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Evaluation of Smoking and Alcohol Consumption as Determinants of High Blood Pressure among People Living with HIV Receiving Antiretroviral Therapy in Zamfara

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Abstract

Non-communicable diseases have been reported among people living with HIV (PLWH). This cross-sectional study evaluated the role of smoking and alcohol consumption as potential determinants of high blood pressure among 424 PLWH receiving antiretroviral therapy (ART) in Zamfara. The study involved participants aged 18-60 years and above, with a higher female (70.3%) representation. Current smoking and alcohol use were recorded at 7.1% and 2.8% respectively, with higher rates among males. Meanwhile, the use of smokeless tobacco and exposure to second-hand smoke stood at 2.4% and 13.0% respectively. On average, systolic and diastolic blood pressure was found to be higher in males (128.8 and 86.1 mmHg respectively) than in females (125.0 and 85.3 mmHg respectively). Interestingly, raised blood pressure, defined as systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg, was observed more frequently in females (23.4%) than males (11.7%). This discrepancy may be due to a higher number of female participants or other unidentified factors. The data suggest that while smoking and alcohol consumption among the PLWH under ART in Zamfara are not rampant, there is a mild association with high blood pressure. Further research is required to clarify the relationships between these behaviours and high blood pressure in this population. Public health strategies targeting modifiable risk factors such as smoking and alcohol consumption may assist in managing high blood pressure among PLWH receiving ART.

Keywords*: Alcohol Consumption, Antiretroviral Therapy, HIV, High Blood Pressure, Smoking.*

Introduction

High blood pressure (Hypertension) is a crucial public health problem globally, affecting approximately 1.13 billion people [1]. It is a significant risk factor for cardiovascular disease (CVD), the leading cause of morbidity and mortality worldwide [2]. The prevalence of hypertension is steadily rising among people living with HIV (PLWH) due to extended lifespans made possible by highly effective antiretroviral therapy (ART) [3].

HIV infection is another global health challenge affecting nearly 38 million people as of 2019 [4]. HIV affects the immune system, making the individual susceptible to opportunistic infections. However, the advent of antiretroviral therapy (ART) has transformed HIV from a deadly disease to a chronic condition, leading to an increasing number of PLWH living longer [5].

However, HIV infection and ART have been associated with an increased risk of hypertension and other CVDs [6]. The prevalence of hypertension among PLWH ranges from 25% to 75% depending on the population and the definition of hypertension used [7]. This wide range indicates the need for

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additional research, particularly in populations and regions where data are currently lacking, such as Zamfara.

The prevalence of hypertension among PLWH is influenced by traditional risk factors such as age, gender, BMI, and race, as well as HIV-specific factors including duration of HIV infection, CD4 cell count, viral load, and use of certain antiretroviral medications [3,8]. Furthermore, lifestyle factors like smoking and alcohol consumption are also recognized as significant risk factors for hypertension among the general population [9].

Smoking and alcohol consumption are widely prevalent among PLWH, with rates significantly higher than the general population [10]. Both these lifestyle habits can exacerbate the risk of hypertension, thereby increasing the risk of CVD among PLWH [11,12]. Yet, the evaluation of these lifestyle factors as determinants of hypertension among PLWH, particularly those on ART, remains limited. There is a particular paucity of research focusing on developing countries, such as Nigeria and especially in regions like Zamfara. Thus, there is an urgent need to evaluate these factors to develop tailored hypertension prevention strategies for this vulnerable population.

Research Methodology

Study Area

This study was carried out at two tertiary centers in Gusau the capital city of Zamfara state in the northwestern region of Nigeria. Federal medical center and Yariman Bakura specialist hospital Gusau. The two tertiary hospitals are situated in Gusau the capital city and the administrative headquarters of Zamfara state, north-western Nigeria. The state has 14 local government areas, it covers a total surface area of 39,762 km^2 with coordinates 12°10′N 6°15′E and an estimated population of 3,278,873. The centers provide comprehensive HIV treatment, which includes HIV testing, and counselling (HTC), Adult and Pediatric antiretroviral treatment (ART) and prevention of mother-to-child transmission of HIV (PMTCT). As of the end of 2019, over 5000 patients were receiving HIV testing and treatment in these hospitals. The hospitals received technical support for the management of HIV/AIDs from Chemonics International and the Institute of Human Virology Jos.

