 (58.9%)	0.001
1 - 2 years	0 (0.0%)	4 (100.0%)	
3-4	131 (60.4%)	86 (39.6%)	
3-4 years	0 (0.0%)	5 (100.0%)	
5 and above	33 (49.3%)	34 (50.8%)	
None	42 (49.4%)	43 (50.6%)	

Utilization of Family Planning Methods among Respondents

The majority (54.9%) of the respondents were currently using one or more methods of family planning in the study locations. Most respondents adopted the injectable family planning method (28.4%), followed by male condoms (23.5%). The least methods used were over half female sterilization and vasectomy (0.3%) each, 0.5% for spermicides, while the withdrawer method accounted for 2.2%. Nearly half (48.8%) adopted the family planning method to prevent unwanted pregnancy, while 34.3 % used family planning to prevent sexually transmitted diseases. Approximately 70.0% of respondents agreed to the decision of their partner to use the modern family planning method. Almost half (48.8%) of respondents' choice of family planning method in both areas was basically to prevent unwanted pregnancies, followed by 34.3% of them who chose family planning to prevent sexually transmitted diseases.

A large proportion (86.0%) of respondents would recommend modern family planning to friends or relatives. Respondents who were not interested in the use of the family planning method as at the time of the survey opined that they want more children (28.8%), while 23.0% were fearful of the side effect and 17.8% were of the view that family planning interferes with sexual pleasures.

Study participants in urban areas were currently using family planning methods than respondents in rural areas (61.8% vs. 38.2%) – table 2. Although there were more respondents in an urban area who used family planning method than in rural areas of the study locations,

but respondents' utilization by duration – over 3 years usage in rural area was more than those in urban area (55.5% vs. 50.6%) respectively.

Two-third (66.7%) of respondents used male condom in urban areas compared to one-third (33.3%) respondents in rural areas. Almost three-quarters (73.7%) of respondents in urban areas used female condom than slightly over one-quarter (26.3%) in rural areas. A large proportion (88.9%) in urban areas used pills than in rural areas (11.1%), while implants were more used in rural areas (73.6%) than in urban areas (26.4%). There was no record of the utilization of family planning methods in rural areas (0.0%), unlike urban areas (100%) such as spermicides, female sterilization, and vasectomy, respectively.

Table 2. Respondents' Utilization of Family Planning Method by Location

Respondents currently using family planning method	**Yes**	**No**	χ^2	**df**	**p-value**
	n (%)	**n (%)**			
Urban	176(61.8)	109(38.2)	10.78	1	0.001*
Rural	137(48.1)	148(51.9)			
Total	313(54.9)	257(45.1)			

*p<0.05

Hypothesis Testing

Socio-cultural factors have a significant effect on the non-use of modern contraceptives among married men and women in rural and urban communities.

Table 3 shows the result of the hypothesis showed that fear of side, spousal disapproval, and the fact that using modern-day conceptual is against respondent's religion contributed significantly to the non-use of modern-day contraceptives among married men and women in rural and urban communities in Oyo state (p<0.0001. Respondents believed that spouse disapproval or hesitancy has contributed to the lower uptake of modern contraceptives.

Table 3. Modern Contraceptive Use among Respondents

Modern contraceptive use	**Coef.**	**Std. Err.**	**t**	**P>t**	**[95% Conf.**	**Interval]**
Fear of side effect	0.029882	0.029527	1.01	0.013	-0.0284121	0.088177
Spousal disapproval	0.053372	0.034943	1.53	0.029	-0.0156148	0.122358
Lack of awareness	-0.00978	0.052783	-0.19	0.853	-0.113989	0.094428
cost	0.005254	0.119373	0.04	0.965	-0.2304212	0.240929
Interferes with pleasure	-0.05224	0.060485	-0.86	0.389	-0.1716551	0.067173
Against religion	0.124932	0.046042	2.71	0.007	0.0340333	0.21583
Want more children	0.022359	0.029143	0.77	0.444	-0.0351774	0.079895

Agreement with Partners to use Modern Day Family Planning and Recommendation to Others

Spousal agreement to use modern-day family planning plays an important role to uptake. It is clear from Figure 3 that over 67% in both rural and urban settings mentioned that their spousal agreed to use modern family planning method.

As shown in Figure. 4, the majority (83%) of the respondents in both rural and urban mentioned that they can recommend family planning to others. Regarding the type of family planning methods that can be recommended in the urban area, the following were the top three – spermicides, vasectomy, pills, and withdrawal methods. In the rural area, the top were implants, female condom, and injectables.

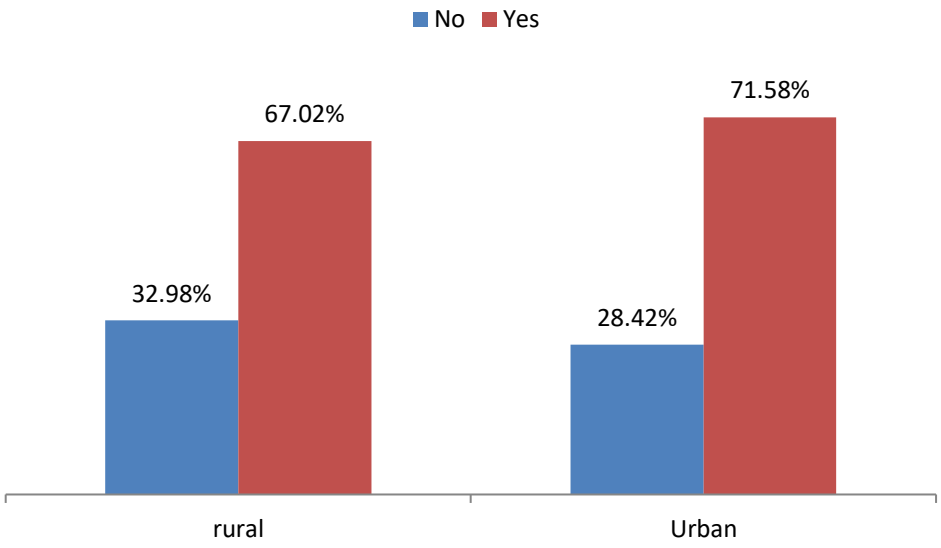

Figure 3. Spousal Agreement to use Family Planning

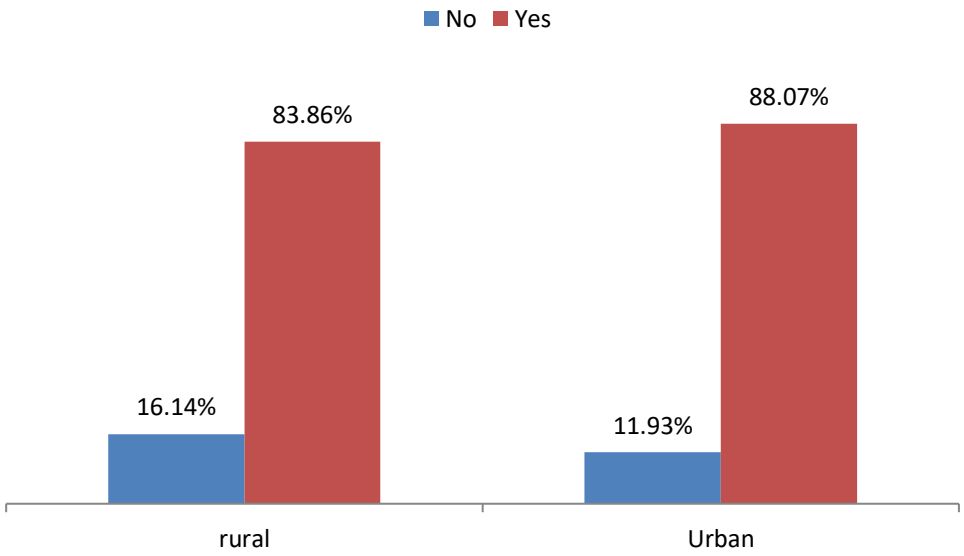

Figure 4. Can you Recommend Family Planning to Others

Table 4 below shows the type of family planning method that would be recommended by either rural or urban to family members. At the urban community's withdrawal method was recommended while implant ranked highest on a recommendation at the rural areas.

Table 4. Type of Family Planning Method to Recommend

	Rural	**Urban**
Male condom	39.66%	60.34%
Female condom	60.47%	39.53%
Withdrawal method	14.29%	85.71%
Spermicides	0.00%	100.00%
Pills	20.00%	80.00%
Injectable	48.43%	51.57%
Implants	68.27%	31.73%

IUD	27.40%	72.60%
Female sterilization	0.00%	100.00%
Vasectomy	0.00%	100.00%

There is a significant different in the perception level of modern family planning methods among men and women of reproductive age in rural and urban communities in Oyo state.

Table 5 below showed the p-value (<0.0001); this implies a significant difference in perception level of modern family planning methods among men and women of reproductive age in rural and urban communities in Oyo state.

Table 5. 95% Confidence Interval on the Difference Between the Means

[0.485,	0.574]
Difference	0.530
t (Observed value)	23.420
|t| (Critical value)	1.964
DF	569
p-value (Two-tailed)	< 0.0001
Alpha	0.05

Hypotheses Testing

Socio-cultural factors have a significant effect on the use of modern contraceptives among married women and women in rural and urban communities.

Table 6. Social Cultural Factors Affecting Uptake in Rural and Urban Communities

Modern contraceptive use	**Coef.**	**Std. Err.**	**T**	**P>t**	**[95% Conf.**	**Interval]**
Fear of side effect	0.029882	0.029527	1.01	0.013	-0.0284121	0.088177
Spousal disapproval	0.053372	0.034943	1.53	0.029	-0.0156148	0.122358
Lack of awareness	-0.00978	0.052783	-0.19	0.853	-0.113989	0.094428
cost	0.005254	0.119373	0.04	0.965	-0.2304212	0.240929
Interferes with pleasure	-0.05224	0.060485	-0.86	0.389	-0.1716551	0.067173
Against religion	0.124932	0.046042	2.71	0.007	0.0340333	0.21583
Want more children	0.022359	0.029143	0.77	0.444	-0.0351774	0.079895

There is a significant difference in the knowledge level of modern family planning methods among men and women of reproductive age in rural and urban communities in Oyo state.

Table 7. 95% Confidence Interval on the Difference between the Means

[1.057,	1.185]
Difference	1.121
t (Observed value)	34.591
|t| (Critical value)	1.964
DF	569
p-value (Two-tailed)	< 0.0001
alpha	0.05

There is a significant difference in perception level of modern family planning methods among men and women of reproductive age in rural and urban communities in Oyo state.

Table 8. 95% Confidence Interval on the Difference Between the Means

[0.485,	0.574]
Difference	0.530
t (Observed value)	23.420
|t| (Critical value)	1.964
DF	569
p-value (Two-tailed)	< 0.0001
alpha	0.05

Family Planning Service Quality in Rural and Urban Area

Table 9 shows that 3 (1.1%) of the respondents in the rural area strongly disagreed that family planning clinics are opened for services all the time, 6 (2.1%) disagreed that family planning clinics are opened for services all the time while more than half of the respondents in the rural area 161 (56.5%) agreed that family planning clinics are opened for services all the time, 60 (21.1%) strongly agreed that family planning clinics are opened for services all the time while 55 (19.3%) were indecisive.

On the other hand, 3 (1.1%) of the respondents in the urban area strongly disagreed that family planning clinics are opened for services all the time, 28 (9.8%) disagreed that family planning clinics are opened for services all the time, 135 (47.4%) agreed that family planning clinics are opened for services all the time, 55 (19.3%) strongly agreed that family planning clinics are opened for services all the time while 64 (22.5%) were indecisive.

Table 9. Respondents' Responses on the Accessibility to Family Planning Service at Family Planning Unit

		Type of settings		
		Rural	**Urban**	**Total**
46. Family planning clinic is opened for services all the time- Morning and evening	Undecided	55 (19.3%)	64 (22.5%)	119 (20.9%)
	Strongly disagree	3 (1.1%)	3 (1.1%)	6 (1.1%)
	Disagree	6 (2.1%)	28 (9.8%)	34 (6.0%)
	Agree	161 (56.5%)	135 (47.4%)	296 (51.9%)
	Strongly agree	60 (21.1%)	55 (19.3%)	115 (20.2%)
	Total	285 (100.0%)	285 (100.0%)	570 (100.0%)

As shown in table 10, 53 (18.6%) of the respondents in the rural area strongly disagreed that most family planning facilities do not have adequate family planning methods, 92 (32.3%) disagreed that most family planning facilities do not have adequate family planning methods, 33 (11.6%) agreed that most family planning facility do not have adequate family planning methods, 28 (9.8%) strongly agreed that most family planning facility do not have adequate family planning methods while 79 (27.7%) were indecisive.

Consequently, table 10 also showed that 55 (19.3%) of the respondents in the urban area strongly disagreed that most family planning facilities do not have adequate family planning methods, 104 (36.5%) disagreed that most family planning facilities do not have adequate family planning methods, 41 (14.4%) agreed that most family planning facility do not have

adequate family planning methods, 13 (4.6%) strongly agreed that most family planning facility do not have adequate family planning methods while 72 (25.3%) were indecisive.

Table 10. Respondents' Responses on the Adequacy of Family Planning Methods at Family Planning Unit

		Type of settings		Total
		Rural	Urban	
Most family planning facility do not have adequate family planning methods	Undecided	79 (27.7%)	72 (25.3%)	151 (26.5%)
	Strongly disagree	53 (18.6%)	55 (19.3%)	108 (18.9%)
	Disagree	92 (32.3%)	104 (36.5%)	196 (34.4%)
	Agree	33 (11.6%)	41 (14.4%)	74 (13.0%)
	Strongly agree	28 (9.8%)	13 (4.6%)	41 (7.2%)
	Total	285 (100.0%)	285 (100.0%)	570 (100.0%)

The study also confirms that no respondents in the rural area strongly disagreed that the attitude of the family planning providers were good, 3 (1.1%) disagreed that the attitude of the family planning providers were good, more than half of the respondents in the rural area 145 (50.9%) agreed that the attitude of the family planning providers were good, more than one-third of the respondents 74 (26.0%) strongly agreed that the attitude of the family planning providers were good while 63 (22.1%) were indecisive. Three of the respondents in the urban area strongly disagreed that the attitude of the family planning providers was good. Only one respondent in the urban area disagreed that the attitude of the family planning providers were good, more than half of the respondents in the urban area 159 (55.8%) agreed that the attitude of most family planning providers were good, 13 (4.6%) strongly agreed that the attitude of the family planning providers were good while 72 (25.3%) were indecisive.

Determination of the Statistical Difference in the Level of Knowledge of Modern Family Planning Methods among Couples between Rural and Urban Settings using Chi-Square Test

Table 11 depicts that the null hypothesis, which states that there is no statistical difference in the level of knowledge of modern family planning methods between couples in rural and couples in urban is rejected at p = 0.000, Pearson chi-square = 27.731.

Table 11. To Determine the Statistical Difference in the Level of Knowledge of Modern Family Planning Methods among Couples between Rural and Urban Settings using Chi-Square Test

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	27.731a	7	0.000
Likelihood Ratio	35.506	7	0.000
N of Valid Cases	570		

a. 4 cells (25.0%) have expected count less than 5. The minimum expected count is .50.

Most of the respondents in the rural area (87.7%) claimed that the adoption of family planning prevents unplanned pregnancy, 61 (21.4%) of the respondents claimed that the adoption of family planning prevents sexual transmitted diseases, 93 (32.6%) responded that the adoption of family planning promotes health and wellbeing of the family while 48 (16.8%) responded that the adoption of family planning reduces that level of poverty in the country.

The majority (90.9%) of the respondents in the urban area claimed that the adoption of family planning prevents unplanned pregnancy, 68 (23.9%) of the respondents claimed that the

adoption of family planning prevents sexual transmitted diseases, 91 (31.9%) responded that the adoption of family planning promotes health and wellbeing of the family while 62 (21.8%) responded that the adoption of family planning reduces that level of poverty in the country.

Second Hypothesis of the Research Study

Table 12 depicts that at two-tailed test, the adoption of modern family planning methods among couples in urban areas was statistically significantly higher than the couples in rural areas (U = 32347.5, p = 0.000) hence the null hypothesis (H_{01}) i.e., there is no statistical significant difference in the level of adoption of modern family planning methods among couples between rural and urban settings using non-parametric Mann-Whitney test is rejected.

Table 12. To Test Hypothesis(H_{01}) using non-parametric Mann-Whitney Test

How long ago did you start using family planning method for the first time?	
Mann-Whitney U	33327.000
Wilcoxon W	74082.000
Z	-3.968
Asymp. Sig. (2-tailed)	0.000

Discussion and Conclusion

The study shows various disparities between urban and rural acceptance and acceptance of family planning services. Individuals' attitudes for family planning methods are influenced by some characteristics, such as economic factors, socio-cultural factors, environmental factors, location, age, educational, traditional beliefs, religion, family type, and level of knowledge. This study shows awareness and adoption of modern family planning among residents in Urban and rural areas were both high and higher in Urban than in rural areas. In terms of knowledge of family planning benefits, more respondents in urban (90.9%) are knowledgeable that family planning prevents unplanned pregnancy than their counterparts in rural areas (87.7%). Several studies have alluded to the findings in this study on the disparity in awareness and knowledge of family planning between rural and urban areas. NDHS [4] reports that more people in the urban areas are more aware of and utilize family planning than the rural areas. Similar studies conducted revealed that religion, education, cultural factors, level of exposure, employment status, and influence the practice of family planning in Nigeria [18, 19, 20].

The reasons for differences in contraceptive adoption are obvious and can be alluded to the concentration of social amenities such as education, access to health services including family planning services and information in the urban areas [21, 22], Corroboratively, a study conducted in Karnataka India found that that contraceptive use was higher in urban areas than rural areas (67% versus 51.66% respectively) and concluded that this finding could be as a result of awareness, availability, and accessibility of contraceptives which are better in the urban areas than in the rural areas [23], this revelation was also highlighted by Nigeria NDHS report where demand for Family planning is lower in Rural than Urban areas, with 20% unmet needs in Urban and 18% in rural respectively [4].

Certain socio-demographic factors have been found to be positively associated with the adoption of family planning. Particularly, the level of education and wealth quintile [23]. The finding of education and being from the richest household as factors that influence modern contraceptive use may be because well-educated

women and those from wealthy homes are well informed and able to make decisions independently. In addition to women's education and wealth index of the household, it was noted that place of residence, age at first cohabitation, current age of the respondent, woman's working status, number of living children, husband's desire for more children, religious affiliation, access to health facilities, exposure to contraceptive information in media and by family planning workers, and current age of husband or partner were determinants of contraceptive use among ever married women in Rwanda [24].

Again, individual perception, place of residence, education wealth quintile, and partner's approval and exposure to family planning information play a significant role in contraceptive uptake. For instance, the role of individual and community normative as a factor in contraceptive use in Mali observed that education and wealth quartile play a significant role in contraceptive adoption. This also aligns with the findings in this study [25].

Similarly, a cross-sectional study in rural Zambia on the determinants of modern contraceptive use among married women of reproductive age established that married women of reproductive age in rural Zambia with higher education, richest wealth quintile, having high parity and family planning information, use more modern contraception method [26].

Other studies found that 85.7% of rural women of childbearing age in the Democratic Republic of Congo did not use any modern contraceptive methods due to socio-cultural and religious factors, husband's disapproval, high cost, and fear side effect [27, 28]. In Nigeria, a study conducted among rural women in Abakaliki to determine barriers to family planning acceptance observed that majority of women (50.3% and 33.3% respectively) gave reasons of side effects and husband's disapproval for the non-use of family planning methods while a few of them (8.2%) gave reasons of religion and cultural barriers [29].

Generally, in this study setting (rural and urban), the adoption of family planning is better when couples make a joint decision. The important role men play in uptake of family planning has been established by other studies. In a study among rural dwellers in the River State of Nigeria, it was affirmed that the husband's decision was a predictor to the use of family planning [30]. In addition, perception by male partners that decisions regarding health should be made jointly was positively related to the use of recent contraceptive methods [31, 32, 33, 34, 35].

Conclusion and Recommendation

Although some progress have been made in family planning at the enumerated communities of this study. A lot more work needs to be done, and a lot will be achieved if new programs are designed to actively involve the men and address other identified fears among women and men about family planning.

The greatest fears that prevented most of the women from accepting family planning were fear of side effects, husband's disapproval, and stigmatization. These are genuine concerns that should be fully addressed by the family planning program to improve uptake of family planning. That these fears persisted, as seen in many research outcomes, is worrisome and needs a more innovative approach to addressing these issues. More bothersome is the fact that the majority of our study participants learned about family planning from health workers and the media, yet their perceptions changed a little. It is either that the health workers and the media are not doing enough to properly inform and convince the women on the fact that the side effects of family planning occur in only a minority of users and is not significant compared to the huge benefits of family planning or there is an alternative source of information that hype these side effects which the women trust. Some studies have found that peers, other community members, social media, and other informal sources have all constituted channels through

which women learn of family planning. In addition to the serious possibility that they are bound to give women wrong information about family planning, they are most likely to hype the side effects and complications out of proportion. Certainly, women trust the information they get from these sources, and these have been found to influence women's decisions on family planning most often negatively.

Citations

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Conflicts of Interest

The authors declare no conflicts of interest.

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Influence of the Registration Process and Requirements on Cooperative Performance in Zambia

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Abstract

Having the registration process and requirements that are easy and affordable is one thing, and having the entire process that supports cooperative performance is yet another. This study intended to establish the influence of the registration process and requirements on the performance of the cooperative societies. The study adopted a descriptive research design using a mix method paradigm.12.6% of the total cooperatives in the Central province of Zambia were sampled from 16% of the total districts in the province. A total of 210 respondents were arrived at through purposive and systematic random sampling techniques. The desk review, semi-structured questionnaires with a reliability test of Cronbach's Alpha of 0.890, and interview schedules were the instruments used to collect data. The data were analyzed qualitatively using themes and quantitatively using descriptive statistics using SPSS Version 22. The study reveals that cooperative registration requirements are affordable, and the process is easy but hardly supports the cooperative growth and performance. The study, therefore, recommends the revision of the registration process being used so as to enhance cooperative performance and eventually bring about social and economic development in rural Zambia.

