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Investigating the Relationship between Medication Adherence Behaviors and the Achievement of Sustained Viral Load Suppression among People Living with HIV (PLHIV) on Antiretroviral Therapy (ART) in Akwa Ibom State, from 2018 - 2022

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Abstract

Background: Nigeria is still endemic for Human Immuno-Deficiency Virus (HIV), and currently among the top five countries with the highest burdens of HIV infection. For a successful HIV program, there should be good access to antiretroviral therapy (ART) and record of viral load suppression (VLS). This study aimed at investigating the relationship between medication adherence behavior (MAB) and sustained VLS among people living with HIV (PLHIV) receiving ART in Akwa Ibom State.

Methods: This was a retrospective cohort study of the medical records of 1,763 PLHIV receiving ART services from January 2018 to December 2022, in selected ten health facilities in Akwa Ibom State. Relevant demographic, clinical, immunological, viral load (VL) information were obtained from the patients' medical records and databases. The proportion of VLS and associated variables were then analyzed.

Results: Out of the 2,550 PLHIV whose medical records were accessed, data for 1,763 PLHIV was accepted for analysis. A total of 795 (45.1%) male and 968 (54.9%) female participated in the study, with a mean age of 38.4 ± 5 years. While 23.8% (n = 420) have unsuppressed VL of >1,000 copies/mL; 76.2% (n = 1,343) of participants achieved VLS of <1,000 copies/mL. 90.4% (n = 1,213) of the virally suppressed participants recorded moderate to high medication adherence levels (X^2 = 94.977, df = 2, p-value = 2.2 x 10^{-16}). CD4 counts and HAART regimen have significant impact on VLS ($p < 0.05$), while pregnancy status, TB Infection, duration on HAART, and WHO disease stage do not have significant effects on VLS ($p > 0.05$).

Conclusion: There was a strong evidence to reject the null hypothesis, which states that there is no positive association between MAB and sustained VLS among PLHIV on ART ($p < 0.05$). The VLS rate in this study indicates a good HIV epidemic control. Good medication adherence level, high baseline CD4 count, and being on first line HAART regimen were strongly associated with VLS.

Keywords: HIV/AIDS; ART Adherence; Viral Load Suppression; Antiretroviral Drugs

Abbreviations: AIDS: Acquired Immune Deficiency Syndrome; ART: Antiretroviral Therapy; ARVs: Antiretroviral Drugs; HAART: Highly Active Antiretroviral Therapy; HBM: Health Belief Model; HIV: Human Immuno-Deficiency Virus; MAB: Medication Adherence Behavior; PLHIV: People Living with HIV; TSR: Treatment Success Rate; UNAIDS: Joint United Nations Program on HIV/AIDS; VL: Viral Load; VLS: Viral Load Suppression; WHO: World Health Organization; SPSS: Statistical Package for Social Sciences.

Introduction

Millions of people are affected all over the world by HIV/AIDS epidemic, making it a serious public health concern. Recent data from the Joint United Nations Program on HIV/AIDS (UNAIDS), indicated that at least 37.7 million PLHIV were reported globally in the year 2020 [1]. New HIV infections have continued to be reported across the world despite the significant progress so far in the global response to the HIV/AIDS pandemic. It is noteworthy that in the sub-Saharan Africa, the disease is still a major public health threat.

The HIV epidemic remains a public health threat both to Nigeria and the world at large, affecting people's socioeconomic well-being [2]. 37.5 million Adults constitute the 39.0 million people living with HIV in 2022 across the globe. ART has been the game changer and has been made available to over 29.8 million patients worldwide, in 2022 [1,3,4]. Progression of HIV to AIDS has been linked to increased mortality among adults in sub-Saharan Africa [5]. In the year 2022 alone, 630 000 fatalities were attributed to AIDS [4].

According to UNAIDS' Global HIV & AIDS statistics, Nigeria has the third largest HIV disease burden worldwide [6,7]. Although there is a considerable decrease in HIV new infections and AIDS related deaths in Nigeria from 2010 till date, access to life saving ARVs is just 30% of the estimated 3.2 million population of PLHIV [6]. According to various studies, early linkage to and commencement of ART by newly diagnosed HIV positive individuals play significant roles in HIV epidemic control [8], through the suppression of viral load and reduction of HIV transmission.

