Texila International Journal of Academic Research
ISSN: 2520-3088
DOI: 10.21522/TIJAR.2014.12.04.Art017

Socio-Demographic Predictors of non-communicable Diseases among People Living with HIV on ART in Enugu, Southeast Nigeria

Douglas Akpu-Agbata
Department of Public Health, Texila American University, Guyana

Abstract

Human Immunodeficiency Virus remains a major global health burden, with millions affected worldwide. Although Antiretroviral Therapy (ART) has reduced HIV-related deaths, its long-term use has been associated with the development of non-communicable diseases (NCDs). This study investigated socio-demographic predictors of NCDs among People Living with HIV (PLHIV) on ART in Enugu, Southeast Nigeria. A hospital-based cross-sectional design was employed to abstract data on socio-demographic characteristics, prevalence, and risk factors among PLHIV aged ≥18 years. Data were analyzed using IBM SPSS Statistics 25, with results presented as frequencies, percentages, and mean ± standard deviation. Logistic regression was applied to generate adjusted odds ratios (AOR) with p-values ≤0.05 at 95% confidence interval. Findings showed that age, marital status, education, and occupation significantly predicted NCD onset. Participants aged 41–60 years were four times more likely to develop hypertension (AOR: 4.47; CI: 3.32–6.18). Being married increased the likelihood of developing any NCD, while secondary education was strongly associated with hypertension (AOR: 4.52; CI: 3.34–5.94) and diabetes (AOR: 2.55; CI: 1.97–3.02). Unemployment also predicted hypertension (AOR: 3.72; CI: 1.32–3.08). Female participants had higher likelihood of hypertension, obesity, and cervical cancer than males. These results highlight the critical role of socio-demographic factors in NCD development among PLHIV on ART. The study underscores the importance of incorporating targeted, context-specific interventions that address socio-economic determinants in HIV care to reduce NCD comorbidities and improve quality of life of affected individuals.

Keywords*: Antiretroviral Therapy, Human Immunodeficiency Virus, Non-communicable Disease, Predictors, Socio-demographics.*

Introduction

According to WHO, approximately 38.4 million people were reported living with HIV globally at the turn of 2021 [1]. Out of this global estimate, Nigeria has an HIV prevalence of 4.1% and presently about 3.6 million people are living with HIV/AIDS [2], making the country second only to South Africa with largest number of people living with HIV (PLHIV).

Although antiretroviral therapy (ART) has been shown to be effective in HIV, expanded access to treatment has exposed PLHIVs to challenges including increase in comorbidity of non-communicable diseases (NCDs) such as hypertension, diabetes, obesity, cardiovascular disease (CVD) and cancer [3]. This increased incidence of NCD comorbidity in HIV accounts for approximately 70% of global deaths annually [4] posing challenging concerns of reduced quality of life among others. Consequently, on the other hand, [3] argued that the use of ART has resulted in decrease in the annual number of HIV-related deaths and new infections in sub-Saharan Africa but with an attendant increase in ageing HIV-infected population [5, 6].

Received: 02.09.2025 ***Accepted: 24.09.2025*** ***Published on: 31.10.2025***
Corresponding Author: ifydouglas@gmail.com

Studies have linked NCDs and aging in PLHIVs [7, 8]. Similarly, prevalence of NCD risk factors have been reported to include smoking, alcohol or drug use, comorbid HPV infection and lower socio-economic status [9, 10], which impact development of NCD but limited data exist on the effect of socio-demographic factors as risk factors or predictors of NCD development in PLHIV on ART use. Further, antiretroviral therapy drugs have been reported to increase risk of abdominal fat, hypercholesterolemia and metabolic fat [11, 12] increasing the risk for developing chronic illnesses such as diabetes mellitus and cardiovascular diseases. Additionally, the increased activation of the immune system and secretion of inflammatory cytokines results in higher risk for atherosclerosis and inflammation [8].

Nonetheless, as public health concerns increase regarding NCD development in PLHIVs on ART, demographic studies which focus on social and economic dimensions of HIV-NCD comorbidity are lacking. Hence, studying this perspective has become a top priority of public health specialists to provide information for policymakers to better manage the intersection of HIV and NCDs. In this light, the present study aimed to investigate socio-demographic characteristics as predictors of NCD in PLHIVs on ART in Enugu, Southeast Nigeria.

Methodology

Study Design

This study employed a hospital-based cross-sectional study design to investigate prevalence and risk factors of non-communicable diseases (NCDs) among people living with HIV (PLHIV) of age ≥18yrs on Antiretroviral Therapy (ART) in Enugu, Southeast Nigeria.

Study Area

The study was conducted in Enugu state located in the southeastern Nigeria (Latitude: 6.5° N and Longitude: 7.5° E) [13]. Geographically, Enugu state is a tropical savanna climate with a topography marked by several rivers as well as characterized by its hills, valleys and plateaus. It is further bounded to the north by Kogi and Benue States, to the south by Abia State, to the east by Ebonyi State, and to the west by Anambra State. The state's health sector is comprised of two tertiary health facilities namely University of Nigeria Teaching Hospital (UNTH) in Ituku-Ozalla and the Enugu State University Teaching Hospital (ESUTH) in Parklane. In addition, the state has a number of private healthcare facilities, offering additional options for patients [14, 15].

