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The Comorbidity of HIV and Diabetes among HIV Patients Attending Katsina General Hospital, Katsina State, Nigeria

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Abstract

Assessing the magnitude of diabetes, a disease that accounts for increasing morbidity and mortality among HIV patients, would help reduce financial losses incurred in treating the disease, considering that the disease is mostly reported when acute and chronic complications are about to begin. This study was conducted to identify the prevalence of diabetes among patients attending the antiretroviral (ART) center of Katsina General Hospital. The study aimed to identify the prevalence of diabetes among HIV patients to identify whether new cases are always recorded or otherwise in the study center. Two hundred (200) HIV-infected adults (aged ≥ 18) who had been on antiretroviral therapy for at least six months in the hospital were recruited. Participants' demographics, HIV characteristics, the presence of diabetes via self-report, clinic folders, and measurement of their plasma fasting glucose and insulin levels on the day of the interview were evaluated. The magnitude of diabetes comorbidity was 3%. There was a weak positive relationship between fasting plasma glucose and alcohol (r=0.004), age (r=0.04), low-density lipoprotein (r=0.01), cholesterol (r=0.01), and viral load (r=0.032). Therefore, these factors are associated with increased odds of having diabetes. Thus, older age, higher BMI, higher viral load, alcohol, and duration on antiretroviral therapy increase the odds of having diabetes among HIV-positive adults. A lower prevalence of diabetes in clinic folders was found, for instance, indicating inadequate diagnosis of the disease in the center. Screening for the incidences of diabetes, addressing modifiable risk factors, and providing integrated care in the center would help improve the quality of life of comorbid patients.

***Keywords:** Antiretroviral drugs, comorbidity, diabetes, HIV, Katsina General Hospital.*

INTRODUCTION

Available data have shown that expanding access to antiretroviral therapy (ART) in sub-Saharan Africa has increased the life expectancy of HIV patients (Abebe *et al.*, 2016). However, the prevalence of non-communicable diseases in people living with Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) has been on the rise due to the side effects of antiretroviral drugs Abraham *et al.* (2015). ART drugs have been documented to cause insulin resistance, dysglycemia, dyslipidemia, and lipodystrophy with significant impact on the economy, basic health, and the quality of life of patients Xu *et al.*(2017). It has been estimated that diabetes comorbidity in HIV patients causes the premature death of about one-third of HIV patients (Atakpe *et al.*, 2015; Xu *et al.*, 2017). In Katsina state, Nigeria, there is a lack of information on the magnitude of prevalence of diabetes mellitus among people living with HIV, and little is known about the long-term effect of ART among these subjects. This study aims to identify the prevalence of diabetes in the study subjects attending the center, compare the prevalence of the disease based on clinic folder and study screening/interview, identify the associated factors, and how the health system responds to the double burden of the disease in the center.

METHODS

Study Area

The study was conducted at an antiretroviral therapy center in Katsina General Hospital, Katsina State, Nigeria. Katsina City's headquarters is Katsina state populated mostly by Hausa/Fulani ethnic group (Ya'u and Osibemhe, 2023). The center is a caring center for referral cases from private, primary, and secondary health facilities within the state.

Ethical Approval

Ethical approval (for the research was obtained from the Ethics and Research Committee of Katsina State Ministry of Health, Katsina, with assigned number MOH/ADM/SUB/1152/1/469. Research participants consented and were recruited on clinic days at the ART center in Katsina.

Inclusion Criteria

All consenting HIV patients aged 18 years and older on ART for at least 6 months at the time of interview were included in the study.

Exclusion Criteria

HIV patients below the age of 18 years, on ART for less than 6 months, and severely ill patients who are too sick to withstand examination or respond to the questionnaires were excluded from this study.

Sample Size Determination

The sample size (n) was calculated using the formula:

$$n = \frac{z^2 pq}{d^2}$$

n= minimum sample size

z= standard normal deviate at 95% confidence level

p= proportion of HIV-positive patients with NCDs previously reported at 12.2%

q=complementary probability of p (1-0.122) = 0.878

d= degree of precision (0.05)

$$n = \frac{1.96^2 \; x \; 0.1222 \; x \; 0.878}{0.025} = 165$$

However, to increase the power of the study and reduce type 1 error, the sample size was increased to 200 (Ya'u and Osibemhe, 2023).

