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Viral Load Suppression and Associated Factors among People Living with HIV on Antiretroviral Therapy in a Tertiary Health Institution in Owo, Southwest, Nigeria

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Abstract

Background: Suppression of Human Immuno-deficiency Virus (HIV) viral load (VL) is essential for preventing disease progression and improved quality of life in persons living with HIV (PLHIV). In 2023, Nigeria had an HIV prevalence rate of 2.1% while Ondo state was 1.1%. No prior characterization of the status of viral load suppression of PLHIV in the Owo, Ondo state has been undertaken. This study aimed to determine the predictors of viral load suppression among PLHIV in Owo, Ondo State, Nigeria.

Methods: This is a retrospective cross-sectional study where the record of PLHIV on Antiretroviral therapy (ART) for at least six months was reviewed. The data source was the database of the HIV clinic of PLHIV enrolled in ART care from 1st September 2009 to 31st August 2024. Plasma viral load was determined using a polymerase chain reaction. The p-value <0.05 was considered significant.

Results: Two thousand and fifty subjects were recruited of which 67.8% were females while 50.8% belonged to the middle-age. The overall prevalence of viral load suppression was 91.5%; the prevalence among paediatrics was 87.1% while among adults was 91.8%. The majority (96.3%) had good ART adherence. Age (p=0.011), sex (p=0.011), current ART status (p=0.000), ART adherence (p=0.032), and baseline CD4 count (p=0.008) were associated with viral load suppression. The predictors of viral load suppression were sex (OR=1.7; p=0.006; 95%CI=1.157–2.360), current ART status (OR=7.8; p=0.000; 95%CI=5.326–11.441), ART adherence (OR=3.1; p=0.041; 95%CI=1.046–9.056), and baseline CD4 count (OR=2.6; p=0.012; 95%CI=1.248–5.022).

Conclusions: The prevalence of viral load suppression was less than the UNAID target of 95% hence, a concerted effort is required in combating the disease.

Keywords: Antiretroviral therapy, HIV/AIDS, Southwest-Nigeria, Viral Load Suppression

Introduction

Human Immuno-Deficiency Virus (HIV) is a pandemic infection that remains a global disease with public health challenges, it is a leading cause of infections globally despite the success rate of the highly active antiretroviral therapy (HAART) [1]. Globally, HIV affected 39.9 million (36.1–44.6 million) people at the end of 2023 of which 0.6% of adults aged 15–49 years were affected [2]. Sadly, the major population affected are people living in low- and middle-income countries [2]. In Nigeria, the prevalence of HIV was 2.1% in 2023 with varying prevalence across the country with Benue (5.7%) having the highest prevalence, Ondo had a prevalence of 1.1%, while Jigawa had the lowest HIV prevalence (0.3%) [3].

In the bid to reduce the burden of HIV globally, the Joint United Nations Programme on HIV and AIDS (UNAIDS) in 2014 set a target referred to as 95-95-95 which aimed to control the HIV/AIDS epidemic by 2030 [4]. The aim was that by 2030, 95% of people living with HIV (PLHIV) should know their HIV status, 95% of them should be on antiretroviral therapy (ART), and 95% of all individuals on ART should have suppressed viral load (VL) and there should be zero discrimination [5,6]. The main rationale for the use of antiretroviral therapy (ART) is to attain maximal viral suppression, reduce the risk of transmission of HIV and improve the well-being of infected persons [7]. In 2018, Nigeria had only 67% of PLHIV that knew their status, of which 53% were on treatment and only 42% were virally suppressed [8,9]. In 2023, Nigeria had approximately two million people living with HIV, the fourth largest in the world [3].

VL measurement is the gold standard for monitoring treatment success. Viral load suppression (VLS) is an essential parameter of the effectiveness of ART, a surrogate marker for disease progression, and one of the 10 global indicators in the 2015 WHO consolidated strategic information guidelines for HIV in the health sector [4,10,11]. PLHIV who are virally unsuppressed are at higher risk of disease progression, transmission, and mortality [12]. WHO recommends VL as a measure of the efficacy of ART and treatment adherence. Treatment success is defined as a VL threshold of <1,000 copies/Ml [13]. VLS is achievable and studies have shown individual, interpersonal, and institutional factors that are associated with VLS in the general population [14,15]. However, factors associated with viral suppression in Owo, Ondo state, Nigeria are not well documented. Furthermore, Nigeria is behind the target of UNAIDS 95-95-95 aspirations despite the decreasing prevalence of HIV. Therefore, this study aimed to determine the level of VLS and its associated factors among PLHIV on ART attending an HIV clinic at Federal Medical Centre, Owo, Nigeria. The knowledge of the level of VLS and the associated factors among PLHIV on ART in Federal Medical Centre, Owo, Nigeria will contribute to the achievement of the third 95 of the UNAIDS goal by 2030 and also inform public health officials of potential risk factors that they need to be verified further and addressed by targeting the high-risk groups for more intense follow-up.

