

Diabetes Mellitus (DM) and Risk Factors Among HIV Patients on Highly Active Antiretroviral Therapy in Taraba State, Nigeria

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Abstract

This study investigates the prevalence and determinants of Diabetes Mellitus (DM) among individuals co-infected with HIV and receiving Highly Active Antiretroviral Therapy (HAART) in Taraba State, Nigeria. As the intersection of HIV and DM poses significant challenges to public health, understanding the risk factors in this specific population is crucial for effective management and prevention. The study employs a cross-sectional design, involving a 411 sample of people living with HIV (PLWHIV) undergoing HAART in four hospital locations: Taraba State Specialists Hospital Jalingo, General Hospital Zing, First Referral Hospital Mutum Biyu and General Hospital Takum of Taraba State. Data collection includes anthropometric, socio-demographic information, BMI, assumed risk factors, HAART regimen, and fasting blood glucose levels measurements are used to diagnose and assess the severity of DM. The findings indicate a prevalence of DM among PLWHIV on HAART in Taraba of 16.1% higher than the general population. Age, duration of HAART, BMI and specific antiretroviral drugs were significant risk factors. These results contribute to the growing body of evidence on the epidemiology of DM in PLWHIV, emphasizing the need for tailored interventions and routine screening protocols within HIV care settings. This research expresses understanding on risk factors of DM among PLWHIV on HAART in Taraba and offers valuable recommendations for proper management of the DM/HIV comorbidities in this population.

Keywords: *Diabete Mellitus (DM), PLWHIV, Risk Factor, HAART, Taraba State*

INTRODUCTION

People living with HIV are estimated to be about 39 million at the end of 2022 (WHO, 2023) and about two-thirds of the population are living in Sub-Africa, while 40.4 million persons were estimated to have died of HIV related cases. However, there is a significant reduction in mortalities and morbidities following the advent of highly active antiretroviral therapy and enhanced healthcare accessibility. A continuous and considerable advancement in HIV/AIDS care and

pharmacotherapy has changed the long narrative of HIV/AIDS from a death sentence to merely a chronic disease. Thus, persons with HIV who adhere strictly to their antiretroviral medications experience normal physical health like the general population without the need to mask any physical identities associated with HIV/AIDS (Wandeler et al., 2016). This is evidence that individuals who are afflicted with HIV experience significantly extended lifespan and enjoy a notable standard of living through advancements in science and technology in healthcare and research. Several modifications have been made to improve treatment plans through changes made to treatment guidelines across countries; now, the WHO treatment guidelines are being adopted by most countries worldwide, and HIV patients are being enrolled in ART care immediately following confirmed diagnoses. These measures have not only reduced the disease burden and deaths from HIV but also reduced the transmission of the disease. While the progress achieved in HIV/AIDS care and support is being commended, the rise in aging within this particular study population is linked to a heightened susceptibility to age-related chronic diseases or non-communicable diseases (NCDs), which pose a significant risk to individuals living with HIV (Friedman and Duffus, 2016). Despite living such a relatively satisfactory mode of life, long termed HAART users face an elevated susceptibility to the onset of chronic comorbidities as they advance in age. These conditions frequently include chronic obstructive pulmonary disease (COPD), atherosclerotic cardiovascular disease (ASCVD), specific forms of cancer (such as those affecting the anus, liver, and lungs), type 2 diabetes mellitus (DM), and acute or chronic kidney disease (CKD) (Webel et al., 2021). Technically therefore, rates of mortality among the population of PLWHIV remain relatively higher than those of the general population because of the increase in comorbidities with non-communicable diseases (Eyawo et al., 2012; Crawford et al., 2017). The rising burden of comorbidities among PLWHIV affects their quality of life, which then raises obvious health equity concerns (Vance et al., 2011; Lambeeket et al., 2017).