Recruitment and interview

Recruitment was conducted from 14th June 2021 to 30th August 2021. The study searched for the clinical and biochemical evidence of hyperglycemia in the subjects receiving antiretroviral treatment at the ART clinic of Katsina General Hospital, Katsina. During the data collection period, as the patients arrived at the center, their clinic folders were transferred to the clinic reception by staff, where they were screened, and those eligible to participate were invited. During the interview, data on the patient's age, sex, marital status, occupation, current and past smoking, and alcoholic habits, self-reported previously diagnosed comorbidity of diabetes mellitus, physical activity, duration of infection, and duration of treatment were collected through administration of the questionnaire. The questionnaire was designed in English and translated into Hausa. The Hausa version of the questionnaire was presented to those who could not read or understand the English version.

Diagnosis of Diabetes Mellitus

World Health Organization (WHO, 2023) guidelines were used for diagnosis of diabetes. Patients with fasting blood glucose measurement ≥7.0mmol/L were considered diabetic (two to three measurements). The body height and weight of each patient were taken using a standing weighing scale and height, SECA GMBH, model 700 (WHO, 2023).

Chemicals and reagents

Analytical grade chemicals and reagents sourced from British Drug Houses (London, UK) were used in this study.

Blood Sample Collection

Before blood sample collection, participants were instructed to observe an 8-12-hour fast. They were given food and water after the interview and blood sample collection. A laboratory scientist was recruited to collect blood, which was used to measure fasting plasma glucose and insulin levels (Ya'u and Osibemhe, 2023).

Blood Processing and Storage

Collected blood was centrifuged for 10 minutes at 10000 rpm (Ya'u and Osibemhe, 2023). Plasma and serum were aspirated into bottles using a pipette. These were then stored at the chemical pathology unit of Katsina General Hospital, Katsina, for the analyses.

Biochemical Analysis

Fasting plasma glucose was determined using the procedure explained by Trinder (1969), while insulin was determined according to a procedure

of Accu-Bind (manufacturer) ELISA microwells using Microplate Reader RT-2100C.

RESULTS

Socio-Demographic Characteristics of the Study Participants Attending Follow-up in Katsina General Hospital and Biochemical Indices of the Participants

The participants for the research were made up of 157 (78.5%) female and 43 (21.5%) male subjects (Table 1). Most participants were in the 26-35 and 35-45 age brackets. Over one-third of the study participants, 92 (46%), had not attended primary education but were literate in Qur'anic education, and 11% had post-secondary qualifications. Exactly 55% of the participants were married. More than half of the participants were in very small-scale businesses (60%); 15% were public servants, and the remainder were students and housewives.

Assessment of biochemical indices for evaluation of diabetes among the study participants found that six (6) had abnormal glucose levels (diabetes), 22 had impaired fasting plasma glucose, and 138 had normal fasting plasma glucose, as presented in Table 3.

HIV-Diabetes comorbidity

The overall prevalence of diabetes among the study subjects was 3 percent only, with 2.5 percent already reported positive for diabetes among the study subjects. Of the 200 participants, 11 percent reported being tested for non-communicable diseases (NCDs) in the study center. This indicates the need for routine measurement or diagnosis of NCDs in the center to reduce NCD episodes among patients. The study also found that 2% of the diabetes patients had a family history of the disease and were diabetic before being infected with HIV.

In the present study, 6 participants were diagnosed with diabetes. Of these, 5 were reported in the clinic folder who reported having diabetes during the conduct of the interview. Of all diabetic patients, 4 had a family history of diabetes and had diabetes before being infected. This indicates the role of genetics in determining the fate of diabetes among the participants.

Factors associated with HIV-Diabetes Comorbidity

For HIV-diabetes comorbidity, older age, alcohol, and higher BMI were the factors that predispose HIV patients to diabetes mellitus (DM) comorbidity (Table 5).

Table 1: Socio-demographic of Participants Attending Follow-up in Katsina General Hospital.