Study Site

The study was conducted in health facilities randomly selected that provide HIV care and treatment in the state.

Study Population

The study was conducted among People living with HIV (PLHIV) age ≥18yrs, initiated on ART in Enugu State, Nigeria.

Sample Size Determination

The estimated number of mothers recruited for the study was determined using the sample size formula for estimation of single proportion.

$$\boldsymbol{N = \frac{Z^2 pq}{d^2}.}$$

Where Z = 1.96 (standard normal deviate); p = 50% = 0.50 (assumed prevalence of NCDs among PLHIV in South East Nigeria), q = 1-p; and d = Level of precision set at 0.05 (95% confidence interval)

$$N = ((1.96)^2 * 0.5 * 0.5))/0.05\text{^}2$$

$$N = 384.16$$

$$\boldsymbol{Non - response\ rate = \frac{n}{1-Q}.}$$

Q = proportion of non-response = 10%

$$Non - response\ rate = \frac{n}{1 - \left(\frac{10}{100}\right)}.$$

$$= \frac{384}{1 - \left(\frac{10}{100}\right)}$$

$$= 426.6.$$

Therefore, final sample size was approximated to be equal to 427.

Sampling Procedure

Multi-stage sampling technique was employed to select local government areas (LGAs), health facilities and eligible clients that took part in the study. The multi-stage technique included three stages in which a sample frame of all LGAs in each senatorial zone were obtained and simple random sampling was used to select LGAs of study. In stage two, a sample frame of all health facilities providing HIV care and treatment services in each selected LGA was developed before simple random sampling was employed to select health facilities. In stage three, proportional allocation was utilized to determine the number of clients to participate in the study. A sample frame of all eligible patients receiving HIV care and treatment was further developed.

Eligibility Criteria

The following criteria guided the inclusion and exclusion of participants into the study:

Inclusion Criteria

1. People living with HIV (PLHIV) aged ≥18 years and are currently engaged in HIV and care and treatment at the time of the study.
2. People living with HIV (PLHIV) who have been on ART for at least six months and actively engaged in HIV and care and treatment at the time of the study.
3. People living with HIV (PLHIV) on HIV care and treatment who are willing to participate and provide informed consent.

Exclusion Criteria

1. People living with HIV (PLHIV) who are not on ART.
2. People living with HIV (PLHIV) who are below 18 years of age.
3. People living with HIV (PLHIV) on HIV care and treatment who do not consent to participate in the study.

Instrument for Data Collection

A medical health informatics script was designed and used to retrieve client level information of study participants from the hospital based electronic medical records (EMR). Clinical chart abstraction was carried out to obtain clinical, socio-demographic, NCDs records and treatment information of study participants not originally captured on the EMR.

Data Collection Method

Research assistants were recruited in the study sites, trained on use of data instruments prior to field visit and then deployed to collect data based on the items of the data collection tool. This process was facilitated by the lead researcher and trained health educators with sound knowledge of the subject theme.

Data Management and Analysis

Data was entered into and analyzed using IBM SPSS Statistics 25 software. Continuous variables were presented as mean ± standard deviation if normally distributed. Adjusted odd ratios (AOR) were used to express predicted values of socio-demographic characteristics using logistic regression analysis and *p* values less than or equal to 0.05 were considered significant at 95% confidence interval.

Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Committee, UNTH Ituku/Ozalla, Enugu and permission was granted by the Hospital management of the selected health facilities where the study took place. Informed consent was obtained from individual study participants as much as confidentiality, anonymity, privacy and security of the participants' information were assured including option of voluntary exit from study.

Results

Socio-demographic characteristics of PLHIVs with NCDs

The socio-demographic characteristics of the study participants are presented in the table below. A total of 8182 abstracted patient records were analyzed and over two-thirds of records (4325) were women while 690 were men representing PLHIVs on ART with evidence of any NCD. At the time of data abstraction, approximately half (50.2%) of patients were aged between 41 and 60 years where women were more likely to be in age group (p = 0.001). The majority (64.9%) of patients were married with over half (55.1%) of the women being in this category (p = 0.001). Further, at time of abstraction, 12.1% were single, 14.3% were never married, 5.2% were widowed, 1.1% were divorced while 0.3% were cohabiting with more women than men (p = 0.01) being in any marital status in this study cohort. While 7.2% of study participants had no formal education, over half (59.7%) had their education up to secondary level with 18.3% and 12.4% up to primary and tertiary education respectively. There was a significant difference (p = 0.001) between the educational levels as well as notable significant difference (p = 0.01) between men and women in formal education in the study cohort. Majority (65.5%) of the patients were employed while 29.6% were unemployed with more women likely to be in formal or informal employment than men (p = 0.01). In this cohort, 61.3% of patients had initiated ART by the time of data abstraction, with no significant differences by sex (p = 0.57). Just over half of the patients in the cohort had been initially enrolled in care between 01 January 2006 to 30 April 2024 (55.3%). No differences were observed by sex across the guideline enrollment periods (p = 0.070).

