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### HIV-Hypertension Comorbidity, Associated Factors and Treatment Option Among HIV Patients Attending Katsina General Hospital, Katsina State Nigeria

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#### ABSTRACT

People living with human immunodeficiency virus (HIV) are facing an increased burden of non-communicable diseases (NCDs) comorbidity. There is however, paucity of information on the magnitude of HIV-hypertension comorbidity, its associated factors, and how the health system responds to the burden in Nigeria. This study aimed to determine the magnitude of comorbidity HIV and hypertension and associated factors among HIV-positive adults receiving antiretroviral therapy (ART) in Katsina General Hospital, Katsina. Two hundred (200) HIV infected adults (aged  $\geq 18$ ) who had been on antiretroviral therapy for at least six months at Katsina General Hospital, Katsina were recruited. Participants' demographics, HIV characteristics, the presence of non-communicable diseases via self-report, from clinic folders and from measurement of their blood pressure on the day of interview and serum lipid profile, were evaluated. The magnitude of HIV and hypertension comorbidity was 28.5%. Old age, higher BMI, higher viral load, alcohol and duration on antiretroviral therapy were found to be factors associated with development of hypertension among HIV-positive adults. The prevalence of hypertension measured on the day of interview was greater than that found on self-report or reported in the clinic folder. Regular screening for the incidences of hypertension, addressing modifiable risk factors, and providing integrated care in the center would help improve the quality of life of comorbid patients.

**Keywords:** Non-communicable diseases, HIV, hypertension, comorbidity, Katsina

## 1.0 INTRODUCTION

### 1.1 Background

For over a decade, expanding access to antiretroviral therapy (ART) in sub Saharan Africa has led to the increase in the life expectancy of HIV patients. However, 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 and to the effect of HIV itself (Zenebework *et al.*, 2019). Recent studies have documented the effect of ART drugs to the cause of metabolic abnormalities including insulin resistance, dysglycemia, dyslipidemia and lipodystrophy that have impacted the basic health, economic system and in patients' life quality (Zenebework *et al.*, 2019). It was reported that premature death of about one-third of HIV patients occur as a result of HIV-NCDs comorbidity especially hypertension and other related cardiovascular disease (Olukemi *et al.*, 2021).

In Katsina State Nigeria, there is limited information on magnitude of prevalence of NCDs among people living with HIV especially HIV-hypertension comorbidity and little is known about the long term effect of ART. This work therefore seeks to bridge the gap by providing information especially on the prevalence of hypertension among the studied population with a view to provide possible means of improving diagnosis of non-communicable diseases among the studied population.

## 2.0 MATERIAL AND METHODS

### 2.1 Study Area

The study was conducted at antiretroviral therapy center in Katsina General Hospital, Katsina State, Nigeria. The center is a caring center for referred cases from private, primary and secondary health facilities within the state. Katsina city is headquarters of Katsina state populated mostly by Hausa/Fulani ethnic group.

## 2.2 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 were consented and recruited on clinic days at the ART center.

## 2.3 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 for the study.

## 2.4 Exclusion Criteria

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

## 2.5 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 hypertension previously reported 12.2%

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

d = degree of precision (0.05)

$$n = \frac{1.96^2 \times 0.122 \times 0.878}{0.025} = 165$$

In this study, the sample size was rounded up to 200 to increase the power of the study.

## 2.6 Recruitment and Interview

Recruitment was between 14<sup>th</sup> June 2021 and 30<sup>th</sup> August 2021. The study population was made up of HIV-infected subjects aged 18 years and above and on antiretroviral therapy for at least six (6) month at the ART center. During the period of data collection, as the patients arrived, staff transferred their clinic folder to the clinic reception, where they were screened and those eligible to participate were invited. Data on the patient's age, sex, marital status, occupation, current and past smoking and alcoholic habits, self-reported previously diagnosed hypertension comorbidity, physical activity, duration of infection and treatment were collected through administration of questionnaire. The questionnaire was designed in English, but Hausa

version of the questionnaire was presented to those that were not opportune to go through the formal education for appropriate response.

## 2.7 Diagnosis of Hypertension

Diagnosis of hypertension was carried out according to the guidelines set out by the World Health Organization (2023) for primary care. Hypertension was diagnosed based on blood pressure readings  $\geq 140$  and or  $\geq 90$ , diabetes diagnosed on the basis of fasting blood glucose measurement  $\geq 7.0$ mmol/L. Measurements of height and weight were taken using standing weighing scale and height, SECA GMBH, model 700.

## 2.8 Chemicals and Reagents

All the chemicals and reagents used in this study were of analytical grade.

## 2.9 Blood Sample Collection

Subjects were instructed to observe an overnight fast of about 8-12 hours in preparation for test procedure. Exactly 5ml of venous blood was drawn from the vein by a laboratory scientist for lipid profiles.