The United Nations Program on HIV/AIDS instituted the 90:90:90 initiative, to be accomplished by the year 2020. The goal of the initiative was to ensure that 90% of PLHIV know their HIV Status, 90% of these PLHIV are placed on ART and 90% of those on ART attaining sustained viral load suppression [9,10]. Due to the COVID-19 pandemic which interrupted resource mobilization and HIV care and treatment services, this ambitious objective was not achieved. However, a new global objective of 95–95–95 has been set and to be accomplished by 2030 [11]. Across the globe, just 47% of PLHIV are virally suppressed, as against 53% that are not virally suppressed [9]. So, strict adherence to antiretroviral medication is a prerequisite for sustained VLS.

ART is a combination of antiretroviral drugs (ARVs) and it has been the basis for effective HIV/AIDS management. If taken consistently, it slows the progression of HIV to AIDS (the disease stage), suppresses HIV replication efficiently and improve the quality of life for PLHIV [12]. ART takes a central position in the global efforts to prevent and control the spread of the virus. It is capable of drastically reducing the risk of HIV transmission, and consequently, HIV infection is no longer a death sentence as once believed, but now a chronic, manageable health condition.

Medication adherence refers to the extent to which individuals take their prescribed medications as instructed by their healthcare providers [13,14]. Medication adherence is pivotal to the success of ART Programs around the world, and it is extensively acknowledged as a strong determinant of viral load suppression and overall treatment effectiveness [15]. It is a significant component of chronic disease management. Adherence to ART regimens is crucial for attaining good treatment success rate (TSR), in the HIV care context. Satisfactory adherence leads to effective suppression of viral replication by maintaining good therapeutic drug levels in the bloodstream, and by preventing the development of drug-resistant strains of HIV [16]. It is therefore important to strengthen medication adherence counselling processes in order to improve TSR amongst PLHIV on ART.

MAB is a multidimensional behavior which is influenced by numerous factors ranging from patient-related, healthcare system-related, to social determinants [15]. Summarily, the commonest factors affecting adherence among PLHIV on ART are: Patient Beliefs and Attitudes Nutor JJ, et al. [17], Psychosocial Factors Azia IN, et al. [18,19], and Healthcare Provider Factors [20]. Poor medication adherence can lead to drug resistance, rapid viral replication, reduced treatment success rate (TSR) and in some cases outright virologic failure.

The attainment and sustenance of suppressed viral load (VL) is one of the principal indicators of a successful ART Program [15]. When HIV ribonucleic acid (RNA) in a patient's blood significantly decreases to a value less than 1,000 copies per milliliter (< 1,000 copies/mL), it is called viral load suppression (VLS) [21]. The characteristics of sustained VLS include improved health outcomes, a reduced risk of opportunistic infections and a reduced risk of the progression to AIDS-related illnesses [21,22].

Sustained VLS is beneficial to the health of patients and it also plays a crucial role in HIV prevention. It is important to note that the transmission of HIV to others through sexual intercourse is almost impossible if the PLHIV have undetectable VL. This concept is known as "Undetectable = Untransmittable" (U=U) [22,23]. Apart from enhancing the well-being of HIV positive individuals, VLS also contributes to the wider public health objective of reducing the transmission of HIV.

There are documented benefits of sustained VLS, however the need to reach a profound understanding of the convoluted relationship between medication adherence behaviors (MAB) and sustained VLS among the PLHIV on ART, is crucial. An area of ongoing research inquiry is unravelling the various MAB and their impact on viral load suppression. The investigation of how MAB influence the attainment and upkeep of sustained VLS among PLHIV receiving ART in Akwa Ibom State, is the primary purpose of this research. This study delivers valuable insights that can inform interventions and strategies to enhance the effectiveness of ART Programs in preventing and controlling the transmission of HIV/AIDS; by exploring the multidimensional relationship between adherence patterns and VL outcomes.

Materials and Methods

Study Design

In this study, a retrospective cohort study was adopted to investigate the relationship between MAB and the achievement of sustained VLS among PLHIV on ART from 2018 to 2022 in Akwa Ibom State. This study design is particularly suitable for evaluating the risk of unsuppressed viral load due to unfavorable changes in MAB.

Study Participants

In this study, the population of interest was primarily PLHIV receiving ART in selected ten high-volume facilities in Akwa Ibom State, Nigeria. A total of 1,763 PLHIV met the criteria for inclusion and their data were collected. The study participants must have medical records, CD4 count and viral load laboratory results available for the study period of interest (year 2018 to 2022).

Inclusion and Exclusion Criteria

Inclusion Criteria

Participants who met the following criteria below were included:

- Having confirmed HIV-positive status and documented test result.
- Participants should have been on antiretroviral therapy (ART) consistently for at least six months.
- Having at least two viral load results available, one of which must be the baseline result.
- Having complete documentation of the ART regimen and adherence information on the Medical records.
- At the time of ART commencement, participants must be 18 years of age or older.

