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Viral Load Suppression Among Adults with HIV on Antiretroviral Therapy: Outcomes from a Lusaka District Hospital, Zambia

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ABSTRACT

Background and Objective: HIV/AIDS remains a major public health issue, worldwide, ranking among the top 10 causes of death, particularly in low-income countries. The objective of this research was to determine factors that influence viral suppression in HIV-positive individuals aged 15 years and older who are receiving antiretroviral therapy (ART) from Chawama First-Level Hospital.

Methods: A cross-sectional study design was used to investigate viral load suppression (VLS) factors in adults on ART. Data were analyzed using descriptive and inferential statistics, specifically, the Pearson Chi-square test to assess variable associations. Additionally, logistic regression was used to analyze the relationship between independent variables and the outcome variable. All statistical tests were set at a 95% confidence level ($p < 0.05$). Data were analyzed using STATA version 14.2, Stata Corp LP, College Station, TX.

Results: Out of 10,758 participants, 10,396 (96.64%) achieved viral suppression. Factors associated with viral suppression included the 35–39 age group (AOR = 1.56, p = 0.042) and the 50-and-above age group (AOR = 2.148, p = 0.006). Those not on tenofovir, lamivudine, and dolutegravir (TLD) or tenofovir alafenamide, emtricitabine, and dolutegravir (TAFED) regimens had lower odds (AOR = 0.14, p = 0.001). Longer treatment duration also showed a positive correlation with better odds: 1 year (AOR: 5.387), 2 years (AOR: 8.18), 3 years (AOR: 8.48), 4 years (AOR: 8.37), and 5 years (AOR: 12.13), all with $p < 0.001$. Additionally, multi-month dispensation (MMD) further demonstrated higher odds, particularly 3–5 months (AOR = 18.257) and 6+ months (AOR = 22.137), both $p < 0.001$.

Conclusion and Implications for Translation: The research findings suggest that different socio-demographic and clinical factors may influence viral suppression. Therefore, the study recommends that People Living with HIV (PLWHIV) adhere to ART which should be encouraged by the health workers and strengthen MMD to increase the likelihood of VLS among PLWHIV.

Keywords: Anti-Retroviral Therapy, Human Immunodeficiency Virus, Multi-Month Dispensation, Regimens, Viral Load

INTRODUCTION

Background of the Study

The Human Immunodeficiency Virus (HIV) attacks the human immune system, causing an infection that leads to the deterioration of the body system. The virus can cause a condition known as Acquired Immune Deficiency Syndrome (AIDS).[1] HIV/AIDS remains a significant global public health issue[2] and ranks among the top 10 causes of death, especially in low-income countries.[3] It was estimated that by the end of 2021, there were about 38.4 million People Living with HIV (PLWHIV), with around 26 million in the African region, which has the highest HIV/AIDS prevalence in the world.[4] The Joint United Nations Programme on HIV/AIDS (UNAIDS) set 2025 goals to reduce HIV-related morbidity and mortality, with an ultimate aim to eliminate HIV/AIDS by 2030. These goals include targets related to HIV services.[5] The UNAIDS has set the "95-95-95" targets for 2025, aiming for 95% awareness of HIV status, 95% of those aware of receiving antiretroviral therapy (ART), and 95% of those on ART achieving viral suppression (viral load less than 1000 copies/mL) among HIV-positive individuals.[6]

Zambia, a low-middle-income country in sub-Saharan Africa, faces a significant HIV/AIDS burden with an estimated 10.8% adult prevalence, 1.3 million individuals living with HIV, 38,000 new infections, and 19,000 AIDS-related deaths in 2021.[7] According to the 2021 Zambia population-based HIV impact assessment (ZAMPHIA) report, 86% of HIV-positive adults in Zambia achieved viral suppression, slightly below the UNAIDS goal of 95%. This statistic supports the "Undetectable = Untransmissible" (U = U) strategy, which aims to reduce virus transmission.[8] In Zambia, multiple strategies and interventions are being implemented to achieve undetectable viral loads in PLWHIV. This not only improves their health but also lowers HIV transmission rates.[9] Furthermore, Zambia provides free and comprehensive HIV treatment.[10]

Objective of the Study

The objective of this study was to determine factors associated with achieving viral suppression in adults aged 15 years and older receiving HIV treatment at Chawama First-Level Hospital in Lusaka, Zambia. Furthermore, the study sought to investigate and identify the factors and effects associated with VLS among adults accessing ART.