Table 1. Socio-demographic Characteristics of PLHIVs with NCDs

Variable	Hypertension		Diabetes		Obesity		Cervical cancer	
	Frequency (*f*)	Percentage (95% CI)	Frequency (*f*)	Percentage (95% CI)	Frequency (*f*)	Percentage (95% CI)	Frequency (*f*)	Percentage (95% CI)
Gender								
Female	710	62.06 (58.76 – 67.71)	54	66.67 (59.91 – 72.83)	681	74.83 (70.92 – 78.31)	2880	100
Male	434	37.93 (35.43 – 43.32)	27	33.33 (29.82 – 37.43)	229	25.16 (21.42 – 29.33)	-	0
Age								
0-20	2 (1M, 1F)	0.17 (M: 0.08 [0.05 – 0.11]; F: 0.08 [0.05 – 011])	-	-	4 (2M, 2F)	0.44 (M: 0.22 [0.09 – 0.34]; F 0.22 [0.09 – 0.34])	38	1.32 (0.86 – 1.73)
21-40	238 (65M, 173F)	20.80 (M: 5.68 [2.34 – 8.31]; F: 15.12 [11.18 – 18.23])	13 (1M, 12F)	16.04 (M: 1.23 [0.98 – 1.75]; F: 14.81 [11.81 – 16.72])	350 (68M, 282F)	38.50 (M: 0.07 [0.02 – 0.10]; F: 30.98 [27.27 – 34.81])	1650	57.29 (53.18 – 64.22)

41-60	765 (299M, 466F)	66.87 (M: 26.13 [21.04 – 29.72]; F: 40.73 [37.27 – 44.73])	52 (19M, 33F)	64.19 (M: 23.45 [19.97 – 27.84]; F: 40.74 [38.82 – 47.94])	509 (141M, 368F)	55.93 (M: 15.49 [12.93 – 19.41]; F: 40.43 [34.62 – 47.35])	1192	41.39 (36.63 – 38.91)
61-80	138 (69M, 69F)	12.06 (M: 6.03 [4.84 – 7.02]; F: 6.03 [4.84 – 7.02])	15 (7M, 9F)	18.51 (M: 8.64 [5.73 – 10.02]; F: 11.11 [7.92 – 14.94])	47 (18M, 29F)	5.16 (M: 1.97 [1.23 – 2.24]; F: 3.18 [2.24 – 5.21])	-	-
81-100	1 (1F)	0.09 (0.02 – 0.11)	-	-	-	-	-	-
Marital status								
Single	124 (49M, 74F)	10.83 (M: 4.28 [2.97 – 5.01]; F: 6.46 [3.27 – 7.28])	3 (1M, 2F)	3.70 (M: 1.23 [0.97 – 1.42]; F: 2.46 [1.72-2.83])	109 (26M, 83F)	11.97 (M: 2.85 [2.01 – 3.24]; F: 9.12 [6.83 – 13.44])	372	12.91 (8.81 – 15.57)
Married	747 (312M, 435F)	65.29 (M: 27.27 [24.23 – 30.01]; F: 38.02 [31.07 – 44.67])	65 (26M, 39F)	80.24 (M: 32.09 [28.07 – 36.92]; F: 48.14 [42.16 – 54.11]	606 (155M, 451F)	66.59 (M: 17.03 [12.07 – 20.01]; F: 49.56 [42.32 – 55.84]	1840	63.88 (59.91 – 72.83)
Never married	150 (46M, 104F)	13.11 (M: 4.02 [2.12 – 4.95]; F: 9.09 [7.68 – 11.21])	7 (7F)	8.64 (4.77 – 9.68)	122 (35M, 87F)	13.40 (M: 3.84 [1.87 – 4.33]; F: 8.90 [5.25 – 11.27]	438	15.21 (12.87 – 18.91)
Widow/er	79 (11M, 68F)	6.91 (M: 0.96 [0.42 – 1.12]: F: 5.94 [3.98 – 7.28])	5 (5F)	6.17 (3.23 – 8.05)	32 (3M, 29F)	3.51 (M: 0.32 [0.27 – 0.63]; F: 3.18 [1.24 – 6.23])	145	5.03 (2.25 – 7.32)
Divorced	16 (7M, 9F)	1.39 (M: 0.61 [0.32 – 0.84]; F: 0.78 [0.44 – 0.92])	-	-	9 (2M, 7F)	0.98	30	1.04
Separated	3 (1M, 2F)	0.26 (M: 0.08 [0.04 – 0.09]; F: 0.17 [0.12 – 1.02])	-	-	1 (1F)	0.11 (0.08 – 0.21)	11	0.38 (0.13 – 0.52)
Cohabiting	-	-	-	-	1 (1M)	0.11 (0.09 – 0.15)	7	0.24 (0.19 – 0.37)
Unknown	25 (8M, 17F)	2.18 (M: 0.70 [0.32 – 0.84];	1 (1F)	1.23 (1.10 – 1.47]	30 (7M, 23F)	3.29 (M: 0.76 [0.52 – 1.13]; F:	37	1.28 (1.14 – 1.42)