Exclusion Criteria: Participants with incomplete medical records, or missing viral load results or with incomplete medication adherence information, or did not meet any other inclusion criteria, were excluded.

Sample Size Calculation

For this study, the sample size was based on a power analysis, taking the expected effect size and statistical power into consideration. This was to ensure that the sample size was appropriately large enough to detect significant relationships between MAB and VLS.

Data Collection

Data Collection Tools

The primary data sources for this study are listed below:

- Medical records of patients which include details of the ART regimen administered.
- Laboratory Registers and result forms with viral load measurements specified.
- Medication Adherence data from the healthcare facilities
- Demographic and clinical database of the patients

Data Collection Procedures: Some research assistants were trained to extract relevant data from the medical records and other documents. We ensured that adherence to data privacy and confidentiality was observed. Data collected included information on patients' medication adherence behaviors, CD4 count and viral load results, over the specified study period.

Data Analysis

The following steps were taken to complete the statistical analysis of study data:

- Data Cleaning: study data that was collected underwent systematic cleaning and validation to ensure accuracy and completeness.
- Descriptive Analysis: Descriptive statistics was used to summarize the means, frequencies, percentages, demographic characteristics, medication adherence behaviors, CD4 count, and viral load measurements of the study participants.
- Bivariate Analysis: The chi-square tests or Fisher's exact tests for categorical variables and t-tests for continuous variables were used to examine the relationship between

medication adherence and VLS.

Data analysis was completed at a statistical significance level of 5%, using version 21 of the Statistical Package for Social Sciences (SPSS).

Ethical Considerations

Approval from the Ethics Committee of the State Ministry of Health was obtained. Permission was also secured from directors/managers of the various health facilities involved in the study. Informed consent from participants was not necessary since we did not have direct encounter with them. However, coding of personal identifying information was done to ensure that utmost confidentiality and privacy was strictly maintained throughout the research process.

Results

In this section, we present the findings from this study, which aimed to investigate the relationship between MAB and the achievement of sustained VLS among PLHIV on ART in Akwa Ibom State. The records of 2,550 PLHIV were assessed, out of which 690 were under the age of 18 years, 72 did not have at least two viral load results documented, 25 had missing demographic information while 1,763 met all the inclusion criteria. So, to understand the impact of adherence behaviors on VLS, we analyzed the data from a sample of 1,763 PLHIV.

Variables	Frequency (n)	Percentage (%)
Current age (years)		
18–27	102	5.8
28–37	606	34.4
38–47	557	31.6
48–57	320	18.2
58–67	102	5.8
≥ 68	76	4.3
Gender		
Male	795	45.1
Female	968	54.9
Occupation		
Business	465	26.4
Employed	702	39.8
Retired	55	3.1
Unemployed	541	30.7
Marital status		
Divorced	27	1.5
Married	1,480	83.9
Single	120	6.8
Widowed	136	7.7
Educational status		
Primary	425	24.1
Secondary	986	55.9
Tertiary	247	14
None	105	6

Table 1: Demographic Characteristics of Study Participants.

The participants are unevenly distributed across a wide range of age groups in this study. The largest pool of participants, 606 (34.4%) came from the age group of 28-37 years; followed by the age group of 38-47 years, which had 31.6% (n = 557). The lowest number of participants were in the age group of ≥ 68 years, accounting for 4.3% (n = 76) of the total participants. Notably, age distribution in this study is relatively even, just like the gender distribution which is 968 (54.9%) female and 795 (45.1%) male. The majority of participants are employed – 702 (39.8%), while a smaller percentages are retired – 55 (3.1%). Majority of the study participants are married – 1,480 (83.9%). 55.6% (n = 986) of the participants attained secondary education, while only 6.0% (n = 105) had no formal education. In relation to age, gender, occupation, marital status, and educational background, the demographic data of this research shows a dissimilar but well-balanced participants' profile.