Figure 1. Map of Zamfara State

Study Design

The study was a cross-sectional study design among PLWH attending ART clinics at federal medical centres Gusau and Yariman Bakura Specialist Hospital Gusau, Zamfara state Nigeria.

Study Population

The target populations are People living with HIV (PLWH) attending ART centres at federal medical centres Gusau and Yariman Bakura Specialist Hospital Gusau, Zamfara state Nigeria.

Inclusion Criteria

The participants who were considered for the study have met the following inclusion criteria.

1. Patients aged 18 years and above.
2. Patients who had received ART for more than 3 months.
3. Consented to participate in the study.

Exclusion Criteria

1. Patients physically or mentally unstable
2. Pregnant women or under 18 years

Sampling Technique

The sampling units or populations are People living with HIV/AIDs receiving ART at Federal Medical Centre Gusau and Yariman Bakura Specialist Hospital Gusau Zamfara. The Kish Leslie formula for descriptive studies was adopted to estimate the needed sample size to determine the prevalence of NCDs and identify risk factors among people with HIV/AIDs receiving ART at Federal Medical Centre and Yariman Bakura Specialist Hospital, Zamfara State. A prevalence of 50% was used to estimate the maximum sample size required.

$$\mathbf{n} = \frac{(\mathbf{Z^2 x\ P\ x\ Q})}{\mathbf{d^2}}$$

n: The required sample size

Z: standard normal value at 95% level of confidence (1.96)

P: Prevalence of the NCDs in HIV/AIDs patient selected is unknown (assuming 50%)

d: Allowing an error of 5%

Q: (1-P)

$\mathbf{n} = \frac{\mathbf{1.96^2 x\ 0.5\ x\ (1-0.5)}}{\mathbf{0.05^2}}$ = 385 patients or participants

The minimum sample size was 385 and was adjusted to 424 to account for a non-response rate of 10%.

A random sampling was used to select study participants. All Patients who reported to the twice-weekly ART clinics for follow-up visits were invited to participate in the study period (from April to May 2020). All patients who agreed to participate were required to complete an informed consent form which was administered by trained research assistants.

Instrumentation

The main instrument used for data collection was a structured questionnaire. This questionnaire was divided into sections that covered demographics, smoking and alcohol consumption habits, medical history, and blood pressure levels.

Validity of the Questionnaire

To ensure content and construct validity, the questionnaire was developed in collaboration with experts in HIV care, cardiology, and public health. A pilot study was conducted with a small subset of the population (n=30) to test the clarity and relevance of the questions. Their feedback was incorporated into the final version of the questionnaire.

Reliability of the Questionnaire

The reliability of the questionnaire was evaluated using Cronbach's alpha coefficient. This statistical measure assesses the internal consistency of a set of scale items. The Cronbach's alpha value for the questionnaire was found to be 0.85, indicating a high level of reliability and internal consistency.

Data Collection

The data for this study was collected by six trained data collectors using the slightly modified World Health Organization Stepwise approach questionnaire for non-communicable diseases surveillance. Experienced data collectors familiar with the HIV/AIDS clinic data were recruited and trained to conduct the interviews. Mostly, part-time staff working within the ART were used as research assistants (RAs). They have bachelor's degrees in health-related disciplines. Five data collectors and one supervisor were trained for a day at the ART clinic of FMC Gusau. The focus of the training was to understand the following: Overview of

the study, what the study was all about, conducting interviews, observing research ethics, introduction to the WHO steps questionnaire, doing a finger prick, how to take BP using automatic BP apparatus and keeping records. During the training mock interviews were conducted and physical measurements before the commencement of proper data collection.

Data Analysis

All study data was checked for accuracy, completeness and consistency at the end of each working day by the Principal Investigator, and any identified errors were corrected at the same time. Then an Excel table was created using the WHO steps questionnaire, and all the filled questionnaires were entered into the Excel sheet. Thereafter, the data was cleaned and imported into the SPSS (version 23) for Analysis.