Keywords*: Cooperative registration, Cooperative requirements, Social and economic development, Performance.*

Introduction

Over the decades, the perception of cooperatives has revolved from that of considering them as food security agents to that of social and economic agents to cooperators, community, and national development. Cooperative societies in the agriculture sector are largely regarded as solutions to poverty reduction, improved livelihood through food security, and directly help to address the high poverty levels in rural areas and contribute positively to social and economic development.

Agriculture and agro-businesses are considered to be the most lucrative or profitable with potential for growth [1]. Therefore, cooperatives in the agriculture sector are largely regarded as solutions to poverty reduction, improved livelihood through food security, and directly help to address high poverty levels in rural areas.

Presently, Africa has several types of cooperatives stretching from agricultural, consumer, and housing to worker-based cooperatives. All these are managed by executive committees and have been subjected to many politics in most of these countries [2, 3].

Formal cooperatives were first introduced in sub-Saharan Africa by the colonial governments, often for promoting the production of cash crops by peasant farmers. After independence, many Sub-Sahara African governments adopted policies that further accentuated the role of cooperatives and other rural organizations in the

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agriculture sector [4, 5]. These became significant channels for government-sponsored credit input supply and marketing programs and usually had to operate under close guidance and control by the state.

Studies by World Bank show that past efforts by governments to promote efficient and sustainable growth of the cooperatives were constrained by inappropriate policies. Extensive government intervention tended to reduce member participation and militated against the objective of building self-sustaining organizations. Registration of cooperatives was strictly controlled. Regulations of prices and markets frequently prevented rural organizations from becoming commercially and financially viable [6]. A World Bank Operations and Evaluation Department (OEP) report covering the period 1965 to 1986 stated that agriculture projects, including group participation, often did not work because the groups were not committed to the project and acted more as an extension of the government than as organizations representing.

Currently, many cooperatives world over are free (independent from the government) to diversify and exploit the existing business opportunities not only for survival and increase individual benefits but also to contribute to social and economic development. Hence, they need to be entrepreneurial in their undertakings. Cooperative registration is now open, and the process is simplified.

Cooperatives are a form of business that benefits members, communities, and the nation in various ways. These are businesses with a minimum of ten members but no specific maximum number of members; they are voluntary businesses in nature formed by a group of people called members whose aim is to create employment for themselves [7]. The Business Enterprise Institute (BEI) describes cooperatives as businesses owned by "member-owners" and that they are democratically controlled by their member-owners, and unlike a traditional business, each member gets a voice on how the business is run. Services or goods provided by the cooperative benefit and serve the member-owners [8].

Agricultural cooperatives play a crucial role in the development of the rural sector and in promoting food security. In Brazil, 37 percent of agricultural gross domestic product (GDP) is produced by cooperatives, while 4 million farmers earn their income through cooperative membership in Egypt. In Ethiopia, the equivalent figure is 900,000, while 16.5 million litres of milk are collected every day from 12 million farmers in dairy cooperatives in India. Further, agricultural cooperatives have an overall market share of about 60 percent of the processing and marketing of agricultural commodities and about 50 percent of the supply of inputs in Europe" [9].

World over, there is a substantial number of cooperatives in the agriculture sector. In Zambia, over 1000 cooperatives are registered annually, and the agriculture cooperatives amount to 96.1% of the total cooperatives in the country, of which 80% are in rural areas [10]. Despite the significant increase in the number of cooperatives being registered, there has been no remarkable improvement in performance and contribution to the well-being of the cooperators.

Motivation

Zambia is still a developing nation after 56 years of independence. The government of the Republic of Zambia has come up with various economic strategies that can facilitate economic growth both in rural areas and in urban areas. One of them is the creation of cooperatives. This is an economic measure to alleviate the poverty levels, especially in rural areas. As of December 2018, Zambia, through the Ministry of Commerce, Trade and Industry, had registered about 2000 cooperatives, of which 80% of them are in rural areas [11]. Despite having a lot of cooperatives in rural areas, extreme poverty levels of more than 60% are in rural areas and 15 in urban areas [12]. Many studies have been conducted on the performance of the

cooperatives, but less has been researched regarding the impact of the registration process and requirements on cooperative performance, hence this study.

Research Objectives

The Study was Guided by the Following Objectives

i. Determine the current registration process and requirements of the cooperatives in Zambia.
ii. Examine the extent to which the registration process, and requirements support the performance of the cooperatives.
iii. Suggest possible measures to be considered in the registration process and requirements so as to enhance cooperative performance.

Literature Review

Helping the creation and development of entrepreneurial cooperatives is one of the ways the government can stimulate employment and alleviate the poverty levels. Poverty eradication has also been prioritized in the Seventh National Development Plan of 2017 [13], in the Vision 2030, and the Sustainable Development Goals (SDGs). Therefore, cooperatives remain the agent to poverty reduction, employment creation, and food security in Zambia.

Overview of the World Cooperatives

Statistics on cooperatives are essential to establish the impact of cooperatives on their members and the economy at large. Nevertheless, reliable and comparable statistics on cooperatives are missing in most countries of the world despite an emphasis that national policies should seek to improve the national statistics on cooperatives with a view of forming and implementing developmental policies (Promotion of Cooperatives Recommendation no. 193, adopted by the ILO [14]. Building on this, the 19th International Conference of Labour Statisticians (ICLS) in 2013 included cooperatives in the Conference agenda for the first time in its history. This further led to the adoption of the guidelines concerning statistics on cooperatives at the 20th ICS but was only approved in March 2019 by the governing body of ILO, being the first sort of an international norm on statistics on cooperatives.

A snapshot of the statistics on cooperatives from the available literature indicates that Iran and Italy have more registered cooperatives, 92,089 and 39,600 respectively, while Mexico, Denmark, and the Netherlands have fewer cooperatives, 142,139 and 70 respectively. One notable country with the highest number of cooperators is Finland, where more than 4.6 million Finns out of the total population of 5.5 million are cooperators [15]. One of the country's biggest cooperative societies, S Group has 2.3 million members operating in retail and service sectors with more than 1800 outlets. Table 1 presents the synopsis of the registered cooperatives in the world with membership.

Table 1. Synopsis of the Registered Cooperatives in the world

Country	No. of Coop.	Year started	No. of employees	Total membership	Main enterprise
Argentina	8,618	19th century	1,963,760	17,818,197	Associated work
Brazil	6,828	1889	425,318	14,618,720	Multipurpose
Canada	5,846	1840s	103,470	8,000,000	Multipurpose
Chile	1320	1887	10,932	2,005,646	Multipurpose
Mexico	142	1872		5,140,944	Multipurpose
Costa Rica	594	1907	17,599	860,855	Multipurpose
Iran	92,089		1,737,426	9,348,364	Multipurpose

Philippines	9,432	1896	226,400	7,647,800	Multipurpose
Rep of Korea	15,233		22000	313,000	Multipurpose
Belgium	338		6846	400,000	Agriculture
Austria	1,684		37,235	3,185,800	Agriculture
Croatia	1,247		2,716	20192	Agriculture
Czech Rep.	1307		53,594	154,323	Housing
Denmark	139		49,552	315,710	Industry/service
Finland	5051		93,511	4,663,239	Industry/service
France	22,517		1,217,466	26,106,829	Agriculture
Germany	7490		860,000	22,200,000	Agriculture
Italy	39,600		1,150,200	12,620,000	Industry/service
Netherlands	70		126,797	19,831,156	Agriculture
Portugal	871		14,198	403,298	Agriculture
Spain	20,050		290,220	7,296,629	Industry/service
Sweden	5,495		34,395	4,355,350	Banking
UK	6,800		33,829	14,919,093	Industry/service
Norway	5,592		37,500	2,411,038	Housing

Source: World Cooperative Monitor, 2019; ICA, 2017; ICA, 2019

Economic Contribution of the Cooperatives in Europe

Despite the agriculture cooperative being second to industry and service cooperatives in terms of quantities and number of employees, they contributed a bigger portion of 39.34 billion British Pounds towards the total annual turnover, only second to consumer cooperatives. With supportive strategic goals, cooperatives can be one of the solutions to help the less privileged in society and help reduce the gap between the wealth and the poor. This is evidenced by the overwhelming rate of the annual turnover of **424.99 billion British Pounds** in European cooperatives. Europe as a continent has over 180,000 cooperative enterprises with more than 140 million cooperators. Table 2 shows the European annual turnover of the cooperatives by sector.

Table 2. Economic Contribution of the Cooperatives in Europe

Sector	**Percentage of coops**	**Percentage by employees**	**Annual turn over**
Agriculture	30.36% (51,392)	14.16%	39.34 billion
Industry & service	36.60% (61,964)	27.53% (1,313,696)	9.65 billion
Housing &infrastructure	22.19% (37,570)	2.29%	2.51 billion
Banking	2.48%	19% (867,345)	-
Insurance	0.01%	0.83%	6.69 billion
Consumer	6.82%	11%	102.6 billion
Pharmacy	0.45%	0.06%	0.09 billion
Renewable energy	0.74%	0.02%	0.11 billion
Retail	22.19%	24% (1,142,658)	264 billion
Total	**100%**		**424.99 billion pounds**

Source: International Cooperative Alliance (2016); https://www.eurocoop.coop/coop-page/co-operative-movement.html

The Zambian Context

It is well known that the United States is the wealthiest country in the world. However, it is shocking that the top 1 percent of US households own more wealth than the bottom 90 percent combined, and the situation is the same in Zambia. Among the many reasons, the main one is that most industries have greatly consolidated, and wealth has become even more concentrated.

The Zambia's 7th National Development Plan (7NDP) in the Vision for 2030 has created a platform for the integration of international, regional, multilateral, and bilateral development strategies and agreements. The main goal of the 7NDP is accelerating development efforts towards Vision 2030 without leaving anyone behind. This has not left out the cooperative societies.

The key development results of the 7NDP are:

i. To diversify and make economic growth inclusive;
ii. To reduce poverty and vulnerability;
iii. To reduce developmental inequalities;
iv. To enhance human development; and
v. To create a conducive governance environment for a diversified and inclusive economy (Ministry of National Development Planning, 2017).

Supporting cooperatives in this regard can facilitate the actualization of Zambia's dream. Since cooperatives are more inclusive and accommodative, it will reduce the widening gap between the rich and the poor.

However, there is scanty literature establishing the relationship between cooperative registration and requirements and its impact on cooperative performance.

Methodology

This study adopted a mixed-method research design. The qualitative approach (phenomenological) was used to provide a detailed account of the impact of the registration process and requirements on cooperative performance. On the other hand, the quantitative approach (positivism) was used to provide descriptive statistics based on the research findings so as to draw possible conclusions that can be generalized [16].

The Central province, which has 12 districts, was purposively sampled, being central in Zambia. The sampled statistics, the sample mean, S (standard deviation), and S^2 (the variance in the sample) were used as estimates of the population parameters μ, σ, and σ^2 [17] to arrive at the 209 cooperators in Kabwe and Kapiri Mposhi districts.

A four Likert scale questionnaire was used to capture quantitative data, while open-ended questions were used to capture qualitative data. The Likert scale was designed to examine how strongly subjects agreed or disagreed with statements on a four-point scale. The response over a number of items tapping a particular concept or variable was then summated for every respondent. The data collected from primary data was later analyzed using themes and descriptive statistics using SPSS Vol. 22.

Reliability and Validity

When testing the reliability of the instruments, the tests of Cronbach's alpha, Kuder-Richardson Formula 20 (KR-20), inter-correlation, and test-retest reliability are the important tools used. However, this study used Cronbach's alpha, which measures the internal consistency among questionnaire items [18].

A Cronbach's alpha showed the questionnaire to reach very acceptable internal reliability with $\alpha = 0.890$, indicating very good reliability. Further, each item test was analyzed to test its reliability. The results are presented in Table 3.

Table 3. Item Statistical Analysis

Item Statistics	Mean	Std. Deviation	N
Gender of Respondent	1.47	0.500	209
Occupation of Respondent	2.03	0.324	209
Education Level	1.83	0.930	209
Number of years in Co-operative	2.41	1.039	209
The registration process of cooperatives is easy	1.72	0.748	209
The requirements for registration are very affordable	1.68	0.671	209
The registration requirements do not predict future performance of the cooperative	2.49	0.894	209
There is no relationship between the registration requirements and future performance of cooperatives.	2.38	0.989	209
There is some level of diversification in our cooperative.	1.87	0.827	209
Extension officers are playing a key role in entrepreneurship development of district cooperatives.	1.89	0.808	209

Source: Research work, 2020

Results of the findings

Analysis of Demography

The demography was analyzed using both frequencies and descriptive statistics as presented below. The statistical analysis of demography gave a mean of 1.47 for gender, 2.03 for occupation, and 1.82 for education level, while the standard deviation is 0.50 for gender, 0.32 for occupation, and 0.93 for education level. Other statistics of the demography of the respondents are presented in Table 4.

Table 4. Frequencies of Demography

Frequency Table			
Variable	**Values**	**Frequency**	**Percent**
Gender	Male	111	52.9
	Female	99	47.1
	Total	210	100.0
Occupation of Respondent	Civil Servant	8	3.8
	Farmer	188	89.5
	Trader	14	6.7
	Total	210	100.0
Education Level	Grade 7	96	45.7
	Grade 9	69	32.9
	Grade 12	33	15.7
	College	10	4.8
	University	2	1.0
	Total	210	100.0
Number of years in Co-operative	0-3	46	21.9
	4-7	72	34.3
	8-10	51	24.3
	More than 10	41	19.5
	Total	210	100.0

Source: Research works, 2020

Occupation

From the study sample of 210, 8 (3.8%) of the respondents were civil servants, 188 (89.5%) were farmers, and 14 (6.7%) were traders (owning various businesses). This suggests that farmers have dominated most of the cooperatives. Civil servants are very few (3.8%) as a result of the government policies that bar civil servants from participating and benefiting from FISP. This has created the perception that agriculture cooperatives are for farmers only. In as much as this policy can help benefit the poor (farmers), it has robbed the cooperatives of the much-needed diverse knowledge and skillsets which the servants can contribute to the cooperatives.

Level of Education

Education is one of the most important principles of cooperatives established by the ICA in 1995. Basic education is key to the success of any cooperative society. The success of the cooperative to a larger extent is dependent on the level of the knowledge base and how that knowledge is used in the cooperative. However, the study reviews that most of the cooperators have low education levels. Out of the total respondents, 99 (45.7%) are below Grade 7, 69 (32.9%) are below Grade 9, 33 (15.7%) are below Grade 12, 10 (4.8%) are below college level, and 2 (1.0%) below university level.

Experience in Cooperatives

Out of a total of 210, 46 representing 21.9% had experience ranging between 0-3 years, 72 representing 34.3% had the experience of between 4-7 years, 51 representing 24.3% had experience ranging between 8-10 years, and 41 representing 19.5% had experienced more than 10 years. The tabular frequency data is further represented in Figure 1.

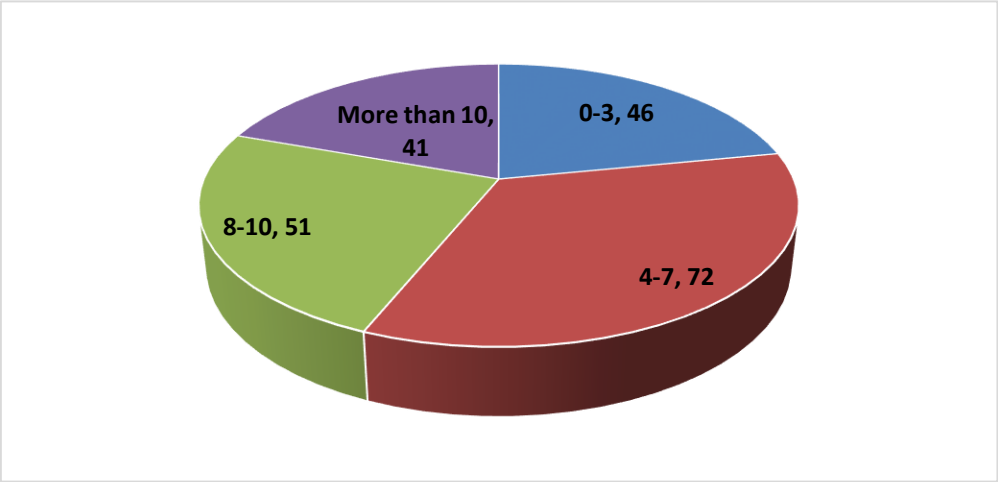

Figure 1. Frequency by experience in cooperatives

Source: Field data, 2020

The Registration Process and Requirements of the Cooperatives

Every legal cooperative is born at the registration stage. This is the stage when the cooperators organize themselves, meet the registration requirements and go to the district cooperative office to register their cooperative so that they can be operating legally. Too strict in the registration process may hinder some cooperatives from registering, and too soft the registration process can contribute to the registration of cooperatives that will not add any value to society. Data was collected from the cooperators on how they perceived the registration process and requirements and how these can affect the future performance of the cooperatives.

The Registration Process and Requirements

From the qualitative data collected through interviews and desk review, there are a number of requirements that need to be met as a group steps forward with the intention of registering a cooperative. The steps are tabulated below;

i. The group should have at least ten members for them to be considered for registration.
ii. The group should present preliminary minutes of its previous meeting. This will give the registration officer an insight of what they were discussing pertaining to the coming together to form a cooperative. It is from such minutes that the officer will ride on the ideas of the group and advise further. If they do not have any minutes, the officer shall advise the group to call for a meeting where the officer shall be invited.
iii. The group will be advised to have certain topics discussed in their meeting, which shall help the registration officer pick such details and assist in formulating the Cooperative By-Laws.
iv. In the minutes, the registration officer normally looks at issues of:
    a) The group needs to propose about three names of what the group shall be called. This is in order to help the officer carry out a name search. The three names at least shall give the officer leverage to have at least one of the names going through in the event that other names are already existing on the system. The PACRA platform is being used for name search.
    b) The officer would also like to hear the type of business that the group is planning. There could be two or three business ideas, and the group can put these in order of priority if they are able to cost them, the better. From this, the officer will guide the group on how much capital investment will be required.
    c) Since cooperatives are formed with a share capital, they are regarded as business entities registered with share capital under the Registrar of Cooperatives.
    d) Thus, the minutes should show the total capital investment from one individual member. The investment needed is called share capital, and these shares are broken into ten equal shares.
    e) The members need to discuss and indicate the value of each share as well as the value of the total ten shares required to be paid by each individual member into the business.
    f) The period that it should take to finish paying for the shares is also vital as this will also have a bearing on how long it shall take for the business to take full effect. In addition, the meeting should also discuss the minimum number of shares expected to be paid for at the time of joining. This will also indicate how much would be raised before the business starts.
    g) The meeting should also discuss the business premises (operational area or office for the cooperative).
    h) The physical address and the chiefdom where they belong must be indicated.
    i) Since cooperative works with the principles of democracy, there is a need to elect the interim leaders for the cooperative. These shall be responsible to do all the necessary logistics to see to it that the cooperative gets registered. The number of these leaders is guided by how big the group is. For example, if the group is less the fifteen members (15), it can only be allowed to have five (5) board members (leaders).
    j) The group needs to provide at least ten members with photocopies of their valid National Registration Cards (NRC).
    k) The group should complete a Cooperative application form.

l) Complete a share register form which will indicate the value of each share and how many have been paid. Furthermore, the form shall indicate the value of the entrance fee and membership fee. The membership fee is renewable every year, while the entrance fee is a non-refundable fee paid just once by each eligible member.

m) The cooperative officer shall use a template by-law and infuse the important points coming from the meeting. This document is given to the members to discuss, and final signed upon understanding the content.

It has to be noted that the officer has to visit the group to give guidance on most of these issues so that there is understanding and the period this may take varies with how the group is able to grasp and understand the concepts of business cooperatives.

In summary, the group applying to register a cooperative submits the following documents.

i. Four (4) copies of by laws
ii. Four (4) copies of minutes
iii. Four (4) copies of membership list
iv. Four (4) copies of application forms
v. Four (4) copies of ten members' NRC's photocopies

Perception of the cooperators on the registration process

On quantitative data, the first stage was to establish how easy the cooperative registration process was perceived and experienced by the cooperators. The findings indicate that 96 (45.7%) strongly agreed that the registration process is easy, 79 (37.6%) agreed, 34 (16.2%) disagreed, and 1 (0.5%) strongly disagreed. This suggests that generally, the registration process is easy. Figure 2 presents the responses of the cooperators.

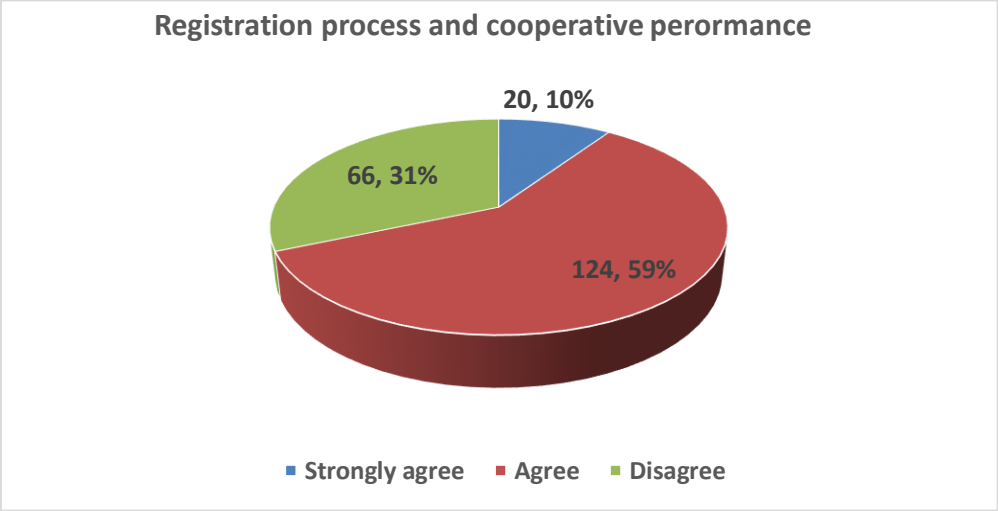

Figure 2. Registration Process and Cooperative Performance

Source: Field data, 2020

Affordability of the registration requirements

The process may be easy to undergo through. However, affordability is another dimension this test item intended to assess. It intended to test how affordable the registration requirements were to the cooperators. The findings are that 89 (42.4%) strongly agreed that the requirements were affordable, 101 (48.1%) agreed, 18 (8.6%) disagreed, and 2 (1.0%) strongly disagreed. This suggests that the registration is not only easy but generally very affordable to many cooperators. This is presented in Figure 3.