METHODS

The study employed a quantitative approach with a cross-sectional study design to examine the relationships between viral suppression, socio-demographic, and clinical factors. The study was conducted at Chawama First-Level Hospital and according to the national health management information system (HMIS), by the end of February 2023, a total number of 12,531 HIV-positive patients were registered as recipients of care at the hospital. The study population included PLWHIV who were on ART for at least six months by the end of 2022. Secondary data were collected from the ART register, which was generated from an Electronic Health Records System (EHRS) known as SmartCare Plus. The participants were included in this study based on the following criteria: Those who were receiving HIV treatment (ART) at the end of 2022 for at least 6 months at Chawama First-Level Hospital, and aged 15 years and older. In this regard, a total number of 10,758 were included in the study, with 99.1% of them being on a first-line ART regimen.

Study Variables

This study primarily focused on viral load status, categorized as either unsuppressed or suppressed. Several independent variables were considered, including sex, age category (less than 25 years to 50 years and above), ART regimen, [Tenofovir, Lamivudine, and Dolutegravir (TLD); Tenofovir, Alafenamide, Emtricitabine, and Dolutegravir (TAFED)], and other regimens, treatment duration, grouped by years, from less than 1 year to 5 years and above, and multi-month dispensation (MMD) categorized as not MMD, 3 MMD, and 6 MMD.

Statistical Analysis

The Pearson Chi-square test was used to determine whether or not there was an association between the categorical independent variables and the categorical outcome variable. Furthermore, logistic regression was used to explain the relationship between the independent variables and the binary outcome variable. All analyses were done using STATA version 14.2 from Stata Corp LP, College Station, TX.

RESULTS

Socio-demographic Characteristics

The socio-demographic characteristics of 10,758 study participants are shown in Table 1. A majority of the participants were female (66.19%), and the age distribution revealed that most were aged 50 and above, with a minority under 25 (6.64%). The predominant ART regimen was TLD (84.35%), followed by TAFED (14.61%), with a small fraction of other regimens (1.04%). Concerning treatment duration, the majority had been on treatment for 5 years or more (54.97%), while 11.51% were on treatment for less

Table 1: Distribution of socio-demographic and clinical characteristics of the participants.

Variables	Count (n)	Percentage (%)
Sex		
Female	7,121	66.19
Male	3,637	33.81
Age category (in years)		
Less than 25	714	6.64
25–29	1,022	9.50
30–34	567	14.57
35–39	1,814	16.86
40–44	1,989	18.49
45–49	1,633	15.18
50+	2,019	18.77
ART regimen		
TDF+3TC+DTG	9,074	84.35
DTG+FTC+TAF	1,572	14.61
Other	112	1.04
Treatment duration (in years)		
Less than 1 year	1,238	11.51
1 year	919	8.54
2 years	752	6.99
3 years	870	8.09
4 years	1,065	9.90
5 years+	5,914	54.97
MMD		
3 to 5 months dispensation	7,356	68.38
6 months or more dispensation	2,999	27.88
Not MMD	403	3.75
VL Status		
Unsuppressed VL	362	3.36
Suppressed VL	10,396	96.64

ART: Antiretroviral therapy, MMD: Multi-month dispensation, VL: Viral load, TDF: Tenofovir disoproxil fumarate, 3TC: Lamivudine, DTG: Dolutegravir, FTC: Emtricitabine, TAF: Tenofovir alafenamide.

than a year, 9.09% for 4 years, 8.09% for 1 year, and 6.99% for 2 years. Dispensation intervals were mostly 3 to 5 months (68.38%), with 27.88% on 6 months or more, and a minority not on MMD (3.75%). Almost all participants were virally suppressed (96.64%).

Dependent or Outcome Variable Results

The frequency distribution of the socio-demographic and clinical characteristics of the participants by viral load status and the Chi-square test results are shown in Table 2.

Table 2: Socio-demographic and clinical characteristics of the participants by viral load suppression (VLS).