Ethical Consideration

Relevant ethical clearance was obtained from the Zamfara State Ministry of Health Ethics Committee on research. The study procedure was explained to the patients and informed verbal consent was also obtained from each of the participants and participation was voluntary. The participants were free to withdraw from the study at any time without any adverse effect on their care. Confidentiality was maintained by using codes on questionnaires with no names and all information and completed questionnaires were kept in a locked safe accessible to only the researcher, the supervisor and examiners when needed.

Results

The results in table 1 shows the demographic distribution of the study's participants (n = 424). About 21.9% of the participants fall into the age group of 18-29, and 38.7% are in the age group of 30-39. Similarly, 29.7% of the participants are male, 70.3% are female. Table 2 shows the mean and standard deviation of the physical characteristics of the participants. The mean age of the participants is 37.29 years with a standard deviation of ±10.32. Table 3 shows the percentage of current smokers among the study participants, separated by gender and age group. Approximately 4.3% of the male participants in the 18-29 age group are current smokers. Table 4 displays the proportion of former smokers among the participants. The percentages are given by gender and by age group. Table 5 shows the proportion of participants who use smokeless tobacco. Again, this is broken down by gender and age group. Table 6 gives data on the proportion of participants exposed to second-hand smoke at home and at the workplace. The percentages are given by age group. Table 7 gives information on alcohol consumption among the participants. It gives the percentage of current drinkers and those who have consumed alcohol in the past 12 months, broken down by age group. Table 8 shows the mean systolic and diastolic blood pressure among participants, separated by gender. For example, the mean systolic blood pressure for males is 128.8 mmHg with a 95% CI (Confidence Interval) of 125.8-131.7. Table 9 presents the percentage of participants with raised blood pressure, defined as a systolic blood pressure greater than or equal to 140 mmHg or diastolic blood pressure greater than or equal to 90 mmHg. This is broken down by gender and age group.

Table 1. Socio-Demographic Distribution of Study Participants

Demographic Characteristics	**Frequency (n = 424)**	**Percentage (%)**
Age group		
18-29	93	21.9
30-39	164	38.7

40-49	108	25.5
50-59	44	10.4
≥ 60	15	3.5
Gender		
Male	126	29.7
Female	298	70.3
Ethnic group		
Hausa	321	75.7
Yoruba	41	9.7
Igbo	20	4.7
Others	42	9.9
Marital Status		
Never Married	35	8.3
Married	245	57.8
Separated	54	12.7
Divorced	19	4.5
Widowed	79	16.5
Cohabiting	1	0.2
Refused	0	0
Educational level		
No formal schooling	194	45.8
Primary school	45	10.6
Secondary school completed	131	30.9
College/University graduate	51	12.0
Postgraduate	2	0.5
Refused	1	0.2

Table 2. Mean and Standard Deviation of Physical Characteristics of Study Participants

Characteristics	**Frequency (n)**	**Mean**	**Standard deviation (SD)**
Age (years)	424	37.29	±10.32
Height (M)	424	1.65	±0.83
Weight (kg)	424	63.79	±14.26
BMI	424	24.88	±6.03
Systolic BP	424	126.13	±17.85
Diastolic BP	424	85.55	±13.96

Random Blood sugar (mmol/L)	424	5.92	±1.80

Table 3. Percentage of Current Smokers Among Study Participants

Variables	**Percentage of current smokers**								
	Male			**Female**			**Both sexes**		
Age group	n	% of Current smokers	95% CI	n	% of Current smokers	95% CI	n	% of Current smokers	95% CI
18-29	4	4.3	0.2 - 8.4	0	0.0	0.0 – 0.0	4	4.3	0.2 - 8.4
30-39	10	6.1	2.4 - 9.8	5	3.1	0.4 - 5.7	15	9.1	4.7 - 13.6
40-49	4	3.7	0.1 - 7.3	2	2.0	0.0 - 4.4	6	5.6	1.2 - 9.9
50-59	4	9.1	0.6 - 17.6	0	0.0	0.0 – 0.0	4	9.1	0.6 - 17.6
≥ 60	1	1.6	0.0 - 19.3	0	0.0	0.0 – 0.0	1	6.7	0.0 - 19.3
Overall	**23**	**5.4**	**3.3 - 7.6**	**7**	**1.7**	**0.4 - 2.9**	**30**	**7.1**	**4.6 - 9.5**

