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ORIGINAL RESEARCH

Prevalence and Determinants of Viral Load Unsuppression among People Living with HIV/AIDS (PLHIV) on Highly Active Antiretroviral Therapy (HAART): The Case of Gombe State, Nigeria

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Abstract

Background: Early identification of patients at risk of viral load unsuppression enables preventative measures to be taken, leading to improved treatment outcomes for PLHIV. This study aimed to unveil factors associated with viral load unsuppression among PLHIV on HAART in Gombe state, Nigeria.

Method: A retrospective study of routinely collected client-level service data was carried out. The data was extracted from an output file generated from National Medical Record System (NMRS).

Results: Out of the 11518 total results analyzed, 11247 and 271 are suppressed and unsuppressed respectively, resulting in a suppression rate of 97.6% and an unsuppression

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rate of 2.4%. Factors significantly associated with viral load unsuppression include clients aged 18-24 (AOR: 2.579, 95% CI: 1.532-4.433), Clients accessing ART at tier 1 facilities (AOR: 0.745, 95% CI: 0.575-0.974) and clients on first line regimen (AOR: 0.250, 95% CI: 0.128-0.566).

Conclusion: Viral load unsuppression rate among PLHIV on HAART in Gombe state is very low. It is crucial to give priority to virologic monitoring for young people, clients accessing ART at tier 2 facilities, and those on second-line regimens due to their risk for viral load unsuppression.

Keywords

PLHIV, Viral load un-suppression, ART, HAART, Gombe

Introduction

Despite progress in treatment and prevention strategies, HIV infection remains a significant global public health issue, with 37.7 million people living with HIV and 1.5 million new cases diagnosed as of 2020 [1]. Nigeria holds the fourth position globally in terms of the HIV burden and is facing a widespread HIV outbreak, with the most significant HIV load in the West and Central African sub-region [2]. The 2018 Nigerian National HIV/AIDS Indicator and Impact Survey (NAIIS) provided significant findings regarding HIV prevalence in the country. The report indicated that the prevalence of HIV is 1.4% in Nigeria, with a total of 1.9 million people living with the virus in the country [3]. Gombe State, located in northeastern Nigeria, faces a significant public health challenge with HIV/AIDS, requiring ongoing efforts to prevent the spread of the disease through awareness campaigns and access to testing and treatment.

Gombe state government and its partners have implemented several initiatives to address the HIV epidemic, including establishing the Gombe State Agency for the Control of AIDS (GomSACA), to coordinate and implement HIV/AIDS prevention, care, and treatment programs in the state. The GomSACA has reported significant progress in the fight against HIV/AIDS in the state. While the prevalence of HIV/AIDS in the state has fluctuated over time, it has shown a consistent downward trend in recent years. In 1999, the prevalence rate was recorded at 4.7%, which rose to 8.2% in 2001. However, the agency's efforts have resulted in a remarkable decrease in the prevalence rate to 4.9% in 2005, 4.2% in 2010, and 3.2% in 2016 [4]. The latest NAIIS report of 2018 confirms that this positive trend has continued, with the prevalence rate dropping even further to a remarkable 1.2% [3]. This underscores the significant progress made by the agency in combating HIV/AIDS in Gombe State.

With the introduction of combination antiretroviral therapy (cART), individuals with HIV have witnessed a significant increase in life expectancy and future prospects, as cART availability and improved treatment options have turned HIV into a chronic condition, with optimal HIV viral suppression and immune system restoration serving as key indicators of long-term favorable health outcomes [5]. Despite significant progress in HIV/AIDS management, treatment failure remains a persistent concern. This highlights the need for continued research, improved treatment options, and greater adherence to medication regimens. The clinical and immunological criteria for identifying treatment failure were found to be ineffective in predicting ART virological failure, as they only detected 58% of failures, highlighting the importance of viral load testing in detecting such failures [6].