## 2.10 Blood Processing and Storage

Collected samples were centrifuged at 10000 rpm for 10 minutes and serum/plasma aspirated using a pipette into respective sample bottles and then stored at the chemical pathology unit of the hospital for biochemical analysis.

## 2.11 Biochemical Analyses

Serum total cholesterol, Triglyceride, HDL and LDL were determined using enzymatic method described by Allain *et al.* (1974), Burstein *et al.* (1970) and Friedewald *et al.* (1972).

## 3.0 RESULTS

### 3.1 Socio-Demographic of Study Participants

The participants for this research were made up of 43 (21.5%) male subjects and 157 (78.5%) female subjects (Table 1). Most of the participants, both male and female were in the 26-35 and 35-45 years 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 qualification. Exactly 55% of the participants were married. More than half of the participants were on very small scale businesses (60%); 15%

were public servants and the remainder were the students (1.5%) and house wives (2%).

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

Variable	Male	Female	Total
<b>Sex</b>	43(21.5)	157(78.5)	200(100.0)
<b>Age</b>			
18-25 yrs	4(2.0)	22(11.0)	26(13.0)
26-35 yrs	17(8.5)	62(31.0)	79(39.5)
36-45	13(6.5)	57(28.5)	70(35.0)
46-55	6(3.0)	12(6.0)	18(9.0)
>55	3(1.5)	4(2.0)	7(3.5)
<b>Marital status</b>			
Single	10(5.0)	8(4.0)	18(9.0)
Married	25(12.5)	76(38.0)	101(50.5)
Widow(er)	2(1.0)	46(23.0)	48(24.0)
Divorced	-	33(16.5)	33(16.5)
<b>Education</b>			
Qur'anic	8(4.0)	83(41.5)	91(45.5)
Primary	2(1.0)	23(11.5)	25(12.5)
Secondary	17(8.5)	45(22.5)	62(31.0)
Tertiary	10(5.0)	12(6.0)	22(11.0)
<b>Occupation</b>			
Public servant	11(5.5)	19(9.5)	30(15.0)
Business	19(9.5)	99(49.5)	118(59.0)
Laborer	4(2.0)	18(9.0)	22(11.0)
House wife & others	4(2.0)	20(10.0)	24(12.0)
Students	3(1.5)	3(1.5)	6(3.0)

### 3.2 Clinical characteristics of the subjects

The major clinical characteristics of the participants found in clinic folders were the duration of HIV infection, which also reflects the duration of ART and the viral load. Among the

study participants, viral load was undetected in 51.5% of the participants. Over half of the participants (55%) were on ART for over 7 years, 36(18%) were 4-6 years, 54 (27%) were 3 years and below (Table 2).

**Table 2: Clinical Characteristics of the Subjects**

Characteristics	Total (%)	Male (%)	Female (%)
<b>Duration on ART</b>			
<3 yrs	54(27.0)	11(5.5)	43(21.5)
4-6 yrs	36(18.0)	13(6.5)	23(11.5)
> 7 yrs	110(55.0)	19(9.5)	91(45.5)
<b>Viral load</b>			
Undetectable	103(51.5)	27(15.9)	76(45.8)
40-500 cp/ml	69(34.5)	12(6.0)	57(28.5)
500-1500 cp/ml	28(14.0)	4(2.0)	24(12.0)

ART: Antiretroviral therapy, Undetectable viral load: below 40 cp/ml.

### 3.3 Biochemical Indices of the Participants

Of the 200 participants, 39 had high cholesterol and triglyceride levels, 57 had high levels of LDL (Table 3), 57 were hypertensive (Table 3).

**Table 3: Characterization of subjects on lipid profile**

	Parameter (mmol/L)									
	TC			TG		LDL			HDL	
	≥5.2	<5.1	≥ 2.29	<2.2	<1.61	≥3.3	< 3.3	≥1.55	<1.55	<1.04
N (sample size)	39	161	39	117	44	57	143	96	47	57
Male	7	36	7	27	9	8	35	28	6	9
Female	32	125	32	90	35	49	108	68	41	

TC: Total cholesterol, TG: triglyceride, LDL: Low density lipoprotein, HDL: High density lipoprotein, TC ≥5.2: High cholesterol, <5.1: normal, TG ≥2.29: Hypertriglycerolemia, <2.2: risk of hypertriglycerolemia, < 1.61: normal, LDL ≥3.3: tendency of cardiovascular disease, <3.3: normal, HDL ≥1.55: normal/low tendency for cardiovascular disease,

1.04-1.55: may likely develop cardiovascular disease but normal presently, <1.04: hypertensive/cardiovascular problem.