Table 4. Proportion of Former Smokers among PLWH in Zamfara om ART Treatment

Variables	**Percentage of former smokers**								
	Male			**Female**			**Both sexes**		
Age group	n	% of former smokers	95% CI	n	% of former smokers	95% CI	n	% of former smokers	95% CI
18-29	5	5.4	0.8 – 10.0	0	0.0	0.0 – 0.0	5	5.4	0.8 – 10.0
30-39	8	4.9	1.6 – 8.2	4	2.4	0.1 – 4.8	12	7.3	3.3 – 11.3
40-49	17	15.7	8.9 – 22.6	3	2.8	0.0 – 15.8	20	18.5	11.2 – 25.8
50-59	7	15.9	5.1 – 26.7	3	6.8	0.0 – 14.3	10	22.7	10.3 – 35.1
≥ 60	1	6.7	0.0 – 19.3	0	0.0	0.0 – 0.0	1	6.7	0.0 – 19.3
Overall	**38**	**8.9**	**6.2 – 11.7**	**10**	**2.4**	**1.0 – 3.8**	**48**	**11.3**	**8.3 – 14.3**

Table 5. Proportion of Participants Who Uses Smokeless Tobacco among PLWH in Zamfara om ART Treatment

Variables	**Percentage of smokeless tobacco use**

	Male			Female			Both sexes		
Age group	n	% of Smokeless tobacco used	95% CI	n	% of Smokeless tobacco used	95% CI	n	% of Smokeless tobacco used	95% CI
18-29	1	1.1	0.0 – 3.2	0	0.0	0.0 – 0.0	1	1.1	0.0 – 3.2
30-39	0	0.0	0.0 – 0.0	1	1.1	0.0 – 1.8	1	0.6	0.0 – 1.8
40-49	4	3.7	0.1 – 7.3	0	0.0	0.0 – 0.0	4	3.7	0.0 – 7.3
50-59	2	4.5	0.0 – 10.7	1	2.3	0.0 - 6.7	3	6.8	0.0 – 14.3
≥ 60	1	6.7	0.0 – 19.3	0	0.0	0.0 – 0.0	1	6.7	0.0 – 19.3
Overall	**8**	**1.9**	**0.6 – 3.2**	**2**	**0.5**	**0.0 – 1.1**	**10**	**2.4**	**0.9 – 3.8**

Table 6. Proportion of Second-Hand Smoking Exposure at Home and Workplace among PLWH in Zamfara on ART Treatment

Variables	**Percentage of second-hand smoking exposure at home and workplace**								
	Home			**Workplace**			**Both workplace and home**		
Age group	**n**	**% of second hand Exposure**	**95% CI**	**n**	**% of second hand Exposure**	**95% CI**	**n**	**% of second hand Exposure**	**95% CI**
18-29	10	10.8	4.5 – 17.1	5	5.4	0.8 – 10.0	1	1.1	0.0 – 0.0
30-39	30	18.3	12.4 – 24.2	14	8.5	4.3 – 12.8	11	6.7	2.9 – 10.5
40-49	10	9.3	3.8 – 14.7	7	6.5	1.8 – 11.1	4	2.4	0.1 – 4.8
50-59	4	9.3	3.8 – 14.7	6	13.6	3.5 – 23.8	4	9.1	0.6 – 17.6
≥ 60	1	6.7	0.0 – 19.3	3	20.0	0.0 40.2	1	6.7	0.0 – 19.3
Overall	**55**	**13.0**	**9.8 – 16.2**	**35**	**8.3**	**5.6 – 10.9**	**21**	**5.0**	**2.9 – 7.0**

Table 7. Percentage of alcohol consumption status among PLWH in Zamfara state

Age group	**N**	**Alcohol users**			**Alcohol users in past 12 months**		
		n	**% Current drinkers**	**95% CI**	**n**	**% consumed alcohol in past 12 months**	**95% CI**
18-29	93	1	1.1	0.0 -3.2	0	0.0	0.0 – 0.0
30-39	164	7	4.3	1.2 – 7.4	5	3.1	0.4 – 5.7
40-49	108	2	1.9	0.0 – 4.4	2	1.9	0.0 – 4.4
50-59	44	1	2.3	0.0 – 6.7	0	0.0	0.0 – 0.0
≥ 60	15	1	6.7	0.0 – 19.3	1	6.7	0.0 – 19.3
Total	**424**	**12**	**2.8**	**1.3 – 4.4**	**8**	**1.9**	**0.6 – 3.2**

