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Levels and Predictors of Unsuppressed Viremia among People Living with HIV on ART in an Urban Population of North-Central Nigeria: A Retrospective Cross-sectional Study

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ABSTRACT

Achieving viral suppression is crucial for the effective management of HIV. We investigated the prevalence and predictors of unsuppressed viremia among adults living with HIV (PLHIV) on antiretroviral therapy (ART) in the urban city of Jos, Plateau State, North-central Nigeria. A cross-sectional study was conducted with 2,748 PLHIV, comprising 1,902 females (69.2%) and 846 males (30.8%). The majority (71.0%) were aged 36-55 years. Most participants (88.1%) were on the first-line ART regimen tenofovir disoproxil fumarate-lamivudine-dolutegravir (TDF+3TC+DTG), with 6.0% on second-line regimens. The prevalence of unsuppressed viremia (viral load >1,000 copies/mL) was assessed, and predictors were identified using chi-square tests and logistic regression analyses. Overall prevalence of unsuppressed viremia was 4.0% (110 participants), with higher proportions among males (5.6%) compared to females (3.3%) and among those aged 18-35 years (7.9%) compared to other age groups. PLHIV on first-line TDF+3TC+DTG ART had the lowest level of unsuppressed viremia (2.6%). Chi-square tests revealed significant associations between unsuppressed viremia and gender ($\chi2=7.67$, $p=0.01$), age group ($\chi2=13.19$, $p=0.01$), and ART regimen ($\chi2=110.97$, $p=0.0001$). Multivariate logistic regression identified males (AOR=1.69; 95% CI: 1.12-2.56), younger age groups (18-35 years: AOR=12.96; 95% CI: 2.12-79.09 and 36-45 years: AOR=12.84; 95% CI: 3.70-44.64), and non-TDF+3TC+DTG regimens as significant predictors of unsuppressed viremia. The study highlights the effectiveness of the TDF+3TC+DTG regimen and the need for targeted interventions to address disparities in viral suppression, particularly among males and younger individuals. These findings are crucial for optimizing HIV treatment strategies and improving health outcomes for PLHIV in urban areas of low-and-middle-income countries.

Keywords:

HIV/AIDS; Antiretroviral Therapy (ART); Unsuppressed Viremia; Associated factors; Northcentral Nigeria

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INTRODUCTION

The HIV/AIDS global epidemic has caused an estimated 36 million deaths globally since it began in the early 1980s but introduction of antiretroviral therapy (ART) in the mid-1990s marked a turning point in the war against the disease [1]. ART has revolutionized HIV treatment, transforming what was once a fatal disease into a manageable chronic condition [2]. Nonetheless, the HIV remains a significant health challenge, particularly in sub-Saharan Africa which accounts for the majority of the global HIV burden [3]. According to UNAIDS, about 39 million people were living with HIV worldwide in 2022, with sub-Saharan Africa accounting for about two-thirds of this population. About 1.3 million people also became newly infected with the virus in that year [4]. The pandemic continues to pose challenges, such as stigma and discrimination, which can hinder access to testing and treatment services.

Nigeria, the most populous country in Africa, has one of the highest burdens of HIV globally [5]. In recent years, significant efforts have been made to scale up ART coverage across the country. However, challenges such as adherence to treatment, drug resistance, and healthcare infrastructure limitations persist. North-central Nigeria, with its relatively high HIV prevalence [5, 6], diverse and densely populated urban areas, and healthcare dynamics provides a valuable context for studying the effectiveness of ART programmes and the factors influencing treatment outcomes. While ART can suppress HIV viral load to undetectable levels in people living with HIV (PLHIV), thereby reducing morbidity, preventing transmission, and improving the quality of life, unsuppressed viremia has been observed among patients accessing ART [7, 8]. Unsuppressed viremia can lead to disease progression, increased risk of HIV transmission, and the emergence of drug-resistant HIV strains [9]. Understanding the levels and predictors of unsuppressed viremia is therefore crucial for optimizing HIV treatment strategies and improving health outcomes.