The type 2 diabetes mellitus (T2DM) is a non-communicable disease that is notably increasing worldwide in the population of PLWHIV (WHO, 2018; Shaw et al., 2010). There is an increase in morbidities and mortalities that have been linked to type 2 diabetes mellitus (T2DM), a prominent chronic comorbid illness in PLWHIV (Monroe et al. 2015). Treatment of HIV patients has significantly high economic consequent on both the government and individuals, and diabetes mellitus has been linked to more hospital visits and prolonged hospital stays, worsened outcomes in terms of cardiovascular and renal disease, and the development of end-stage renal disease (ESRD) in PLWHIV (Akgun et al., 2013; Medapalli et al., 2012; Jotwani et al., 2012). Aging, obesity, genetic predisposition, family history, and inflammation are factors that poise risk of developing type 2 diabetes mellitus which are basically the same for those that are not HIV patients. However, many extra risk factors make it more likely for PLWHIV to get type 2 diabetes mellitus. These include oxidative stress, mitochondrial damage, chronic inflammation, having a low CD4 count, living with HIV for a long time, and taking some medications along with a combination antiretroviral therapy regimen (Blas-Garcia et al., 2011; Tingstedt et al., 2019; Capeau et al., 2012). A meta-analyzed 41 observational studies had found that the risk of type 2 diabetes mellitus in PLWHIV who are taking antiretroviral medications is four times (x4) higher than in HIV-positive individuals not on ART. This suggests that ART is potentially the single most significant and coherent determinant factor for the development of type 2 diabetes mellitus in PLWHIV (Nduka et al., 2017). Fiseha and Belek (2019) found that the prevalence or occurrence

of diabetes mellitus among PLWHIV was 8.8% in northeast Ethiopia. Gebrie et al. (2020) conducted a study in Northwest Ethiopia and reported that the prevalence of T2DM was much greater in the population of PLWHIV, at a rate of 8.8%, in comparison to the prevalence seen in the overall population of Ethiopia. Several researchers have found out that there is a high occurrence of diabetes in the population of people living with PLWHIV against the general population (WHO, 2022;). DM prevalence among PLWHIV in USA is approximated at 12% (Ketra et al., 2011), which is higher than the prevalence of 10.5% found in the US general population, according to the CDC (2020). However, the prevalence of diabetes mellitus in the population of PLWHIV lacks solid statistics owing to a lack of research interest that specifically focuses on DM concerning PLWHIV. The world health body, WHO, estimated the prevalence of diabetes mellitus in Nigeria as 4.3% in the general population (WHO, 2022). Nigeria ranking fourth largest in the world HIV burden but has limited data related to prevalence of diabetes mellitus among its population of people living with HIV despite growing interest in this population across the world. This necessitated this research to investigate diabetes mellitus (DM) as a risk factor among people living on HAART in Taraba State and its burden on health conditions.

METHODOLOGY OF THE STUDY

Taraba State is positioned within the north-eastern geopolitical zone of Nigeria, specifically between latitudes 6°00'N and 11°30'N and longitudes 9°00'E and 11°30'E. The state has a wide range of geographical features, such as the Mambilla Plateau, rivers, and a variety of vegetation zones. Taraba has a population of 2,300,736 individuals and a population density of 54 inhabitants per km². There are more than 77 ethnic groups that make up the region, and they all practice different religions. The state may face numerous health concerns that are prevalent in both the region and the entire country. The prevalence of communicable diseases, such as malaria, respiratory infections, and waterborne diseases, is possible. Non-communicable disorders such as hypertension, diabetes, and malnutrition may also be areas of concern. The state's health authorities are probably involved in public health efforts aimed at addressing these concerns. The study was cross-sectional research done from August to October 2023 at the ART clinics of selected hospitals in each senatorial zone and the Specialist Hospital in Jalingo, Taraba State. The hospitals included General Hospital Zing, situated in Zing, the administrative centre of Zing LGA in Taraba North; First Referral Hospital Mutum Biyu, located in the headquarters of Gassol LGA in Taraba Central; and General Hospital Takum, situated in Takum LGA in Taraba South. These hospitals provided a wide range of HIV care services, encompassing diagnostic procedures such as testing, CD4 count, HIV viral load, dry blood spotting, and polymerase chain reaction. They also offer treatment for both adults and children, as well as monitoring and evaluation (M&E) services. Additionally, they provided prevention of mother-to-child transmission (PMTCT) services. The study focused on individuals who were infected with HIV and were enrolled into highly active antiretroviral therapy in Taraba State. The study recruited participants using random selection, ensuring that they satisfied the eligibility requirements of being above 15 years old, having been on antiretroviral therapy for at least the past 12 months, possessing verbal communication skills, and being available for the duration of the research. The study excluded pregnant women, known diabetic patients and the critically ill. The initial sample size was determined to be 374, with an additional 10% added to account for non-respondents, resulting in a final size of 411. A team of 12 research