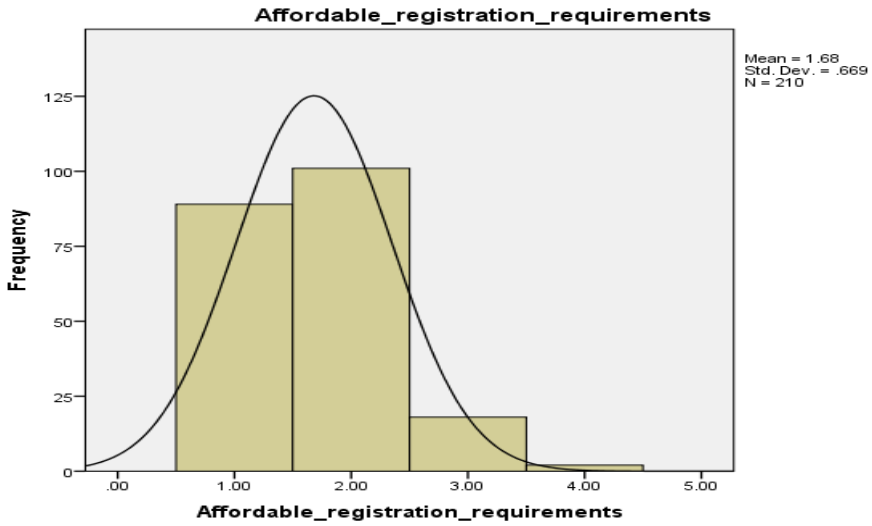

Figure 3. Affordability of the Registration Requirements

Source: Field data, 2020

Registration Process and How it Supports the Performance of the Cooperatives

It is always encouraging to have an easy and affordable registration process for cooperative societies in the country. However, it is another thing to have a registration process that supports the performance of the cooperatives. The test item intended to test the perception and experience of the cooperators on how the registration process supports the performance of the cooperatives.

The findings indicate that 36 (17.1%) strongly agreed that the process supports the cooperative performance, 55 (36.2%) agreed, 98 (46.7%) disagreed, and 21 (10.0%) strongly disagreed. Although the graph may show a slightly normal curve, a mean of 2.50 with a standard deviation of 0.893 suggests that a relatively bigger number does not agree that the registration process supports the performance of the cooperative societies, as presented in Figure 4.

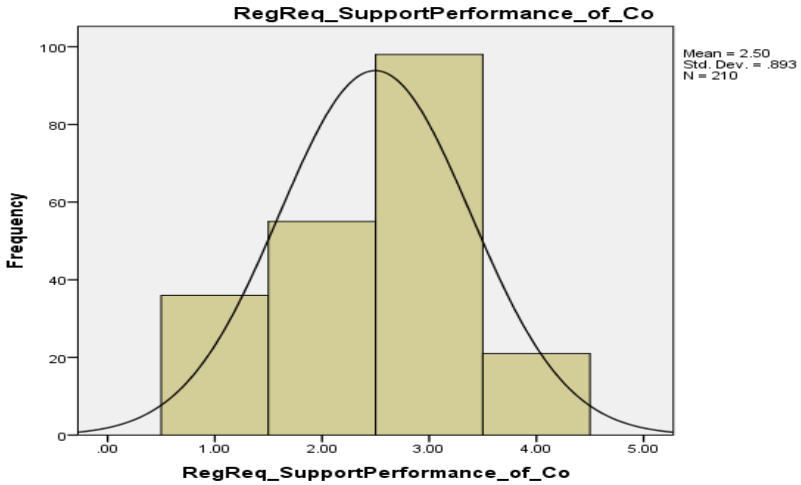

Figure 4. Registration Process Supports the Performance of the Cooperative

Source: Field data, 2020

Relationship between the Registration Process and Requirements, and the Future Performance of the Cooperatives

The entire registration process and requirements should have a direct implication on the performance of the cooperative. It is either the registration process, and requirements is meant to enhance the future performance of the cooperative society or a mere process for awarding of registration certificates. This test item determined the relationship between the registration process and requirements and the future performance of the cooperatives. This study reveals that 52 (24.8%) of the respondents strongly agreed that there is a relationship, 59 (28.1%) agreed, 83 (39.5%) disagreed, and 16 (7.6%) strongly disagreed. Although the curve shows a relatively normal distribution, it does not explicitly indicate that there is a relationship. This is presented in Figure 5.

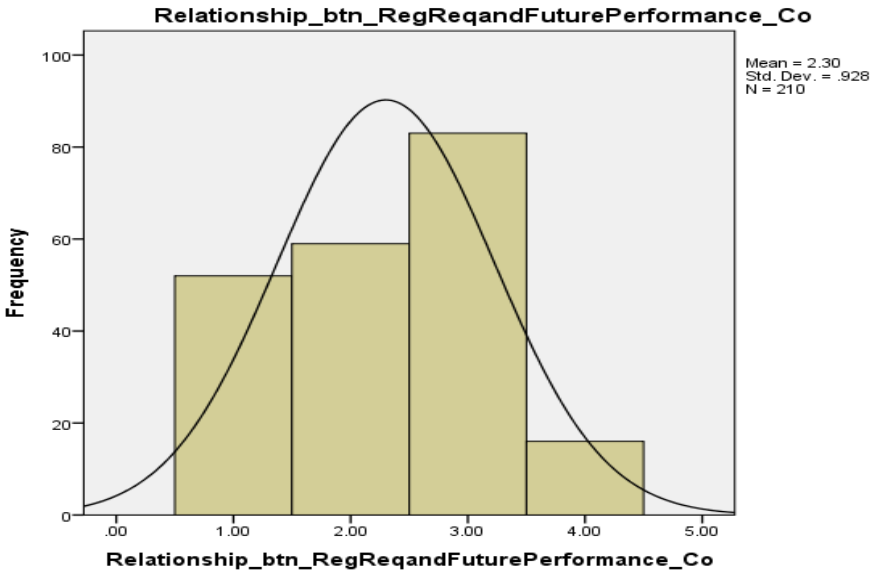

Figure 5: Registration Requirements Predict the Performance of the Cooperative

Source: Field data, 2020

Discussion and Interpretation of the Findings

Extent of the Registration Process in Supporting Cooperative Performance

Cooperative registration is one thing, cooperative performance is another. This objective, therefore, was intended to examine the extent to the registration process supports the performance of the cooperatives. It cannot be over-emphasized that every registered cooperative is expected to perform and contribute to the social and economic development of the community and nation at large. However, it is imperative to establish whether the registration process supports the cooperative performance.

It is well understood that the registration process goes with the registration requirements that every cooperative must meet. The findings indicate that the requirements are very affordable, and cooperators go through the registration process quite easily. However, the requirements must point to the expected performance indicators in the cooperative society to be registered.

Relevance of the Current Requirements on Cooperative Performance

This is the key question in discussing the first objective. Basically, only five requirements are currently needed for the cooperative society to be registered in Zambia. Do they really matter in adding value to the performance of the

agriculture cooperative societies afterwards? These five requirements are discussed below.

i. Four (4) copies of by laws

The by-laws spell out the dos and don'ts in the cooperatives, bring orderliness in the cooperative and ensure that the rights of everyone are protected. However, the by-laws may not point to or predict the future performance and growth of the cooperative society.

ii. Four (4) copies of minutes

The minutes as a requirement serve to document the proceedings of the meeting prior to the commencement of the cooperative. The minutes simply entails that the member met and agreed to form a cooperative and have nothing to do with or guaranteeing the future performance of the cooperative.

iii. Four (4) copies of the membership list

This requirement merely presents the details of the members of the cooperative society. The list may include the name of the co-operator, NRC, address, and phone number where possible.

iv. Four (4) copies of application forms

The application form for registration is obtained from the district cooperative office prior to registration. The form spells out the few requirements, physical address, and name of the cooperative society, among others. Although the application form indicates the type of cooperative and requirements, it does not show or provide the operational plan or guidelines to make the cooperative have a competitive edge and maximise the profits and shares of the co-operators.

v. Four (4) copies of ten members' National Registration Cards (NRCs) photocopies

These are personal identification documents proving the citizenship of the members of the cooperative to be registered. Despite the NRCs being used anywhere nationwide, they have no contribution to the general performance of the cooperative society as they just serve the purpose of identifying individuals in the cooperative society.

Basically, these five documents and requirements are very relevant to the registration process. However, they have little contribution to the future performance of the cooperative as their usefulness ceases right at the registration stage except for the by-laws that are constantly referred to for guidance and when resolving internal disputes.

The registration process and requirements of the cooperative societies, therefore, need enhancement if they are to influence and predict the future performance of the cooperatives.

Possible Inclusions in the Cooperative Registration Requirements

Consequently, this study suggests two important documents to be included in the registration process as part of the requirements so as to guide the operation of the cooperatives, and further help predict their future performance. These are the strategic plan and the business plan.

The Business Plan

The business plan is a written document in which the cooperators describe the business they intend to start and how they are going to start it.

Following the shift of the Department of Cooperatives from the Ministry of Agriculture to the Ministry of Trade, Commerce and Industry so as to make cooperatives more commercial, there was also a need to change in the perception, requirements, and the registration process of the cooperatives.

The business plan should now become one of the key requirements in the registration process of cooperative societies for various reasons. The business plan spells out a number of key indicators and determinants of how successful the business is likely to be [20]. Below are the questions the business plan intends to tackle,

which are pivotal to the performance of the cooperative societies.

Where are we now?

There is a need for the cooperators to answer the above question before the cooperative is registered. This is the analysis of the current situation of the cooperative in terms of the vision, the market place, the competition, the business concept, and the people involved. It may include any historical background relevant to the current state. Strengths and weaknesses must be analyzed as well as opportunities and threats. Table 5 presents a typical example of the situational analysis of a cooperative society.

Table 5. SWOT Analysis

Strengths	**Weaknesses**
The cooperative has the necessary skills	Increasing numbers of late payments and bad debts
Strong management team	Need for more training of staff
Modern machinery and technology	Communication systems need strengthening
Adequate capital	Tribalism, nepotism discrimination
Availability of (cheap) labour and land	Lack of entrepreneurial skills
Opportunities	**Threats**
Has an existing loyal customer base	Imported cheaper goods from overseas
There is demand for the new products/services	Workers demanding for higher wages
There is little local competition	Theft from community members
Availability of technical support	Droughts and floods
Population increase	Army worms and pests

Source: Research work, 2020

The above analysis tool will bring a full understanding of the exact current situation of the cooperative to the co-operators before they can embark on anything.

Where do we Intend to Go?

Only after knowing the current situation can one move to the next stage. At this stage, the co-operators need to visualize where they intend to go and be for a certain period of time. The direction the business intends to go needs to be clear and precise. Clear identification of likely changes to the business environment and assessment of possible threats to the business is vital.

How do we get there?

The 'how' question concludes the basis of the business plan. This calls for the clear setting of goals and objectives and the identification of possible causes of action to be taken. This leads to a business plan which should show how to get there.

The cooperative society may start the business plan by designing a cover sheet that should provide the following information;

i. The name of the business.
ii. The name of the cooperative society (the owners).
iii. Contact details, for example, telephone, postal and physical address, and email.
iv. Logo or emblem of the business where possible.

The Need for the Strategic and Business Plan in Cooperative Registration

There are many reasons why the strategic and business plans should be among the requirements in the cooperative registration process so as to increase the performance of the cooperatives. Some of them include;

i. They provide clearer and organized business ideas.
ii. They are a road map that show how to reach the destination whereby foretelling the future performance of the cooperative society.
iii. Ideas are put down in writing to check that they are being implemented logically at the implementation stage.
iv. These are devised operational plans that show what must be done, how it must be done, and by who?
v. They act as the basis for the evaluation of the cooperative society.
vi. They are used to get loans from lending institutions.
vii. They help to determine the viability of the business idea.
viii. They show the profitability of the business.
ix. They help in assessing the overall competence of the *cooperative* team.
x. They predict the future performance of the cooperative society.
xi. They answer 5 questions. These are;
    a) *WHAT the cooperative plans to do.*
    b) *WHERE the cooperative is going, the goals and vision of the business.*
    c) *HOW the cooperative is going to start the business to reach the destination.*
    d) *WHEN the cooperative intends to start the business.*
    e) *WHY the cooperative thinks that the business will succeed?*

It may amount to nothing to organize a cooperative society without any plan showing where to start from, the expected destination, and how to get there. It is, therefore, imperative to help co-operators to enter into an association with a clear vision that is well enshrined in a five-year strategic and business plan. This should be verified and ratified right at the registration stage by experts [21].

Further, the groups intending to register a cooperative should be given a time frame in which they should show their seriousness with their intended business ideas. The registration process and requirements should clearly state certain bench marks to be followed after which the group should meet for them to be recommended for registration. The findings in this study reveal that quite a good number of cooperatives that are hurriedly organized and registered lack substance and often do not go anywhere and are deregistered earlier than expected, while others continue depending on the Farmers Input Support Programme (FISP) where the government subsidizes on fertilizer and other farm inputs [22].

Conclusion and Recommendations

The findings reveal that there are basically five requirements in the registration process of the cooperatives namely, the by-laws, photocopies of ten NRCs, minutes from the meeting, the application form, and membership list. This study reveals that despite the relevance of these requirements, none of these are instrumental in facilitating the future performance of the cooperatives. The cooperative society is as good as its registration process.Every member of the community has a role to play to its well-being. In the same line, every cooperative is born with a role to play in alleviating the poverty levels and add a distinguished value to the general well-being of the members and the nation at large. This common understanding must be fundamental from cooperative registration to evaluation [23]. However, a cooperative remains a more united association in alleviating the poverty levels in rural Zambia and contribute exceptionally to the social and economic development of the nation.

Based on the research findings, this study recommends that to make the cooperative societies as good as their registration process, the registration requirements and process be revised so as to accommodate the strategic and business plans as basic requirements in the registration process. This will be making cooperators realise the core vision of the cooperative right from the beginning. These two will be additional to the by-laws, photocopies of ten NRCs, minutes from

the meeting, the application form, and membership list.

Conflict of Interest

It is important to disclose any conflict of interest that may have influenced either the conduct or the presentation of this paper, including academic interests and rivalries and any personal, religious, or political convictions relevant to the topic at hand. The study basically determined the current registration process and requirements of the cooperatives in Zambia and went further to examine the extent to which the registration process and requirements support the performance of the cooperatives. The study took the neutrality, and the researcher sought consent with the participants who are not revealed in any way and presented the findings and recommendations accordingly. Further, people's works are acknowledged.

Acknowledgement

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Socio-Demographic, Behavioural and Biomedical Factors Contributing to HIV Spread among Adults in Ghana - A Case-Control Study

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Abstract

HIV/AIDS prevalence remains a major global public health and development challenge despite key interventions to curb its spread. Ghana, in particular, for a decade now, has experienced a persistent increase in the number of HIV new infections among adults, with the new infection rates varying across the administrative regions. The study examines socio-demographic, health, social, behavioural, and biomedical factors contributing to the spread of HIV among adults in Ghana and how these factors vary across administrative regions. A case-control study was carried on involving 362 respondents made of 181 HIV cases and controls, each from the Ahafo and Northern regions of Ghana. Structured questionnaires were administered. Socio-demographic characteristics of respondents, their health status, social behavioural, and biomedical factors that have potential influence on the spread of HIV was collected. A logistic regression model was used to estimate the degree to which each of the risk factors collected were associated with the spread of HIV in Ghana and across regions. Out of 21 risk factors identified, 13 accounted for the spread of HIV in the Ahafo region compared to only 6 in the Northern region. The study concludes that factors for HIV spread in Ghana are many but vary across administrative regions in the country. It, therefore, suggests the need to create job opportunities, have HIV awareness campaign programmes, regulate the sale of alcoholic and other related drugs, discourage sex trade, promote condom use throughout the country for those who cannot abstain, and tailored to regions.

Keywords*: Adults, Biomedical Factors, HIV Spread, Socio-Behavioural.*

Introduction

The prevalence of HIV/AIDS and measures to curb its spread remained a major global public health and development challenges. For decades now, key global efforts have been galvanized to address the epidemic, and great strides have been made. For instance, the number of newly infected people with HIV and the number of AIDS-related deaths had progressively declined over the years, while the number of people with the infection receiving treatment increased to 23.3 million in 2018 [1]. In particular, coming down to developing countries and Sub-Saharan Africa reveals rather a slow average progress rate in reducing the spread of HIV infections.

It is observed that globally, an estimated 37.9 million people were living with HIV, out of which about 1.7 million were new infections in 2018 alone, a decline of 40% in the number of new infections since the peak in 1997 [1]. An estimated 32.0 million (23.6 million–43.8 million) people have died from AIDS-related illnesses since the beginning of the epidemic. Sub-Saharan Africa in particular, accounts for the largest percentage of infections and people living with HIV/AIDS in the whole world. Approximately 25.6 million (67% of the global

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total) people live with the virus in sub-Saharan African countries [1]. The countries within this sub-region with the highest prevalence rate and the number of people living with HIV/AIDS include South Africa, Nigeria, Kenya, Uganda, Zimbabwe, Namibia, Tanzania, Swaziland, Lesotho, Botswana, Zambia, Mozambique, Ghana, Bahamas, Belize, Jamaica, Haiti, India, Thailand, Nepal, Myanmar, Indonesia, and Malaysia.

Despite recent reports of decreases in HIV infection prevalence in parts of Africa, Ghana recorded an increase in the number of new HIV infections in 2018 [2]. Though the country also experienced an increase in numerous prevention strategies and awareness campaigns, HIV transmission and prevalence rates remain high, thwarting the progress of the fight against the disease. The adult HIV/AIDS prevalence rate in the country has been estimated at 1.69 percent, according to 2018 national HIV estimates [2]. Also, based on regional variation in the prevalence and spread of HIV, the Ahafo region recorded one of the highest prevalence rates of 2.66 percent, while the lowest prevalence of 0.40 percent was recorded in the Northern region according to the 2018 national prevalence survey.

To understand why HIV/AIDS remains an epidemic in Ghana, we examined the factors that are contributing to the spread of the disease and the variations across administrative regions within Ghana. For the past decades, Ghana experienced a persistent increase in the number of HIV new infections [3] with wide regional variations of as high as 2.66% in the Ahafo region and as low as 0.40% in the Northern region. The purpose of the investigator was to identify the various risk factors associated with the new HIV infections and the regional variation in the prevalence rate for the Ahafo and the Northern regions. Particularly, little scientific research exists on the subject matter in Ghana. This study addresses the knowledge gap in the literature by investigating the determinants of HIV prevalence and the wide regional variations in Ghana. Based on the findings, the appropriate intervention measures to curb the spread of the virus are proposed.

The current trends on HIV infections reveal that many people are either living with the condition or at high risk of being effected with the virus. Even though progress has been made at the global level on prevention, treatment, and care, there remains no cure for the disease [1]. Notwithstanding the challenges, significant progress has been made to address the epidemic. For instance, the Sustainable Development Goal 3 enjoins the global community to end the AIDS epidemic by 2030, and under the UNAIDS "90-90-90" targets, countries work toward achieving, by 2020, "90% of people living with HIV knowing their HIV status; 90% of people who know their HIV-positive status on treatment; and 90% of people on treatment with suppressed viral loads." Despite Ghana's weak performance in these targets as at December 2018, Ghana attained 63%, 42%, and 15% of the first, second and third 90-90-90 targets, respectively [4], new HIV infections remain high. To understand the various reasons accounting for high new infections and the regional variations in the spread of the virus, we first identified the socio-demographic, behavioural, and biomedical factors contributing to HIV spread among adults in Ghana; and then examined the variation in these factors in the Ahafo and Northern regions; and further established their associations with the spread of HIV in these regions of the country.

A review of literature shows that HIV/AIDS is a global burden that continues to threaten the world's development efforts since 1981, when the first cases were reported. In almost 4 decades, the disease has infected over 70 million people, with 35 million related deaths [5]. The prevalence of HIV differs from country to country, though the majority of the cases come from low and middle-income countries, including Africa [5]. The number of HIV-infected people in 2017 in sub-Sahara Africa was 25.7 million as compared to 5.9 million in Asia and 2.2 million in Europe and America [5].

HIV/AIDS affects people of all ages and sex in all countries, but the impact varies. According to the world bank 2017 report on the proportion of adults living with HIV/AIDS, the following ten countries top the league table with the highest prevalence of HIV/AIDS in the world. Swaziland recorded the highest prevalence of 27.2%, followed by Lesotho with 25%, Botswana 21.9%, South Africa 18.9%, Namibia 13.8%, Zimbabwe 13.5%, Zambia 12.4%, Mozambique 12.3%, Malawi 9.2% and Uganda 6.5% [6].

Relevant literature has shown that the majority of factors such as demographic factors, alcohol use, smoking, late testing for HIV, previous history of STI, multiple sexual partners, infrequent condom use, and knowledge on HIV could contribute to the prevalence of HIV in the world. Though such studies could not conclude on the extent to which these factors influence different groups and populations, they provided associations. Nonetheless, the interplay of these factors has serious consequences on people at higher risk of infection, deaths, and the communities in which these people reside.

It is reported that heterosexual transmission is the leading factor of HIV spread in Sub-Saharan Africa [7] and that it is the only region where the women infection rate is high as compared to men. Coupled with the relative easiness of man-to-woman transmission than for woman-to-man transmission, [8] observed that poverty pushes many girls to accept relationships with older men who are ready to give money, gift items and/or favours in return for sex. Some researchers [9] reported that looking for money to attend school, buy goods, and food to live on have been some of the reasons why adolescent girls in sub-Saharan Africa indulge in sexual relationships.

Some studies put it that the high prevalence of HIV/AIDS in Africa is associated with concomitant multiple sexual partnerships among Africans, whether single or married [10]. While others [11] were more straight in underscoring the fact that there would be no AIDS pandemic in the world if it were no multiple sexual partnerships. Stoneburner and Low-Beer reviewed the Ugandan HIV success story on sexual partner reduction and linked it to a study they conducted in Zambia, Malawi, and Kenya and reported that reduction in sexual partners and abstinence among unmarried youth are strong factors in reducing HIV spread. Similarly, others reported that those who engaged in multiple concomitant sexual relationships are considered as main movers of the HIV/AIDS epidemic [12, 13].