This retrospective cross-sectional study aims to evaluate the levels of unsuppressed viremia among PLHIV on ART in Jos, Nigeria. Additionally, the study seeks to identify predictors of unsuppressed viremia to inform targeted interventions. By analyzing patient records and treatment histories, this research hopes to contribute to a better understanding of the factors that affect viral suppression and support the development of strategies to enhance ART effectiveness in similar settings.

MATERIALS AND METHODS

Study Design and Study Location

This was a retrospective cross-sectional study conducted to analyze the levels and predictors of unsuppressed viremia among people living with HIV (PLHIV) accessing antiretroviral therapy (ART) for at least 6 months at Faith Alive Foundation Hospital, a secondary healthcare facility in Jos, Plateau State, Nigeria. Jos is the urban and cosmopolitan administrative capital of Plateau State, north-central Nigeria. It is also a transit city that serves as a link to the northeastern and parts of northwestern parts of the country as it shares contiguous borders with Bauchi, Kaduna, Nasarawa, and Taraba States to the northeast, northwest, southwest, southeast [10]. The source population comprised all PLHIV accessing ART at the facility from January to December, 2016.

Study Population

The study population comprised adult PLHIV aged 18 years and above accessing antiretroviral therapy at Faith Alive Foundation Hospital, Jos, Plateau State, Nigeria from January to December, 2016, and who had been on ART for at least 6 months with adequate follow-up and adherence counselling.

DATA SOURCE AND DATA COLLECTION PROCEDURE

This study used secondary data of registered adult PLHIV aged 18 years and above on ART at Faith Alive Foundation Hospital, Jos, Plateau State, Nigeria from January to December 2016. Data collection procedure was based on patient's electronic database system, using their hospital registration number, to retrieve necessary demographic and clinical data. Patients younger than 18 years, and those with incomplete data on required

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parameters such as viral load, ART regimen, gender and age were excluded. Secondary data from a total of 2748 patients were finally selected for this study.

Data Quality Control

Data were retrieved by trained ART data extractors. All extraction processes were also overseen by professional data scientists, and extracted data were also regularly checked for completeness and consistency by the data analysis section of the research team.

Variables

For this study, the response variable was unsuppressed viremia which was defined as a viral load count $\geq$1000 copies/mL after at least 6 months on ART with adequate follow-up. Suppressed viremia implied viral load counts <1000 copies/mL. Predictor variables comprised gender, age, and ART regimen, and they were assessed based on different categories. For instance, ART regimen had five categories including three under first-line regimens and two under second-line regimens. First-line ART regimens were tenofovir disoproxil fumarate, lamivudine, and dolutegravir (TDF+3TC+DTG), Tenofovir disoproxil fumarate, lamivudine, and efavirenz (TDF-3TC-EFV), and "other first-line regimens" which comprised three different regimens that were grouped together in this study because very few participants were administered each of them. The three regimens under "other first-line regimens" are Abacavir, lamivudine, and dolutegravir (ABC+3TC+DTG), Zidovudine, lamivudine, and nevirapine (AZT+3TC+NVP), and Tenofovir disoproxil fumarate, emtricitabine, and dolutegravir (TDF+FTC+DTG). The two second-line regimens included were ritonavir-boosted protease inhibitor-containing regimens, Tenofovir disoproxil fumarate, lamivudine, and lopinavir/ritonavir (TDF+3TC+LPV/r) and Tenofovir disoproxil fumarate, lamivudine, and atazanavir/ritonavir (TDF+3TC+ATV/r).