assistants underwent training and were assigned the task of administering a systematic questionnaire to collect anthropometric data, vital signs, socio-demographic information, and behavioural characteristics from the study participants. The body mass index (BMI) was determined using a straightforward formula: weight (in kilogrammes) divided by height (in metres). BMI values ranging from 25 to 29.9 kg/m² were considered overweight, while values greater than 30 kg/m² were considered obese. These conditions offer a risk factor for diabetes mellitus in individuals living with HIV who have been subjected to HAART. The FBS method of screening, which takes less than 10 minutes, was chosen for this investigation. Urine samples were analysed to detect the presence of proteinuria, albuminuria, haemorrhagia, and urine pH as indicators of the risk of kidney disease in patients that showed elevated blood sugar levels. The research work analyzed the data using SPSS 23.0 version to present the result in a descriptive statistic and Chi square (X^2) was used for categorical variables while student t-test was employed for continuous variables to test for statistical significance. Statistical significant was defined as *P*-value of <0.05.

Special Considerations

The study protocol was approved by the Health Research and Ethics Committee of the Taraba State Ministry of Health reference number TRSHREC/2023/016. Verbal and written consent was obtained from each respondent before being recruited for the study. Respondents were informed that all information will be handled with utmost confidentiality and participants have the right to withdraw their participation at anytime during the conduct of the research.

RESULTS

A total of 409 respondents were recruited into the study from four hospitals: three hospitals representing the three senatorial districts of the state while the Specialist Hospital Jalingo constitute the fourth facility being a referral tertiary hospital. As shown clearly on Table 1 demographic characteristics of the participants, 125 males (30.6%) and 284 females (69.4%) were involved in the study. The mean age of the participants was 47 ± 1.46 and ranged from 24 to 72 years. The age group 64 years and above accounted for the highest number of participants representing about a quarter (22.2%) of the study population while The age group 54-63 (9.8%) accounted for the least number of participants, the age grouping had a statistical association ($P=0.007$). BMI assessment showed that majority of the participants, 160 (39.1%) were overweight while 117 which constitutes 28.6% of the participants were obese and this was statistically significant ($P= 0.022$). Majority of the participants were rural dwellers (59.2%) and were married (232 representing 56.7%). Most of the respondents were more likely to have higher school certificate 117 (28.6%; $p = 0.000$) (table 1).

Table 1
Demographic Characteristics of the Participants (N= 409)

Description	Frequency	Percentage %	Mean	P-Value
Selected Hospitals				
Specialists Hospital Jalingo (SHJ)	110	26.9	2.47	0.000
General Hospital Zing (GHZ)	98	24.0		
General Hospital Takum (GHT)	101	24.7		
First Referral Hosp. M/Biyu (FRH)	100	24.4		
Gender				
Male---	125	30.6	1.69	0.050
Female	284	69.4		
Age (years) mean ± SD (47 ± 1.49)				
Age-Group of Respondents				
24-33	77	18.8	2.95	0.007
34-43	88	21.5		
44-53	77	18.8		
54-63	40	9.8		
64>	91	22.2		
Body Mass Index				
Underweight < 18.5kg/m ²	32	7.8	3.85	0.022
Normal <18.5- 22.9kg/m ²	100	24.4		
Overweight 23.0-27.5kg/m ²	160	39.1		
Obesity >27.5kg/m ²	117	28.6		
Settlement				
Rural	242	59.2	1.41	0.000
Urban	162	40.8		
Marital Status				
Single	80	19.6	2.32	0.000
Married	232	56.7		
Divorce	29	7.1		
Separated	25	6.1		
Widowed/widower	43	10.5		
Educational Qualification				
Non-Formal	82	20.1	2.28	0.000
Primary	98	23.9		
High School	117	28.6		
Degree	73	17.8		
Postgraduate	30	7.4		
Occupation				
Farmer	113	27.6	2.86	0.012
Civil Servant	66	16.1		
Business/trader	106	25.9		