Variable	Unsuppressed VL (n = 362)	Suppressed VL (n = 10,396)	*p*-Value
Sex			
Female	239 (66.02%)	6,882 (66.20%)	0.944
Male	123 (33.98%)	3,514 (33.80%)	
Age category (in years)			
Less than 25	55 (15.19%)	659 (6.34%)	<0.001*
25–29	57 (15.75%)	965 (9.28%)	
30–34	71 (19.61%)	1,496 (14.39%)	
35–39	54 (14.92%)	1,760 (16.93%)	
40–44	61 (16.85%)	1,928 (18.55%)	
45–49	39 (10.77%)	1,594 (15.33%)	
50+	25 (6.91%)	1,994 (19.18%)	
ART Regimen			
TDF+3TC+ DTG	331 (91.44%)	8,743 (84.10%)	<0.001*
DTG+FTC+ TAF	15 (4.14%)	1,557 (14.98%)	
Other	16 (4.42%)	96 (0.92%)	
Treatment duration (in years)			
Less than 1 year	156 (43.09%)	1,082 (10.41%)	<0.001*
1 year	38 (10.50%)	881 (8.47%)	
2 years	23 (6.35%)	729 (7.01%)	
3 years	22 (6.08%)	848 (8.16%)	
4 years	28 (7.73%)	1,037 (9.97%)	
5 years+	95 (26.24%)	5,819 (55.97%)	
MMD			
Not MMD	107 (29.56%)	296 (2.85%)	<0.001*
3 to 5 months dispensation	134 (37.02%)	7,222 (69.47%)	
6 months or more dispensation	121 (33.43%)	2,878 (27.68%)	

*Significant *p*-value at 95% CI. ART: Antiretroviral therapy, MMD: Multi-month dispensation, VL: Viral load, TDF: Tenofovir disoproxil fumarate, 3TC: Lamivudine, DTG: Dolutegravir, FTC: Emtricitabine, TAF: Tenofovir alafenamide.

Factors Associated with Viral Suppression Among Adults

The socio-demographic factors associated with viral suppression are shown in Table 2. Age group ($p < 0.001$), ART regimens ($p < 0.001$), treatment duration ($p < 0.001$), and MMD ($p < 0.001$) were associated with viral suppression.

Table 3: Logistic regression results.

Variable *(Reference)*	OR (95% CI)	*p* -Value	AOR (95% CI)	*p* -Value
Sex				
Male	0.99 (0.80, 1.238)	0.944	0.84 (0.66, 1.07)	0.165
Age category (in years)				
25–29	1.41 (0.96, 2.07)	0.077	1.27 (0.83, 1.94)	0.272
30–34	1.76 (1.22, 2.53)	0.002*	1.28 (0.85, 1.91)	0.237
35–39	2.72 (1.85, 4.00)	<0.001*	1.56 (1.02, 2.38)	0.042*
40–44	2.64 (1.81, 3.84)	<0.001*	1.27 (0.83, 1.95)	0.264
45–49	3.41 (2.24, 5.19)	<0.001*	1.35 (0.85, 2.16)	0.209
50+	6.66 (4.12, 10.77)	<0.001*	2.15 (1.24, 3.71)	0.006*
ART Regimen				
TAFED	3.93 (2.34, 6.61)	<0.001*	1.44 (0.81, 2.59)	0.217
Other	0.23 (0.13, 0.39)	<0.001*	0.14 (0.07, 0.27)	<0.001*
Treatment duration				
1 year	3.34 (2.32, 4.82)	<0.001*	5.39 (3.54, 8.19)	<0.001*
2 years	4.57 (2.92, 7.15)	<0.001*	8.18 (4.92, 13.61)	<0.001*
3 years	5.56 (3.52, 8.76)	<0.001*	8.48 (5.09, 14.12)	<0.001*
4 years	5.34 (3.54, 8.06)	<0.001*	8.37 (5.24, 13.36)	<0.001*
5 years and above	8.83 (6.79, 11.49)	<0.001*	12.13 (8.63, 17.06)	<0.001*
MMD				
3 to 5 months dispensation	19.48 (14.73, 25.76)	<0.001*	18.26 (13.47, 24.74)	<0.001*
6 months or more dispensation	8.60 (6.46, 11.45)	<0.001*	22.14 (15.45, 31.72)	<0.001*

*Significant *p*-value at 95% CI. ART: Antiretroviral therapy, MMD: Multi-month dispensation, TAFED: Tenofovir alafenamide, emtricitabine, and dolutegravir, OR: Odds ratio, AOR: Adjusted odds ratio, CI: Confidence interval.