		F: 1.48 [0.97 – 1.73])				2.52 [1.93 – 2.83]		
Education level								
No formal education	94 (16M, 78F)	8.21 (M: 1.39 [0.72 – 1.51]; F: 6.81 [4.21 – 7.89])	8 (3M, 5F)	9.87 (M 3.70 [1.28 – 5.03]; F 6.17 [3.11 – 8.13])	59 (13M, 46F)	6.48 (M 1.42 [1.12 – 2.11]; F 5.05 [2.15 – 8.01])	200	6.94 (4.47 – 8.83)
Primary	186 (74M, 112F)	16.25 (M: 6.46 [4.32 – 9.48] F: 9.96 [7.82 – 11.02])	19 (6M, 13F)	23.45 (M: 7.41 [5.32 – 9.44]; F: 16.04 [12.43 – 20.95])	107 (30M, 77F)	11.75 (M 3.29 [1.19 – 5.83]; F 8.46 [7.72 – 10.02])	607	21.07 (18.98 – 24.74)
Secondary	675 (274M, 401F)	59 (M: 23.95 [20.03 – 27.88]; F: 35.05 [30.04 – 38.73])	36 (12M, 24F)	44.44 (M: 14.81 [12.93 – 17.57]; F: 29.63 [21.76 – 34.65])	548 (139M, 409F)	60.22 (M 15.27 [11.34 – 18.55]; F 44.94 [38.91 – 47.87])	1733	60.17 (54.54 – 71.83)
Tertiary	165 (57M, 108F)	14.42 (M: 4.98 [3.32 – 6.08]; F: 9.44 [6.47 – 12.03])	17 (5M, 12F)	20.98 (M: 6.17 [4.54 – 8.98]; F: 14.81 [10.23 – 17.87])	176 (42M, 134F)	19.34 (M 4.61 [2.32 – 7.72]; F 14.72 [10.08 – 16.38])	265	9.20 (6.71 – 12.23)
Other	11 (6M, 5F)	0.96 (M: 0.52 [0.33 – 0.81]; F: 0.44 [0.17 – 0.73])	1 (1M)	1.23 (0.72 – 1.45)	12 (2M, 10F)	1.31 (M 0.21 [0.19 – 0.42]; F 1.09 [0.88 – 1.34])	39	1.35 (0.76 – 1.89)
Unknown	13 (7M, 6F)	1.14 (M: 0.61 [0.33 – 0.87]; F: 0.52 [0.24 – 0.77])	-	-	8 (3M, 5F)	0.87 (M 0.32 [0.11 – 0.64]; F 0.55 [0.27 – 0.71])	36	1.25 (0.92 – 1.41)
Occupation								
Employed	765 (318M, 447F)	66.87 (M: 27.7 [23.02 – 31.75]; F: 39.07 [33.07 – 43.13])	49 (20M, 29F)	60.49 (M: 24.69 [18.13 – 28.76]; F: 35.80 [29.43 – 41.12])	626 (180M, 446F)	68.79 (M: 19.78 [15.47 – 22.03]; F: 49.01 [43.43 – 54.65])	1846	64.09 (59.01 – 67.58)
Business	-	-	-	-	-	-	3	0.10 (0.07 – 0.13)
Student	23 (7M, 16F)	2.01 (M: 0.61 [0.36 – 0.93]; F: 1.39 [1.15 – 1.77])	-	-	32 (8M, 24F)	3.51 (M: 0.88 [0.54 – 1.23]; F: 2.64 [1.12 – 3.07])	96	3.33 (1.34 – 5.67)

Trader	1 (1F)	0.08 (0.01 – 0.10)	-	-	1 (1F)	0.11 (0.07 – 0.14)	-	-
Retired	11 (5M, 6F)	0.96 (M: 0.43 [0.15 – 0.78]; F: 0.52 [0.38 – 0.84])	3 (3F)	3.70 (1.32 – 5.62)	3 (2M, 1F)	0.33 (M: 0.22 [0.10 – 0.39]; F: 0.11 [0.09 – 0.35])	1	0.03 (0.01 – 0.05)
Unemployed	328 (97M, 231F)	28.67 (M: 8.48 [6.32 – 12.09]; F: 20.19 [17.31 – 22.72])	28 (7M, 21F)	34.56 (M: 8.64 [3.33 – 9.74]; F: 25.92 [17.82 – 27.94])	235 (37M, 198F)	25.82 (M: 4.07 [1.34 – 6.77]; F: 21.75 [19.35 – 24.33])	896	31.11 (26.87 – 37.78)
Unknown	16 (7M, 9F)	1.39 (M: 0.61 [0.32 – 0.91]; F: 0.78 [0.44 – 0.96])	1 (1F)	1.23 (0.94 – 1.47)	13 (3M, 10F)	1.42 (M: 0.33 [0.14 – 0.73]; F: 1.09 [0.97 – 1.37])	38	1.32 (0.90 – 1.64)
Total	1144	100	81	100	910	100	2880	100