Nevertheless, [14], as cited in [15], contested the multiple and concurrent partners' notion and reported that some ecological studies of HIV/AIDS and concurrency have not found a statistically significant correlation between rates of self-reported concurrency and HIV/AIDS prevalence. In Sub-Saharan Africa, sexual activity seems not only to be mostly influenced by poverty but by cultural beliefs and practices [16]. Thus, [1] upheld the view that cultural beliefs and demands in most African countries embolden men to have multiple partners, while women are expected to abstain or remain faithful. According to [17], discussing sex is considered a taboo in many African countries, a situation that denies many young people the needed information to protect themselves. According to [18], other practices such as ritual cleansing and wife inheritance that report as prevalent in the Upper East Region of Ghana have also been identified as risk factors for the spread of HIV/AIDS. Certainly, the rates of HIV infection among young women are 300 to 400% more than those among young men in some countries in Sub-Saharan African [19].

Some studies have also shown a statistically significant association between having more than one sexual partner [20], having sex for benefits or money [21], medical history of injections, and HIV infection [22, 23]. Also, [24] indicated that many factors contribute to HIV infection, and these include older age, separated (marriage), women of lower social and

economic status, divorced, and lower education levels.

Biomedical factors, according to [25] have a significant association with HIV infection. They found men with a past 12-months history of genital ulcers (AOR), 1.91; 95% confidence interval (CI), 1.04–3.49), In women, 12-months previous history of unusual vaginal discharge to be associated with HIV infection. Similarly, the World Health Organization found the previous history of tuberculosis to be a major risk factor among People Living with HIV [5]. [26] suggests related illnesses as a major contributor to HIV morbidities and mortalities among PLWHA.

Methods

A case-control study design was used to determine the demographics, health, social behavior, and biomedical conditions associated with the spread of HIV in Ghana. Quantitative data were collected to determine the prevalence of risk factors of HIV amongst the adult population of 15 to 49 years in the Ahafo and Northern regions of Ghana. In a previous national prevalence study, the Ahafo region and the Northern region, out of the 16 regions in Ghana, recorded one of the highest (2.66%) and lowest (0.40%) HIV prevalence rates respectively in 2018 [27]. HIV new infections were estimated for all ages at 20, 000 (15,000-26,000) with close to a similar number of 14,000 (11,000-18,000) HIV related deaths in 2018 which formed the study population [27].

The design comprised comparable case (adult HIV positive persons) and control (adult HIV negative persons) groups determined by inclusion and exclusion criteria. A total of 362 participants from both the Ahafo region (155 cases, 155controls) and the Northern region (26 cases, controls 26) were randomly selected using a simple random selection approach given regional HIV difference in prevalence. The sample size of the study was determined using the following formula:

$$n = \left(\frac{r+1}{r}\right)\frac{(\bar{p})(1-\bar{p})(Z_{\beta}+Z_{\alpha/2})^2}{(p_1-p_2)^2}$$

Where n is the sample size (362), $Z_{\beta} = 0.84$, 0.05 significance level ($Z_{\alpha}=1.96$), an equal number of cases and controls (r =1), odds of 2 or greater, and take the proportion of cases exposed in the control group at 20%. The average proportion exposed was taken at (0.33 + 0.20)/2 = 0.265.

A structured questionnaire covering socio-demographic, behavioural, and biomedical factors was the main tool for data collection. Some aspects of the questionnaire were adapted from the 2018 Ghana Demographic and Health Survey tool, while the remaining portion was designed by the researchers to suit the research objectives. Both closed and open-ended questions were used to provide qualitative and quantitative data for analysis. The questionnaires were administered by trained HIV counsellors as it was difficult for the researcher to directly obtained this confidential information from the targeted respondents. The questionnaire administration came after a four-step process was employed involving: 1. identification of sources of cases, 2. assigning a case definition, 3. deciding what type of control population is appropriate, and 4. matching of cases and controls.

The Regional and District Directors of Health Services and Management Teams of the study regions and ART centres were contacted to seek for their consent to conduct the study after ethical clearance has been given for the collection of data. The researcher was not in any way exposed to participants of the study to cause physical or psychological harm. Participation in the study was strictly participatory with the informed consent of participants that guarantees their right to privacy. Information obtained was treated with the strictest confidentiality and integrity by ensuring that responses are not linked to the names of respondents.

For analysis, data were entered, cleaned, and analyzed using Statistical Package for Social Science (SPSS, v.16). Descriptive statistical procedures such as tables and proportions were used to report and describe findings. For each variable, adjusted odds ratios (ORs) and population-attributable fractions (PAFs) for socio-demographic, biomedical, and behavioural factors were obtained using the logistic regression technique. Chi-square was used to identify factors associated with HIV prevalence and multiple logistics regression for identifying the contributing factors to the spread of HIV infection among adults in Ghana.

Results

Demographic Characteristics and Association with HIV Status

Table 1 presents the demographic characteristics of respondents interviewed during the survey and how those characteristics relate to the HIV status of the respondents. Two districts, the Tano South (Bechem) district in the Ahafo region and the Karaga district in the Northern region of Ghana, formed the study site. A total of 155 HIV carriers and 155 controls were interviewed in Bechem, while 26 carriers and 26 controls were interviewed in the Karaga district, forming an overall total of 181 carriers and 181 non-carriers. The majority of HIV positives, 45.9%, were within the middle (25-39) year group, while the least, 11.1%, fell in the young (15-24) year group. Females formed the largest, 75.1% carriers of HIV. Of the 181 HIV positives, the majority, 66.3%, were unemployed, while 31% were unemployed in the control group. About 42.5% of HIV-positive respondents were still in marriage compared to 63% of non-carriers. Also, 60.2% of respondents with HIV carries lived in rural areas compared to 41.4% of the non-carriers.

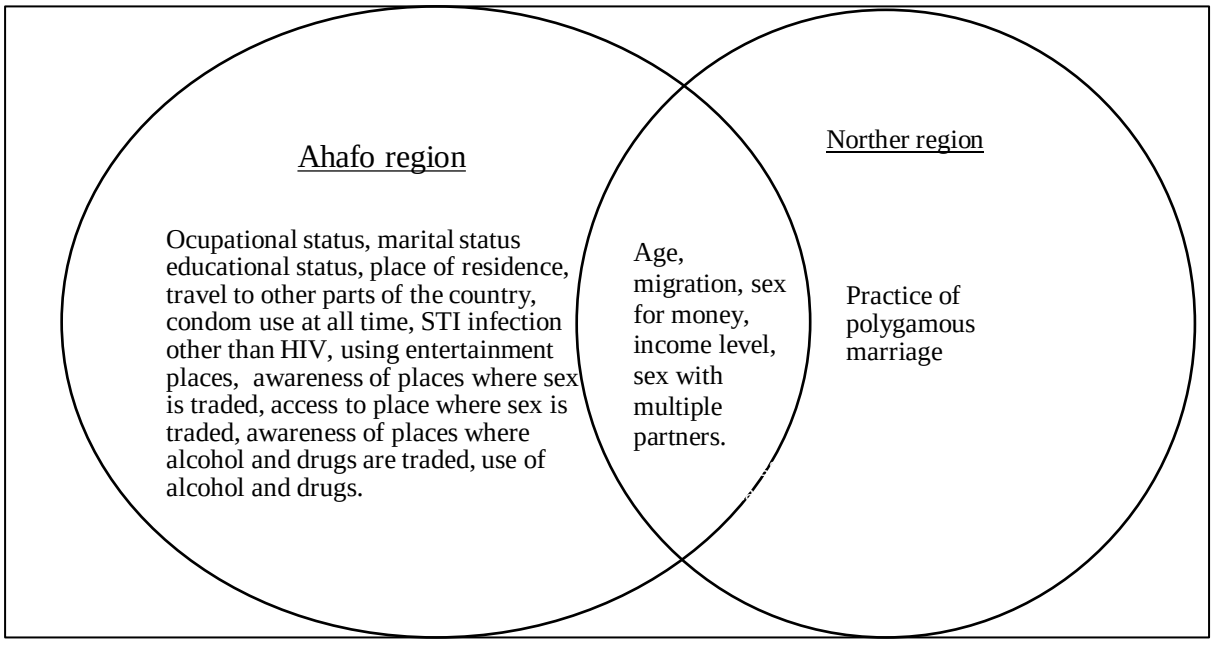

Figure 1. Factors Accounting for Spread of HIV Infections in Ahafo and Northern Regions of Ghana

Table 1. Relationship/Association Between Demographics and HIV Status

Respondents' Demographic Information	Responses	HIV Status				$\chi 2$
		Negative		Positive		
		N	%	N	%	
Respondent's District	Bechem	155	85.60%	155	85.60%	0.00
	Karaga	26	14.40%	26	14.40%	
Age group of respondents (Years)	15 – 24 (Younger)	39	21.60%	20	11.10%	23.24**
	25 - 39 (Middle)	115	63.60%	83	45.90%	55.70***
	40 - 49 (Older)	27	14.80%	78	43.10%	49.10***
Sex of Respondent	Female	125	69.10%	136	75.10%	1.66
	Male	56	30.90%	45	24.90%	
Occupational Status of Respondent	Full – Time	122	67.40%	115	63.50%	23.75***
	Part – Time	2	1.10%	26	14.40%	
	Unemployed	57	31.50%	40	22.10%	
Educational Status of Respondent	University	30	16.60%	10	5.50%	45.93***
	Senior high school	44	24.30%	16	8.80%	
	Junior high school	56	30.90%	48	26.50%	
	Primary school	28	15.50%	47	26.00%	
	No formal Education	23	12.70%	60	33.10%	
Marital Status of Respondents	Cohabiting	2	1.10%	13	7.20%	51.21***
	Divorced	1	0.60%	19	10.50%	
	Married	114	63.00%	77	42.50%	
	Never married	12	6.60%	3	1.70%	
	Separated	1	0.60%	2	1.10%	
	Single	51	28.20%	53	29.30%	
	Widow	0	0.00%	14	7.70%	
Respondents' Place of Residence	Rural	75	41.40%	109	60.20%	12.78***
	Urban	106	58.60%	72	39.80%	

Source**:** Author's Field Survey, 2020), Significant level; 1% (***), 5% (**)

Factors influencing HIV Spread among Adults in Ghana

Table 2 reports on the demographics, health, social behaviour, and biomedical conditions such as; age groups, sex, occupational, educational, marital status, age group first time of sex, having sex with multiple partners, condom usage at all time, ever had sex with a partner 15 years older, sex for money, infected with sexually transmitted infections (STIs) among others included in the logistic regression model. Out of 21 independent variables, 13 variables (age group of respondents, sex of respondents, marital status of respondents, having sex with multiple partners, condom usage at all times, sex for money, infected with sexually transmitted infection (STI) among others) were reported by the model to be statistically significant at 1% and 5% level that might influence HIV spread among adults in Ghana.

For each variable, adjusted odds ratios (AORs) were reported, and the overall significance of independent variables on the spread of HIV was tested using Chi-square. Also, the explanatory power of the independent variables on the dependent variable was estimated using Pseudo R2. The model diagnostics (Table 2) demonstrate good model fitness to the data as indicated by the highly

significant Prob>chi2 value of 0.0000 and the explanatory power exhibited by the pseudo-R2 of 0.7094. The result of the Pseudo R2 showed the independent variables in the model explain about 70.9% of the factors that might influence the spread of HIV among adults in Ghana.

Table 2. Factors Influencing HIV Spread Among Adults in Ghana

Variables	**AOR**	**P>z**	**[95% Conf.Interval]**
Age Group of Respondent	1.795	0.002***	1.24321 - 2.59137
Sex of Respondent	4.443	0.027**	1.189168 - 16.59735
Occupational Status of Respondent	0.410	0.207	0.1024159 - 1.639884
Educational Status of Respondent	0.515	0.203	0.1851685 - 1.430976
Marital Status of Respondents	0.210	0.003***	0.0753018 - 0.5871516
Respondents' Place of Residence	0.405	0.083	0.1459216 - 1.123671
Age group first time of sex	0.665	0.479	0.2140524 - 2.062923
Having sex with multiple partner	4.269	0.009**	1.448189 - 12.58322
Condom usage at all time	0.069	0.016**	0.007898 - 0.6095435
Ever had sex with a partner 15 years older	1.581	0.492	0 .4272804 - 5.853243
Sex for money	21.404	0.000***	6.098537 - 75.12323
Infected with sexually transmitted infection	7.135	0.000***	2.491865 - 20.42966
Alcohol or Drug addiction	0.082	0.000***	0.0240381 - 0.2818849
Awareness of places where sex is traded	6.792	0.007**	1.68661 - 27.34769
Awareness of drugs/alcohol selling places	0.123	0.006**	0.0278064 - 0.544935
Income level	0.201	0.008**	0.0609327 - 0.6613691
Access to place of sex trade	12.708	0.011**	1.791786 - 90.13664
Used to traveling to other parts of the country	0.664	0.480	0.2127659 - 2.069773
Migration Status	10.616	0.000***	2.881842 - 39.10868
Practice polygamy marriage	1.157	0.867	0 .2110345 - 6.34252
Entertainment	0.529	0.415	0.1145077 - 2.446815
Number of obs = 362		Prob > chi2 = 0.0000	
LR chi2(21) =356		Pseudo R2 = 0.7094	

Source: Author's Field Survey, 2020), Significant level; 1% (***) and 5% (**)

Difference in Factors influencing HIV Spread among Adults in Ghana

We analysed how factors influence the spread of HIV among adults across administrative regions of Ghana. Table 3 reports the variation of demographics, health, social behaviour, and biomedical conditions of respondents between Ahafo and the Northern region. Out of the 21 variables that were analyzed, 13 were found to be statistically significant (0.00001) for the Ahafo region, while only 6 variables were significant at 1% and 5% for the Northern region. The mean total scores of the factors that were found to be statistically significant vary in the two regions. The Ahafo region recorded a mean total score of 1.52 while the Northern region recorded 0.52 (Table 3). This means that people living in the Ahafo region were 100 times more likely to get HIV infection than those living in the Northern region. This proved the null hypothesis wrong and favours the alternative hypothesis since there are significant differences in the presence and power of the factors across the regions. We, therefore, accept the alternative that there is a difference in factors accounting for the spread of HIV infection of persons across administrative regions in Ghana.

Table 3. Difference in Factors Influencing HIV Spread among Adults in Ghana

Variables	**AOR**	**P>z**	**(95% Conf.Interval)**	**Ahafo region**	**Norther region**
Age Group of Respondent	1.58	0.002***	1.24321 - 2.59137	***	***
Sex of Respondent	4.443	0.027**	1.189168 - 16.59735	**	
Occupational Status of Respondent	0.41	0.207	0.1024159 - 1.639884		
Educational Status of Respondent	0.515	0.203	0.1851685 - 1.430976		
Marital Status of Respondents	0.21	0.003***	0.0753018 - 0.5871516	***	
Respondents' Place of Residence	0.405	0.083	0.1459216 - 1.123671		
Age group first time of sex	0.665	0.479	0.2140524 - 2.062923		
Having sex with multiple partner	4.269	0.009**	1.448189 - 12.58322	**	**
Condom usage at all time	0.069	0.016**	0.007898 - 0.6095435	**	
Ever had sex with a partner 15 years older	1.581	0.492	0 .4272804 - 5.853243		
Sex for money	21.404	0.000***	6.098537 - 75.12323	***	**
Infected with sexually transmitted infection (STI)	7.135	0.000***	2.491865 - 20.42966	***	
Alcohol or Drug addiction	0.082	0.000***	0.0240381 - 0.2818849	***	
Awareness of places where sex is traded	6.792	0.007**	1.68661 - 27.34769	**	
Awareness of drugs/alcohol selling places	0.123	0.006**	0.0278064 - 0.544935	**	
Income level	0.201	0.008**	0.0609327 - 0.6613691	**	**
Access to place of sex trade	12.708	0.011**	1.791786 - 90.13664	**	
Used to traveling to other parts of the country	0.664	0.48	0.2127659 - 2.069773		
Migration status	10.616	0.000***	2.881842 - 39.10868	***	***
Practice polygamy marriage	1.157	0.007	0 .2110345 - 6.34252		***
Entertainment	0.529	0.415	0.1145077 - 2.446815		
Population Mean				1.52	0.52
Number of obs = 362		Prob > chi2 = 0.0000			
LR chi2(21) =356		Pseudo R2 = 0.7094			

Source: Author's Field Survey, 2020, Significant level; 1% (***) and 5% (**)

Demographics, Health, Social Behaviour and Biomedical Conditions influencing the Spread of HIV in Ahafo Region and Northern Region

To appraise the established variables influencing the spread of HIV in the two regions, Table 4a and Table 4b report these risk factors from the perspectives of both cases and control groups. The results showed that while marital status significantly affects HIV status in the Ahafo region, 15% of HIV positives faced divorce as compared to 1% of HIV negative (Table 4a). For the Northern region, while 15.4% of HIV carriers faced divorce as compared to 0% of the non-carriers, marital status, in general, does not have a significant influence on HIV status (Table 4b). Also, 65.2% of HIV patients indicated they had sex for money as compared to only 9% of HIV negatives in the Ahafo region (Table 4a), while in the Northern region, 23.1%

of HIV patients affirmed that they had sex for money compared to 3.8% of the HIV negative. An inspection on the medical history of STIs other than HIV revealed that in the Northern region, 69.2% HIV positive respondents reported of ever suffering from other STIs as compared to a relatively larger percentage (23.1%) in the HIV-negative cohorts (Table 4b). However, that of the Ahafo region showed that 94.8% of HIV patients reported of ever having other STIs compared to 38.1% of the non-carriers (Table 4a).

Table 4a. Relationships/Associations between Demographics, Health, social Behaviour and Biomedical Conditions with the Spread of HIV in Ahafo Region

Variables	**Responses**	**HIV Status**				**χ2**	**P-value**
		Negative		**Positive**			
		N	**%**	**N**	**%**		
Age Group of Respondents (Years)	15 - 24 (Younger)	31	20.0%	16	10.3%	49.125	0.000***
	25 - 39 (Middle)	98	63.2%	68	43.8%		
	40 - 49 (Older)	26	16.8%	71	45.8%		
Sex of Respondent	Female	102	65.8%	115	74.2%	2.554	0.107
	Male	53	34.2%	40	25.8%		
Occupational Status of Respondent	Full – Time	119	76.8%	22	14.2%	20.565	0.000***
	Part – Time	2	1.3%	23	14.8%		
	Unemployed	34	21.9%	110	71.0%		
Educational Status of Respondent	University	26	16.7%	9	5.8%	65.107	0.000***
	Senior high school	44	28.4%	15	9.7%		
	Junior high school	56	36.1%	46	29.7%		
	Primary school Education	25	16.1%	44	28.4%		
	No formal Education	4	2.6%	41	26.4%		
Marital Status of Respondents	Cohabiting	2	1.3%	12	7.7%	48.458	0.000***
	Divorced	1	.6%	15	9.7%		
	Married	92	59.4%	64	41.3%		
	Never married	10	6.5%	0	0.0%		
	Separated	1	.6%	0	0.0%		
	Single	49	31.6%	51	32.9%		
	Widow	0	0.0%	13	8.4%		
Respondents' Place of Residence	Rural	49	31.6%	87	56.1%	18.916	0.000***
	Urban	106	68.4%	68	43.9%		
Any knowledge on HIV	No	5	3.2%	1	.6%	2.719	0.099
	Yes	150	96.8%	154	99.4%		
Age group first sex	Above 18	118	76.1%	117	75.5%	0.017	0.894
	Below 18 years	37	23.9%	38	24.5%		
Sex with multiple partners	No	79	51.0%	51	32.9%	10.386	0.001***
	Yes	76	49.0%	104	67.1%		
Condom Usage at all times	No	116	74.8%	151	97.4%	31.076	0.000***
	Yes	39	25.2%	4	2.6%		
Sex for money	No	141	91.0%	54	34.8%	104.632	0.000***
	Yes	14	9.0%	101	65.2%		

STI Infection other than HIV	No	96	61.9%	8	5.2%	112.053	0.000***
	Yes	59	38.1%	147	94.8%		
Alcohol and drugs status	No	63	40.6%	118	76.1%	40.162	0.000***
	Yes	92	59.4%	37	23.9%		
Awareness of places where sex is traded	No	141	91.0%	128	82.6%	4.75	0.029**
	Yes	14	9.0%	27	17.4%		
Access to place where sex is traded	No	153	98.7%	130	83.9%	21.461	0.000***
	Yes	2	1.3%	25	16.1%		
Awareness of places where alcohol and drugs are traded	No	136	87.7%	147	94.8%	4.909	0.027**
	Yes	19	12.3%	8	5.2%		
Access to place where alcohol/drugs traded	No	152	98.1%	146	94.2%	3.12	0.077
	Yes	3	1.9%	9	5.8%		
Traveling to other parts of the country	No	71	45.8%	105	67.7%	15.195	0.000***
	Yes	84	54.2%	50	32.3%		
Migration status	No	141	91.0%	126	81.3%	6.075	0.014**
	Yes	14	9.0%	29	18.7%		
Practice of polygamy marriage	No	153	98.7%	150	96.8%	4.501	0.051
	Yes	2	1.3%	5	3.2%		
Entertainment Status	No	98	63.2%	142	91.6%	35.723	0.000***
	Yes	57	36.8%	13	8.4%		

Source: Author's Field Survey, 2020, Significant level; 1% (***) and 5% (**)

Table 4b. Relationships/Associations between Demographics, Health, Social Behaviour and Biomedical Conditions with the Spread of HIV in Northern Region

Variables	**Responses**	**HIV Status**				**$\chi 2$**	**P-value**
		Negative		**Positive**			
		N	**%**	**N**	**%**		
Age Group of Respondents (Years)	15 - 19 (Younger)	8	30.8%	4	15.4%	10.488	0.015***
	20 - 24 (Middle)	17	65.4%	15	57.7%		
	25 - 29 (Older)	1	3.8%	7	26.9%		
Sex of Respondent	Female	23	88.5%	21	80.8%	0.59	0.442
	Male	3	11.5%	5	19.2%		
Occupational Status of Respondent	Full – Time	3	11.5%	5	19.2%	4.109	0.128
	Part – Time	0	0.0%	3	11.5%		
	Unemployed	23	88.5%	18	69.2%		
Educational Status of Respondent	University	4	15.4%	1	3.8%	5.827	0.323
	Senior high school	0	0.0%	1	3.8%		
	Junior high school	0	0.0%	2	7.7%		
	Primary school Education	3	11.5%	3	11.5%		
	No formal Education	19	73.1%	19	73.0%		
Marital Status of Respondents	Cohabiting	0	0.0%	1	3.8%	10.514	0.105
	Divorced	0	0.0%	4	15.4%		
	Married	22	84.6%	13	50.0%		
	Never married	2	7.7%	3	11.5%		

	Separated	0	0.0%	2	7.7%		
	Single	2	7.7%	2	7.7%		
	Widow	0	0.0%	1	3.8%		
Respondents' Place of Residence	Rural	26	100.0%	22	84.6%	4.333	0.037**
	Urban	0	0.0%	4	15.4%		
Any knowledge on HIV	No	1	3.8%	0	0.0%	1.019	0.313
	Yes	25	96.2%	26	100.0 %		
Age group first sex	Above 18	22	84.6%	19	73.1%	1.037	0.308
	below 18 years	4	15.4%	7	26.9%		
Sex with multiple partners	No	6	23.1%	2	7.7%	2.363	0.124
	Yes	20	76.9%	24	92.3%		
Condom Usage at all times	No	25	96.2%	25	96.2%	0.000	1.000
	Yes	1	3.8%	1	3.8%		
Sex for money	No	25	96.2%	20	76.9%	4.127	0.042**
	Yes	1	3.8%	6	23.1%		
STI Infection other than HIV	No	7	76.9%	8	30.8%	0.093	0.760
	Yes	19	23.1%	18	69.2%		
Alcohol and drugs status	No	25	96.2%	19	73.1%	5.318	0.021**
	Yes	1	3.8%	7	26.9%		
Awareness of places where sex is traded	No	24	92.3%	21	80.8%	3.143	0.092
	Yes	2	7.7%	5	19.2%		
Access to place where sex is traded	No	25	96.2%	24	92.3%	2.835	0.231
	Yes	1	3.8%	2	7.7%		
Awareness of places where alcohol and drugs are traded	No	0	0.0%	2	7.7%	2.080	0.149
	Yes	26	100.0%	24	92.3%		
Access to place where alcohol/drugs traded	No	5	19.2%	1	3.8%	3.014	0.083
	Yes	21	80.8%	25	96.2%		
Traveling to other parts of the country	No	12	46.2%	3	11.5%	7.589	0.006**
	Yes	14	53.8%	23	88.5%		
Practice of polygamy marriage	No	15	57.7%	8	30.7%	15.437	0.001***
	Yes	11	42.3%	18	69.3%		
Entertainment Status	No	26	100.0%	24	92.3%	6.088	0.054

Source: Author's Field Survey, 2020, Significant level; 1% (***) and 5% (**)

Discussion

Factors Influencing HIV Spread Among Adults in Ghana

Out of 21 independent variables, 13 were reported by the logistic regression model to be statistically significant at 1% and 5% level, thus influencing HIV spread among adults in Ghana. These include age, sex, marital status, having sex with multiple partners, condom usage at all times, sex for money, infected with sexually transmitted infection (STI), alcohol or drug addiction, awareness of places where sex is traded, awareness of drugs selling places, income level, access to places where sex is traded and migration status of respondents.