**3.4 HIV-hypertension comorbidity**

Among the study participants, 17(8.5%) reported that they were hypertensive. During measurement of blood pressure, 57(27.5%) subjects were diagnosed with hypertension. Of the 200 study participants, 17(8.5%) reported that they were

diagnosed for hypertension in the center, during follow up. Of the 200 study participants, 13(6.5%) reported having a family history of hypertension while 15(7.5%) were hypertensive before being infected with HIV.

**Table 4: Prevalence of Hypertension Based on Self-report and Interview**

	Clinic folder	Self-report	Measurement	Family history	Hypertension before infection
Hypertension	Total (%)				
Yes	17(8.5)	17(8.5)	57(28.5)	13(6.5)	15(7.5)
No	183(91.5)	183(91.5)	143(71.5)	187(93.5)	185(92.5)

**3.5 Factors Associated with HIV-Hypertension Comorbidity**

Risk factors such as age, duration of ART treatment, alcohol, BMI value above 24.9 were the factors significantly associated with HIV-hypertension comorbidity (Table 5).

having hypertension was higher among the age groups between 35 years and 54 years and above respectively compared to the aged between 18 years and 34 years. The odds of having hypertension among patients having BMI 18.5-24.9 and greater were 2.5 to 4.2 times higher respectively, compared to those participants having a BMI less than 18.5. On the duration of ART treatment, the odds of having hypertension was lower among patients who took ART drug regimen of < 5 years.

Longer duration of exposure to ART (above 2 years), age, alcohol and BMI higher than 24.9 were the factors significantly associated with HIV-hypertension comorbidity. The odds of

**Table 5: Factors Associated With HIV-Hypertension Comorbidity**

Variables		Yes (%)	No (%)
Sex	Male	14(7.0)	29(14.5)
	Female	43(21.5)	114(57.0)
Age category	18-34	20(10.0)	63(31.5)
	35-54	36(18.0)	66(33.0)
	55+	6.0(3.0)	9.0(4.5)
Alcohol use	Yes	3.0(1.5)	1.0(0.5)
	No	55(27.5)	141(70.5)
Physical exercise	Yes	58(29.0)	136(68.0)
	No	-	6.0(3.0)
Duration on ART	5 yrs	11(5.5)	6.0(3.0)
	5-10 yrs	3(1.5)	21(10.5)
	>10 yrs	19(9.5)	101(50.5)
BMI	<18.5	9(4.5)	19(9.5)
	18.5-24.9	33(16.5)	103(51.5)
	≥ 30	15(7.5)	21(10.5)

BMI: Body mass index, ART: antiretroviral therapy, <18.5: underweight, 18.5-24.9: Normal BMI, 25+: Overweight/obese, BMI: Body Mass Index

**4.0 DISCUSSION**

The socio-demographic data of the study population show that more than 60% of the

population was young patients aged 26-45. This may be due to the fact that it is the most sexually active stage and mostly female. This study

suggest that females were three times more likely to have HIV infection than males. Probably, most of the male were either absent or died of the infection. The study agrees the findings of Zenebework *et al.* (2020) who found higher prevalence of HIV infected female than male population in Ethiopia. Another reason for the high number of HIV infected female in this study could be connected to the religious and cultural practice of the people of Katsina state, in which a man is allowed to marry more than one wife. Therefore, an infected man can infect all his wives. It could also be due to the marriage-test and send away habit of some males in the area. Another reason may be the events such as childbirth, child care, immunization and so on which give females more opportunity to be screened than their male counter parts.

On educational background of the participants however, the data collected showed that the participants are of various educational qualifications and background. The initial rejection of Western Education by the people of Katsina state could had been the reason the level of Qur'an education was high in most participants of the study. Perhaps, did not have the opportunity to go through the formal education process. The wide gap between the number of participants with Qur'anic education and those with post-secondary education explains the later acceptance of Western education in Katsina State which was confirmed by the number of primary and secondary leavers. The present study also suggests that married people are at high risk of contracting HIV infection. The culture of Katsina state encourages early marriage of both boys and girls, this is why a fairly large number of participants for this research were married.

Suppression of viral load is considered a key therapeutic target for HIV treatment and involves use of various classes of drugs mainly nucleoside reverse transcriptase inhibitors, integrase inhibitors and protease inhibitors (George *et al.*, 2019). The result of the present study found that majority of the patients had an undetectable viral load, suggesting the good action of the drugs in suppressing viral replication. This agrees with the findings from studies by Zenebework *et al.* (2020).

Body mass index of HIV patients on ART treatment have been shown to increase due to

improved health and nutrition (Zenebework *et al.*, 2020). In the present study (Table 5), most of the patients had normal BMI and nearly one third were overweight and or obese. This is consistent with findings from study of Zenebework *et al.* (2020). The number of underweight patients found in this study is closely similar to the report of Lelani *et al.* (2019) in Subsaharan Africa. Such underweight observed may be due to psychological stress that the patients suffer. It may also be due to insufficient intake of nutritionally adequate food associated with low socioeconomic status of the patients.