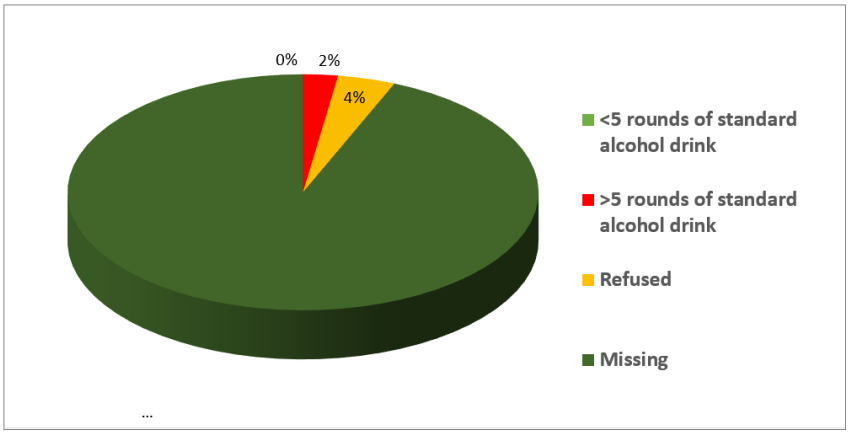

Figure 2. Frequency of Alcohol Consumption by Sex among Male Participants Who Drank in the Past 30 Thirty Days

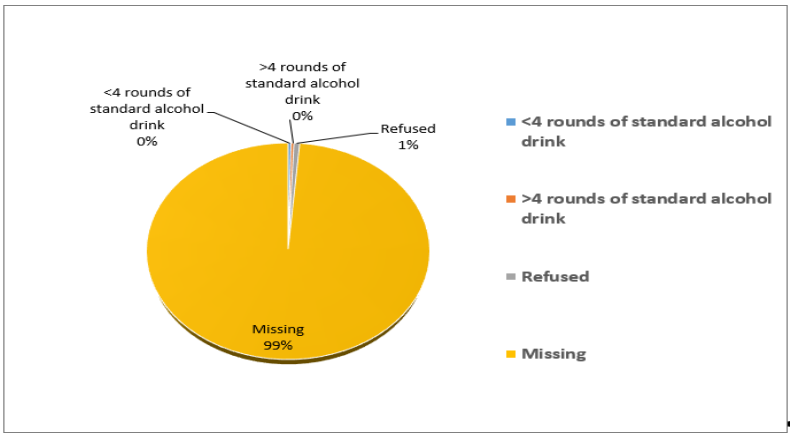

Figure 3. Frequency of Alcohol Consumption by Sex among Female Participants Who Drank in the Past Thirty Days

Table 8. Mean Blood Pressure Among PLWH in Zamfara State

Gender	Mean SBP (mmHg)	95% CI	Mean DBP (mmHg)	95% CI
Male	128.8	125.8-131.7	86.1	83.6-88.5
Female	125.0	122.9-127.1	85.3	83.7-86.9
Both sexes	**126.1**	**124.4-127.8**	**85.5**	**84.2-86.9**

Table 9. Percentage of Respondents with Raised Blood Pressured (systolic BP >=140 mm Hg &/or Diastolic BP >= 90 mmHg)

Variables	**Percentage of respondents with raised blood pressured (systolic BP>=140mmHg &/or Diastolic BP >= 90mmHg)**								
	Male			**Female**			**Both sexes**		
Age group	**n**	**% with Raised BP**	**95% CI**	**n**	**% with Raised BP**	**95% CI**	**n**	**% with Raised BP**	**95% CI**
18-29	5	4.0	0.6-7.4	14	4.7	2.3-7.1	19	4.5	2.5-6.5
30-39	12	9.5	4.4-14.7	44	14.8	10.7-18.8	56	13.2	10.0-16.4
40-49	16	12.7	6.9-18.5	26	8.7	5.5-11.9	42	10.0	7.1-12.8