Variable	Male	Female	Total
Sex	43 (21.5)	157 (78.5)	200 (100)
Age (8-25) years	4 (2.0)	22 (11.0)	26 (13.0)^{b}
26-35	17 (8.5)	62 (31.0)	79 (39.5)^{a}
36-45	13 (6.5)	57 (28.5)	70 (35.0)^{a}
46-55	6 (3.0)	12 (6.0)^{b}	18 (9.0)^{b}
>55	3 (1.5)	4 (2.0)^{b}	7 (3.5)^{b}
Marital status			
Single	10 (5.0)	8 (4.0)	18 (9.0)^{bc}
Married	25 (12.5)	76 (38.0)	101 (50.5)^{a}
Widow(er)	2 (1.0)	46 (23.0)	48 (24.0)^{b}
Divorced	-	33 (16.5)	33 (16.5)^{b}
Educational status			
Qur'anic	8 (4.0)	83 (41.5)	91 (45.5)^{a}
Primary	2 (1.0)	43 (21.5)	25 (12.5)^{c}
Secondary	17 (8.5)	25 (12.5)	62 (31.0)^{b}
Tertiary	10 (5.0)	12 (6.0)	22 (11.0)^{c}
Occupation			
Public servant	11 (10.5)	19 (9.5)	30 (15.0)^{b}
Business	19 (9.5)	99 (49.5)	118 (59.0)^{a}
Laborer	4 (2.0)	18 (9.0)	22 (11.0)^{b}
Others	4 (2.0)	20 (10.0)	24 (12.0)^{b}
Student	3 (1.5)	3 (1.5)	6 (3.0)^{b}

Different superscripts in the same column are statistically significant using student t-test. $P<0.05$.

Table 2: Clinical characteristics of the subjects.

Characteristics	Duration on ART		Viral load (c/mL)		
Male	< 3 years	> 7 years	Undetectable	40-500	500-1500
<3 yrs	11(5.5)[b]	19(9.5)[b]	23(11.5)[b]	10(5.0)[b]	4(2.0)[a]
> 7yrs	43(21.5)[a]	91(45.5)[a]	66(33.0)[a]	34(17.0)[a]	7(3.5)[a]

Different superscripts in the same column are statistically significant using student t-test at P<0.05. ART: Antiretroviral therapy, Undetectable viral load: below 40 cp/ml.

Table 3: Biochemical Indices of the Participants

Parameters	Total	Male	Female
FPG (mMol/L)			
> 7.0	6	1	5
6.1-6.9	22	7	15
4.1-6.0	138	24	114
< 4.0	34	11	23

≥ 7.0: diabetes, 6.1-6.9: High FPG above normal, 4.1-6.0: Normal FPG, ≤4.0: below normal, FPG: Fasting plasma glucose.

Table 4: Overall prevalence of diabetes among the study participants according to gender

Male		Female		X^2 (P-value)
N.E	NP(%)	N.E	NP (%)	
43	1(0.5)	157	5(2.5)	1.971(0.96)

NE: No Examined, NP: No positive. X^2 =chi square, p<0.05

Table 5: Factors Associated with HIV-DM Comorbidity

Variables		Yes (%)	No (%)	r Value
Sex	Male	1 (0.5)	42 (21.0)	
	Female	5 (2.5)	152 (76.0)	
Age category	18-34	1 (0.5)	82(41.0)	r = 0.04
	35-54	4 (2.0)	98	
	55+	1 (0.5)	14	
Alcohol consumption	Yes	3 (1.5)	1 (0.5)	r = 0.004
	No	2 (1.0)	194 (97.0)	
Physical activity	Yes	6 (3.0)	194 (97.0)	
	No	0 (0.0)	200 (100)	
Duration on ART	<5 years	3 (1.5)	60 (30.0)	
	5-10 years	2 (1.0)	96 (48.0)	r = 0.032
	> 10 years	1 (0.5)	38 (19.0)	
BMI	< 18.5	1 (0.5)	25 (12.5)	
	18.5-24.9	3 (1.5)	135 (67.5)	r = 0.01
	≥25	2 (1.0)	34 (17.0)	

BMI: Body Mass Index, ART: Antiretroviral therapy, <18.5: Underweight, 18.5-24.9: Normal, >25.0: Overweight/obese; r value: correlation value.