There was high proportion of participants with measured hypertension on the interview day without a previous diagnosis of hypertension. NCDs comorbidity is rapidly emerging in people living with HIV due to gain in weight, side effects of antiretroviral drugs and other factors (George *et al.*, 2019). The prevalence of hypertension in this study is closely similar to the total prevalence of hypertension in the general population where it was reported to be 32% world-wide (Nompumelelo *et al.*, 2019). This prevalence was consistent with that found in HIV-infected adults who had been on antiretroviral therapy (ART) for over 1 year (Sheila *et al.*, 2019). It also agrees with the findings of Dunstan *et al.* (2019) who found that a higher prevalence of non communicable diseases in HIV patients.

Comparing the hypertension comorbidity measurement between the HIV clinic folders and self-report, it was found that there was a lower level of comorbidity in the clinic folders than was self-reported on interview. Over three-fourth of the patients reported that they were not diagnosed for hypertension for even once during follow up of ART treatment which is a reflection of the absence of screening for NCDs. Inadequate and to some extent inaccurate self-report may be a factor. This may be due to low level of awareness of the diagnosis. The lack of integration between HIV and NCD healthcare systems at the time of this study is also a significant shield towards ascertaining NCD co-morbidity in this population group. Past studies have recognized under diagnosis of NCD alongside the scarcity of data on NCD in HIV-infected individuals (Dunstan *et al.*, 2019). The present study highlights the importance of integration of HIV and primary care systems to facilitate routine monitoring for

NCDs in HIV-infected patients in the center. The trending side effect of separation of healthcare in HIV infected patients is the separation of folders for HIV and other primary health care services such that decisions of HIV control from one clinic are likely not sent or communicated to the other. Therefore, strengthening the healthcare system through integration of care is needed in the center to enable sharing of clinic folders and implementation of active screening routinely for common NCDs in HIV-infected patients in the center. These measures and strategies could help ensure improved care for the patients in the center (WHO, 2023).

The present study highlights the importance of age, alcohol, BMI, ART treatment and viral load risk factors for comorbidity in the study population. Age, obesity, longer duration on ART and the type of ART regimen are predictors of HIV-hypertension comorbidity. Studies reported that the prevalence of hypertension increases when age increases. Overweight/obesity is one of the modifiable factors to development of hypertension in the subjects of the present study. This is consistent with previous findings of Chang *et al.* (2019). This may be due to alteration in metabolic processes. It may be that the patients are affected by the drugs. It has been documented that antiretroviral drugs causes accumulation of lipids, raised BMI and weight gain (Chang *et al.*, 2019). The elevated lipid profiles levels of the patients observed including plasma levels of cholesterol, triglycerides, LDL and functional HDL is consistent with findings of Zenebework *et al.* (2020). The elevated triglycerides, LDL and cholesterol levels observed may be connected to the effect of the drugs in promoting atherosclerosis. It may also be due to the enhanced biogenesis of lipids induced by the drugs. It could be due to the effect of the drugs on inhibition of lipoprotein lipase and consequently suppressed lipolysis.

Higher levels of alcohol consumption has been proven to impact T-cell function and worsen the immune profile due to increased exposure to pro-inflammatory cytokines (WHO, 2023). Data collected from the present study reported that 98% of the patients were on nucleoside transcriptase inhibitors and integrase inhibitors. These drugs were in use at the clinic and their side effects of dyslipidemia may increase the risk of hypertension. It is therefore recommended that

data on NCD risk factors such as smoking, alcohol consumption, BMI, physical inactivity be included in clinical data base/ folders to encourage routine monitoring and to inform clinical decision making such as choice of ART drug prescription.

Generally, patients on ART are expected to have at least one form of lipid abnormality (Chang *et al.*, 2019). The most commonly reported ones are increased TC, LDL, and TG. In this study, there was prevalence of dyslipidemia with elevated levels of TG, LDL and TC/HDL levels. This is consistent with findings from other studies in which ART treated subjects were found to have atherogenic lipid pattern and increased cardiovascular risk (Zhongfang *et al.*, 2021; Chang *et al.*, 2019). The prevalence of abnormal HDL levels found in this study was consistent with that reported in studies conducted by Eunice *et al.* (2022).

## 5.0 CONCLUSION

Non-communicable diseases especially hypertension and diabetes are common among the study subjects with older age, viral load, BMI and ART being the significant risk factors. There is the need for integrative health care system to ensure early diagnosis of non-communicable diseases to reduce the morbidity and mortality burden of HIV patients. Future research should focus on monitoring of ART to identify the effects as to whether it worsen diseases state or not.

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