Data Management and Analysis Procedure

Cleaning and comprehensive analysis of data collected was done using SPSS (Armonk, USA) version 22. Categorical variables were measured using frequencies and percentages. Chi-square test of association was used for preliminary assessment of association between unsuppressed viremia and predictor variables at α0.05, while univariate logistic regression analysis was used to obtain crude odds ratio (COR) for initial assessment of associated factors of unsuppressed viremia. Variables with *p*-values less than 0.25 in univariate logistic regression analysis were selected for binary logistic regression analysis [11-13]. A stepwise, backward elimination method was used to remove non-significant variables from the model. Variables with *p*-values of less than 0.05 were considered statistically significant. Adjusted odds ratio (AOR) with 95% confidence interval (CI) was calculated to determine associated factors. Hosmer–Lemeshow goodness-of-fit test was applied, while variance inflation factor (VIF) was used to check for multicollinearity and none was found [12, 13].

RESULTS

Characteristics of Study Participants and Levels of Unsuppressed Viremia

A total of 2748 PLHIV, comprising 1902 (69.2%) females and 846 (30.8%) males were included in this study, with those aged 36-55 years accounting for about 71.0% of the participants. Majority (88.1%) were on TDF+3TC+DTG first-line ART regimen, while about 6.0% were on second-line ART regimens. These results are shown in Table 1. As shown in Table 2, overall prevalence of unsuppressed viremia during the study was 4.0%, representing 110 participants made up of 63 females (57.3%) and 47 males (42.7%). However, the proportions of PLHIV with unsuppressed viremia was higher among males (5.6%) than among females (3.3%), and among age group 18-35 years (7.9%), with lowest values obtained among PLHIV aged 56-65 years (2.7%). Figure 1 shows the viremia status (based on actual counts) of study participants, which revealed higher levels of suppressed viremia within all the categories of gender, age, and ART regimens. Table 2 also shows that while the majority of study participants (88.1%) were on TDF+3TC+DTG, this ART regimen category had the lowest level of unsuppressed viremia (2.6%). As shown in Figure 2, among PLHIV with unsuppressed viremia, those on "other first-line" ART regimens had the highest prevalence.

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Assessment of association between unsuppressed viremia and independent variables

Chi-square test of association revealed that gender (χ^2=7.67, p=0.01), age group (χ^2=13.19, p=0.01), and ART regimen group (χ^2=110.97, p=0.0001) were significantly associated with unsuppressed viremia at α0.05 (Table 2). Table 3 reveals the results of univariate logistic regression analysis, with all three independent variables having at least 50.0% of their categories showing a statistically significant association with unsuppressed viremia at the selected significant level ($\alpha_{0.25}$), compared to their respective reference categories. The significantly associated categories were "female" (COR=0.60; 95% CI: 0.41-0.87) under "gender" which had two categories; "18-35 years" (COR=33.42; 95% CI: 6.90-161.94) and "36-45 years" (COR=10.44; 95% CI: 3.28-33.20) under "age group" which had five categories; and "TDF+3TC+DTG" (COR=0.08; 95% CI: 0.04-0.16), "TDF-3TC-EFV" (COR=0.49; 95% CI: 0.22-1.11), "TDF+3TC+LPV/r" (COR=0.48; 95% CI: 0.20-1.18), and "Other First-line" (COR=0.38; 95% CI: 0.15-0.99) under "ART regimen group" which had five categories.

Predictors of unsuppressed viremia among PLHIV on ART during the study

Binary logistic regression analysis, using a stepwise, backward elimination procedure, was performed on independent variables that were significant in the univariate model to eliminate non-significant variables and determine predictors of unsuppressed viremia among study participants [13]. Variables with *p*-values less than 0.05 were considered statistically significant. Adjusted odds ratio (AOR) with 95% confidence interval (CI) was calculated to determine associated factors. Results obtained, as shown in Table 4, revealed that females had 0.59 times the odds (AOR=0.59; 95% CI: 0.39-0.89) of having unsuppressed viremia compared to males. PLHIV aged 18-35 years and 36-45 years had significantly higher odds (AOR=12.96; 95% CI: 2.12-79.09 and AOR=12.84; 95% CI: 3.70-44.64, respectively) of having unsuppressed viremia at α0.05, compared to the reference group aged 66 years and older. Study participants on first-line regimen TDF+3TC+DTG also had significantly lower odds (AOR=0.09; 95% CI: 0.04-0.20) of having unsuppressed viremia compared to the reference category on "other first-line" regimens comprising ABC+3TC+DTG, AZT+3TC+NVP, and TDF+FTC+DTG.