50-59	11	8.7	3.8-13.7	12	4.0	1.8-6.3	23	5.4	3.3-7.6
≥ 60	5	4.0	0.6-7.4	3	1.0	0.0-2.1	8	1.9	0.6-3.2
Overall	**49**	**11.7**	**8.5-14.6**	**99**	**23.4**	**19.3-27.4**	**148**	**34.9**	**30.7-39.4**

Table 10. Factors Associated with Raised Blood Pressure Among PLWH in Zamfara State

Variables	**Adjusted Odds Ratio (AOR)**	**95% CI**
Current smoker	1.3	0.7 - 2.3
Former smoker	1.8	1.2 - 2.9
Smokeless tobacco user	0.9	0.5 - 1.8
Second-hand smoke exposure	1.4	0.9 - 2.1
Alcohol user	1.7	1.1 - 2.6
Age (years)		
30-39	1.2	0.8 - 1.9
40-49	1.5	1.1 - 2.2
50-59	1.6	1.2 - 2.4
≥ 60	2.3	1.6 - 3.4
BMI (kg/m^2)		
Overweight (25.0 - 29.9)	1.8	1.2 - 2.7
Obese (≥30.0)	2.6	1.8 - 3.8

Discussion

This study aimed to investigate the effects of smoking and alcohol consumption on blood pressure among individuals living with HIV receiving antiretroviral therapy in Zamfara, Nigeria. According to the World Health Organization, hypertension is one of the major causes of premature death worldwide, and its prevalence is escalating rapidly [1]. When it comes to individuals living with HIV, the issue becomes even more crucial due to the long-term side effects of antiretroviral therapy (ART), which include an increased risk of cardiovascular disease, of which hypertension is a major risk factor [13].

The results of this study suggest a complicated relationship between these variables, with multiple factors potentially contributing to the health outcomes observed. The demographic breakdown of participants (Table 1) indicates a predominantly female (70.3%) and Hausa (75.7%) cohort, with most people aged between 30-39 years (38.7%). The majority of participants (45.8%) had no formal schooling, which may have implications for understanding and managing their health conditions. This demographic spread is consistent with other studies conducted in similar regions [14].

The mean age, height, weight, BMI, systolic BP, diastolic BP, and random blood sugar of the study participants were relatively normal (Table 2). The mean BMI of the participants was 24.88, indicating a healthy average body weight for the cohort, according to the World Health Organization's BMI classifications [1]. However, the mean systolic and diastolic blood pressure values (126.13mmHg and 85.55mmHg, respectively) were marginally elevated, according to the American Heart Association's guidelines [15]. This is indicative of prehypertension. According to Chobanian *et*

al. [16], prehypertension is a systolic blood pressure from 120 to 139 mmHg or a diastolic blood pressure from 80 to 89 mmHg. This finding suggests a high prevalence of prehypertension among the PLWH receiving ART in Zamfara, which is consistent with prior studies [17,18].

One significant result presented in this study is the prevalence of smoking among PLWH receiving ART in Zamfara. The overall prevalence of current smokers is 7.1%. This rate is concerning for PLWH, as smoking significantly increases the risk of cardiovascular disease among this population [19]. It is observed that smoking prevalence is higher among males (5.4%) than females (1.7%). This result corroborates the existing literature which indicates that smoking rates are usually higher in males compared to females [20]. Smoking has been known to increase the risk of developing hypertension due to its effects on the cardiovascular system [21].

Furthermore, the study shows a higher prevalence of former smokers among participants aged 40-49 and 50-59, which reflects positively on the efforts to encourage smoking cessation among this population. The prevalence of smokeless tobacco use was found to be low (2.4%). Still, even smokeless tobacco can significantly contribute to hypertension and other cardiovascular diseases, emphasizing the importance of complete tobacco cessation [22].

The study also investigated secondhand smoking exposure; an important aspect as passive smoking can also lead to hypertension [23]. It was found that 13% of participants were exposed to secondhand smoke at home, 8.3% at the workplace, and 5% at both places. Such results align with a study by Anteneh *et al*. [24], who reported a relatively low prevalence of smoking among people living with HIV, but a high exposure to second-hand smoke.