Transportation	31	7.6
Unemployed	54	13.2
Student	32	7.8

All the variables in table 1 were statistically significant; hospitals, settlement, marital status, and educational qualification all had $P=0.000$

Among the 409 respondents in this study, fasting blood sugar test (FBS) results showed 66 (16.1%) were diabetic with highly significant elevated sugar levels of 126mg/dL ($P=0.000$), while 153 (37.4%) were found to be prediabetic. Majority of the respondents 119 (29.1%; $p = 0.000$) were statistically significantly more likely to have stage 2 hypertension (table 2)

Table 2

Prevalence of DM and investigation outcomes of the participants (N=409)

Description	Frequency	Percentage %	Mean	P-Value
FBS (mg/dL)				
Normal <99.9	190	46.5	1.74	0.000
Prediabetic 100.0 – 125.9	153	37.4		
Diabetic ≥ 126.0	66	16.1		
Blood pressure measurement				
Normal < 120/80	100	24.4	2.91	0.000
Pre-hypertension 120/80-139/89	104	25.4		
Stage 1 hypertension 140/90-159/99	86	21.0		
Stage 2 hypertension >160/100	119	29.1		

Amid the participants with DM (66 participants), the age group 45-54 years, $P = 0.034$; obesity, $P= 0.024$; 1-5 years duration on ART, $P= 0.030$; and being hypertensive, $P = 0.002$ were statistically significant risk factors associated with diabetes (table 3). Body mass index with significant level of $P=0.024$ had the obesity group with highest prevalence of 26 out of 66 (39.4%) while the overweight component had 23 (34.8%). Duration on ART $P=0.030$ showed 29 out of the 66 (43.9%) cases of DM among individuals that were on HAART between 1 and 5 years highest in this variable. In the blood pressure category 28 (42.4%) cases of DM among participants with elevated blood pressure $\geq 140/90$ mmHg.

Table 3

Proportion of Diabetic patients as relate to selected risk factors (N=66)

Description	n	Diabeti c	Percentage 66	(DM% in group(n))	P- value
Age-Group					
24-34	77	14	21.2	18.1	0.034
35-44	88	14	21.2	15.9	
45-54	77	16	24.2	20.8	
55-64	40	10	15.2	25.0	
65>	91	12	18.2	13.2	
Body Mass Index					
Underweight < 18.5kg/m ²		5	7.6		0.024
Normal 18.5 -22.99Kg/m ²		12	18.2		
Overweight 23.0 - 27.49Kg/m ²		23	34.8		
Obesity > 27.5kg/m ²		26	39.4		
Duration on ART					
1-5 years	189	29	43.9	15.3	0.030
6-10 years	84	15	22.7	17.9	
11-15 years	115	17	25.8	14.7	
>15 years	23	5	7.6	21.7	
Blood Pressure					
Normal < 120/80		23	34.8		0.002
Pre-hypertensive 120/80-139/89		15	22.7		
Hypertension ≥140/90		28	42.4		

Participants who were overweight/obese had higher tendencies to diabetes 49 (74.2%) out of 66 p=0.024, hypertensive participants also recorded high percentage 42.2% of the total diabetes reported.