DISCUSSION

Overall prevalence of unsuppressed viremia among PLHIV on ART during this study was 4.0%. This rate is relatively low compared to other low-and-middle-income countries (LMICs), especially in sub-Saharan Africa [14]. For instance, studies in Ghana and Ethiopia have reported 19.0% and 20.3% prevalence of unsuppressed viremia among adults on ART [15, 16]. The lower prevalence observed in our study could be attributed to the high coverage and efficacy of the TDF+3TC+DTG regimen, which was used by the majority (88.1%) of the participants. Our findings also indicate a significant gender disparity in the prevalence of unsuppressed viremia. Males had a higher prevalence (5.6%) of unsuppressed viremia compared to females (3.3%). This aligns with previous research suggesting that men are less likely to achieve viral suppression than women [15, 17, 18]. Factors contributing to this difference include lower health-seeking behavior among men, higher rates of treatment non-adherence, and delayed initiation of ART. Addressing these barriers through targeted interventions, such as male-focused health campaigns and adherence support, is crucial for improving treatment outcomes among men.

The prevalence of unsuppressed viremia varied significantly across different age groups. Younger PLHIV, particularly those aged 18-35 years, exhibited the highest prevalence of unsuppressed viremia at 7.9%. This finding is consistent with studies reporting higher rates of unsuppressed viremia among teenagers and other younger individuals, potentially due to lower adherence to ART and higher rates of drug resistance. Conversely, the lowest prevalence was observed among PLHIV aged 56-65 years (2.7%). Older adults often show better adherence to ART, leading to improved viral suppression [14, 19]. The effectiveness of different ART regimens in achieving viral suppression is a crucial determinant in managing HIV treatment outcomes. In our study, the majority of participants (88.1%) were on the TDF+3TC+DTG regimen, which demonstrated the lowest level of unsuppressed viremia at 2.6%. However, for those on "other first-line" ART regimens, comprising ABC+3TC+DTG, AZT+3TC+NVP, and TDF+FTC+DTG, prevalence of unsuppressed viremia was notably higher. These regimens were grouped together due to small sample sizes, which could impact the reliability of the comparative analysis. Integrase strand transfer inhibitors (INSTIs), such as Dolutegravir (DTG), are known

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for their high efficacy and low risk of resistance [20, 21]. *Despite DTG's robust antiviral properties,* studies have shown mixed results, with some indicating comparable viral suppression of ABC+3TC+DTG to many other regimens containing 3TC+DTG [22], while others suggest slightly lower efficacy due to adherence issues and potential side effects associated with ABC [23].

The AZT+3TC+NVP regimen includes zidovudine (AZT) and nevirapine (NVP), both older antiretroviral drugs with known limitations. AZT is associated with significant side effects, including anemia and gastrointestinal disturbances, which can affect adherence [24, 25]. Nevirapine, while effective, has a lower barrier to resistance and is associated with severe hepatotoxicity and hypersensitivity reactions [26, 27]. Studies have also shown that regimens containing AZT and NVP are less effective in achieving viral suppression compared to newer regimens, and this is reflected in our study by the higher prevalence of unsuppressed viremia among those on AZT+3TC+NVP. The third regimen in the "other first-line" ART regimens, TDF+FTC+DTG, like TDF+3TC+DTG, includes DTG, which is highly effective. Emtricitabine (FTC) is similar to lamivudine (3TC) in efficacy and pharmacological profile, the main difference being the longer intracellular half-life of emtricitabine [28]. The high effectiveness of DTG in this regimen should theoretically result in good viral suppression outcomes. However, the small sample size in our study necessitated merging TDF+FTC+DTG with other regimens, which may obscure the true efficacy of this specific combination.