Predictors of non-communicable diseases among PLHIVs on ART in Enugu, Nigeria

The table below presents the predictors of non-communicable disease among PLHIVs on ART in the study area. The significant predictors were age, marital status, education level and being unemployed. The findings of the present study revealed no association between gender and prediction of any known NCD in the sample study population. However, study participants of age 41 – 60 were 4.47 times more likely of developing hypertension, found to be significantly different ($p < 0.05$), than any other NCD in this cohort study. Moreso, female participants aged 21 – 40 and 41 – 60 were 3.37 and 2.44 times more likely to develop cervical cancer than any other age group in the cohort respectively. These were observed to be significantly different at the 95% confidence interval. Similarly, being married predicted the likelihood of developing any known NCD except cervical cancer in this cohort study, with values found to be significantly different ($p < 0.05$). Interestingly, being widowed was shown to be 2.38 times more likely to predict onset of diabetes in participants on ART regardless of gender and age. This was also found to be significantly different ($p < 0.05$). Furthermore, secondary school education was shown to be 4.52 and 2.55 times more likely to predict development of hypertension and diabetes respectively in the study participants indicating a significant difference in this likelihood of NCD onset in the study cohort. In the same vein, being unemployed was 3.72 times more likely to predict onset of hypertension among PLHIVs on ART in the study cohort in the study area. This was observed to be significantly different ($p < 0.05$).

Table 2. Predictors of NCDs among PLHIVs on ART in Enugu, Southeast Nigeria

Variable	Hypertension		Diabetes		Obesity		Cervical cancer	
	AOR (95% CI)	*p*-value	AOR (95% CI)	*p*-value	AOR (95% CI)	*p*-value	AOR (95% CI)	*p*-value
Gender								
Female	3.11 (1.05 – 4.71)	0.07	2.32 (1.15 – 3.57)	0.95	1.23 (1.01 – 3.84)	0.47	12.03 (8.48 – 14.23)	0.82
Male	1.22 (0.93 – 2.25)	0.92	1.03 (0.88 – 4.11)	0.12	0.85 (0.33 – 1.42)	0.35	-	-
Age								
0-20	1.32 (0.34 – 1.87)	0.63	-	-	1.13 (0.81 – 1.72)	0.08	2.32 (1.07 – 3.54)	0.05
21-40	3.12 (1.57 – 4.02)	0.57	2.24 (1.38 – 3.07)	0.09	0.73 (0.54 – 1.21)	0.43	3.37 (2.03 – 4.19)	0.01
41-60	4.47 (3.32 – 6.18)	0.03	1.11 (0.91 – 1.35)	0.07	0.96 (0.33 – 1.02)	0.67	2.44 (1.79 – 3.43)	0.03
61-80	1.07 (0.94 – 2.22)	0.92	1.08 (0.83 – 1.17)	0.55	0.12 (0.06 – 0.53)	0.17	-	-
81-100	0.12 (0.06 – 0.24)	0.15	-	-	-	-	-	-
Marital status								
Single	2.34 (1.03 – 4.32)	0.12	2.55 (1.23 – 4.05)	0.11	1.39 (1.09 – 2.54)	0.24	2.57 (1.32 – 4.84)	0.42
Married	3.72 (1.17 – 5.17)	0.03	3.57 (1.18 – 4.40)	0.03	3.42 (1.15 – 5.32)	0.02	1.56 (0.77 – 1.94)	0.21
Never married	1.03 (0.82 – 2.17)	0.52	1.17 (0.92 – 2.33)	0.83	1.19 (0.87 – 2.03)	0.49	0.43 (0.16 – 1.03)	0.07
Widow/er	2.44 (1.14 – 3.05)	0.14	2.38 (1.29 – 3.52)	0.04	2.05 (1.12 – 4.34)	0.08	1.35 (1.01 – 2.14)	0.10
Divorced	1.13 (0.73 – 1.54)	0.23	-	-	1.37 (1.01 – 2.34)	0.51	2.32 (1.42 – 2.56)	0.40
Separated	0.79 (0.09 – 2.11)	0.48	-	-	2.67 (1.04 – 4.45)	0.92	1.25 (1.01 – 1.78)	0.06
Cohabiting	-	-	-	-	1.24 (0.98 – 1.53)	0.11	2.17 (1.40 – 3.84)	0.08
Unknown	2.53 (1.17 – 3.74)	0.57	1.54 (1.23 – 2.41)	0.91	2.33 (1.08 – 3.11)	0.72	1.33 (1.02 – 2.04)	0.10
Education level								
No formal education	0.72 (0.43 – 0.98)	0.14	1.21 (0.94 – 2.12)	0.07	0.13 (0.09 – 1.30)	0.23	0.23 (0.09 – 1.14)	0.12
Primary	1.13 (0.65 – 1.57)	0.39	0.53 (0.31 – 0.74)	0.47	0.77 (0.32 – 1.01)	0.40	0.14	0.31
Secondary	4.52 (3.34 – 5.94)	0.02	2.55 (1.97 – 3.02)	0.03	2.11 (1.05 – 2.78)	0.14	1.03 (0.59 – 2.02)	0.63