Methodology

Study site

The study was carried out at the HIV infection disease clinic of Federal Medical Centre Owo, Ondo state, Nigeria. Federal Medical Centre (FMC, Owo) is strategically situated along Adekunle Ajasin Way in the ancient Owo township in Owo Local Government Area of Ondo State, Nigeria. According to the 2006 national population census, the population of Owo LGA was 218,886 [16]. The hospital, being the only federal tertiary health institution in Ondo state has annexes in Oka Akoko, Ikaramu Akoko, Ijebu Owo, Emure Ile and Akure. It therefore, serves as a referral centre to many hospitals within and outside Ondo state. The major language is Yoruba language while the major occupation is farming.

The HIV infection disease clinic runs every Tuesday, Wednesday, and Friday. The clinic provides services for the diagnosis, treatment, prevention of HIV, and free counselling and testing. The HIV clinic is divided into units which include the Adult HIV clinic, the Paediatrics HIV clinic, the Prevention of Mother-to-Child Transmission (PMTCT) unit, the Pharmacy unit, and the laboratory. The clinic can accommodate about 100 patients per day. The clinic is run by specialists in their respective fields – medical consultant specialists, pharmacists, laboratory scientists, and nurses.

Study design

The study is a retrospective cross-sectional descriptive study.

Study period

1st September 2009 to 31st August 2024.

Study population

All people living with HIV on ART receiving care at Federal Medical Centre, Owo, Ondo state, Nigeria during the study period.

Ethical clearance/approval

The study was approved by the Health Research Ethics Committee of the Federal Medical Centre, Owo, Ondo state, Nigeria with number FMCOWO/HREC/2024/124.

Study participants and data collection

The source of data was from the database of the HIV clinic obtained from all people living with HIV (PLHIV) enrolled in ART care from 1st September 2009 to 31st August 2024 at FMC Owo, Nigeria. A total of 2,050 clients were registered within this period. The database provided information on socio-demographics, clinical, immunological, virological and other relevant parameters of patients. All clients, both children and adults within the study period were enrolled and

considered as the study subjects. VL testing data for samples corresponding to HIV-positive patients who had been on HAART for at least six months was used. Where there was more than one VL result, the most recent (not more than 12 months prior in line with the country's national guideline for HIV) was used for the data [17]. Data on VL testing results (for plasma) was measured in terms of viral RNA copies/ml of blood. Before 2017, virological monitoring was carried out only in those with clinical suspicion of failure or poor adherence. Following policy changes in the country and an update of National guidelines in 2020, [17] all enrolled patients in the PLHIV had a minimum of yearly viral load monitoring. However, where the viral load was above the threshold of 1,000 copies/ml, intensified adherence counselling was carried out and viral load assays were repeated in three months.

Outcome measures

The primary outcome is virological suppression, defined as having <1,000 copies of viral RNA/ml of blood for plasma, as provided by the National Guideline for Treatment and Control of HIV/AIDS 2020 [17]. The secondary outcome of this study are factors associated with viral load suppression.

Laboratory testing methods

The laboratory analysis was carried out by the Nigerian Centre for Disease Control and Prevention accredited laboratory. For each sample collected from the patients, RNA was extracted and plasma viral load was determined using Polymerase chain reaction (PCR).

Viral Load RT-PCR and CD4 count samples are moved from areas without PCR laboratories (FMC, Owo) to testing laboratories (Obafemi Awolowo University Teaching Hospital Ile-Ife) in the optimized networks and results are returned to FMC, Owo. All the standard-of-care PCR laboratories are linked to the National Laboratory Information Management Systems (LIMS) which is in turn linked to the Nigeria Medical Records System (NMRS) and National Data Repository (NDR) for real-time reporting of patient results into the health facility records and health repository.

For the VL analysis, three millilitres of blood was collected from the peripheral veins of the participants into the EDTA bottle. The blood sample was then centrifuged at 3,000 revs for 5 minutes after which the supernatant was collected using a pipette into a plain bottle and stored at -80°C in a refrigerator until it was transported to Obafemi Awolowo University Teaching Hospital Ile-Ife for VL analysis according to the Nigeria National guideline [17].

Operational definitions

Baseline CD4 count: This is the CD4 count at the commencement of HAART.