DISCUSSION

The socio-demographic data found that more than 60% of the participants were between 26-45 years, the sexually active reproductive stage. Also, females were three times more than males, possibly due to the morphological and anatomical makeup of female genitalia, making them more prone to infection than males. This is in line with the report of the study by Zenebework *et al.* (2020), where females had higher HIV infection than males in Ethiopia. The high number of HIV-infected females in this study could be connected to the cultural practice of polygamy by the people of Katsina state. Thus, an infected man can infect all his wives. Also, frequent marrying and divorcing of males in the area contribute to the spread of the disease among the female gender. Natural events of immunization, childcare, antenatal care, and childbirth could be the reason for the higher number of female subjects with HIV that enable them to be screened and identified compared to male subjects. Unmarried participants found with HIV infection might have gotten infected with the disease through sexual

intercourse with HIV patients, which can occur male to male, male to female, female to male, and female to female. They may also got infected through transfusion of blood, sharing of needles among intravenous or injecting drug users, or from their mothers in utero, during labor and delivery, and through breastfeeding.

Most participants were literate in Qur'anic education only, with only few being literate in formal and informal education. Very few were graduates, indicating low enrollment and low acceptance of Western education by the participants. Based on the present study, married people were at high risk of contracting infection of HIV, which may reflect the culture of early marriage of the people in the area.

Impairment of glucose metabolism has been associated with intake of ARTmedications (Oni *et al.*, 2015). Overall, dysglycemia recorded in this study was 3%, which was lower than the study report by George *et al.* (2019) and Zenebework *et al.* (2020). This could be due to differences in the ART drugs patients use in this study center.

In this study, patients with impaired insulin levels did not have symptoms suggestive of diabetes mellitus and were not more overweight or obese compared to those who did not have dysglycemia. Such impaired insulin levels may be due to the family history of diabetes or due to gain in weight after the start of ART treatment. Patients could be overweight before they were infected with HIV.

Suppression of viral load is considered a key therapeutic target for HIV treatment and involves the use of various classes of drugs (George *et al.*, 2019). In the present study, most of the patients had undetectable viral load, suggesting the good action of the drugs in suppressing viral replication. This aligns with the study's findings by Zenebework *et al.* (2020).

The body mass index of HIV patients on ART treatment has been shown to increase due to improved health and nutrition. Consistent with the study of Zenebework *et al.* (2020), nearly one-third of the participants were overweight. The number of underweight patients found in this study is similar to the findings of Olukemi *et al.* (2021). The underweight seen by some participants could be due to psychological stress. It may also be associated with the low socioeconomic status of the participants.

The lower level of diabetes comorbid patients found in the clinic folder than was diagnosed during measurement on interview day suggests an absence of routine screening for NCDs in the center, possibly due to a lack of awareness of the diagnosis or self-report. This suggests the need for integration of the HIV center and non-communicable diseases (NCDs)healthcare system in the center to facilitate routine monitoring of NCDs in the center. Olukemi *et al.* (2021) reported under-diagnosis of NCDs in HIV centers.

Risk factors for comorbidity in the present study were age, alcohol, viral load, and BMI, as a positive relationship was recorded. A study by Zenebework *et al.* (2020) found an alteration in glucose tolerance with advancing age. Being overweight is another factor due to the elevated lipid profile of the participants attributed to the effect of the drugs in promoting atherosclerosis.

Alcohol consumption impacts T-cell function and worsens the immune profile due to increased exposure to pro-inflammatory cytokines (Abebe *et al.*, 2016). In this study, 98% of the participants were on nucleoside transcriptase and integrase inhibitors. The side effects of the drugs cause dyslipidemia, which increases the risk of diabetes mellitus. It is therefore recommended that data on NCD risk factors such as smoking, alcohol consumption, BMI, and physical inactivity be included in clinical databases/ folders to encourage routine monitoring and to inform clinical decision-making such as choice of ART drug prescription.

CONCLUSION

This study revealed the low prevalence of diabetes among the study subjects, which was weakly correlated with a positive relationship between fasting plasma glucose and alcohol (r=0.004), age (r=0.04), low-density lipoprotein (r=0.01), cholesterol (r=0.01), and viral load (r=0.032).

The study recommends routine diagnosis of NCDs in the study center to improve the patient's quality of life. Therefore, integrating the HIV center with the NCD healthcare system can help

facilitate routine monitoring of NCDs and reduce associated morbidity and mortality.

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