Plasma HIV viral load (VL) is a critical measure in clinical practice for assessing the effectiveness of HIV treatment and determining adherence to ART while providing valuable information about the treatment response and helping in making informed decisions regarding patient care [7]. Viral load monitoring provides a quicker and more precise means of detecting treatment failure and the need to switch from first-line to second-line medications. This approach also decreases the accumulation of drug resistance mutations and improves clinical outcomes compared to clinical or immunological monitoring [8].

HIV viral load suppression refers to reducing the amount of HIV virus in a person's blood to undetectable levels through antiretroviral therapy, which helps maintain their health and prevent disease progression while greatly reducing the risk of transmission to others. Previous research highlighted that factors associated with achieving viral suppression in HIV patients using antiretroviral therapy (ART) comprise adherence to treatment, ART regimen, length of time on ART, and gender, while other studies identified virological failure to be significantly associated with factors such as educational level, male gender, unmarried status, young age, multiple sexual partners, and poor adherence to treatment [9-12].

Identifying patients who are at risk of viral load unsuppression in the early stages will enable the application of preventive measures. Consequently, patients will obtain exceptional treatment and support that will assist in sustaining HIV viral suppression, restoring their immune systems, improving their clinical well-being, reducing mortality rates, and decreasing HIV transmission within the community [13]. Therefore, this study aims to uncover the risk factors linked with viral load unsuppression in this population. The study's results can help stakeholders make informed decisions to improve viral load suppression and fast-track epidemic control efforts. By identifying the risk factors associated with viral load unsuppression in PHIV patients, the study can also aid in developing targeted interventions to address the root causes of the issue.

Methodology

Study design and setting

A retrospective cohort study was conducted using routinely collected service data of clients enrolled on

ART from 2000 to 2022 at facilities within Gombe State. The study setting includes all the facilities providing ART services supported by the Centers for Disease Control (CDC) through the Center for Integrated Health programmes (CIHP) within Gombe State. This includes a total of 24 facilities across all 11 local government areas (LGAs) of the state that offer a free and comprehensive package of HIV care for PLHIVs.

Study population and study variables

All PLHIV aged 18 years and older who commenced ART from 2000 to 2022 with at least one active viral load result (results received from January 2022 to December 2022). Clients who are lost to follow-up, transferred out, died, stopped treatment, had less than 6 months on ART, and had missing/incomplete records were excluded from the study. After data cleaning, a total of 11518 cases were included in the study. Viral load unsuppression, defined as a viral load result of ≥ 1000 cp/ml is the outcome variable of the study. Sociodemographic characteristics, that include sex, current age, level of education, marital status, employment status, and facility category and ART-related characteristics such as time on ART, current regimen line, and current regimen, were the explanatory/predictor variables.

Data collection

The variables of the study were extracted from Retention and Audit Determination Tool (RADET) file, which was generated from National Medical Record System (NMRS). NMRS is used for collecting and storing client-level service data across all the service delivery points at some ART clinics in Nigeria. The RADET file contains some sociodemographic, ART, and clinically related information about the PLHIV.

Baseline data extracted from the RADET file included the client's sociodemographic (sex, current age, level of education, marital status, and employment status), ART related (time on ART, current regimen line, and current regimen), and clinical related (viral load) characteristics. The classification of facilities into Tier 1 or Tier 2 was determined by the number of clients who have been receiving ART. Facilities with 1000 or more clients receiving ART were categorized as Tier 1, while sites with less than 1000 clients were categorized as Tier 2.

Data analysis

The raw RADET file containing the study data was cleaned using Microsoft Excel 2016 and later loaded into R statistical software version 1.0.143. The categorical variables of the study, which included all the sociodemographic, ART related and clinically related characteristics were described using frequencies and percentages. Bivariate analysis using Chi-square (X^2) and Fischer's exact test was used to explore the association between the independent variables of the study and viral load unsuppression where applicable. Variables with a P-value ≤ 0.25 from the bivariate analysis were further entered into a multivariable logistic regression model to determine the predictors of viral load unsuppression. Lastly, the adjusted odds ratio with 95% CI was determined, and variables were considered statistically significant at p-value ≤ 0.05.