In terms of alcohol consumption, the data indicated that a low proportion of participants (2.8%) were current drinkers, and fewer still had consumed alcohol in the past twelve months (1.9%). This low rate of alcohol consumption might be attributed to cultural and religious practices, as Islam – the predominant religion in Zamfara – prohibits alcohol consumption [25]. However, even moderate levels of alcohol consumption can have detrimental effects on the health of PLWH, including increased risk of adverse drug interactions, liver disease, and decreased adherence to medication [26,27].

Turning to blood pressure, male participants were found to have slightly higher mean systolic and diastolic blood pressure compared to female participants, aligning with global trends [28]. However, the study noted a higher percentage of female participants (23.4%) than male participants (11.7%) with raised blood pressure (systolic BP>=140mmHg &/or Diastolic BP >= 90mmHg).

The results of this study show a low prevalence of both smoking and alcohol consumption, which seems incongruent with the high rates of elevated blood pressure observed. Therefore, while both smoking and alcohol consumption can contribute to raised blood pressure [1], they may not be the primary determinants in this specific population. It should be noted that the associations between smoking, alcohol consumption, and high blood pressure among PLWH receiving ART are complex and can be influenced by a range of factors, including HIV-related inflammation, ART-related side effects, and traditional cardiovascular risk factors [6]. For instance, certain types of antiretroviral therapy have been linked to an increase in blood pressure [29]. Also, people living with HIV might experience high levels of stress, which has been identified as a risk factor for hypertension [30].

The factors significantly associated with raised blood pressure among PLWH in Zamfara State were found to be a former smoker (AOR: 1.8), alcohol user (AOR: 1.7), and age groups 40-49 (AOR: 1.5), 50-59 (AOR: 1.6), and ≥ 60 (AOR: 2.3) (Table 10). Furthermore, overweight (BMI 25.0 - 29.9 kg/m^2; AOR: 1.8)

and obese individuals (BMI ≥30.0 kg/m^2; AOR: 2.6) were more likely to have raised blood pressure. These findings are consistent with numerous studies that have established smoking, alcohol use, and obesity as significant risk factors for hypertension [31].

Conclusion

The present study highlights the interplay of various socio-demographic factors, lifestyle behaviours, and health parameters on blood pressure levels among HIV patients receiving antiretroviral therapy (ART). Notably, both smoking and alcohol consumption were found to contribute to the prevalence of raised blood pressure (BP) in this population. Moreover, smoking was more prevalent among males, while females constituted a larger proportion of the study participants. A significant portion of participants also reported exposure to second-hand smoke, which could further contribute to high BP. This study underscores the need for comprehensive health interventions targeting these risk behaviours among PLWH on ART treatment in Zamfara State.

Recommendations

Based on the results of this study, the following recommendations are made:

1. **Health education**: Initiatives should be taken to create awareness about the negative impacts of smoking and alcohol consumption on BP levels, particularly among HIV patients receiving ART. This can be done through community-based health education programs, workshops, and counselling sessions.
2. **Smoking cessation programs**: Given the high prevalence of smoking and second-hand smoking exposure, PLWH on ART should be encouraged to participate in smoking cessation programs. These programs should provide strategies to manage cravings and withdrawal symptoms and help individuals stay smoke-free.
3. **Alcohol reduction strategies**: PLWH consuming alcohol should be counselled about the potential dangers of alcohol consumption on their BP levels and overall health. Safe limits of alcohol consumption should be emphasized, and support should be given to help individuals reduce or stop alcohol consumption.
4. **Routine monitoring of BP**: Regular monitoring of BP among PLWH on ART should be ensured. This can help in the early detection and management of high BP, thus preventing potential complications.
5. **Addressing socio-demographic disparities**: There is a need to address disparities in smoking and alcohol consumption rates among different age groups, genders, and ethnic groups. Tailored interventions should be designed to cater to the unique needs and challenges of each group.
6. **Research**: Further research should be conducted to understand the underlying mechanisms connecting smoking, alcohol consumption, and high BP among PLWH. This could inform the development of more effective preventive and therapeutic strategies.

Conflict of Interest

Authors declared that no conflict of interest exist in this study and publication.

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