Variables	Frequency (n=1763)	Viral load suppressed: n = 1343 (%)	Viral load unsuppressed: n = 420 (%)	p-Value
Baseline CD4 counts (cells/µl)				
< 500	652 (37.0)	346 (25.8)	305 (72.6)	<0.001
≥ 500	1,111 (63.0)	997 (74.2)	116 (27.4)	
Years on HAART				
< 5 years	477 (27.1)	325 (24.2)	152 (36.3)	0.237
≥ 5 years	1,286 (72.9)	1,018 (75.8)	268 (63.7)	
HAART Regimen				
First Line	1,071 (60.7)	729 (54.3)	341 (81.3)	<0.001
Second Line	692 (39.3)	614 (45.7)	79 (18.7)	
TB confirmed				
Yes	31 (1.8)	19 (1.4)	12 (2.8)	1.000f
No	1,732 (98.2)	1,324 (98.6)	408 (97.2)	
Disease stage				
WHO stages 1 and 2	1,646 (93.4)	1,242 (92.5)	404 (96.3)	0.461f
WHO stages 3 and 4	117 (6.6)	101 (7.5)	16 (3.7)	
Pregnancy Status (n = 968)				
Not Pregnant	771 (79.6)	814 (84.1)	615 (63.5)	0.452f
Pregnant	197 (20.4)	154 (15.9)	353 (36.5)	

Table 2: Factors Associated with Viral Suppression (n = 1,763).

The association between baseline CD4 counts and VLS is strong and statistically significant ($p < 0.05$). The VLS rate of 74.2% was observed amongst participants with CD4 counts ≥ 500 cells/µl. This is higher than the VLS rate of 25.8% recorded amongst participants with CD4 counts <500 cells/µl. Conversely, the duration of treatment (HAART) does not have significant impact on VLS (p-Value = 0.237). But the choice of HAART regimen indicates a statistically significant impact on VLS ($p < 0.05$); unlike HIV WHO Staging ($p = 0.461$), Pregnancy status ($p = 0.452$), and TB Confirmation ($p = 1.000$) which do not have significant influence on VLS.

Medication Adherence Level	Participants: n=1,763 (%)	Viral load suppressed: n = 1.343 (%)	Viral load unsuppressed: n = 420 (%)	p-Value
Low (<80%)	400 (22.7)	130 (9.7)	270 (64.3)	0.000
Moderate (80-95%)	905 (51.3)	761 (56.7)	144 (34.3)	
High (>95%)	458 (26.0)	452 (33.7)	6 (1.4)	

Table 3: Medication Adherence Level amongst Participants (n = 1,763).
source: X2 = 94.977, df = 2, p-value = 2.2 x 10-16

From Table 3 above, 90.4% (n = 1,213) of the participants who were virally suppressed, achieved moderate to high medication adherence levels; while low medication adherence level (<80%) significantly increased the likelihood of unsuppressed viral load ($p < 0.05$). Thus, there is a strong evidence to reject the null hypothesis, which states that there is no positive association between MAB and sustained VLS among PLHIV on ART ($p < 0.05$).

Viral Load Category	Viral Load Results	Number of Participants	Percentage (%)
Viral Load Suppressed	<50 copies/mL	294	16.7
	200 - 499 copies/mL	560	31.8
	500 - 999 copies/mL	489	27.7
Viral Load Unsuppressed	> 1,000 copies/mL	420	23.8

Table 4: Viral Load Suppression Rate.

Table 4 data above shows that 76.2% (n = 1,343) of participants achieved VLS of <1,000 copies/mL while 23.8% (n = 420) have unsuppressed viral load of >1,000 copies/mL. Though only 16.7% (n = 294) of participants achieved VLS of <50 copies/mL, the results of this study represents an effective viral load control. However, the notable percentage (23.8%) of participants with unsuppressed viral loads exceeding 1,000 copies/mL, suggests a need for improved MAB or perhaps the exploration of alternative antiretroviral regimens for the patients.

Discussion

The analysis of this research data gives enthralling insights into the relationship between MAB and sustained VLS among PLHIV in Akwa Ibom State.

First, we found that overall VLS (VL < 1,000 copies/mL) was achieved by 76.2% (n = 1,343) of the study participants (Table 2). Conversely, overall unsuppressed viral load (VL > 1,000 copies/mL) was reported for 23.8% (n = 420) of the study participants. Although the results show that there is effective viral load control, the percentage of unsuppressed viral load is still worrisome. The overall virologic failure/non-suppression in this study is higher than the 16.33% reported in Borno State by Sunkanmi et al., [24] and 11% in Uganda [4]. VLS rate in this study is higher than 73.61% reported in Ethiopia [25], but notably lower than 79% reported in a multi-center study research in Nigeria [26]. In the study by Stafford et al., [26], VLS was defined as a VL measurement of ≤400 copies/mL. Nonetheless, the importance of sustained VLS in the management of HIV/AIDS is accentuated by this discovery.