Our study identified some predictors of unsuppressed viremia among PLHIV on ART in the metropolitan city of Jos, North-central Nigeria. The chi-square test of association revealed that gender ($\chi2=7.67$, $p=0.01$), age group ($\chi2=13.19$, $p=0.01$), and ART regimen ($\chi2=110.97$, $p=0.0001$) were significantly associated with unsuppressed viremia. Univariate logistic regression analysis showed that females had lower odds (COR=0.60; 95% CI: 0.41-0.87) of having unsuppressed viremia compared to males. This association remained significant in the multivariate analysis, with females having 0.59 times the odds (AOR=0.59; 95% CI: 0.39-0.89) of unsuppressed viremia compared to males. These findings align with previous research indicating that men are less likely to achieve viral suppression than women due to factors such as lower health-seeking behavior, higher rates of treatment non-adherence, and delayed initiation of ART [14, 17, 18].

For age group, participants aged 18-35 years and 36-45 years had significantly higher odds of having unsuppressed viremia compared to those aged 66 years and older. The univariate analysis indicated very high odds ratios for these groups (COR=33.42; 95% CI: 6.90-161.94 and COR=10.44; 95% CI: 3.28-33.20, respectively). The multivariate analysis confirmed these associations, with the 18-35 years and 36-45 years age groups having AORs of 12.96 (95% CI: 2.12-79.09) and 12.84 (95% CI: 3.70-44.64), respectively. This age-related disparity in viral suppression is consistent with other studies, which suggest that younger individuals may have lower adherence to ART and higher rates of drug resistance due to behavioral and psychosocial factors [16, 29, 30].

ART regimen was the most significant predictor of unsuppressed viremia. Participants on the TDF+3TC+DTG regimen had the lowest odds (COR=0.08; 95% CI: 0.04-0.16) of unsuppressed viremia, which remained significant in the multivariate analysis (AOR=0.09; 95% CI: 0.04-0.20). The effectiveness of the TDF+3TC+DTG regimen is well-documented, with DTG being recognized for its high genetic barrier to resistance, robust efficacy, and favorable side-effect profile [20, 21]. Other regimens, such as TDF-3TC-EFV and TDF+3TC+LPV/r, also showed lower odds of unsuppressed viremia (COR=0.49; 95% CI: 0.22-1.11 and COR=0.48; 95% CI: 0.20-1.18, respectively), though these did not reach statistical significance in the multivariate analysis. The "other first-line" regimens category, which included ABC+3TC+DTG, AZT+3TC+NVP, and TDF+FTC+DTG, was used as the reference group due to the higher prevalence of unsuppressed viremia observed within this category.

The findings of this study have important implications for HIV treatment programs in urban areas of LMICs. The low prevalence of unsuppressed viremia suggests that current ART programmes are effective, yet the identified disparities highlight areas needing targeted interventions. Based on our findings, several recommendations can be made to improve viral suppression rates among PLHIV on ART in the study location and similar settings in other LMICs. These include g**ender-specific interventions** to improve ART adherence and viral suppression among men. This could include male-focused health campaigns, support groups, and adherence counselling. Development and implementation of y**outh-focused strategies** to support younger

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PLHIV is also crucial. These may include youth-friendly health services, peer support programs, and tailored adherence interventions. Addressing behavioral and psychosocial barriers is crucial in this demographic. Moreover, o**ptimizing ART regimens** to ensure that the most effective ART regimens, particularly DTG-containing regimens, are widely available and accessible is pertinent. Continuous monitoring and support for individuals on alternative regimens, such as those in the "other first-line" category, are necessary to address potential challenges and improve outcomes. Lastly, e**nhanced monitoring and support** systems should be developed to identify individuals at risk of unsuppressed viremia early and provide additional support and interventions for those identified.