For instance, growing older increases the likelihood of HIV infection by 1.795 times the immediate young age group at 1% significance level, as also found by [28]. Education (both formal and informal), though was insignificant, reduces the likelihood of getting HIV by about

54.5% (AOR=0.515). This finding was in contrast to [29], who found a significant positive relationship between education and HIV status. Also, females were found to be about 4.443 times more likely to be affected by HIV than their male counterpart at the 5% significance level. This finding was almost the same as [19], who found females in Africa were about 3 to 4 times more likely to get HIV compared to males. Married respondents were about 79% (AOR=0.21) less likely to be effected with HIV at the 1% level of significance.

In terms of sexual practice among respondents, respondents who indicated they ever had sex with multiple partners were about 4.269 times more likely to be effected/spread HIV compared to those who indicated they were never involved in multiple sex partners. This difference was statistically significant at 5% and confirms the findings of [20, 30]. [11] were more straight in underscoring the fact that there would be no AIDS pandemic in the world if it were no multiple sexual partnerships. Respondents who indicated that they use condoms at all the time were found to be about 93.1% (AOR=0.069) less likely to be effected with HIV compared to those who do not practice frequent condom use. Respondents who engage in sex for money were found to be about 21.4 times (AOR=21.404) more likely to be infected with HIV than those who do not trade sex for money. This finding implies that, as one pursues money by offering themselves for sex, they are likely to have multiple sex partners, and therefore the likelihood of them being infected is high. This confirms the finding of [21].

Comparing the medical history of other STIs infections, respondents who reported of being previously effected with STIs where more likely, 7.135 times to be effected with HIV than those without STIs. The finding supported those of [22] who noted that HIV prevalence is reported to be higher among people with previous sexual transmitted infections. Non-alcohol users were also predicted at the 5% significant level to be 91.2% (AOR=0.082) less likely to have HIV as compared to alcohol addicts. This was consistent with [11] and means that drunkards are mostly exposed to unsolicited sex or sometimes turn to be indifferent on sexual demands under the influence of alcohol.

The level of income was found to be negatively related with the probability of one acquiring HIV. From the results, high-income earners were about 79.9% (AOR=0.201) less likely to acquire HIV as compared to low-income earners, this was consistent to [21, 23]. On the other hand, [9] reported that girls from low-income families in Africa are the most vulnerable to HIV infections as they turn to offer themselves for sex to raise money to attend school, buy goods and food to live on. Also, high-income earners could afford HIV preventive measures or afford a decent life without trading themselves for money. The results further revealed that migrants are about 10.6 (AOR=10.616) times more likely to spread HIV than those who do not travel. This finding was not surprising as travelers are often the reasons why viruses that are transmitted by human contacts gets to other places; confirming the statement that has been made by Ghanaian Health Authorities during the COVID 19 pandemic that “virus does not have legs; it is human beings that carry them”. This statement was used to restrict human movement in order to contain the virus and break the transmission of the Covid-19. This strategy, in essence, can be applied in reducing slams in the cities and ensure the safety of migrants and travelers and that they are not displaced and get into poor and risky behavioural practices that could spread HIV.

Difference in factors influencing HIV Spread among Adults in Ghana

We analysed how factors influence the spread of HIV in Ghana among adults and vary across the administrative regions. The results indicated that demographics, health, social behaviour, and biomedical conditions of respondents have varied effects on HIV status between Ahafo and the Northern region. Out of the 21 variables that

were analyzed, 11 were found to be statistically significant at 1% level for the Ahafo region, while only 6 variables were significant at 1% and 5% for the Northern region. For instance, while marital status was found to be associated with HIV spread in the Ahafo region, that was not so in the Northern region. Non-usage of condom was also a significant factor influencing the spread of HIV in the Ahafo region but insignificant for the northern region. Also, factors such as sexually transmitted infection (STI), alcohol or drug addiction, awareness of places where sex is traded, awareness of drugs/alcohol selling places, and access to a place of sex trade were all found to be significant in HIV spread in the Ahafo region but insignificant for the Northern region.

Factors that have the same influence on HIV spread for the two regions were the age of the respondents, having sex with multiple partners, income level of respondents, and their migration status. The practice of polygamy was the only factor the influence the spread of HIV in the Northern region but was found to be insignificant for the Ahafo region.

The mean total scores of the factors that were found to be statistically significant vary for the two regions. The Ahafo region recorded a mean total score of 1.52, while the Northern region recorded 0.52. This means that people living in Ahafo region were 100 times more likely to get HIV infection than those living in the Northern region. This proved the null hypothesis that stated that there was no significant difference in factors influencing the spread of HIV in the two regions wrong. We, therefore, accept the alternative that there is a difference in factors accounting for the spread of HIV infection of persons across administrative regions in Ghana.

In summary, the study found that the majority of HIV carriers had had sex with multiple partners and that the majority of HIV carriers had had sex for money before in the Ahafo region compared to Northern region. It was found that the majority of HIV carriers especially in the Northern region, are not alcoholic/drug addicts, aren't aware of any place where sex, alcohol, and drugs are traded in the Northern region, contrary to earlier reports by [31].

Demographics, Health, Social Behaviour and Biomedical Conditions influencing the Spread of HIV in Ahafo Region and Northern Region

To appraise the established factors influencing the spread of HIV in the two regions, these risk factors were analyzed from the perspectives of both cases and control groups. The results showed that while marital status significantly affects HIV status in the Ahafo region, 15% of HIV positives faced divorce as compared to 1% of HIV negative. For the Northern region, while 15.4% of HIV carriers faced divorce as compared to 0% of the non-carriers, marital status, in general, does not have a significant influence on HIV status. The findings indicated that previously married couples prior to HIV acquisition are more likely to be divorced compared to the same cohorts in the control group.

Also, 65.2% of HIV patients indicated they had sex for money as compared to only 9% of HIV negatives in the Ahafo region, while in the Northern region, 23.1% of HIV patients affirmed that they had sex for money compared to 3.8% of the control group. Generally, offering sex for money implies having with multiple partners and, therefore a high likelihood of contracting the virus. An inspection on the medical history of STIs other than HIV revealed that 69.2% of HIV carriers reported suffering from other STIs in the Northern region compared to a relatively larger percentage (73.1%) in the HIV negative cohorts. That of the Ahafo region showed that 94.8% of HIV patients reported of having other STIs compared to 38.1% of the non-carriers. Based on the exposure to STIs, the Ahafo region was seen to have a high risk of HIV infections and spread.

Recommendations to Address the Findings

From the analysis of the demographics, health, social behaviour and biomedical conditions associated with the spread of HIV and their variations across administrative regions, key risk factors such as sex with multiple partners, sex for money, attitude towards condom use, alcohol and drugs addiction, availability of places for commercial sex, income levels among others were the main drivers for the spread of HIV among adults in Ghana. As a result, measures should be tailored in addressing this social, behavioural characteristic exhibited by HIV carriers. This will lead to a reduction of the spread of HIV.

The study, therefore, recommends that the Ministry of Health should fill HIV programme implementation gaps and provide adequate information regarding HIV spread in the country. The Government of Ghana should create enough job opportunities so that people can get employed to satisfy their basic needs. Employment will reduce the tendency of engaging in sex for money which means having multiple sex partners, thus reducing the chance of spreading HIV. The display of alcoholic and other drug substances to the public should be regulated by the government to curb the number of people who consume alcohol and other drugs. Health workers should use the media (radio, TV, and other social media channels) to discourage the society from sex trade which is one key source of the spread of HIV infections in the country.

Conclusion

This study determined the demographics, health, social behaviour, and biomedical conditions associated with the spread of HIV and their variations across administrative regions among adults in Ghana. Two regions, Ahafo and Northern regions, were selected since they form the regions with the highest and lowest prevalence rates, respectively. The study Adopted a case-control study on 362 respondents (181 cases and 181 controls) where questionnaires were administered by HIV/AIDS trained counsellors.

The findings from the logistic regression model showed that age group of respondents, occupation, education, marital status, respondents' place of residence, sex with multiple partners, condom usage at all times, sex for money, alcohol, and drugs addiction status and awareness of places where sex is traded among other risk factors, significantly influence the spread of HIV in Ghana. These factors, however, were found to vary between the two regions used in the study. For instance, the Ahafo region recorded a total mean score of 1.52 while the Northern region recorded 0.52. This means that people living in the Ahafo region were 100 times more likely to get HIV infection than those living in the Northern region. Therefore, HIV programmes implementations should be pursued appropriately to address the spread of the virus in Ghana.

Conflict of Interests

The authors declare that they have no competing interests.

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Self-injected Depot–Medroxyprogesterone Acetate Subcutaneous (DMPA-SC) Uptake in Nigeria: A Paradigm Shift

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Abstract

Self-injection of DMPA-SC method is one of the Government of Nigeria's (GON) national family planning goals to address the unmet need for contraception. Some studies on DMPA-SC/SI have demonstrated its feasibility to improve modern contraceptive uptake. However, there is a gap in the predictors of method uptake and continuation across self-injecting and provider-administered in Nigeria. This study explored the uptake of self-injection DMPA-SC contraceptives among women in two geopolitical zones of Nigeria. The study employed 20 focused group discussions (FGDs) and 40 In-depth interviews (IDIs). Self-structured pretested questionnaire to elicit information from 844 women registered for Family Planning in selected health facilities. Descriptive statistics were calculated and multivariate logistic regression was used to model determinants of DMPA-SC/SI family planning uptake. Six months of Secondary Data from the Health Management Information system (HMIS) was used to triangulate the trends in uptake. About 97.6% reported ever heard DMPA-SC/SI family planning method; 78.4% reported its uptake; while 88.5% reported ever heard of self-injection as an option of family planning method. Data for each State showed a remarkable increase in uptake of DMPA-SC/SI. The motivations to use DMPA-SC/Self Injection were ease of accessibility, convenience, and self-administer/care. Factors that encourage the uptake of DMPA-SC/SI were; health benefits, the prevailing economic situation and its effectiveness. Findings from the study showed that interventions that deploy health education, awareness, social mobilization, advocacy, policy implementation, and public sensitization, making contraceptive services available for free, will increase the uptake of DMPA-SC/SI in the study areas.

Keywords: *Determinants, DMPA-SC/SI, Practice, Self-injection, Uptake.*

Introduction

In 2019, 1.1 billion of the 1.9 billion women of reproductive age (15–49 years) in the world have a need for family planning. 842 million people (44%) use natural method contraception, 80 million people use traditional contraception, and 190 million people use no contraception at all (10 percent) [1-2]. More than 208 million pregnancies occur each year worldwide, with 185 million occurring in developing countries alone. Almost one-fifth of all pregnant women in the world get an abortion or give birth to an unintended child [3]. Unintended pregnancies account for more than 40% of all pregnancies worldwide. In poor nations, an estimated 222 million women want to delay or stop having children but do not utilize contraception. In less-developed nations, an estimated 18 million unsafe abortions occur each year, resulting in high maternal deaths and injuries [4]. Unwanted birth also puts children's health and well-being

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in danger and contributes to rapid population expansion. One of the most important elements of safe parenthood and reproductive right is family planning [4].

In 2019, 75.7 percent of the global demand for family planning was addressed by contemporary technologies. According to Sustainable Development Goals (SDG) indicator 3.7.1, in Middle and Western Africa, less than half of the need was met [2]. The use of contraception advances the human right of people to determine the number and spacing of their children [1]. Variations in preference and pattern of usage of family planning strategies have been documented in some research. In Southeast Asia, the most prevalent contraceptive technique is the intrauterine device, which is used by 18.6% of women [1]. The pill and female condom are the most regularly used methods in Europe and Northern America (17.8% and 14.6 percent of women, respectively), whereas female sterilization and the pill are the most commonly used methods in Latin America and the Caribbean (16.0 and 14.9 percent, respectively) [1]. With a prevalence of 9.6% among women of reproductive age, Sub-Saharan Africa is the only region where injectables are the most common procedure [1].

In 2018, 17 percent of Nigerian women used all forms of contraception, and this was higher among sexually active single women (28 percent) than currently married women (12 percent). Despite the fact that married women now have more sexual exposure, all forms of contraceptive use have only increased modestly from 15% in 2013 to 17% in 2018, with the use of any modern method of contraception increased from 10% to 12% [5]. A three-year study of contraceptive use among women aged 15 to 52 in southwest Nigeria found that the majority (46.3%) chose the Jadelle implant, while Norplant (0.5%) was the least popular [6]. Married women were more likely to seek family planning methods in that study, with the motivating element being the increasing difficulty of raising children and the need to minimize family size [6]. Unintended pregnancy was found to be roughly 13 per 100 women during the first year after delivery, with well over three-quarters of these pregnancies occurring as a result of contraceptive product non-usage, inappropriate use, or failure. Delaying contraception until the first hospital visit or the sixth week after delivery increases the chances of unwanted pregnancy [7].

Modern family planning methods are a cost-effective strategy for minimizing high-risk pregnancies, unsafe abortions, and birth spacing and limitation [8-10]. In 2017, 214 million women had an unmet demand for modern family planning, despite advances in contraception technology and availability [11]. Progesterone-only contraceptives, such as injectable depot medroxy progesterone acetate (DMPA), are an extremely efficient means of contraception, particularly during the postpartum period. Each woman can choose her best option for preventing unwanted pregnancy by having access to a variety of contraceptive options. In Sub-Saharan Africa, injectable contraceptives, which provide three months of pregnancy protection, are a popular option. Self-injection of contraception is a new alternative that gives women more autonomy and control over when and if they want to have children while reducing the time and costs involved with quarterly clinic visits. Subcutaneous DMPA (DMPA-SC) is a new, simple-to-use injectable contraception that is especially suited for self-injection due to its design [12]. It is an intentional strategy of the Nigerian government's national family planning goals to address the unmet need for contraception, especially in hard-to-reach communities. It has the potential to be a game-changer in terms of increasing and scaling up DMPA-SC. DMPA-SC/SI has been demonstrated to improve contraceptive prevalence rates in studies. However, there is a gap in the predictors of method uptake and continuance across self-injecting and provider-

administered customers in Nigeria [13-15]. This study explored the uptake of self-injection DMPA-SC contraceptive among reproductive age women in Nigeria's South Western and North-Central geopolitical zones.

Materials and Methods

Study Settings

The study was conducted among women in two states each of Nigeria's South-West and North-Central geopolitical zones. There are six states (Niger, Kogi, Benue, Plateau, Nasarawa, and Kwara), including the Federal Capital Territory (FCT) in the North-Central geopolitical zone and in the southwest zone, there are equally six states, which are Ekiti, Ondo, Lagos, Osun, Ogun, and Oyo States. While the population of South West was put at 32.5 million people, that of North-Central is put at 45 million people. The study was conducted in two states from two geopolitical zones; North Central Niger and Plateau States and South-Western–Oyo and Lagos States [16].

Study Design

The study was a descriptive cross-sectional study conducted among 844 reproductive-aged (15 - 49 years) women residents in the four selected states. This study employed a mixed-method qualitative and quantitative design (Mixed-method approach; questionnaire-based, In-depth Interview, Focused Group Discussion). Data from the Health Management information system (HMIS) was used as Triangulation to substantiate the use of Self-injection.

Sample Size Calculation

Assuming a 50% DMPA-SC use in the study areas due to lack of reliable information, a z-score value of 1.96 for 95% confidence interval (CI), an error margin of 0.05, a non-response rate of 10% a, a minimum sample size of 844 was worked out using the Cochrane's [17] formula for a single proportion.

Sampling procedure

A multi-stage sampling procedure was used in selecting respondents for the study. In stage 1, we purposively selected two geopolitical zones, which are north-central and southwest. In stage 2, a simple random sampling technique was used to select two states in each of the geopolitical zones. In north-central, Niger and Plateau States were selected; while in the south west, Oyo and Lagos States were selected. In stage 3, the lists of all the LGAs in each of the selected States were obtained, out of which 50% of the LGAs were selected, ensuring an equitable percentage of half-drawn from urban and a half from rural. In stage 4, simple random sampling was used to select 10 Primary Healthcare Centres in each of the LGA. In the final stage, respondents were selected from the health facility register.

Inclusion/Exclusion Criteria

The eligibility criteria include women within the reproductive ages, 15-49 years, who were sexually active and mentally stable. We considered only women who were currently residing in the communities.

Research Instrument

Three research instruments were used for the study, and they are focused group discussion (FGDs); In-depth Interviews (IDIs), and structured questionnaires. The questionnaire was self-structured and was administered in the English language. The questionnaire elicited information on women's socio-economic characteristics; women's reproductive characteristics; awareness and practice of modern family planning, experience with self-injected DMPA-S, reasons for the use of self-injection, barriers to use of self-injection, negative influence to using DMPA-SC, what factors influence the use of DMPA-SC, what prompted women to take their last DMPA-SC, perception of quality of information given on DMPA-SC and description of the respondent experience of service delivery on DMPA-SC

attitude of healthcare workers to respondent. The questionnaire was pretested by administering it to 20 women in a health centre that was not included in the study. The questionnaire was administered through face-to-face interviews with respondents. However, where face-to-face contacts were not possible, mobile phones were used for data collection. The questionnaire was administered using an open data kit (ODK) in which the questionnaire called form was scripted into a computer and uploaded into a server. The completed forms were saved on the tablet and later uploaded into the server. The uploaded data were ready for error checking.

A total of 20 FGDs (5 per State) were held among women of reproductive age in the four states. Each of the FGDs lasted between 45 minutes and an hour, and an end was put to each of the discussions when no further issue was raised. Each of the discussions featured between 10 and 12 participants who share similar socio-economic characteristics. The numbers of participants were small enough to allow cordial conversation but large enough to allow divergent views [18]. The FGDs were held in Pidgin English and were recorded after permission was sought from participants.

Also, a total of 40 IDIs (10 per State) were conducted among family planning providers. IDIs lasted between 45 minutes and an hour. They were one-on-one interviews conducted with identified stakeholders and persons relevant to the focus of the research. Well-detailed FGDs and IDIs guides were used in conducting the interviews. The guides were structured to promote uniformity in the discussions. Some of the issues discussed in the FGDs and IDIs were the perception of women on DMPA-SC, the perception of the community on DMPA-SC, place of the utilization of DMPA-SC, motivation to use DMPA-SC, factors that encourage the use of DMPA-SC; internal and external triggers to use DMPA-SC and factors that influence the ability to demand for DMPA-SC and availability of the products in the health facilities. Both FGDs and IDIs were audiotaped using NVIVO 12.0. In addition to the recording; a research assistant took notes using a template.

Data Collection Procedure

Trained field research assistants were used in collecting the data five research assistants, which comprised 3 community resource persons and 2 other persons with B.Sc. Degrees in health-related disciplines were recruited for data collection. Research assistants were given training on the following areas: overview of family planning, explanation of the study goals and objectives, study locations-urban and rural LGAs, study data collection, and ethics in the field survey. Six months records Secondary data analysis of HMIS was used to determine the trends in self-injection.

Dependent Variable

The outcome indicator used in this study is the use of DMPA-SC. The outcome indicator is binary; hence women who reported uptake of DMPA-SC were coded 1, while those who reported otherwise were coded 0.