Ethical approval

Our study was approved by Gombe State Ministry of Health Ethics Committee (approval number **GMHREC 2023/006**). As the secondary data collected and analyzed were anonymous, obtaining informed consent from patients was not necessary.

Table 1: Sociodemographic and Clinical/ART Related Characteristics of PLHIV in Gombe State from 2000 to 2022.

Variables	Frequency	Percentage (%)
Sex		
Male	4471	38.8
Female	7047	61.2
Current Age		
18-24	773	6.7
25-49	9542	82.9
≥ 50	1203	10.4
Level of education		
No education	4616	40.1
Primary education	2955	25.7
Secondary education	3107	27.0
Tertiary education	840	7.3
Marital status		
Married/cohabiting	6023	52.3
Divorced/widow/separated	4718	41.0
Never married	777	6.7
Employment status		
Employed	2678	23.3
Unemployed	8840	76.7
Facility category		
Tier 1	8688	75.4
Tier 2	2830	24.6
Time on ART		
< 5 years	9339	81.1
≥ 5 years	2179	18.9
Current Regimen Line		
First line	11425	99.2
Second line	93	0.8
Current ART Regimen		
TDF-3TC based	11488	99.7
Non TDF-3TC based	30	0.3
Current Viral load		
Undetectable (< 20 cp/ml)	8652	75.1
Suppressed (20-999 cp/ml)	2595	22.5
Unsuppressed (≥ 1000 cp/ml)	271	2.4

Results

Table 1 shows the sociodemographic; ART related and clinically related characteristics of adult PLHIV on HAART in Gombe State. A vast majority of the clients were female, 7047 (61.2%). 9542 (82.9%) were 25-49 year-old, and 4616 (40.1%) had no education. Most of the clients, 6023 (52.3%), were also married/cohabiting, 8840 (76.7%) unemployed, 9339 (81.1%) had been on ART less than 5 years, 8688 (75.4%) were accessing ART at a tier 1 facility, 11425 (99.2%) were on a first line regimen with 11488 (99.7%) being on a TDF + 3TC based regimen and 8652 (75.1%) have an undetectable viral load result.

Interestingly, out of a total of 11518 results analyzed, 11247 and 271 were suppressed and unsuppressed, respectively, thus yielding a suppression rate of 97.6% and an unsuppression rate of 2.4%. Unsuppressed viral load was more prevalent among categories that include males (2.4%) aged 18-24 years (4.8%); clients who had secondary education (2.90%), had never married (3.09%),unemployed (2.4%); and clients accessing ART at Tier 2 facilities (2.90%). Similarly, viral suppression was prevalent among clients who had been on ART for less than 5 years (2.2%), clients on ARV second line regimens (8.6%), and those on a non-TDF+3TC based regimen (3.3%).

Bivariate analysis to determine factors associated with viral load unsuppression revealed that a statistically significant association ($p \leq 0.05$) exists between viral load unsuppression and the following independent variables of the study: Current age, level of education, facility category and current regimen line, as shown in Table 2.

Table 2: Bivariate analysis of factors associated with viral load suppression among PLHIV in Gombe State from 2000 to 2022.

Variables	Viral Load		X^2	P-value
	Suppressed	Unsuppressed		
Sex				
Male	4362 (97.6%)	109 (2.4%)	0.230	0.631
Female	6885 (97.7%)	162 (2.3%)		
Current Age				
18-24	736 (95.2%)	37 (4.8)	21.778	0.000
25-49	9331 (97.8%)	211 (2.2%)		
≥ 50	11247 (98.1%)	23 (1.9%)		
Level of education				
No education	4511 (97.7%)	105 (2.3%)	8.688	0.034
Primary education	2902 (98.2%)	53 (1.8%)		
Secondary education	3017 (97.1%)	90 (2.9%)		
Tertiary education	817 (97.3%)	23 (2.7%)		
Marital status				
Married/cohabiting	5889 (97.8%)	134 (2.2%)	2.298	0.317
Divorced/widow/separated	4605 (97.6%)	113 (2.4%)		
Never married	753 (96.9%)	24 (3.1%)		
Employment status				
Employed	2619 (97.8%)	59 (2.2%)	0.340	0.560
Unemployed	8628 (97.6%)	212 (2.4%)		
Years on ART				
< 5	9116 (97.6%)	223 (2.4%)	0.263	0.608
≥ 5	2131 (97.8%)	48 (2.2%)		
Facility category				
Tier 1	8499 (97.8%)	189 (2.2%)	4.845	0.028
Tier 2	2748 (97.1%)	82 (2.9%)		
Current Regimen Line				
First line	11162 (97.7%)	263 (2.3%)	15.937	0.000
Second line	85 (91.4%)	8 (8.6%)		
Current ART Regimen				
TDF-3TC based	11218 (97.6%)	270 (2.4%)	0.126	0.723
Non TDF-3TC based	29 (96.7%)	7 (3.3%)		