CONCLUSION

The study revealed a low overall prevalence of unsuppressed viremia among adult PLHIV on ART in Jos, the administrative cosmopolitan capital of Plateau State, North-central Nigeria. However, significant disparities were observed based on gender, age, and ART regimen. Males and younger individuals were more likely to have unsuppressed viremia, while the TDF+3TC+DTG regimen was associated with the highest rates of viral suppression. These findings highlight the need for targeted interventions to address the specific needs of men and younger PLHIV and to ensure access to the most effective ART regimens, especially those containing INSTIs such as DTG. By addressing these disparities and optimizing treatment strategies, it is possible to further reduce the prevalence of unsuppressed viremia and improve health outcomes for PLHIV in the study location and similar settings in other LMICs.

LIMITATIONS OF THE STUDY

The small sample sizes of ABC+3TC+DTG, AZT+3TC+NVP, and TDF+FTC+DTG regimens in our study necessitated their merging under "other first-line" ART regimens. This merging could potentially bias the observed prevalence of unsuppressed viremia, as it does not allow for a clear distinction of the efficacy of each individual regimen. The variability in the pharmacological properties, side effect profiles, and barriers to adherence among these regimens can significantly impact their effectiveness in achieving viral suppression. Therefore, interpreting the higher prevalence of unsuppressed viremia in the "other first-line" category requires caution, acknowledging the limitations imposed by the small sample sizes. Other potential socio-demographic predictors, such as educational status and marital status were also not included in our models. Future studies may include such as covariates for a more robust interpretation.

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Conflict of Interest

None declared

Authors Contributions

Study design and supervision (JO, OAA, PE, AAGC); literature search (JO, OAA, GOS, AE, CCH, CGN); analysis and interpretation of data (OAA, AAGC); preparation of original and revised manuscripts (OAA). All authors have made significant contributions to this study and have approved the final manuscript.

Ethical Approval

Ethical approval was obtained from the Health Research Ethics Committee (HREC) of Bingham University Teaching Hospital, Jos, Nigeria under approval number NHREC/21/05/2005/00950. The requirement for

informed consent from each participant was waived as data used for the study were obtained as part of routine standard of treatment and follow-up care for monitoring HIV treatment response and all data were completely anonymized.

Data Availability

The data used in support of the findings of this study are available on reasonable request from the corresponding author at extradeola@gmail.com.

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Table 1: Background information of study participants

Characteristics	**Category**	**Frequency (%)**
Gender	Female	1902 (69.2)
	Male	846 (30.8)
	Total	2748 (100.0)
Age (years)	18-35 years	164 (6.0)
	36-45 years	968 (35.2)
	46-55 years	987 (35.9)
	56-65 years	490 (17.8)
	≥66 years	139 (5.1)
	Total	2748 (100.0)
Viremia Status	Suppressed viremia (0-999 copies/ml)	2638 (96.0)
	Unsuppressed viremia (≥1000 copies/ml)	110 (4.0)
	Total	2748 (100.0)
ART Regimens	TDF-3TC-DTG	2420 (88.1)
	TDF-3TC-EFV	129 (4.7)
	TDF-3TC-LPV/r	81 (2.9)
	TDF-3TC-ATV/r	76 (2.8)
	Other First-line Regimens	42 (1.5)
	Total	2748 (100.0)

Table 2: Association between viremia status and predictor variables

Characteristics and Categories	**Viremia Status**		**Chi-square**	***p*-value**
	Suppressed viremia (%)	**Unsuppressed viremia (%)**		
Gender			7.67	0.01*
Female (*n* = 1902)	1839 (96.7)	63 (3.3)		
Male (*n* = 846)	799 (94.4)	47 (5.6)		
Total (N = 2748)	2638 (96.0)	110 (4.0)		
Age (years)			13.19	0.01*