Second, this study clearly established that the relationship between medication adherence levels and VLS is statistically significant (Table 3). 77.3% (n = 1,363) of the participants achieved moderate to high medication adherence levels; of which 89% (n = 1,363) had sustained VLS while 11% (n = 150) had unsuppressed viral load. 26% (n = 458) of participants reported high adherence level (>95%), from which 98% achieved VLS, higher than the VLS rate of 72.9% reported for sub-Sahara Africa [20]. Low medication adherence (<80%) was responsible for only 9.7% suppressed viral load and 64.3% of unsuppressed viral load. This is corroborated by the findings from a study on the factors connected to unsuppressed Viral Loads among PLHIV on ART in northern Ethiopia, which strongly linked poor medication adherence to virologic failure [25]. The implication of these findings is that improved medication adherence is strongly correlated with VLS, which is in line with the alternate hypotheses of this research.

Third, the subgroup analysis conducted base on the level of education indicated that, PLHIV with tertiary education levels achieved the highest medication adherence rates including the highest percentage of VLS. This finding agrees with that of Abdullahi, et al. [27] in the study which reported that PLHIV with formal education had a more significant VLS than those without formal education (AOR 4.221, 95% CI 1.098, 16.223). Similarly in this study, those without formal education at all and those with primary education recorded lower medication adherence rates. Therefore, personalized medication adherence support and educational interventions, are necessary to improved TSR amongst PLHIV. This is corroborated by Aghedo OG, et al. [28], in their study that evaluated the trends of tuberculosis prevalence in Bayelsa State.

Generally, the result of this study emphasizes the critical role of optimal medication adherence in achieving sustained VLS among PLHIV on ART. Therefore, stimulating adherence support programs as well as tailored educational initiatives among those with lower education levels, will go a long way in enhancing HIV care and treatment in Akwa Ibom State.

Conclusion

This study investigated the link between MAB and the achievement of sustained VLS among PLHIV receiving ARVs

in Akwa Ibom State. The factors such as MAB which impact HIV care and its importance in the sustenance of VLS, constitutes the foundation for the findings of this research, as summarized below:

Summary of Key Findings

- Adherence and Viral Load Suppression: this research established a strong relationship between adherence to HIV medications and the attainment of sustained VLS. 92% (n = 452) of PLHIV who demonstrated high adherence levels (>95%) also achieved sustained VLS.
- Educational Status: Variations in medication adherence and VLS rates were observed based on educational status of the research participants. Those with tertiary education had medication adherence and VLS rates higher than those with primary or no education status. Interventions focused on improving medication adherence and care for this group will eventually enhance overall success of the HIV program.
- Program Implications: The significance of medication adherence support programs and educational initiatives to improve MAB, especially among PLHIV with lower education levels is highlighted by the results of this study. Custom-made interventions are crucial for achieving better HIV management and sustained VLS.
- Gender Differences: Female participants were found to be more adherent to HIV therapy than the male participants in this research. This observation cuts across various age groups. Although, this is beyond the scope of this study, further analysis to examine gender disparities in medication adherence and VLS is required. This is because, addressing potential significant gender-based variations can improve the status of HIV care in Akwa Ibom State.

In a nutshell, the importance of medication adherence in achieving sustained VLS among PLHIV on ART in Akwa Ibom State, was addressed by this study. To enhance HIV care, reduce the burden of the disease, and improve the general well-being of PLHIV, the implementation of tailored medication adherence support programs, and educational initiatives, will go a long way.

Limitations and Recommendations

Although this study offers treasured insights, it still has its limitations, one of which is its geographic scope. The study was conducted in a purposefully chosen specific locations and that may limit how much of its findings can be generalized to other regions. Again, potential socioeconomic factors that could impact medication adherence was not investigated in this study. Therefore, future research conducted in an expanded, multi-center study locations will be ideal to consolidate the findings of this study across diverse settings. Similarly, studies conducted on the impact of socioeconomic factors (like the levels of income and access to healthcare), on medication adherence and VLS are needed.

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Contributors

The lead author (Aghedo, OG.) conceived, designed, implemented the project, participated in the collection of research data, analyzed the data and drafted the manuscript. The co- authors: Akwolu CC, Oluka PO, Nwankwo AU, Achime NE, participated in the implementation, manuscripts review, editing and inputs. The final manuscript has been reviewed and approved by all the authors.

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Competing interests

The authors have declared having no conflict of interest in this research.

Data Availability Statement

We do not have the permission to share the data used in this research beyond the publication of this article. However, the data are available at the various hospitals where the study took place. Also, no online supplemental information is required because all data collected have been analyzed and reported in this article.

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