Low CD4 count for aged 5 years and above: CD4 count below 100 cells/μl for HIV patients [17,18].

Low CD4 count for aged below 5 years: CD4 count below 200 cells/μl for HIV patients [17,18].

Viral suppression: VL<1,000 copies/mL [17,18].

Adherence to ART treatment: It is categorized as good or poor according to the percentage of drug dosage calculated from a total monthly dose of ART drugs. Good (>95% or <2 doses missed per month), and poor (<95% or >2 doses missed per month) [17].

Data quality assurance: The author extracted the data into a Microsoft Excel spreadsheet and this was verified independently by the data analyst to ensure accuracy and consistency of the data.

Data analysis: Statistical analysis was done using the Statistical Package for Social Science (SPSS) version 23.0 (SPSS for Windows Inc, Chicago LL, USA) statistical software. Continuous variables such as age, VL, and CD4 count were summarized using mean and standard deviation. The proportion of subjects with virological suppression was expressed as a percentage. Categorical variables such as sex and age group were summarized using frequencies and proportions and presented using tables and charts. An Independent sample t-test was used to compare the means of two normally distributed variables. Bivariate analysis was used to determine the factors associated with VLS while multivariate analysis was used to determine the predictor of VLS. The level of significance was set at p-value <0.05.

Results

A total of 2,050 patients were seen during the study period of which females accounted for about two-thirds of the participants (67.8%) and the predominant age group was age 45–64 years which accounted for half (50.8%) of the population while the paediatrics age group were 137 (6.7%) of which the under 5 years were six (0.3%).

The majority (60.6%) of the population were active on ART while 94 (5.4%) were reported dead and seventy-three (4.2%) had discontinued care. The majority (96.4%) had good ART adherence. About half (46.7%) were on ART for more than a decade while only 60 (2.9%) were on ART for less than a year but more than six months. Almost all (99.5%) were on first-line ART. More than four-fifths (88.7%) reside within Ondo state. These can be seen in **Table 1**.

Table 2 shows the clinical, virological and immunological characteristics of the participants. Two-thirds (66.7%) of the population were in stage 1 of the WHO clinical staging while 353 (17.3%) were in the advanced clinical stage. The majority (91.5%) had suppressed VL and 685 (85.9%) had a normal baseline CD4 count. The VLS among the paediatrics (children and adolescents) patients was 87.1% while among the adults was 91.8%.

Table 1. Sociodemographic and antiretroviral characteristics of participants on ART.

Variable	Frequency (2050)	Percentages
Sex		
Males	661	32.2
Females	1,389	67.8
Age (years)		
<5	6	0.3
5-9	10	0.5
10-19	121	5.9
20-44	713	34.8
45-64	1,042	50.8
≥65	158	7.7
Current ART status		
Active on ART	1,242	60.6
Non-active on ART	808	39.4
ART adherence of active on ART (1272)		
Good	1,226	96.4
Poor	46	3.6
Duration on ART (years)		
6 months-1 year	60	2.9
1-5	340	16.6
6-10	692	33.8
>10	958	46.7
Regime of ART		
1st line ART	2,039	99.5
2nd line ART	11	0.5
Location		
Within Ondo state	1,818	88.7
Outside Ondo state	232	11.3

ART: Antiretroviral Therapy

Table 2. Clinical, virological and immunological characteristics of participants on ART.

Variables	Frequency	Percentages
WHO clinical staging (2050)		
1	1,368	66.7
2	329	16.0
3	317	15.5
4	36	1.8
Viral load (copy/ml) (1,741)		
<1000	1,593	91.5
≥1000	148	8.5
Base line CD4 count (cells/µl) (797)		
Normal	685	85.9
Low	112	14.1

WHO: World Health Organization

The factors associated with VLS are shown in **Table 3**. The participants that had VLS were majorly (69.0%) females and the difference from the males was statistically significant (χ^2=6.495; p=0.011). More than half (53.7%) of the participants that were virally suppressed were within the age group 45–64 years while 90 (5.6%) of the participants that had viral suppression were adolescents. All the participants within the age group 0–9 years were virally suppressed. The VLS within

Table 3. The factors associated with viral load suppression among the participants on ART.