Independent Variables

For the dependent variable, we assessed the predictive value of several independent variables (covariate), which include maternal age, marital status, maternal education, occupation, place of residence, parity (number of children), number of children alive, desire for more children and geopolitical zones of residence were examined. Maternal age examined the current age of the respondents, and we considered the following age groups: <19; 20-29; 30-39 and ≥ 40 years. Marital status is considered the marital status of the respondents. We considered five marital categories which were married, single, separate, divorced, and widowed. Maternal education was considered the highest educational attainment of the respondents, and we considered the following groups: non-formal education, primary, secondary and tertiary

education. For occupation, the following categories were examined: housewife, artisan, farming, civil servant, trading, and student. Place of residence categorized the women into rural and urban. Parity examined the number of children which the woman had given birth to ever, and the following categories were considered: none, 1-3, 4-6, and ≥ 7. The number of children alive is considered the actual number of children alive out of the number of children to which the woman has given birth to. We considered the following categories: none, 1-3, 4-6, and ≥ 7. A desire for more children considered whether the woman desires more children or not. Those who desire more children were coded one while otherwise coded 0. The geopolitical zone categorized the women into South West and North Central. These variables were used by past studies that examined the determinants of family planning in Nigeria and elsewhere [19-25].

Statistical Analysis

Descriptive statistics were used to analyze the categorical and continuous variables of the socio-economic characteristics of women of reproductive age. Cross-tabulation analysis was conducted to establish the association between dependent variables and selected independent variables. The Chi-square test was used to set variables that were statistically significant at 5%. The binary logistic regression was used to examine determinants of DMPA-SC/SI uptake among the women. Audio-taped voices were transcribed verbatim. Important themes related to the discussion were highlighted. Recorded voices were reported using translated quotations, which were denoted using brackets. The literal translation gave credibility to the reports. The In-depth Interview (IDIs) and Focus Group discussions were subjected to descriptive and inferential statistics using NVIVO version 12. Quantitative data collected was analyzed using IBM Statistical Package for Service Solution (SPSS) Version 26.

Ethical Clearance and Approval

Approval to conduct the study was obtained from the Nigerian Health Research Ethics Committee in line with the established guidelines of the Federal Ministry of Health. Approval was sought from the health facilities where the study was conducted. Informed consent was obtained from individual participants, having provided detailed information about the survey to them.

Results

The respondents comprise of women between the ages of nineteen and forty-nine years. However, the majority of them, 689 (81.6%) were women of age 20 – 39 years. Most of the respondents, 718 (85.1%), were married women, about three quarter 73.9% of them had at least secondary level of education, 355 (42.2%) were traders, while 385 (45.6%) were rural dwellers. More so, 456 (54.0%) were from the southwestern part of Nigeria, while 388 (46.0%) were from the northcentral part. About half 418 (49.5%) of the women had 1 -3 children, while about the same number of women still desire more children (Table 1a, Table 1b).

Table 1a. Socio-demographic Characteristics of the Respondents

Variables	Frequency (n = 844)	Percent
Age (years)		
≤19	18	2.1
20-29	341	40.4
30-39	348	41.3
≥40	137	16.2
Marital status		

Married	718	85.1
Single	80	9.5
Separated	22	2.6
Divorced	11	1.3
Widowed	13	1.5
Highest educational level		
None	81	9.6
Primary	139	16.5
Secondary	400	47.4
Tertiary	224	26.5
Occupation		
Housewife	93	11.0
Artisan	108	12.8
Farmer	76	9.0
Civil Servant	133	15.7
Trading	355	42.1
Student	79	9.4
Type of residence		
Rural	385	45.6
Urban	459	54.4
State of residence		
Lagos	252	29.8
Oyo	204	24.2
Niger	185	21.9
Plateau	203	24.1

Table 1b. Socio-demographic Characteristics Continued

Variables	**Frequency (n = 844)**	**Percent**
Geopolitical zone of residence		
Southwestern	456	54.0
Northcentral	388	46.0
LGA of residence		
Epe	118	14.0
Ifako Ijaiye	134	15.9
IBNE	126	14.9
Ido	78	9.2
Bassa	83	9.8
Jos South	119	14.1
Bosso	101	12.0
Tafa	85	10.1
Parity (number of children)		
None	63	7.5
1-3.	418	49.5
4-6.	314	37.2
≥7	49	5.8

Number of children alive		
None	63	7.5
1-3.	455	53.9
4-6.	301	35.7
≥7	25	3
Desire for more children		
No	425	50.4
Yes	419	49.6

An overwhelming majority, 824 (97.6%) of the respondents, have heard the term Depot Medroxyl Progesterone Acetate Subcutaneous (DMPA-SC). Seven hundred and forty-seven (88.5%) of the respondents have heard about self-injection as an option of family planning methods. Six hundred and sixty-two (78.4%) are using DMPA-SC/SI. Over a half (53.5%) of the respondents have never self-injected DMPA-SC/SI, with fear of self-injecting 31.7%, fear of needle/injection 21.2% and no knowledge of how to self-inject 14.4%, dominating the reasons these women have never administered the DMPA-SC/SI family planning method themselves. A vast majority, 462 (74.5%) of the respondents, have been using the DMPA-SC/SI method of family planning for the past 12 months. Those who have not been using DMPA-SC/SI for over three months cited the unavailability of the products (38.8%) and desire for pregnancy and childbirth (24.1%) as the major reasons they have not been using the product (Table 2).

Table 2. Awareness and Uptake of DMPA-SC among Respondents

Variables	**Frequency**	**Percent**
Ever heard of DMPA-SC (n = 844)		
Yes	824	97.6
No	20	2.4
Ever heard of self-injection (SI) as option of FP (n = 844)		
Yes	747	88.5
No	97	11.5
Uptake of DMPA-SC (n = 844)		
Yes	662	78.4
No	182	21.6
Ever Self-Injected DMPA-SC (n = 662)		
Yes	308	46.5
No	354	53.5
Reasons for never self-injected* (n = 354)		
Fear of self-injecting	112	31.7
Fear of needle/injection	75	21.2
I do not know how to do it	51	14.4
I do not know I can self-inject	43	12.1
Fear of not doing it right	43	12.1
It is safer for someone to inject me	30	8.5
Duration of using DMPA-SC/SI (n = 662)		
<6 months	273	41.2
6-11 months	231	34.9

≥12 months	158	23.9
Non-use of DMPA-SC/SI for more than 3 months (n = 662)		
Yes	546	82.5
No	116	17.5
Reasons for non-use for more than 3 months (n = 116)		
Unavailability of DMPA-SC/SI at health facility	45	38.8
Desire for pregnancy and to have more children	28	24.1
No reason for non-use	17	14.7
I changed method	15	12.9
Husband is not available	11	9.5

*Multiple Responses

The most mentioned factors the influence the use of DMPA-SC was the health benefits 45.0%, and financial implications were other factors that positively influenced respondents to using DMPA-SC. A majority (69.6%) of respondents were reminded to take their last DMPA-SC/SI by their appointment cards, 14.0% were reminded by phone calls from a health worker, while 2.7% took their last jab of DMPA-SC/SI through the help of text message from the health facility. Easy-to-use, effective and free family planning products were the most mentioned motivating factors to women's use of DMPA-SC/SI family planning method 207 (31.1%). Child spacing 15.5% and enlightenment 11.8% were other factors that motivated the respondents to use DMPA-SC/SI family planning. The majority of study participants believed that health education, awareness creation and social mobilization (46.5%), and advocacy, policy implementation, and public sensitization (33.4%), can help to encourage women to continue using a DMPA-SC/SI family planning method. Spousal/partners' encouragement (50.0%) was the most mentioned factor that made it easy for the respondent to initiate DMPA-SC/SI uptake. Other factors mentioned were ability to self-administer (19.0%), cost and availability of DMPA-SC/SI (13.3%), proximity to health facility (11.5%), and self-interest (6.2%) (Table 3).

Table 3. Factors Influencing DMPA-SC/SI Uptake among Respondents

Factors	**Frequency (n = 662)**	**Percent**
Influence to DMPA-SC /SI use		
The health benefits	298	45.0
The Financial implications	153	23.1
Encouragement from family and friends	118	17.9
The effectiveness, safety and availability of the products	73	11.0
Proximity of community Providers	20	3.0
Benefits associated with Self-injection		
It is easy to use and self-administered	278	42.0
It is safe and dependable	135	20.4
It helps in child spacing an d prevention of unwanted pregnancy	116	17.5
It is available, accessible and affordable	75	11.3
It is provided free of charge	58	8.8
Reminder to take DMPA-SC/SI		
Appointment card	461	69.6
Phone calls from health worker	93	14.0

Phone reminder (alarm)	54	8.2
Spousal encouragement/reminder	36	5.4
Text message from health facility	18	2.7
The motivators to use DMPA-SC/SI FP methods		
The product is free, easy to use and effective	207	31.1
Child spacing	173	26.1
Availability of the product	105	15.5
Enlightenment	78	11.8
Economic situation of the country	47	7.1
Spousal encouragement	35	5.3
Attitude of health workers	17	2.6
What can be done to encourage women to continue using DMPA-SC/SI		
Health education, awareness creation and social mobilization	308	46.5
Advocacy, policy implementation and public sensitization	221	33.4
Making products available and accessible	83	12.5
Provision of the products free for women	50	7.6
Why it easy for respondent initiating the use of DMPA-SC/SI method		
Spousal/partner encouragement	331	50.0
Ability to self-administer	126	19.0
Cost of method	88	13.3
Proximity to health facility	76	11.5
Self interest	41	6.2

From the Focus Group Discussions (FGDs) and In-Depth Interviews (IDIs) on the influence, benefits, and motivators of DMPA-SC/SI family planning uptake, the following information was gathered from the participants.

Influencers to DMPA-SC/SI Uptake

From the FGDs and IDIs, it was gathered that there are some factors that serve influence on respondents who reported they use of self-injectable DMPA-SC contraceptive. Prominent among the factors were health benefits, the country's economic situation, financial implications involved in raising children, and the effectiveness, safety, and availability of the products whenever they need it. Some of the participants in the IDIs and FGDs has these to say:

"Mostly what motivates our women here is suffering. They are suffering a lot, the men are not taking good care of them, so if a woman just gives birth to one child and she sees the condition she is facing in that house, she will decide and contact her husband for family planning, and at times, all of them agree, and they would come to the clinic together, and sometimes the woman will come, and she will say that they have agreed with her husband because of their condition, they want to rest first" **IDI Plateau.**

"We see that there is need for children to have good food, to have a good education and then to have good health care, so that is why we encourage them so that they will use the family planning, in order for them to be able to take good care of their children" **IDI Plateau.**

"One has to do family planning because, one should not have children intermittently, and they will start looking like twins. If you are taking one derica of rice before when children are too much, how will one get food to eat. So, one has to plan. Not even this period that everywhere is dry" **FGD Lagos.**

"It is effective, no complain of bleeding, and it reduce the number of visit of clients" **IDI Oyo.**

"When I was using the implant, access to the commodity was a problem because you have to go to and queue and wait you have to also pay, but this DMPA SC is easy because it does not take time and it does not waste time" **FGD Plateau.**

"It is easy, and its complication are less, women complain about it less unlike the pills that you can forget, the loop you will bleed other are headache and what have you, in the ratio of women in the community of women using family planning method is the least women complain about its complications" **FGD Plateau.**

"I think the only thing that makes them use it is that by the time they plan their family, they will be at rest, there will not be issue of unwanted pregnancy, they will enjoy their husband, and they will enjoy their wife. I think that is one of the things that make them to turn out" **IDI Oyo.**

"My husband encourages me" **IDI Oyo.**

"The cost…it is cost-effective; it is free, so, there's no money attached to it. Then the proximity too is one of it. but probably because of the self-injection" **IDI Lagos.**

"My ideal family planning method will be implant. Although, it's okay with all other methods, but because I can just take a method and disappear for five years except, I have complaints, it makes it easy for me. And for Sayana press or DMPA-SC, if I'm educated on self-injection, and I'm given two, three unijects to take home, it also encourages me to stay on that method because I can take three and for the next nine months, I won't have to leave my job to go to any facility to go and take" **IDI Lagos.**

"Firstly, family planning protects life. It prolongs a woman's life. Because this maternal and child health problem that we used to face during childbirth, it affects our lives, we die on time because we do not plan well, but if we plan well, unwanted pregnancy would not occur, and at times when we are taking it, it makes us strong and healthy to prepare ourself for another baby that is coming" **IDI Plateau.**

"FP has a lot of benefits. If we leave a gap between one child and the other, you know we will have time to plan for the unborn child to save enough to plan ahead and the one on the ground we would have time to properly take care of him/her" **IDI Oyo.**

"My husband is very pleased with this one because I was on another family planning method, but I was not enjoying it at all, but this one (DMPA-SC) is very okay for me. I'm enjoying it; even my husband likes it" **FGD Plateau.**

"It is even the husband that said the wife should go and collect it that food stuffs is now expensive, school fees is now expensive" **FGD Oyo.**

My husband consented because I using Noristerate, but I was bleeding, so I stopped so when i was ready my husband said we should go together so that we will hear and we will be given lectures, so they agree and we went together" **FGD Plateau.**

Analysis

The bivariate analysis of women uptake of DMPA-SC/SI, in association with socio-demographic and some reproductive health characteristics, shows that respondents' age, marital status, the highest level of education, occupation, type of residence, and State of residence were statistically significantly associated with uptake of DMPA-SC/SI, among the studied population. The age of respondents shows that an increase in age has a corresponding increase in the use of DMPA-SC/SI, especially from the age of 20 upwards. The majority of respondents (92.3%) who were widows were users of DMPA-SC/SI much more than those who are single (57.5%). Though education was found to be statistically significant (< 0.001) in association with DMPA-SC/SI uptake, there were no much difference between those who had tertiary level of education and those who had primary level. A higher proportion of respondents from the urban areas (93.9%) and those from the north-

central zone (Plateau, 100.0% and Niger, (82.7%) respectively had higher uptake of DMPA-SC/SI than their counterparts from the rural areas and southwestern zone of Nigeria. The association between type of residence and State of residence was statistically significant (<0.001) (Table 4a).

Table 4a. Socio-demographic Characteristics of the Respondents and Uptake of DMPA-SC/SI

	Uptake of DMPA-SC/SI		
Variables	**Uptake (n = 662)**	**Not Uptake (n = 182)**	**p-value/χ2**
Age (years)			
≤19	13 (72.2)	5 (27.8)	< **0.001**
20-29	242 (71.0)	99 (29.0)	22.461
30-39	286 (82.2)	62 (17.8)	
≥40	121 (88.3)	16 (11.7)	
Marital status			
Married	580 (80.8)	138 (19.2)	< **0.001**
Single	46 (57.5)	34 (42.5)	25.179
Separated	16 (72.7)	6 (27.3)	
Divorced	8 (72.7)	3 (27.3)	
Widowed	12 (92.3)	1 (7.7)	
Highest educational level			
None	57 (70.4)	24 (29.6)	**0.002**
Primary	118 (84.9)	21 (15.1)	14.876
Secondary	298 (74.5)	102 (25.5)	
Tertiary	189 (84.4)	35 (15.6)	
Occupation			
Housewife	74 (79.6)	19 (20.4)	< **0.001**
Artisan	89 (82.4)	19 (17.6)	53.198
Farmer	48 (63.2)	28 (36.8)	
Civil Servant	119 (89.5)	14 (10.5)	
Trading	290 (81.7)	65 (18.3)	
Student	42 (53.2)	37 (46.8)	
Type of residence			
Rural	231 (60.0)	154 (40.0)	< **0.001**
Urban	431 (93.9)	28 (6.1)	142.259
State of residence			
Lagos	150 (59.5)	102 (40.5)	< **0.001**
Oyo	156 (76.5)	48 (23.5)	111.556
Niger	153 (82.7)	32 (17.3)	
Plateau	203 (100.0)	0 (0.0)	

χ2; Chi-Square

The Figure 1 shows that among the respondents who have used modern contraceptives, 74.8 percent of them are using DMPA-SC/SI in the surveyed areas.

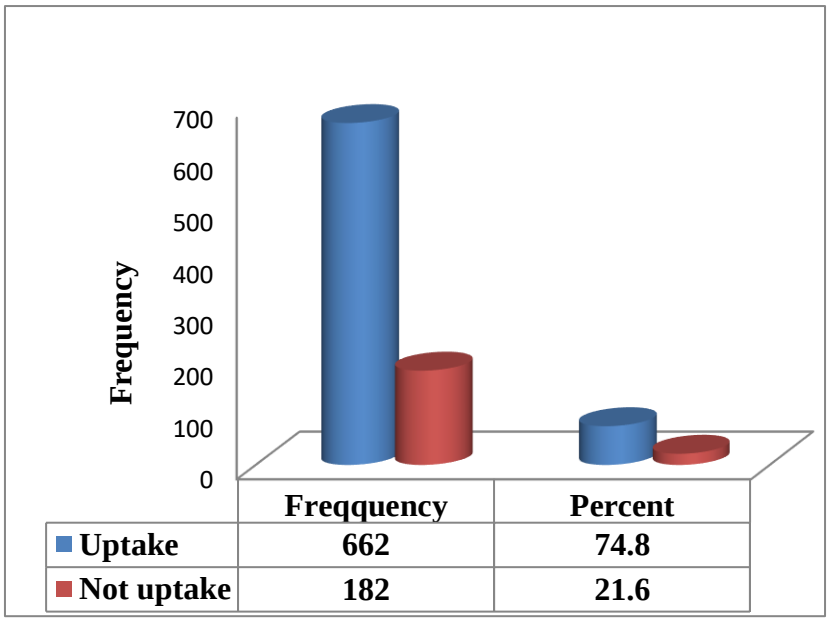

Figure 1. Uptake of DMPA-SC/SI among Respondents

Respondents' geopolitical zones, the local government of residence, parity, number of living children, desire for more children, awareness of modern contraceptive, DMPA-SC/SI, and self-injection were all statistically significantly associated with uptake of DMPA-SC/SI (<0.001). A higher proportion of respondents from the north-central states and local government areas had higher uptake of DMPA-SC/SI when compared with their southwestern counterparts. Awareness of DMPA-SC/SI, modern family planning, and self-injection provided the respondent a higher opportunity for a higher uptake of DMPA-SC/SI among the study participant. The association between geopolitical zones, local government, parity, number of living children, awareness of modern contraceptives, DMPA-SC/SI, and self-injection was statistically significant (p <0.001) (Table 4b).

Table 4b. Socio-demographic Characteristics of the Respondents and Uptake of DMPA-SC/SI Continued

Uptake of DMPA-SC/SI			
Variables	**Uptake (n = 662)**	**No Uptake (n = 182)**	**p-value/χ2**
Geopolitical zone of residence			
Southwestern	306 (67.1)	150 (32.9)	< **0.001**
Northcentral	356 (91.8)	32 (8.2)	75.292
LGA of residence			
Epe	19 (16.1)	99 (83.9)	< **0.001**
Ifako Ijaiye	131 (97.8)	3 (2.2)	388.786
IBNE	111 (88.1)	15 (11.9)	
Ido	45 (57.7)	33 (42.3)	
Bassa	83 (100.0)	0 (0.0)	
Jos South	119 (100.0)	0 (0.0)	
Bosso	89 (88.1)	12 (11.9)	
Tafa	65 (76.5)	20 (23.5)	
Parity (number of children)			
None	29 (46.0)	34 (54.0)	< **0.001**
1-3.	335 (80.1)	83 (19.9)	42.913

4-6.	259 (82.5)	55 (17.5)	
≥7	39 (79.6)	10 (20.4)	
Number of children alive			
None	29 (46.0)	34 (54.0)	< **0.001**
1-3.	372 (81.8)	83 (18.2)	43.630
4-6.	243 (80.7)	58 (19.3)	
≥7	18 (72.0)	7 (28.0)	
Desire for more children			
Yes	345 (82.3)	74 (17.7)	**0.007**
No	317(74.6)	108 (25.4)	7.494
Ever heard of modern FP			
Yes	658 (87.2)	97 (12.8)	< **0.001**
No	4 (4.5)	85 (95.5)	321.602
Ever heard of DMPA-SC/SI			
Yes	662 (80.3)	162 (19.7)	< **0.001**
No	0 (0.0)	20 (100.0)	74.513
Ever heard of self-injection as a FP			
Yes	622 (83.3)	125 (16.7)	< **0.001**
No	40 (41.2)	57 (58.8)	89.662

$\chi 2$; Chi-Square

Respondents who were between the ages of 20 – 29 years were found to be statistically significantly less likely to uptake DMPA-SC/SI when compare with those who were 40 years and above (AOR, 0.42; 95% CI, 0.23-0.77; P = 0.005). Those who had no educational level as well as those who had secondary level of education were found to be statistically significantly less likely to have DMPA-SC/SI uptake when compared with those with tertiary level of education (AOR, 0.30 95% CI, 0.16-0.56; p <0.001) and (AOR, 0.46; 95% CI, 0.29-0.74; p = 0.001) respectively. Those who are artisans, civil servants, and traders were about 4 times, 6 times and 4 times statistically significantly more likely to uptake DMPA-SC/SI family planning method when compared with those who were students (AOR, 3.77; 95% CI, 1.54-9.18; p < 0.004), (AOR, 6.07; 95% CI, 2.30-16.02; p <0.001) and (AOR, 4.05; 95% CI, 1.88-8.72; p < 0.001) respectively. Respondents from the rural areas were statistically significantly less likely to uptake or use DMPA-SC/SI when compared with those from the urban areas (AOR, 0.08; 95% CI, 0.05-0.14; p <0.001) (Table 5a).