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18-35 years (*n* = 164)	151 (92.1)	13 (7.9)		
36-45 years (*n* = 968)	934 (96.5)	34 (3.5)		
46-55 years (*n* = 987)	947 (95.9)	40 (4.1)		
56-65 years (*n* = 490)	477 (97.3)	13 (2.7)		
≥66 years (*n* = 139)	129 (92.8)	10 (7.2)		
Total (N = 2748)	2638 (96.0)	110 (4.0)		
ART Regimens			110.97	0.0001*
TDF-3TC-DTG (*n* = 2420)	2357 (97.4)	63 (2.6)		
TDF-3TC-EFV (*n* = 129)	110 (85.3)	19 (14.7)		
TDF-3TC-LPV/r (*n* = 81)	71 (87.7)	10 (12.3)		
TDF-3TC-ATV/r (*n* = 76)	67 (88.2)	9 (11.8)		
Other First-line (*n* = 42) Regimens	33 (78.6)	9 (21.4)		
Total (N = 2748)	2638 (96.0)	110 (4.0)		

**p*-value < 0.05

Table 3: Univariate logistic regression analysis of factors associated with unsuppressed viremia among study participants

Characteristics and Categories	**Viremia Status**		**COR (95% CI)**	***p*-value**
	Suppressed viremia (n = 2638)	**Unsuppressed viremia (n = 110)**		
Gender				
Female (*n* = 1902)	1839	63	0.60 (0.41-0.87)	0.01*
Male (*n* = 846)	799	47	I	
Age (years)				
18-35 years	151	13	33.42 (6.90-161.94)	0.001*
36-45 years	934	34	10.44 (3.28-33.20)	0.001*
46-55 years	947	40	0.98 (0.49-1.97)	0.95
56-65 years	477	13	1.03 (0.59-1.79)	0.91
≥66 years	129	10	I	
ART Regimens				
TDF-3TC-DTG	2357	63	0.08 (0.04-0.16)	0.001*
TDF-3TC-EFV	110	19	0.49 (0.22-1.11)	0.09*

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TDF-3TC-LPV/r	71	10	0.48 (0.20-1.18)	0.11*
TDF-3TC-ATV/r	67	9	0.38 (0.15-0.99)	0.05*
Other First-line Regimens	33	9	I	

*p-value < 0.25; COR, Crude odds ratio; CI, Confidence interval; I, reference

Table 4: Binary logistic regression analysis for predictors of unsuppressed viremia among study participants

Characteristics and Categories	**Viremia Status**		**COR (95% CI)**	**AOR (95% CI)**	***p*-value**
	Suppressed viremia (n = 2638)	**Unsuppressed viremia (n = 110)**			
Gender					
Female	1839	63	0.60 (0.41-0.87)	0.59 (0.39-0.89)	0.01*
Male	799	47	I	I	
Age (years)					
18-35 years	151	13	33.42 (6.90-161.94)	12.96 (2.12-79.09)	0.01*
36-45 years	934	34	10.44 (3.28-33.20)	12.84 (3.70-44.64)	0.001*
46-55 years	947	40	0.98 (0.49-1.97)	1.25 (0.59-2.65)	0.56
56-65 years	477	13	1.03 (0.59-1.79)	1.36 (0.76-2.44)	0.30
≥66 years	129	10	I	I	
ART Regimens					
TDF-3TC-DTG	2357	63	0.08 (0.04-0.16)	0.09 (0.04-0.20)	0.001*
TDF-3TC-EFV	110	19	0.49 (0.22-1.11)	0.61 (0.25-1.49)	0.28
TDF-3TC-LPV/r	71	10	0.48 (0.20-1.18)	0.53 (0.20-1.38)	0.19
TDF-3TC-ATV/r	67	9	0.38 (0.15-0.99)	0.50 (0.18-1.40)	0.19
Other First-line Regimens	33	9	I	I	

*p-value < 0.05; COR, Crude odds ratio; AOR, Adjusted odds ratio; CI, Confidence interval; I, reference