Table 3 depicts the output of the multivariate logistic regression analysis. Age and current regimen were significantly associated (P-value ≤ 0.05) with viral load unsuppression in both the unadjusted and adjusted models, while the facility category was only significantly associated with the outcome of interest in the adjusted model. The results suggest that clients aged 18-24 (AOR: 2.579, 95% CI: 1.532-4.433) are approximately 2.6 times more likely to be virally unsuppressed compared to clients aged 50 and above in the adjusted model. Clients accessing ART at tier 1 facilities (AOR: 0.745, 95% CI: 0.575-0.974) are less likely to be virally unsuppressed compared to their counterparts accessing ART at tier 2 sites. Similarly, clients on a first line regimen (AOR: 0.250, 95% CI: 0.128-0.566) are less likely to be virally unsuppressed than their counterparts on a second line regimen.

Discussion

The goal of antiretroviral therapy is to inhibit the replication of the virus and lower the level of viral particles in the patient's body to undetectable levels. This helps to prevent additional harm to the immune system and enables the patient to regain and sustain a good quality of life [14]. This study aims to determine the factors that are associated with viral load unsuppression among PLHIV on HAART in Gombe State, Nigeria.

Our study reported a viral load suppression and unsuppression rate of 97.6% and 2.6%, respectively. This is more important as the suppression rate reported in this study has exceeded UNAIDS' third target of 95 percent and is also higher than the national estimate of 80.9% as reported by NAIIS [3]. This finding suggests that Gombe State is on track to achieving epidemic control of HIV/AIDS. Furthermore, the unsuppression rate reported is lower than that of other studies conducted within Africa, including Uganda 12.2% [15], Ethiopia, 18.6% [16], and Ghana 47.0% [17]. This discrepancy could be because of differences in the methods used to enhance patients' adherence to ART, as well as the specific type of medication regimen administered. The study found that age, facility category, and regimen line were statistically significantly associated with viral load unsuppression.

It is further revealed in this study that clients aged 18-24 who fall into the WHO age category for "young people'' [18], were more likely to be virally unsuppressed than older clients. This finding corroborates that of other studies in Ethiopia [19] and Uganda [9] which reported that the odds of virologic failure decrease with increasing age and vice versa. The higher risk of viral load unsuppression among these clients may be explained by poor adherence to ART, which may be due to several distinct behavioral and psychosocial factors such as heightened levels of anxiety, a sense of social stigma surrounding their condition, reluctance to disclose their status, and the challenges of navigating life with limited financial resources [20]. More so, it might be due to poor optimization of tailored care models that address their unique needs [10]. To address this issue, it may be necessary to develop and fine-tune strategies that specifically target young people and cater to their unique needs, with the ultimate goal of improving viral load suppression rates among these individuals. This could involve exploring a range of different approaches, such as increasing access to education and counseling services, improving medication adherence through tailored interventions, and creating supportive networks that help young people overcome the challenges they face in managing their condition.

Clients accessing ART at tier 2 facilities were found to be more likely to have viral load unsuppression than those accessing ART at tier 1 sites. Achieving

Table 3: Predictors of virologic failure among PLHIV in Gombe state from 2000 to 2022.