Table 5a. Predictors of Uptake of DMPA-SC/SI among Respondents

Uptake of DMPA-SC/SI			
Variables	**Regression coefficient**	**AOR (95% CI)**	**p-value**
Age (years)			
≤19	-0.440	0.633 (0.19-2.20)	0.482
20-29	-0.861	0.42 (0.23-0.77)	**0.005**
30-39	-0.415	0.66 (0.36-1.20)	0.175
≥40		1	
Marital status			
Married	-0.697	0.50 (0.06-3.96)	0.510
Single	-1.842	0.16 (0.02-1.33)	0.090

Separated	-1.131	0.32 (0.03-3.15)	0.330
Divorced	-0.832	0.44 (0.04-5.18)	0.510
Widowed		1	
Highest educational level			
None	-1.217	0.30 (0.16-0.56)	**<0.001**
Primary	-0.309	0.73 (0.39-1.37)	0.333
Secondary	-0.771	0.46 (0.29-0.74)	**0.001**
Tertiary		1	
Occupation			
Housewife	-0.216	0.81 (0.27-2.42)	0.701
Artisan	1.326	3.77 (1.54-9.18)	**0.004**
Farmer	0.498	1.65 (0.61-4.48)	0.329
Civil Servant	1.804	6.07 (2.30-16.02)	**<0.001**
Trading	1.399	4.05 (1.88-8.72)	**<0.001**
Student		1	
Type of residence			
Rural	-2.496	0.08 (0.05-0.14)	**<0.001**
Urban		1	
Geopolitical zone of residence			
Southwestern	-0.221	0.801 (0.36-1.76)	0.582
Northcentral		1	

Respondents who were resident in Epe and Ifako Ijaiye local government areas of Lagos State, southwest geopolitical zone were found to be statistically significantly less likely and about 19 times more likely, respectively, to use or have an uptake of DMPA-SC/SI when compare with those from Tafa in Niger State north central geopolitical zone (AOR, 0.08; 95% CI, 0.04-0.10; p <0.001) and (AOR, 19.39; 95% CI, 5.46-68.91; p <0.001). Those who are resident in Ibadan North-East local government area of Oyo State and those living in Bosso local government area of Niger State were about 3 and 2 times respectively, statistically significantly more likely to have DMPA-SC/SI uptake when compared with those residents in Tafa (AOR, 3.06 95% CI, 0.16-0.56; p = 0.005) and (AOR, 2.36 95% CI, 1.08-5.19; p = 0.032). Respondents who had no child or any living child are statistically significantly less likely to make use of DMPA-SC/SI when compared with those who have at least 7 children (AOR, 0.26 95% CI, 0.07-0.93; p = 0.038) and (AOR, 0.03; 95% CI, 0.01-0.21; p < 0.001) respectively. Respondents who have never heard about self-injection were statistically significantly less likely to uptake or use DMPA-SC/SI when compared with those who have heard (AOR, 0.01; 95% CI, 0.00-0.01; p < 0.001) (Table 5b).

Table 5b. Predictors of Uptake of DMPA-SC/SI among Respondents Continued

Uptake of DMPA-SC/SI			
Variables	**Regression coefficient**	**AOR (95% CI)**	**p-value**
LGA of residence			
Epe	-2.505	0.08 (0.04-0.18)	**<0.001**
Ifako Ijaiye	2.965	19.39 (5.46-68.91)	**<0.001**
IBNE	1.118	3.06 (1.39-6.72)	**0.005**
Ido	NA	NA	NA

Bassa	20.170	0	0.996
Jos South	20.122	0	0.996
Bosso	0.860	2.36 (1.08-5.19)	**0.032**
Tafa		1	
Parity (number of children)			
None	-1.346	0.26 (0.07-0.93)	**0.038**
1-3.	0.125	1.13 (0.40-3.19)	0.812
4-6.	0.209	1.23 (0.44-3.49)	0.694
≥7		1	
Number of children alive			
None	-3.56	0.03 (0.01-0.21)	**<0.001**
1-3.	-1.85	0.16 (0.02-1.05)	0.056
4-6.	-1.47	0.23 (0.04-1.51)	0.125
≥7		1	()
Desire for more children			
No	0.147	1.16 (0.69-1.95)	0.580
Yes		1	
Ever heard of modern FP			
No	-5.530	0.01(0.00-0.01)	**<0.001**
Yes		1	
Ever heard of self-injection as a FP			
No	0.430	1.54 (0.32-7.51)	0.595
Yes		1	

The below Figure 2 showed an upward trend in the utilization of DMPA-SC in the 4 study sites from November 2020 to January 2021 followed by a sharp decline in March 2021. This was largely due to the national stock-out of DMPA-SC units. Following the resupply of the commodity to the states, there was an upward increase of 139% (18,100) in April 2021 from the utilization of the previous month (7,564).

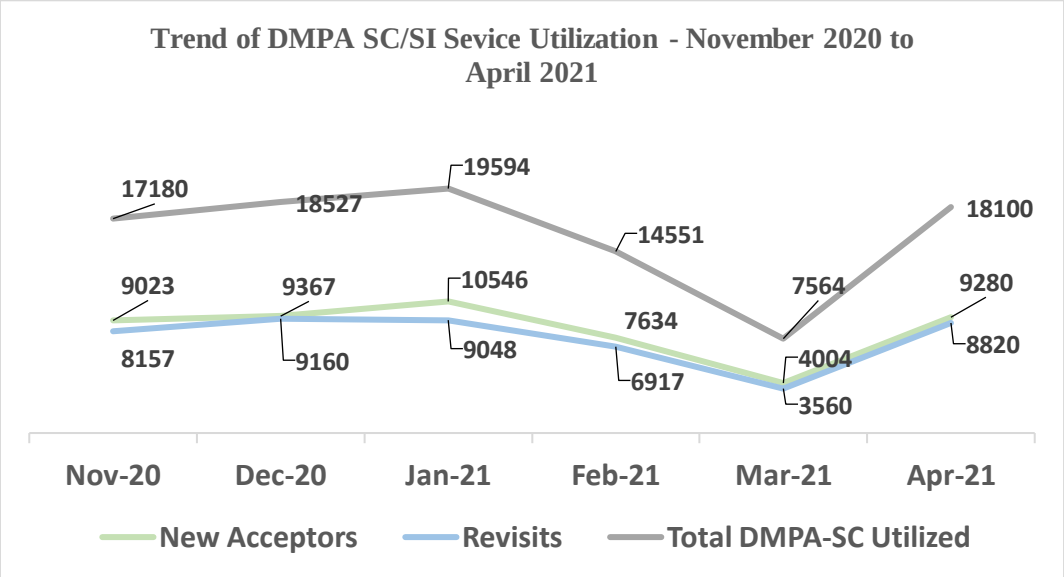

Figure 2. Trend of Service Utilization – November 2020 to April 2021

Source: Secondary Data-HMIS from 4 study states: Six months trends in uptake

The contribution of new users of DMPA-SC to the total new users of family planning in the 4 states was 21.2% (table 6 above). This implies that 1 in 5 Women of Reproductive Age (WRA) will choose DMPA-SC as a family planning method among the broader family planning method mix. Among the 4 study sites, Niger state has the highest contribution of new users of DMPA-SC (32.7%) among the total new users of family planning methods in the State followed by Plateau state (29.7%), Oyo state (21.6%), and Lagos state (11.4%) (Table 6).

Table 6. Percentage Contribution of New Acceptors of DMPA-SC to Total New Acceptors of other Family Planning methods combined

States	Contribution
Lagos	11.4%
Oyo	21.6%
Niger	32.7%
Plateau	29.7%
Summary	**21.2%**

Source: Secondary Data-HMIS from 4 study states: Six months trends in uptake

Figure 3 below depicts the approaches in the delivery of DMPA-SC and self-injection. Community providers – CORPs – contributed more to self-injection uptake (62%) than their facility counterpart (37%). This suggests direct-to-client access at the community level holds greater promise than facility channels in closing the access gap, averting thousands of unplanned pregnancies, and addressing the unmet need for FP.

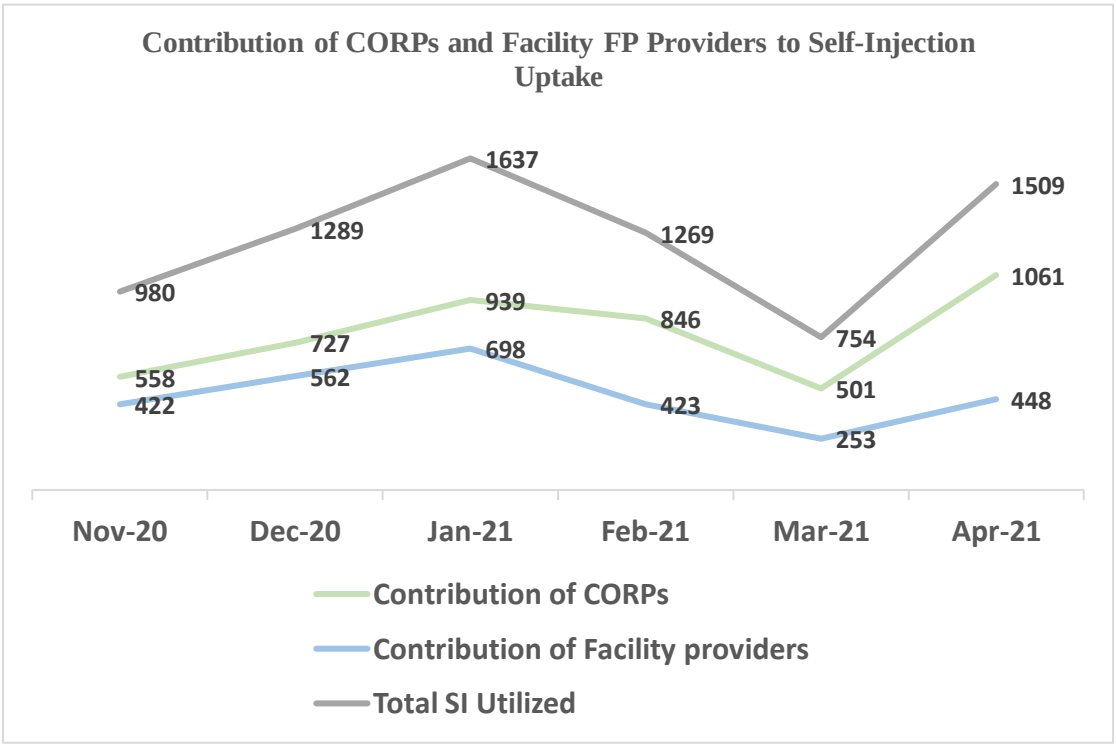

Figure 3. Percentage Contribution of Cadres of Service Providers to Self-injection Uptake

Source: Secondary Data-HMIS from 4 study states: Six months trends in uptake

Figure 4 below shows that among the respondents who have used modern contraceptives, 74.8 percent of them are using DMPA-SC/SI in the surveyed areas.

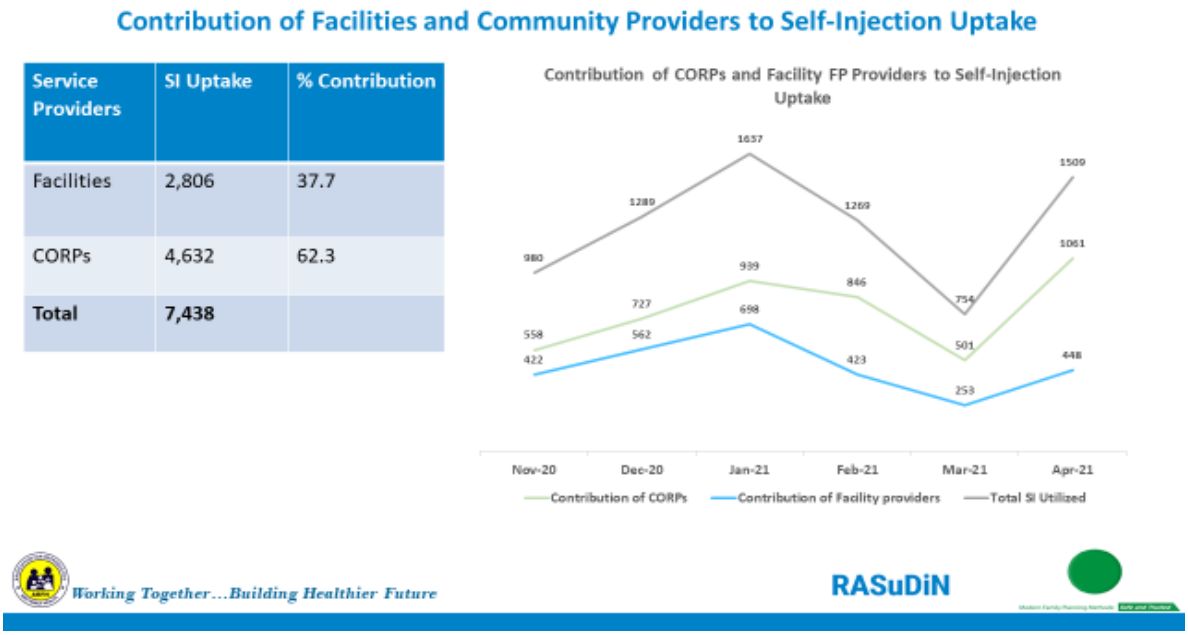

Figure. 4. Secondary Data from HMIS in Four study sites-November 2020 – April 2021

Source: Secondary Data-HMIS from 4 study states: Six months trends in uptake

Discussion

This study explored the uptake of Depot Medroxyl -Progesterone –Acetate-Subcutaneous/Self Injection (DMPA-SC/SI) among women in two geopolitical zones of Nigeria. The study was conducted in two selected states from the southwestern geopolitical zone of Nigeria (Lagos and Oyo States) and two selected states of north-central geopolitical zone (Niger and Plateau States). The respondents were made up of mostly women at the middle of their reproductive age, 20 – 39 years, constituting about 82% of the total population of the study participants. There are not many differences in the socio-demographic characteristics of the women in terms of their type of residence (whether urban or rural dwellers). The average age of 31.4 ± 6.9 was observed among the respondents in this study. This mean age is similar to prior Nigerian studies [26-27]. This could indicate that DMPA-SC is most commonly used for terminal contraception by women who have reached the end of their reproductive careers and want to stop having children [26]. This is not surprising given that the surgical method of contraception is not widely accepted by women in this society for cultural and religious reasons [4].

According to current scientific evidence, DMPA use has risen dramatically in Sub-Saharan Africa, and it is quickly becoming the most widely used modern method of contraception in many health facilities and reproductive and family health centers in Nigeria [26]. Also, the overwhelming majority 97.6% of the study participants was aware of the Depot Medroxyprogesterone Acetate Subcutaneous (DMPA-SC) contraceptive method, and self-injection, 88.5%. Generally, this study demonstrated that the level of knowledge of contraceptive methods is predicated upon the socio-demographic and socio-economic characteristics of the study participants. The FGD and IDI conducted among women in the two geopolitical zones also corroborated with the quantitative results regarding awareness of DMPA-SC/SI contraceptive methods. Participants from the northern region of the country seem to be more in the know of the DMPA-SC/SI family planning method compared to their southern

counterparts. This is noticed in both the FGDs and IDIs as DMPA-SC/SI family planning methods was mentioned among the northern participants than their counterparts in the south. The high awareness of DMPA-SC/SI observed from the qualitative and quantitative studies may still be due to the aggressive campaign embarked by many local non-governmental organizations to help in the unmet need rampant in the northern region of the country. It must also be noted that when DKT in collaboration with the federal government, introduced the DMPA-SC/SI some years ago, the northern region of the country was a major focus. The majority of the women have never self-injected themselves though over three-quarters of them are using the product. Fear of self-injecting was the most reason given by those who do not self-inject as the reason they have never self-injected themselves. Some of the respondents who have been using DMPA-SC/SI reported that they have stopped and the major reason for halting their uptake was among others, unavailability of DMPA-SC/SI at health facility and desire for pregnancy and to have more children.

Numerous factors were determinants of uptake of DMPA-SC/SI among the women respondents. Among these factors are those that influence them, which include health benefits associated with the use of contraceptive products, the prevailing economic situation in the country, encouragement they receive from their friends and members of their families. Other influencers are the availability, affordability, accessibility of the DMPA-SC/SI and the ease with which it is administered. When these women consider that often, DMPA-SC/SI is provided for then without cost, the education or enlightenment, and the encouragement and support they receive from their husbands, they are motivated to obtain DMPA-SC/SI. It, therefore, infers that that women empowerment through awareness creation, enhancement of husband's or partner's support, public mobilization and sensitization, economic and financial empowerment, and positive peer influence can bring an increase in the DMPA-SC/SI contraceptive or family planning method. To this end, an improvement on women's knowledge of contraceptives and granting them decision-making autonomy to decide about their health and that of their child are major factors that need urgent consideration by policy makers and implementers in the area of reproductive and family health. Health-related programs that focus in the provision of population-moderation benefits to a wide range of the societal sub-groups, especially the most vulnerable, are key to improving the health of women in general [18]. The consideration of financial implication in acquiring a family planning method by the study participants suggests that underprivileged women such as those financially incapacitated and those from strictly patriarchal societies will be prejudiced on the consequences of such inability of being unable to provide herself with contraceptives. These financial incapacitations could be indirect and direct costs, including travelling cost to a health facility for family planning method, the amount of time spent in facility visit, or cost of getting the needed health care service or acquiring family planning commodities [28, 29].

Though various factors were discovered to impact the uptake of DMPA-SC/SI by the study participants, there were significant differences in the motivational and enabling factors that influenced usage. Understanding the benefits of contraceptive use, sensitization/awareness creation, lack of adverse effects, financial hardships, and accessibility to contraceptive services, whether geographical or financial, was found to have a significant impact on DMPA-SC/SI contraceptive uptake. Several other reasons were identified to promote or influence the use of DMPA-SC/SI contraceptive methods by the study participants. This study's findings suggest that efforts to promote healthy interpregnancy intervals are needed to reduce negative child health outcomes [30].

Furthermore, healthcare stakeholders would find the study's findings fascinating and useful as a foundation for policy design and implementation. Under normal situations, there are factors that have been identified to be major contributors to the use of contraceptives in Nigeria. They include the type of health facility within a location, the geographical environment (urban or rural), and the cultural norms and beliefs of the geopolitical zone the individual comes from or lives in. Urban dwellers are more conscious of their reproductive health life and fertility rate than their counterparts in rural communities. Contraceptive use is generally poor in Nigeria, especially in the northern part of the country and other rural areas, where only 11 - 13% of women were reportedly using at least one modern contraceptive in 2010 [31]. This low use of contraceptive may be part of the reason there are high fertility rates in most rural communities, and this contributes to high infant mortality as well as maternal mortality and morbidity in Nigeria [31]. However, as have noted earlier, the high rate of DMPA-SC use observed in this study from the north-central zone of the country compared to the south western zone could be attributed to the effort of aggressive reproductive and family health campaigns that focus more on the northern part of the country. The age, marital status, occupation, whether respondents is rural or urban dwellers, their State of residence, geopolitical zone, parity, and number of living children were significant variables in the uptake of the DMPA-SC/SI contraceptive method.

In the typical African setting, women are usually dependent on their male partners or husbands for money and other resources required running the home. Contraceptives pose an extra cost in addition to the cost of housekeeping. Hence women whose partners agree to the use of contraceptives are likely to have their spouse's support monetary wise compared to those whose partner's decisions do not influence their use of contraceptives [5, 32]. The best decisions about family planning are those that people make for themselves based on accurate information and a range of contraceptive options. When one decides whether to use contraception or not without any interference, she can safely and effectively use the product and derive the benefit that accrued to it [32, 33]. Therefore, it is the responsibility of health care providers to help people make informed contraceptive choices. It has been reported that women whose use of contraceptives was influenced by informed choice and exposure to messages on contraception were more likely to use contraceptives. Exposure to messages on contraception serves as an avenue for individuals to know the various methods of contraception and gives them an opportunity to choose from the array of contraceptives available based on their preference. If there are insufficient or lack of information on proper use of contraceptive methods, it may result in low uptake of contraception, which has been the case in many African societies.

The six months secondary data from the HMIS records of trends in uptake showed the contribution of new users of DMPA-SC to the total new users of other family planning methods in the 4 states was 21.2% (table1b of trends). This implies that 1 in 5 women of reproductive age will choose DMPA-SC/SI as a family planning method among the broader family planning method mix. Among the 4 study sites, Niger state has the highest contribution of new users of DMPA-SC (32.7%) among the total new users of family planning methods in the State followed by Plateau state (29.7%), Oyo state (21.6%), and Lagos state (11.4%).

Conclusion and Policy Recommendations

This study noted that a high proportion of the women have heard of DMPA-SC and that slightly below average (46.5%) reported that they had self-injected themselves before. A higher proportion of the respondents had DMPA-SC/SI contraceptive uptake compared

to national estimates. The major reasons why respondents use DMPA-SC/SI family planning were its easily accessibility, affordability, and one being able to self-administer it. The sub-analysis based on the use of logistic regression showed that mothers who were between the age of 20 – 29 years and those without education and secondary education were less likely to report the use of DMPA-SC/SI contraceptive and that being an artisan, civil servant, and a trader confers an advantage in DMPA-SC/SI uptake while residing in rural parts of the country confers disadvantage in DMPA-SC/SI contraceptive uptake. Fears were associated with the use of self-injectable DMPA-SC, and common among the fears were phobias associated with self-injection, fear of side effects, and fear of self-injury. Intervention programmes with the intent to improve coverage of contraceptives should use health education programme, awareness, and public sensitization to encourage women to use contraceptives. Efforts should focus more on poor rural women with limited opportunities for education.

Interestingly Community-level service delivery of DMPA-SC/SI was successful in sustaining FP uptake among women of reproductive age during the COVID-19 pandemic. There was a 70.8% increase in Self Injection (SI) administered by CORPS between the Pre COVID and the peak of COVID-19. In conclusion, this study on DMPA-SC and self-injection has demonstrated that the use of self-Injection has the potential to be the game changer and paradigm shift for improving, bridging, and sustaining the FP Contraceptive Prevalence (CPR) in the Nigerian FP landscape.

Acknowledgement

The author appreciates the approval of the Association for Reproductive and Family Health (ARFH) for allowing this study to be conducted in four of the ten RASUDiN project states of DMPA-SC and Self Injection Implementation. The contribution of all stakeholders and study participants in the four states is sincerely acknowledged.

Ethics Approval and Consent to Participate

Ethical clearance was obtained from the National Health Research Ethics Committee, Nigeria, for PhD research study in the four study sites.

Consent for Publication

No consent to publish was needed for this study as the author did not use any details, images, or videos related to individual participants.

Conflict of Interest

There was no conflicting interest in this study.

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Effects of Big Data Management on Industrial Growth: A Case for the Organization of Economic Cooperation and Development Countries

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Abstract

Industrial growth is an essential condition for sustainable economic development. However, data management also plays an important role in ensuring effective planning and result-oriented decision-making in an organization. Although big data management is essential in this regard, its usage in most countries seems to be a new field. The aim of this study was to examine the effect of big data management on industrial growth in the Organization of Economic Cooperation and Development (OECD) countries. The study used expost-facto design approach and time-series or secondary data covering 2018 to 2020. A sample of 43 countries were used for the study. The Ordinary Least Square (OLS) regression technique was used as a technique for data analysis. The results from the descriptive analysis revealed that ICT access and usage had a higher mean value than internet access which signifies that ICT access and usage contributed more to industrial growth in OECD than internet access (INA). The findings from the analysis of the hypotheses also found that ICT access and usage and internet access have a significant effect on industrial growth in OECD countries. The study, therefore, concluded that big data management had positive effects on industrial growth in OECD countries and recommended that governments of OECD countries should invest more on internet access so as to promote efficiency in big data management and that they should also provide ICT infrastructure that are necessary for effective management of big data and industrial growth.