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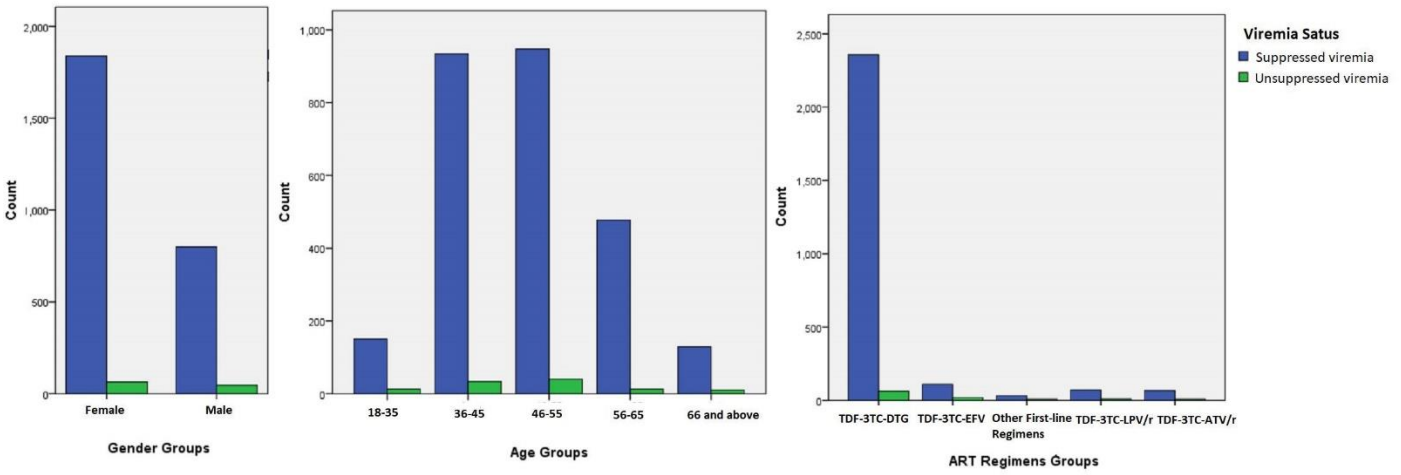

Fig. 1: Chart showing number of participants with suppressed and unsuppressed viremia categorized by gender, age group, and ART regimen.

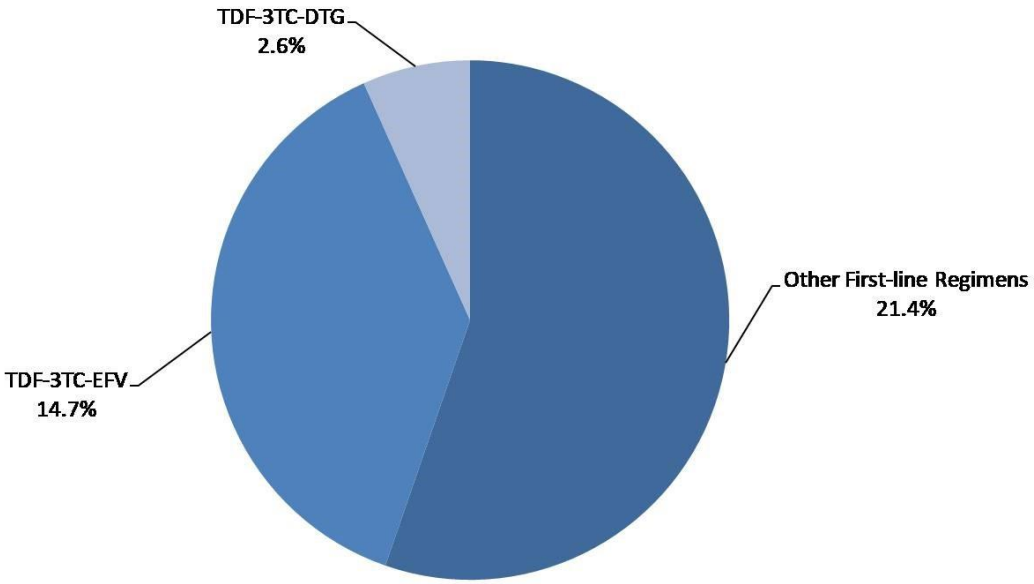

Fig. 2: Pie chart showing proportions of study participants on different first-line ART regimens with unsuppressed viremia