Tertiary	2.35 (1.56 – 3.01)	0.51	1.01 (0.75 – 1.32)	0.71	1.79 (1.07 – 2.33)	0.19	0.71 (0.33 – 0.92)	0.44
Other	1.47 (1.11 – 1.93)	0.06	2.33 (1.03 – 3.32)	0.32	2.13 (1.77 – 2.54)	0.09	1.13 (0.82 – 1.58)	0.09
Unknown	0.52 (0.21-0.88)	0.30	-	-	1.17 (0.83 – 1.45)	0.62	0.56 (0.23 – 1.98)	0.11
Occupation								
Employed	3.44 (1.23 – 3.72)	0.05	2.36 (1.47 – 3.14)	0.89	1.47 (1.01 – 2.03)	0.05	0.37 (0.11 – 0.78)	0.51
Business	-	-	-	-	-	-	0.35 (0.14 – 0.53)	0.07
Student	0.95 (0.31 – 1.02)	0.09	-	-	0.14 (0.09 – 1.33)	0.08	1.12 (0.78 – 1.74)	0.32
Trader	0.12 (0.07 – 0.42)	0.14	-	-	0.31 (0.24 – 0.59)	0.06	-	-
Retired	0.78 (0.49 – 1.12)	0.68	2.33 (1.37 – 4.32)	0.34	1.05 (0.32 – 1.82)	0.13	1.12 (0.11 – 2.49)	0.73
Unemployed	3.72 (1.32 – 3.08)	0.01	1.14 (1.03 – 3.04)	0.22	2.32 (1.03 – 3.43)	0.71	0.32 (0.14 – 0.83)	0.48
Unknown	2.11 (1.42 – 3.14)	0.70	0.57 (0.12 – 0.92)	0.08	1.17 (0.72 – 2.01)	0.06	1.46 (0.97 – 3.07)	0.07

Discussion

The study profiled the socio-demographic characteristics of the participants in the study area highlighting the importance of the social and economic determinants in influencing the risk for development of NCDs and its prevalence. From the findings, females (86.2%) were more than males (13.8%) in the abstracted data of PLHIVs on ART with 62.1% (95% CI: 58.76 – 67.71) representing their total number of females in the research study. Stratified by NCD, the data revealed more females in the cohort than the males. This trend could be explained by the fact that the health-seeking behaviour of men in the study area may be an underlying factor for the low turn-out of men for help concerning their health issues. Health-seeking behaviours of individuals go a long to enable proper documentation of debilitating ailments as well as facilitate enhanced treatment protocols for the individuals. Marital status has been shown to be an important indicator in the health outcomes of HIV-affected individuals as spousal support can drastically improve adherence to treatment regimens, clinic visits and increased laboratory testing for any comorbidities. In the current study, married participants for any NCD group were observed to be more in the present cohort of participants indicating that support from spouses can increase reporting of NCD/HIV comorbidity and thus improve quality of life. Education level has been demonstrated to inform one's health decisions, seeking behaviour and lifestyle choices. In Nigeria, the basic education is at the secondary level and most participants had up to secondary education highlighting the importance of literacy in aiding individuals to make informed decisions about their health and lifestyle choices.

Gender has been noted to be a socioeconomic determinant of health as

reported by several studies. These studies have revealed that women are more vulnerable to the risk of obesity, heart disease, stroke, different forms of cancer when compared to men. In this study, female gender (AOR 2.15; 95% CI: 1.47 – 3.22) was significantly associated with obesity risk comorbidity as similarly reported by [16] among PLHIVs in Zimbabwe as they were found to be 2.15 times more likely to develop obesity from the pooled data. More significantly, females in the age range of 18 – 55 years were also associated with obesity risk than in any other age group indicating the fact that women of reproductive age are predisposed to the biochemical interplay of events that result in weight gain and hormonal imbalance resulting in onset of certain diseases associated with women. Contrary to studies [16, 17] that observed that men on ART were more likely to develop high blood pressure, this study revealed that women (AOR 3.23; 95% CI: 1.37 – 3.55) were found to be 3.23 times more likely to develop risk of systolic blood pressure than their male counterparts. However, this finding is similar to study findings conducted in South Africa and India where more females were found to be disproportionately affected by NCDs compared to males [18]. Additionally, [19] also found that systolic blood pressure, fasting blood sugar, and low-density lipoprotein were found to be significantly lower in Indian women.

Age was also implicated as a risk factor in NCD development in PLHIVs on ART highlighting the importance and impact of age on one's health regardless of HIV status. The current study found that 40.5% of the patients between the ages of 41-50 years enrolled in the ART programme are at risk of hypertension. Findings of the study such as increased prevalence of high blood pressure, obesity among PLHIV initiated on ART concur with [20], who postulated that an increase in age is a critical determinant of traditional risk factors and the role it plays in relation to CVD events. Several studies revealed similar trends in Africa and globally [18, 21].