Variables	Viral load suppressed (%)	Viral load unsuppressed (%)	Statistical test (χ^2)	P value
Sex				
Males	494 (31.0)	61 (41.2)	6.495	0.011
Females	1,099 (69.0)	87 (58.8)		
Age (years)				
<5	5 (0.3)	0 (0.0)	14.846*	0.011
5-9	10 (0.6)	0 (0.0)		
10-19	90 (5.6)	17 (11.5)		
20-44	506 (31.8)	58 (39.2)		
45-64	856 (53.7)	62 (41.9)		
≥65	126 (7.9)	11 (7.4)		
Current ART status				
Active	1,173 (73.6)	39 (26.4)	143.131	0.000
Non-active	420 (26.4)	109 (73.6)		
ART adherence of active on ART				
Good	1,131 (96.4)	95 (89.7)	4.607	0.032
Poor	42 (3.6)	4 (10.3)		
Duration on ART (years)				
6 months–1year	23 (1.4)	1 (0.7)	3.255*	0.354
1–5	249 (15.6)	19 (12.8)		
6–10	520 (32.6)	58 (39.2)		
>10	801 (50.3)	70 (47.3)		
Regime of ART				
1st line ART	1,583 (99.4)	147 (99.3)	0.005*	0.944
2nd line ART	10 (0.6)	1 (0.7)		
WHO clinical staging				
1	1,064 (66.8)	100 (67.6)	2.036*	0.565
2	256 (16.1)	24 (16.2)		
3	251 (15.8)	20 (13.5)		
4	22 (1.4)	4 (2.7)		
Location				
Within Ondo state	1,434 (90.0)	126 (85.1)	3.467	0.063
Outside Ondo state	159 (10.0)	22 (14.9)		
Base line CD4 count (cells/µl)				
Normal	539 (88.8)	38 (76.0)	7.075	0.008
Low	68 (11.2)	12 (24.0)		
Mean (SD) of viral load (copy/ml)	36.7 (76.4)	217,128.7 (548,539.3)	-15.840t	0.000
Median viral load (IQR)	19.0 (19.0–19.0)	48,800.0 (8,928.5–193,399.8		

* = Fischer exact test
t = Independent student t test

the age group was statistically significant (χ^2=14.846; p=0.011). About three-quarters (73.6%) of participants that had VLS were active on ART while 26.4% of the unsuppressed VL were active on ART and the difference was statistically significant (χ^2=143.131; p=0.000). Among the non-active participants, 73 (17.4%) of them who were virally suppressed and 21 (19.3%) of those who had VL unsuppressed died. Among the participants who were active on ART, VLS was observed among 96.4% of those who had good adherence (χ^2=4.607; p=0.032).

Half (50.3%) of the subjects that were virally suppressed had been on the ART for more than a decade while 1.4% of the virally suppressed participants had been on ART between 6 months and one year, the difference was not statistically significant (χ2=3.255; p=0.354). Almost all (99.4%) of the participants with suppressed VL were on first-line ART regimen, there was however no statistically significant difference from those on second-line ART regimen (χ^2=0.005; p=0.944). Two-thirds (66.8%) of the participants that had VLS were in WHO clinical stage 1 while 1.4% were in WHO clinical stage 4. The difference was not statistically significant (χ2=2.036; p=0.565). More (88.8%) of the participants with suppressed VL had a normal baseline CD4 count while 12 (24.0%) with unsuppressed VL had a low baseline CD4 count and the difference was statistically significant (χ^2=7.075; p=0.008).

The mean VL was 18,491.4 (170,553.1) cp/ml with a median of 19.0 (19.0–30.0) and a range of 0–4,979,399 cp/ml among the study population. The mean viral load among subjects that were suppressed was 36.7 (76.4) cp/ml and median of 19.0 (19.0–19.0) cp/ml with a range of 19–896 cp/ml while among the unsuppressed, the mean viral load was 217,128.7 (548,539.3) cp/ml and the median was 48,800.00 (8,928.5–193,399.8) cp/ml with range of 1030–4,979,399 cp/ml. The difference in the mean between the suppressed VL and unsuppressed VL was statistically significant (t=-15.840; p=0.000).

The predictors of VLS among the participants were sex, current ART status, ART adherence, and baseline CD4 count. The females were 1.7 times more likely to have VLS than the males (OR=1.653; p=0.006; 95%CI=1.157–2.360). The participants who were active on ART were eight times more likely to have suppressed VL than those who were not active on ART (OR=7.806; p=0.000; 95%CI=5.326–11.441). Of those who were active on ART, participants with good adherence to ART were thrice more likely to have suppressed VL than those with poor adherence (OR=3.078; p=0.041; 95%CI=1.046–9.056). The subjects who had a normal baseline CD4 count were 2.6 more likely to have a suppressed VL than those with a low baseline CD4 count (OR=2.569; p=0.012; 95%CI=1.248–5.022). This is shown in **Table 4**.

Table 4. Predictors of viral load suppression among participants on ART.