DISCUSSION

Prevalence of DM was found to be 16.1% among PLWHIV in the State. Although there is paucity of data on prevalence of DM in the general population for Taraba state, prevalence in the general population in Nigeria was given as 4.3% (WHO, 2022). Global prevalence of DM in the general population had been postulated at 9.3% (Saeedi et al., 2019). The prevalence of DM among PLWHIV reported in this study had shown to be much higher than the prevalence in the general population both in Nigeria and at the global levels. This is consistent with findings from other similar studies which showed that DM among PLWHIV had higher prevalence when compared to the general population (Brown et al., 2005) and, notably higher than 8.8% from Northeast and Northwest Ethiopia (Fiseha and Belek, 2019; Gebrie et al., 2020), higher than 12% obtained among PLWHIV in USA (Ketra et al., 2011), also higher than 14.5% in a study in Senegal (Diouf et al., 2012). It is however, lower compared to 18.0% reported in a Tanzania (Maganga et al., 2015). Differences in prevalence in these reports may be attributed to lifestyle variations across different cultures in these countries. Age is a significant and common risk factor for the development of

DM in the general population and PLWHIV. Age 45 to 64 have showed higher prevalence compared to the other age groups. 77 participants aged between 45 and 54 with 20.8% cases of DM prevalence while age group 55–64 had 25.0% cases of DM prevalence which is consistent with other studies (Ledergerber et al., 2007; Fiseha and Belek, 2019). Individuals aged >45 years old have higher tendencies for developing DM. Most importantly, early onset of DM in PLWHIV among the youngest age group 24–34 had 77 out of 373 persons with 14 cases of DM among them which represents 18.1% prevalence. There is need to focus on the prevalence of DM among younger age of PLWHIV who are at risk as evident in this study.

Obesity was observed as the most leading factor for the development of T2DM in the general population (Barnes and Coulter, 2011) that was typically consistent with our findings in this study. Chukwuonye et al. (2022) conducted a systemic review and a meta-analysis reported prevalence of overweight and obesity in the general population in Nigeria as 27.6% and 14.5% respectively. There were no known data on prevalence of obesity among PLWHIV in Nigeria. There was high significant relationship between high BMI and diabetes in PLWHIV which was exacerbated by use of ART. Length of time spent on ART medication is also implicated in development DM among PLWHIV in previous studies, not the duration of time being with the infection but the time duration of use of the HIV medicines that predisposed the patients to DM, since ART is the most implicated factor for developing DM (Nduka et al., 2017). 29 cases out of 189 participants in the study on ART between the period of 1 and 5 years have 15.3% chances of DM. However, in longest duration group >15 year had 5 DM cases which represent 21.7% higher chances of having DM. Other studies supported the assertion that the longer the time spent on medication the higher likelihood of developing DM (Abrahams et al., 2015; Calza et al., 2011).

High blood pressure is a forefront cause of morbidity and mortality in Africa and Nigeria. Adeloye et al. (2015) reported 28.9% *prevalence* of hypertension in the general population in Nigeria. Among PLWHIV, Jackson et al. (2022) reported prevalence of 24.9% in a study conducted at University of Uyo Teaching Hospital. In this study the prevalence of high blood pressure among PLWHIV in Taraba state was 21.0% for persons with stage 1 hypertension and 29.1% for persons with stage 2 hypertension, while in both cases combined we found 50.1% high blood pressure prevalence among PLWHIV. The results were much higher than 15.1% obtained by Chhoun et al. (2017) higher than Jackson et al. (2022) report, also higher than the Northeast Ethiopia report of 29.7% (Fiseha and Belek, 2019) as well as higher than (34.4%) prevalence of hypertension among PLWHIV in Senegal (Diouf et al., 2012)

CONCLUSION

In conclusion, this study identified high prevalence of diabetes mellitus as 16.1% (66) among patients on highly active antiretroviral therapy in Taraba State, Nigeria. Alcohol consumption, lack of physical exercise, tobacco use, family history, body mass index and hypertension are found to be contributing factors for diabetes mellitus among people living with HIV on therapy and there is strong relationship between diabetes in HIV and age, duration of ART, regimen and body mass index. People living with HIV and on HAART should be allowed to access hospital facilities at regular intervals and regular medical checkup needed for possible presentation of non-communicable diseases especially diabetes mellitus.

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