Variable	Unadjusted OR (95% C.I)	p-value	Adjusted OR (95% C.I)	p-value
Age 18-24 (0)	Ref			
Age 25-49 (1)	2.682 (1.585-4.633)	< 0.001	2.579 (1.532-4.433)	< 0.001
Age ≥ 50 (2)	1.209 (0.798-1.924)	0.395	1.160 (0.768-1.840)	0.503
Level of education				
No education (0)	Ref			
Primary education (1)	0.893 (0.570-1.458)	0.635	0.827 (0.533-1.337)	0.415
Secondary education (2)	0.721 (0.439-1.221)	0.208	0.649 (0.400-1.084)	0.087
Tertiary education (3)	1.103 (0.701-1.804)	0.684	1.060 (0.678-1.724)	0.807
Facility category				
Facility category-Tier 2 (0)	Ref			
Facility category-Tier 1 (1)	0.810 (0.620-1.067)	0.127	0.745 (0.575-0.974)	0.028
Current regimen line				
Second regimen line (0)	Ref			
First regimen line (1)	0.236 (0.119-0.537)	< 0.001	0.250 (0.128-0.566)	< 0.001

better outcomes for people living with HIV (PLHIV), specifically in terms of viral load suppression, may be impeded by the scarcity of healthcare personnel in medical facilities with low patient volumes [21]. To a significant degree, many tier 2 sites have inadequate staffing levels and are mostly managed by lower-level healthcare workers who lack proper clinical training in HIV care and management. Due to this, there is a risk that important aspects or underlying health issues that may impact viral suppression are overlooked since they may not have a comprehensive understanding of the patient's clinical and psychological status. In order to overcome this constraint, it may be necessary to explore innovative solutions that maximize the impact of available resources, such as telemedicine, routine capacity building of health workers, task-shifting and community-based care models.

The study has also revealed that clients on a second line regimen are more likely to have an unsuppressed viral load than their counterparts on a first line regimen. This finding is in line with that of other studies [20]. This outcome is expected, as most individuals who have been switched to second-line therapy for their HIV treatment are typically those who have experienced treatment failure on a previous regimen. In general, if a patient had poor adherence to their first-line therapy, there is a higher likelihood that they may also have poor adherence to their second therapy [20]. This can increase the risk of viral load unsuppression, which can have negative health outcomes for the patient. To mitigate this, several strategies can be employed, including optimizing adherence support programs, providing treatment literacy, addressing barriers to adherence, regular monitoring, and early intervention. These strategies can help improve treatment outcomes, promote overall health and well-being, and reduce the risk of unsuppressed viral load.

Although this study provides valuable insights, it is important to note its limitations. Firstly, due to the use of routine program data, some demographic and clinical variables were missing, which could have helped predict viral load unsuppression. Although viral mutation is a possible cause of viral load unsuppression, the absence of drug resistance testing services meant that no evidence was available. Additionally, the data presented in this study only represents a single state in Nigeria and may not be generalisable to other states. Despite these limitations, we employed statistical and data management techniques to ensure data quality, mitigating the challenges posed by using secondary data. Moreover, this study is the first of its kind to examine the prevalence of viral load unsuppression in Gombe State as well as factors that contribute to it. Hence, the findings from this study will provide significant insights that can be utilized to inform policy by HIV/AIDS programs operating within the state.

Conclusion

The rate of unsuppressed viral load in Gombe is significantly lower than that observed in other settings, and the rate of viral load suppression has already surpassed the UNAIDS target of 95% for individuals receiving antiretroviral therapy. The study identified several factors, including age, facility category, and regimen line, that increase the risk of an unsuppressed viral load. Thus, it is essential to prioritize virologic monitoring for young people, clients accessing ART at tier 2 facilities, and those on second-line regimens.

Contribution of Authors

All authors contributed to the conceptualization and writing different versions of the draft and, they all read and approved the final manuscript.

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Ethical Approval

Ethical approval for this study was obtained from the ethical clearance committee of Gombe State Ministry of Health.

Declaration of Competing Interest

None to declare.

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