Variables	Odds ratio	P-value	95% Confidence interval	
			Lower	Upper
Sex				
Male	1			
Female	1.653	0.006	1.157	2.360
Age (years)				
<5	1			
5–9	0.000	0.999	0.000	0.000
10–19	0.000	0.999	0.000	0.000
20–44	2.081	0.076	0.927	4.669
45–64	1.477	0.262	0.748	2.919
≥65	0.851	0.636	0.435	1.662
Current ART status				
Non-active	1			
Active	7.806	0.000	5.326	11.441
ART adherence of active on ART				
Poor	1			
Good	3.078	0.041	1.046	9.056
Base line CD4 count (cells/µl)				
Low	1			
Normal	2.569	0.012	1.248	5.022

Discussion

This present study sets out to determine the prevalence of VLS and its associated factors among PLHIV in Owo, Ondo state, Southwest Nigeria. Two thousand and fifty people were recruited. The majority of the patients in this study were females in keeping with Africa [19–21] and the global trends [2]. These are attributed to various factors such as the females' physiologic vulnerability and gender inequalities at the individual, socio-cultural, economic, and systemic levels [19]. The increased prevalence of HIV among females could be due to Female Genital Mutilation, unequal power dynamics in the negotiation of safer sex and lack of economic empowerment [19,21].

A higher percentage of the adult population was living with HIV than the children in this present study. This is similar to findings in other national surveys [22,23], the Centre for Disease Control (CDC) in the USA [23] and the WHO summary of the global HIV epidemic, 2023 [2]. This is not surprising as adults engaged in sexual activities (a major mode of transmission) more than children and it is known that most infections in children occur via vertical transmission [24,25].

The present study revealed that 91.5% of the participants had their VL suppressed, although, the VLS among the paediatrics (children and adolescents) patients was 87.1% which was lower than the adults (91.8%). The overall VLS in this present study was higher than what was reported in Kenya (88.3%) [26] and Ghana (66.7%) [27]. The present study also reported a higher VLS than the global study which showed a VLS among adults as 72% while among children it was 46% [2,28]. However, it was lower than what was reported in Namibia (94.4%) [29]. The differences in the reported VLS could be due to the different settings in which the study was done. It could also be due to the concerted effort of our institution to ensure drug adherence and clinic compliance.

The predictors of VLS in this present study were sex, current ART status, ART adherence, and baseline CD4 count. In this study, the females were more likely to have VLS than the males which was similar to other studies where the females had more VLS than the males [20,30]. In contrast, other studies found being female was a significant factor in viral non-suppression [31,32]. While in other surveys, gender did not affect VLS [33,34].

Being active on ART was another predictor of viral suppression in our study. This correlates with other findings of a positive association between ART and viral suppression [20,35–37]. The WHO has stated that consistent use of ART can lead to undetectable levels of the virus and stop the progression of the disease [28,38]. Effective ART also prevents onward transmission of HIV [38]. Therefore, the WHO has recommended early initiation of ART for all people with HIV [38]. Our study findings are thus not surprising. Similarly, participants on ART with good adherence were thrice more likely to have suppressed VL than those with poor adherence. A study done by Silveira in Brazil revealed that of all the factors that had positive associations with VLS, treatment adherence had the largest effect [39]. Similarly, a retrospective cohort study in Uganda revealed that adherence was a predictor of VLS in the district [40]. A study in Ethiopia, reported that poor adherence was a risk factor for unsuppressed VL [41]. As earlier stated, a major goal of ART is to achieve undetectable viral levels and individual behavioural factors such as good adherence are key to achieving that. The more the adherence, the more the virus is exposed and likely to be susceptible to the effects of the antiretroviral drugs.

The baseline CD4 count of subjects in this study was another significant predictor of VLS. It has been known that there is an inverse relationship between the CD4 count and the VL and that the loss of CD4 cells results in the inability to mount a proper immune response [15,20]. So, patients with normal baseline CD4 count will likely have the ability to have adequate immune response to the virus and with the use of ART, achieve VLS. Our finding was consistent with some other results that patients with higher CD4 counts are likely to achieve VLS and vice versa [15,20,30,40].

The limitation of this study is the limited availability of the paediatrics age group data.

In conclusion, the overall prevalence rate of VLS is high, but still suboptimal to the 95-95-95 target set by the UNAIDS for 2030. The significant predictors of VLS found in this study were sex, current ART status, ART adherence and baseline CD4 count. We recommend that concerted efforts be made in combating the disease with a focus on the predictors.

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Conflict of Interest

The authors declared that there are no conflicts of interest.

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