Similarly, a study conducted in Tanzania by [22] showed that older age (AOR = 3.42, 95% CI 2.06–5.70) was a risk factor that predicted the prevalence of hypertension among participants on ART [23, 22] which concurs with findings from the current study as it was revealed that increase in age or older age was 1.6 times more likely to be predispose study participants to hypertension ($p < 0.005$). [22] further observed that hypertension significantly associated with ART regimens Dumiva and alluvia and this concurs with studies conducted in Zimbabwe and Tanzania [22, 16]. Again, similar to a study conducted in North-western Tanzania and Southern Uganda [22, 24], there was a significant association between hypertension and age. Additionally, the male gender has been found to be significantly associated with smoking (AOR = 22.5, 95% CI 7.8–64.7) and alcohol consumption (OR = 4.0, 95% CI 2.1–7.7) in ART patients in several studies (da Silva et al., 2017), which have been observed to be significant predictors of hypertension in PLHIVs on ART.

Conclusion

The findings from this study are important to inform health care and training, resource and research priorities and also to establish how non-communicable disease risk factors vary amongst HIV positive population. As the continent and particularly the study area is facing intersecting epidemics of HIV and hypertension, it is essential to address the occurrence of NCDs and their risk factors with an aim to achieve positive effects of the long-term ART use. As adverse effects are markedly noted with HIV treatment on lipids, this may have serious implications for context-specific health care system which is burdened by HIV epidemic. Therefore, monitoring of the interaction of HIV, ART use, and non-communicable diseases is needed at both individual and population levels. This can be

achieved by strengthening interventions and services which will lead to the integration of HIV/AIDS and NCDs programme or services with other health services and interventions or programs in both urban and rural areas alike.

Recommendations

Our findings suggest an empirical support for an integrated all-inclusive approach to addressing the socio-economic determinants of HIV-positive individuals. It emphasizes the need for interventions that can be designed and implemented to reach PLHIVs of all socio-economic strata as well as benefitting other population groups at risk for NCDs. Beyond treatment intervention strategy, it is also suggested that health promotion and programs for NCD socio-demographic risk factors be strengthened in order to achieve reduction in mortality rates associated with NCDs among PLHIVs. Further, the need for comprehensive health programs that will focus on screening and treatment of HIV and NCD tailored alongside patient demographics can be instituted.

Acknowledgement

The author extends sincere appreciation to the management and staff of the participating health facilities in Enugu State for their cooperation during data collection. Special thanks go to the research assistants for their diligence and to all study participants for their willingness to be part of this research. Gratitude is also expressed to colleagues and mentors at Texila American University for their valuable input and guidance throughout the study.

References

[1]. WHO, 2021, in HIV, Estimated number of people (all ages) living with HIV 2023 [Available from: .

[2]. National Agency for the control of AIDS 2011, Update on the HIV/AIDS epidemic response in Nigeria.

[3]. Coetzee, L., Bogler, L., De Neve, J-W., Barnighausen, T., Geldsetzer, P., and Vollmer, S., 2019, HIV, antiretroviral therapy and non-communicable diseases in sub-Saharan Africa: empirical evidence from 44 countries over the period 2000 to 2016. *J. Int. AIDS Soc.* 22(7), e25364.

[4]. WHO, Noncommunicable diseases 2017, *World Health Organization.*

[5]. Jadeja, S., Pai, G., Bhat, K., and Sathyanarayana, M. B., 2018, President's emergency plan for AIDS relief. *Syst Rev Pharm.*, 9(1):6–9.

[6]. Bor, J., Herbst, A. J., Newell, M-L., and Barnighausen, T., 2013, Increases in adult life expectancy in rural South Africa: valuing the scale-up of HIV treatment. *Science*, 3396122:961–965.

[7]. Achwoka, D., Oyugi, J. O., Mutave, R., Munywoki, P., Achia, T., Akolo, M., Muriuki, F., Muthui, M., and Kimani, J., 2020, High prevalence of non-communicable diseases among key populations enrolled at a large HIV prevention & treatment program in Kenya. *PLoS One*, 15(7), e0235606.

[8]. Feinstein, M. J., Hsue, P. Y., Benjamin, L. A., Bloomfield, G. S., Currier, J. S., Freiberg, M. S., Grinspoon, S. K., Levin, J., Longenecker, C. T., Post, W. S., and American Heart Association Prevention Science Committee of the Council on Epidemiology and Prevention and Council on Cardiovascular and Stroke Nursing; Council on Clinical Cardiology; and Stroke Council. 2019. Characteristics, prevention, and management of cardiovascular disease in people living with HIV: a scientific statement from the American Heart Association. *Circulation*, 140(2), e98-e124.