Keywords: *Big Data, ICT Access, and Usage, Internet Access, Industrial Growth.*

Introduction

The advent of globalization as brought to limelight the need for data management by organizations. Smart technology surfaced with many industrial advantages, yet it pulled along some challenges. A study [1] stated that the view that current digital business landscape requires companies to be able to provide employees, partners, and customers with secure access to critical enterprise systems and applications at any time, anywhere. While responding to this need, data management challenges are inevitable. [2] held the view that sensors spread around the world produce shocking amounts of machine data, but also highlighting the challenges of capturing and managing these massive amounts of data that are generated continuously in real-time and in multi-structured format. Therefore, considering the nature of big data today, the management of the data is observed to be held in proportions that were unimaginable in the past. According to [3], the term Big Data was coined by Roger Mougalas in 2005, but the application of big data and the quest to understand the available data is something that has been in existence as far back as 7,000 years where some earliest records of the application of data to analyze and control business activities are traceable to that period.

This implies that big data management has been in existence long ago, but its universal and formal usage is a recent development. [4] opined that currently, data is identified in numerous environments in volumes never seen before, increasing daily as a result of smart technology

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and increased in internet use. The scholar maintained that the world today is tech-savvy, where 90% of data is produced in just the past two years, and daily 2.5 quintillion bytes of data are produced by humans every day. The author also stated that 2.5 quintillion bytes of data are produced by humans every day and that it will increase to 463 exabytes each day by the same humans by 2025. [5] pointed out that all industries use big data because big data helps companies evolve and achieve success. This means that the role of big data management to industries cannot be over-emphasized, and hence, the increasing studies on the nature of the relationship between industrial big data management and productivity-related variables.

The benefits of big data management have been clearly explained in the extant literature, yet the consensus is that effective management of this data helps organizational planning and in decision making. In the light of this assumption, [6] stated that reflections on big data must be able to effectively meet business competitiveness and support decision-making, which should also be related to the information science and knowledge engineering, besides elements that integrate the application of information management and knowledge management to business. Thus, the advantage of big data management is that they enable the organization to align itself with the right manpower, specific technologies and techniques required for better control of processes and human resources with specific skills to meet needs that are related to big data management and organizational goals and objectives. However, industries are challenged with difficulties in managing big data. [7] shows that 95% of industries in different sectors have been wondering on how to manage the surge in big data, to enable them to capitalize on the abundance of big data for effective decision-making. Big Data offers a ton of benefits. It comes with its own set of issues, for it is a new set of complex technologies and still in the nascent stages of development and evolution [8]. The author identified some of the challenges to big data management to include; handling a large amount of data, real-time can be complex, data security, and shortage of skilled people.

Therefore, in view of the industrial changes occasioned by big industrial data, how to engage and optimize the new industrial big data management techniques are becoming tougher for the captains of industries. That is, the management processes, realization processes, and support process. Therefore, there is a need for industries to fully invest in industrial big data management in their industrial activities.[9] argued that insight-driven industries will continue to dried up those industries relying on traditional methods of data management. Thus, he predicted by 2021, insight-driven businesses are predicted to take $1.8 trillion annually from their less-informed peers. The author added that data-driven organizations and industries are 23 times more likely to acquire customers than their peers, signifying that there is no substitute to industrial big data management.

The global working group conducted a global survey on Big Data in official statistics approved by the Statistical Commission. The aim of the survey was to examine the practical experiences of national statistical offices with Big Data and to identify all of their concerns in order to recommend future steps for the implementation of Big Data in the modernization of statistical production. The survey was conducted from June to August 2015, containing questions on the management of Big Data, advocacy, communication, link to the sustainable development goals, access, privacy, confidentiality, skills, training, and concrete experience with the use of Big Data [10]. The findings revealed that about a half of the national statistical offices reported at least one Big Data-related project, mostly on price statistics (scanner data), transport and labour statistics (web-scraping data), tourism, and population (mobile phone data), and agriculture (satellite imagery data). Among the main reasons for using Big Data are: they can be collected faster

and are produced in a timelier fashion, and they reduce the respondents' burden due to the modernization of the statistical production process [11] evaluated the impact of information and communication technology (ICT) on the economic growth of selected developing countries in the Middle East and North Africa region and the Sub-Saharan Africa region using a panel Generalized Method of Moment (GMM) growth model over the period 2007 to 2016.

The results revealed that except fixed telephone, other information and communication technologies such as mobile phone, Internet usage, and broadband adoption are the main drivers of economic growth in MENA and SSA developing countries. This study underscored the need to manage big industrial data, which benefits are yet to be tapped in the light of new smart technology preferences emerging in both developed and developing economies.

Statement of the Problem

Globally, the growth of industrial big data generation a data that is generated but not analyzed (dark data) among industries is so alarming such that there seem to be increasing rates of industrial decline instead of industrial development considering the fact that more data means more decision variable for effective decision making. Industrial big data management is now an essential reality before all industries considering big data roles in industrial decisions for industrial development and competitive advantages. The presence of smart technology heralded the generation of big cheap data for industries, suggesting timely and efficient decision variables that guarantee success for industries. As such, big industrial management remains crucial in facilitating industrial development through industrial big data management.

However, despite the undeniable presence of big industrial data, industries have not given the needed attention to industrial big data management resulting in the continuous growth of dark industrial data and industrial mortality while big industrial data keeps increasing. Rai (2020) [12], lately, the term big data has been under the limelight, but not many people know what big data is. The current situation regarding big data management ushers in diverse studies involving technological issues, big data management issues, and data analysis.

The motivation for this study, however, is that extant studies of big data link it to either business intelligence or to other consolidated information technology approaches. In this case, most of these studies only propose two approaches; that is, one that strongly addresses the technological and technical issues so as to institutionalize and maintain an infrastructure that considers big data, and another that seeks to meet the business goals. Contrary to these views, big data management in this study will in addition to examining its role management based exclusively on information technology will also consider the involvement of human resources at all levels, including organizational processes for managing big data. But, to what extent to access to information communication technology (ICT) and internet services as measures on big data management affected industrial growth? Hence, this study seeks to point out the role of industrial big data management on industrial development among Organization for Economic Cooperation and Development (OECD) member countries and partners and also to highlight some reasons for persistent difficulties and necessary infrastructure needed in big data management among industries.

Research Objectives

The study was guided by the following research objectives in line with the aim of the research:

i. To assess the effect of ICT access and usage on industrial growth in OECD countries.
ii. To determine the effect of internet access on industrial growth in OECD countries.

Research Hypotheses

The following hypotheses were tested at 0.05 level of significance:

HO_1: ICT access and usage has no significant effects on industrial growth in OECD countries

HO_2: Internet access has no significant effects on industrial growth in OECD countries

Literature Review

The concept of big industrial data refers to a structure, semi-structure, and unstructured industrial data that are diverse, voluminous, and speedily generated. Those traditional methods of data management cannot handle it. The expression, or the full-term big data, presents diverse definitions observed in the recent scientific literature.[13] stated that big data refers to datasets whose size is beyond the ability of a typical database software tools to capture, store, managed, and analyze. Big data is data that goes beyond the traditional limits of data along three dimensions: volume, variety, velocity. Similarly, [14] defined big data as data generated in high volume, high variety, and high velocity that require new technologies of processing to enable better decision making, knowledge discovery, and process optimization. The study [15] identified some considerations that will give the best results for big data management that include: security or data policies definition, system integration to build a solid big data environment, skilled staff or organizational change and talents; the best use of the information gathered from your data and data access, and cost and infrastructure. Another Study [16] asserted that 99.5% of collected data never gets used or analyzed, resulting to much potential wasted.

In view of the fact that most industrial big data generated is not used, giving rise to lake of unused data known as dark data or unknown data. A study [17] noted that most of the data collected by businesses simply goes unused. This dark data usually comprises more than half the data collected by companies. Research [18] defined dark data as all the unknown and untapped data across a company, generated by systems, devices, and interactions. The scholar stated further that dark data may be the biggest untapped resource in business today for it includes the "data exhaust" generated as a byproduct of our online lives, is all the unknown and untapped data across your organization generated by systems, devices, and interactions. This data at times may be soloed off somewhere, formatted, or metadata that is inconsistent. On the other hand, it may be no one can figure out what to do with it or literally, you do not know it exists. Johnson [19] opined dark data, however, emerges from the user-centric point of view, when the users are the engineers, dark data will refer to unstructured data that does not get analyzed, and it is the data stored through various network processes on servers and in data lakes that end up sitting around to satisfy the industry's statute of limitations or is kept because data storage can be so cheap.

An organization's ability to effectively manage big data depends on a lot of factors. Consequently, [20] identified to the barriers that organizations faced in managing big data management to include, amongst others; technological and cultural barriers. The technological barriers range from the costly infrastructures required for big data acquisition, storage, and analysis to the shortage of qualified data scientists and analysts, while cultural barriers: Organizational culture is a set of values, beliefs, and attitudes shared by the members of an organization as cultural barriers to big data strategy implementation, the challenges related to developing a data-driven culture have to do with given consideration of values, beliefs, and attitudes shared by the members of an organization. Bulao reported that that 1.7MB of data is created every second by every person during 2020, in the last two years alone, an astonishing 90% of the world's data has been created [4]. Besides**,** 2.5 quintillion bytes of data are produced by humans every day**;** 463 exabytes of data will be generated each day by humans as of 2025. The scholar further asserted

that 95 million photos and videos are shared every day on Instagram, by the end of 2020, 44 zettabytes will make up the entire digital universe, and that every day, 306.4 billion emails are sent, and 500 million Tweets are made.

The structure of big data differs from other data. [12] stated that that big data takes any of the following types: big structured data is one of the types big data that can be processed stored, and retrieved in a fixed format. Structured big data refers to highly organized information that can be readily and seamlessly stored and accessed from a database by simple search engine algorithms; unstructured big data refers to the data that is devoid of any specific form or structure whatsoever. This makes it very difficult and time-consuming to process and analyze unstructured data; semi-structured data relates to the data containing both structured and unstructured data types. It refers to the data that, although it has not been classified under a particular database, yet contains vital information or tags that segregate individual elements within the data. Regardless of the type of big data that is considered, [21] reported that different industries used big data for specific purposes, such as:

Banking

Retail banks use big data extensively to understand how their customers use their accounts and to help identify security risks besides understanding the markets and making smart trading decisions.

Agriculture

Data analytics are now crucial for agriculture, and they are poised to grow only more important as predicting the weather and squeezing maximum productivity out of the land become essential for feeding a growing world population.

Real Estate and Property Management

Real estate firms are leveraging Big Data for better property analysis, better trend analysis, and better understanding of their customers and markets. Similarly, property management companies are utilizing Big Data collected from their building systems to optimize performance, surface areas of concern, and streamline maintenance processes.

Telco

The telco industry is using Big Data to improve in several key areas, including customer experience, network monitoring, and management, fraud reduction, churn prediction, and dynamic pricing. With Big Data, telco no longer simply ‘dials it in’ when it comes to impactful analytics.

Healthcare

Data has long been crucial for doctors seeking to figure out, based on analysis of a large number of data points collected from many patients, which blood pressure range is normal or how much sugar you should consume each day. Now, the healthcare industry is using data analytics to answer bigger, more complex questions.

Be that as it may, the benefits of big data management cut across different sectors and industries, partly because they help in decision making regarding resources allocation and policy implementation. Thus, to realize business objectives, managing big data becomes essential to provide relevant results from the huge amount of data. Hence, [16] argued that 43% of organizations are changing their structures to take advantage of the big data market. This implies that big data management has an influence on the size and structure of an organization or company. This brings to bear the question of big data management dimensions that will produce results. There are different views about classifying or dimensions of the big data management system, [22] opined that as part of an information system and as the principal component of this type of system, data are collected, qualified, stored, and processed by information systems to deliver results that satisfy its users. The author further considered information systems in three dimensions: people

which have to do with the role of humans in big data management, Technology processes that focus on the role of technology in big data management, and organization process which has to do with the organization frame that supports big data management. There are many challenges bedeviling big data management by companies and organizations.

The challenges to big data management refer to organizational problems of managing huge volumes of data to aid effective decision-making processes in an organization. For [23], big data challenges are numerous. Thus, big data projects have become a normal part of doing business, even though it doesn't mean that big data is easy. [24] reported that these challenges as insufficient understanding and acceptance of big data, the confusing variety of big data technologies**,** paying loads of money, the complexity of managing data quality, dangerous big data security holes, the tricky process of converting big data into valuable insights, and troubles of upscaling. According to [25], no organization can function without data these days. With huge amounts of data being generated every second from business transactions, sales figures, customer logs, and stakeholders, data is the fuel that drives companies. The deduction from these views is that big data management reflects several aspects, both in the technological field and in how to manage teams (technical or users); big data management is also strongly related to the processes involved that consider aspects related to collection, storage, and retrieval of data by using technical and user knowledge. Hence, it can be argued that the human, technological dimensions and related processes for big data management should be organized in way that they would be able to provide more favorable conditions for industrial development.

Methodology

This study employed *expost-facto* design approach based on the fact that secondary (time series) data were used. Based on this, the research had no opportunity of manipulating the variables under investigation. The data were source from big data management statistics for the 43 countries that are members of the Organization of Economic Cooperation and Development (OECD) and other 7 countries that are referred to as strategic partners in big data management for the period of 2018 to 2020 considering the non-availability of up-to-date data for the years before 2018.

Model Specification

This study used big data management as the independent variable, while industrial development in these countries was considered the dependent variable. Thus, ICT access and usage (ICTAU) and internet access (INA) were used as proxies of big data management while the sum total of industrial productivity and tourism services were also used as proxies of industrial growth (ING) respectively. The functional form of the relationship between big data management and industrial growth, therefore, is expressed as follows:

$$IND = f(ICTA, INA) \quad (1)$$

The model is therefore specified mathematically in their log form as follows:

$$\ln ING = \alpha_0 + \beta_1 \ln ICTA + \beta_2 INA + \varepsilon_t \quad (2)$$

Model Estimation Technique

The study used the Ordinary Least Square (OLS) multiple regression techniques for the estimation of the data collected from secondary sources. The essence was to examine the linear relationship that exists between big data management and industrial growth in OECD countries. The estimated form of the model specified in equation 2 above takes the form:

$$\ln ING = \alpha_0 + \beta_1 \ln ICTA + \beta_2 INA \quad (3)$$

In addition to estimating the OLS model, the model was also diagnosed using the tolerance value, the VIF, multicollinearity, Durbin Watson (DW) for serial correlation test, normality test, t-statistics, and F-statistics were also used to test the significance of the estimated parameters and the overall model significance at 0.05 level of

significance. Furthermore, the goodness-of-fit of the model was determined using the adjusted R square coefficient. The statistical computation of the coefficients was carried out using the Statistical Package for Social Sciences (SPSS) version 25 because it has the capacity of accommodating data covering a small sample size, while the views, which is a more robust software application, does not.

Results

The findings in Table 1 revealed that industrial growth had a mean coefficient of 118.23, and a standard deviation of 59.98, while ICTA had a mean of 65.36 and a standard deviation of 31.09. Furthermore, the results showed a mean value of 52.87 and a standard deviation of 36.9, respectively, for INA. This implies that ICT access contributed more to industrial growth in OECD than internet access (INA). The findings also revealed that the deviation of the individual countries' ICTA contributions to industrial growth was statistically smaller than that of their internet access (INA).

Table 1. Results of Descriptive Analysis

Variables	N	Mean	Standard Deviation
ING	36	118.2250	59.98149
ICTA	36	65.3553	31.08884
INA	36	52.8703	36.98297

The fitted form of the model is therefore shown as follows:

$$ING = 0.211 + 0.518ICTA + 0.617INA \quad (4)$$

The findings from the analysis revealed an estimated coefficient of 0.528 and 0.617 for ICT access and internet access, respectively. The results show that ICTA and INA have a positive relationship with industrial growth. More so, the F-statistic had $p<0.05$, which implies that the overall model is statistically significant at 0.05 level, and hence, it can be used for statistical decisions. The correlation of regression R for the combined effects of ICTA and INA revealed a coefficient of 0. 894.This suggests that a positive relationship exists between the variables of big data management and industrial growth in the Study area. The coefficient of the adjusted R square computed as 0.842 means that the model is a good fit because ICTA and INA explained about 84.2% of the changes in industrial growth in Nigeria.

Table 2. Result of OLS Regression Analysis

Variable	Coefficient	t	p-value	Tolerance Value	VIF
Constant	0.211	0.422	0.696	-	-
ICTA	0.518	41022	0.000	0.698	1.43
INA	0.617	48799	0.000	0.698	1.43
R	0.894				
Adjusted R Square	0.842				

F-Statistic =4486708919, p=0.000, Durbin Watson (DW) = 2.649

The results of the correlation matrix in Table 3 revealed that all the variables (ING, ICTA, and INA) had a correlation value that is less than 0.8, which is used as the benchmark for multicollinearity. Based on this, the study concluded that there was no multi correlineairy or covariance between the explanatory variables of big data management.

Table 3. Correlation Matrix for Multicollinearity

Variable	ING	ICTA	INA
ING	1	.657	.701
ICTA	.657	1	549
INA	.701	.549	1

The histogram and the normal curve in figure 1 revealed that the data used for the study were normally distributed around their mean value of zero (0) and constant variance. This is captured by the belt-shaped nature of the normal distribution curve.

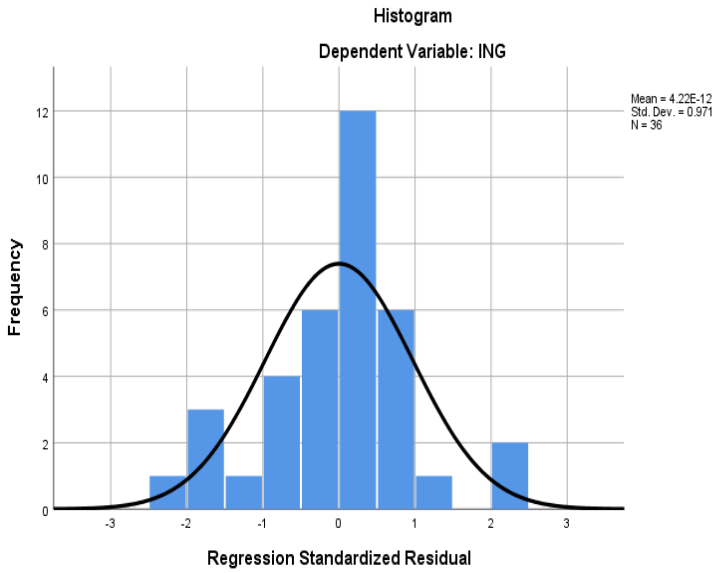

Figure 1. Histogram and the Normal Distribution Curve for the Normality Test

Discussion of Findings

The aim of this study was to examine the effect of big data management on industrial growth in OECD countries. The results of the estimated model in revealed a slope coefficient of 0.518 for ICTA and 0.617 for INA, respectively. The results indicated that a unit increase in ICT access which is an indicator of big data management by industries, will leads to a 51.8% increase in industrial growth. It was also found that a unit increase in internal access (INA) which is also another index for measuring big data management will leads to a 71.7% increase in industrial growth in OECD countries. Similarly, the coefficients of the t-statistic revealed that ICTA had a probability value (p-value) that is less than 0.05($p<0.05$). [26] stated that the most advanced firms around the world have not slowed their rate of productivity growth; the aggregate productivity slowdown masks a widening performance gap between more and less productive firms, especially in the ICT services sectors. This implies that the null hypothesis was rejected. The study concluded that ICTA has significant positive effects on industrial growth in OECD countries. However, the diffusion of digital technologies across OECD countries is far from complete, even amongst the most advanced economies.

While most firms now have access to high-speed broadband networks, more advanced, productivity-enhancing digital tools and applications, such as enterprise resource planning systems or big data analytics, have diffused to far fewer firms in OECD countries [27]. While, digital transformation, as with other technological changes, is not just about the diffusion of technology but also about the

complementary investments that firms need to make in skills, organizational changes, process innovation, new systems, and new business models [28]. Brynjolfsson, Rock, and Syverson (2017) [29] asserted that these investments involve much trial and error and take time. Productivity growth may be low and can even turn negative during this process of adjustment and experimentation.

Furthermore, the findings from the t-statistic of internet access (INA) were also less than 0.05($p<0.05$). Hence, the null hypothesis was rejected, and the study concluded that internet access (INA) had a significant positive effect on industrial development in OECD countries. This is in conformity with the study of [11] who found in their study on the impact of information and communication technology (ICT) on the economic growth of selected developing countries that information and communication technologies such as mobile phone, Internet usage, and broadband adoption are the main drivers of economic growth in MENA and SSA developing countries.

Hence, [27] pointed out that Policies should promote successful diffusion to unleash the potential of ICTs and digital tools for firms to increase productivity. Approaches to boost diffusion should take into account not only the individual firm but also networks of suppliers, users, and customers. This agreed with the view of [5] that all industries use big data because big data helps companies evolve and achieve success.

The implication of these results is that to enhance industrial growth, big data management by organizations should focus on ICT access and usage and internet access. But, [30] argued that there are large differences among countries, industries, and firms in the state of digital transformation and thus in how digital transformation affects productivity, and that recent OECD analysis shows that some sectors are less advanced than others in terms of the pace of digital transformation.

Conclusion

The review of literature on big data management in extant literature showed that industrial big data management has attracted the attention of many researchers because of the relevance of data in planning and decision-making by organizations. The results from the descriptive analysis revealed that ICT access and usage had a higher mean value than internet access which signifies that ICT access and usage contributed more to industrial growth in OECD than internet access (INA). The findings from the analysis of the hypotheses also found that ICT access and usage and internet access have a significant effect on industrial growth in OECD countries. The study, therefore, concluded that big data management had positive effects on industrial growth in OECD countries.

Recommendations

Based on the results of the findings and the conclusion made, the following recommendations have been made amongst others:

i. There is a need for Organization of Economic Cooperation and Development (OECD) countries to take decisive steps toward implementing effective management of big data so as to promote industrial growth.
ii. The government of OECD countries should invest more in internet access so as to promote efficiency in big data management and industrial growth.
iii. The government of OECD countries should provide ICT infrastructure that are necessary for effective management of big data and industrial growth.

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Conflict of Interest

The writer has no conflict of interest.

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