[9]. Seang, K., Javanbakht, M., Lee, S-J., Brookmeyer, R., Pheng, P., Chea, P., Saphonn, V., and Gorbach, P. M., 2022, Differences in prevalence and risk factors of non-communicable diseases between young people living with HIV (YLWH) and young general population in Cambodia. *PLoS ONE* 17(6), e0269989

[10]. Kansiime, S., Mwesigire, D., & Mugerwa, H., Prevalence of non-communicable diseases among HIV positive patients on antiretroviral therapy at joint clinical research centre, Lubowa, Uganda. *PLoS ONE* 14(8), e0221022 2019.

[11]. Thet, D., and Siritientong, T., 2020, Antiretroviral therapy-associated metabolic complications: Review of the recent studies. HIV/AIDS – Res. *Palliative Care* 12, 507–524. .

[12]. Gausi, B., Otiku, P., Jacob, N., & Oni, T., Patient outcomes in integrated HIV and non-communicable disease models of care: A scoping review. *J. Global Health Rep*. 5, e2021084 2021.

[13]. Okeke, F. O., Sam-Amobi, C. G., & Okeke, F. I., 2020, Role of local town planning authorities in building collapse in Nigeria: evidence from Enugu metropolis. *Heliyon*, 6(7), e04361.

[14]. Ezeala-Adikaibe, B., Aneke, E., Orjioke, C., Ezeala-Adikaibe, N., Mbadiwe, N., Chime, P., & Okafor, U., 2014, Pattern of medical admissions at Enugu state University of Science and Technology Teaching Hospital: a 5-year review. *Annals of medical and health sciences research*, 4(3), 426–431.

[15]. Abugu, J. O., Chukwu, A. M., Onyeso, O. K., et al., 2023, Determinants of the managerial staff's disposition towards e-payment platforms in public tertiary hospitals in Enugu, Nigeria: a cross-sectional study. *BMC Health Serv Res* 23, 1240.

[16]. Magodoro, I. M., Esterhuizen, T. M., Chivese, T., 2016, A cross-sectional, facility-based study of comorbid non-communicable diseases among adults living with HIV infection in Zimbabwe. *BMC Res Notes*, 9(1):379.

[17]. Achwoka, D., Waruru, A., Chen, T. H., Masamaro, K., Ngugi, E., Kimani, M., Mukui, I., Oyugi, J.O., Mutave, R., Achia, T., Katana, A., Ng'ang'a, L., and De Cock, K. M., 2019, Noncommunicable disease burden among HIV patients in care: a national retrospective longitudinal analysis of HIV-treatment outcomes in Kenya, 2003-2013. *BMC Public Health*, 3;19(1):372.

[18]. Mathebula, R. L., Maimela, E., & Ntuli, N. S., 2020, The prevalence of selected non-communicable disease risk factors among HIV patients on anti-retroviral therapy in Bushbuckridge sub-district, Mpumalanga province. *BMC Public Health* 20, 247, https://doi.org/10.1186/s12889-019-8134-x.

[19]. Anish, T. S., Shahulhameed, S., Vijayakumar, K., Joy, T. M., Sreelakshmi, P. R., Kuriakose, A., 2013, Gender Difference in Blood pressure, Blood Sugar, and Cholesterol in Young Adults with Comparable Routine Physical Exertion. *J Family Med Prim Care*, 2(2):200-203. doi: 10.4103/2249-4863.117424.

[20]. Bogorodskaya, M., Chow, F. C., Triant, V. A., 2013, Stroke in HIV. *Canadian Journal of Cardiology*, 35(3), 280-287.

[21]. Tate, T., Willig, A. L., Willig, J. H., Raper, J. L., Moneyham, L., Kempf, M. C., Saag, M. S., Mugavero, M. J., 2012, HIV infection and obesity: where did all the wasting go? *Antivir Ther.* 17(7):1281.

[22]. Kagaruki, G. B., Mayige, M. T., Ngadaya, E. S., Kimaro, G. D., Kalinga, A. K., Kilale, A. M., Kahwa, A. M., Materu, G. S., and Mfinanga, S. G., 2014, Magnitude and risk factors of non-communicable diseases among people living with HIV in Tanzania: a cross-sectional study from Mbeya and Dar es Salaam regions. *BMC Public Health*, 14(1):904.

[23]. Braithwaite, R. S., Conigliaro, J., McGinnis, K. A., Maisto, S. A., Bryant, K., and Justice, A. C., 2008, Adjusting alcohol quantity for mean consumption and intoxication threshold improves prediction of nonadherence in HIV patients and HIV-negative controls. *Alcohol Clin Exp Res.*, 32(9):1645–51.

[24]. Justice, A., Sullivan, L., and Fiellin, D., 2010, Veterans Aging Cohort Study Project Team. HIV/AIDS, comorbidity, and alcohol: can we make a difference? *Alcohol Res Health*, 33(3):258.

[25]. da Silva, C. M., Mendoza-Sassi, R. A., da Mota, L. D., Nader, M. M. and de Martinez, A. M., 2017, Alcohol use disorders among people living with HIV/AIDS in Southern Brazil: prevalence, risk factors and biological markers outcomes. *BMC Infect Dis.*, 17(1):263.