Factors Associated with Viral Suppression

The logistic regression results of the factors associated with viral suppression are shown in Table 3. Participants aged 30–34 years were 75.9% more likely to be virally suppressed than those under 25 years old (OR: 1.75, 95% CI: 1.22, 2.53). Participants aged 35–39 years were 2.72 times more likely to be virally suppressed than those under 25 years old (OR: 2.72, 95% CI: 1.85, 4.00). Participants aged 40–44 years were 2.64 times more likely to be virally suppressed than those under 25 years old (OR: 2.64, 95% CI: 1.81, 3.84). Participants aged 45–49 years were 3.41 times more likely to be virally suppressed than those under 25 years old (OR: 3.41, 95% CI: 2.24, 5.19). Participants aged 50 years and above were 6.66 times more likely to be virally suppressed than those under 25 years old (OR: 6.66, 95% CI: 4.12, 10.77). Participants on the TAFED regimen were four times more likely to be virally suppressed than those on the TLD regimen (OR: 3.93, 95% CI: 2.34, 6.61). Participants on other regimens were 77.3% less likely to be virally suppressed than those on TLD (OR: 0.23, 95% CI: 0.13, 0.39). Participants on treatment for one year were three times more likely to achieve viral suppression compared to those on treatment for less than one year (OR: 3.34, 95% CI: 2.32, 4.82). Adjusting for other variables increased this likelihood to five times (AOR: 5.39, 95% CI: 3.54, 8.19). Participants on treatment for two years were five times more likely to achieve viral suppression compared to those on treatment for less than one year (OR: 4.57, 95% CI: 2.92, 7.15). Adjusting for other variables, this likelihood increased to eight times (AOR: 8.18, 95% CI: 4.92, 13.61). Participants on treatment for three years were six times more likely to achieve viral suppression compared to those on treatment for less than one year (OR: 5.56, 95% CI: 3.53, 8.76). Adjusting for other variables also resulted in an eight times higher likelihood (AOR: 8.48, 95% CI: 5.09, 14.12). Participants on treatment for four years were five times more likely to achieve viral suppression compared to those on treatment for less than one year (OR: 5.34, 95% CI:

3.54, 8.06). Adjusted odds also showed an eight-fold higher likelihood (AOR: 8.37, 95% CI: 5.243, 13.36). Participants on treatment for five years or more were nine times more likely to achieve viral suppression compared to those on treatment for less than one year (OR: 8.83, 95% CI: 6.79, 11.49). After adjusting for other variables, this likelihood increased to 12 times (AOR: 12.13, 95% CI: 8.63, 17.06). Participants on three to five months of dispensation were 19 times more likely to achieve viral suppression compared to those not on MMD (OR: 19.48, 95% CI: 14.73, 25.76). After adjusting for other variables, this likelihood remained high at 18 times (AOR: 18.26, 95% CI: 13.47, 24.74). Participants on six months or more dispensation were nine times more likely to achieve viral suppression compared to those not on MMD (OR: 8.60, 95% CI: 6.46, 11.448). After adjusting for other variables, this likelihood increased to 22 times (AOR: 22.14, 95% CI: 15.45, 31.72).

DISCUSSION

This study aims to determine factors that are associated with viral suppression among adults aged 15 years and older who are living with HIV and have access to HIV treatment from public first-level hospitals in the Lusaka district in Zambia.

Effect of Sex and Age on Viral Suppression

The study revealed that there was no significant difference in viral suppression rates between males (96.2%) and females (96.64%). These findings align with the summary sheet, which also showed a relatively small difference in VLS between males and females (85.5% vs. 86.6%).[11] The findings align with other studies.[12,13] Age was a significant predictor of viral suppression. Participants under 25 years had similar odds of viral suppression as those aged 25–29 years. However, those aged 30–34 years had a 75.9% higher likelihood of suppression, decreasing to 55.5% after adjustments. For those aged 35–39 years, the likelihood was 2.72 times higher, while those aged 40–44 and 45–49 years were three times more likely to be suppressed. Participants aged 50 years and above had a seven times higher likelihood, decreasing to two times after adjustments. Viral suppression odds increased with age. This finding is in line with the findings from Jiamsakul et al.[14]

Effect of ART Regimen, Treatment Duration, and MMD on Viral Suppression

In this study, participants on the TAFED anti-retroviral regimen had a four-fold higher likelihood of achieving viral suppression compared to those on the TLD regimen. To this effect, various studies have indicated that, despite being used for many years in the treatment of HIV, TDF is associated with long-term side effects such as bone and kidney issues.[15] On the other hand, tenofovir alafenamide (TAF), which is a newer formation of tenofovir allows for lower doses and has lower effects on the kidneys and bones.[16] This may suggest higher adherence among those on TAFED combination compared to those on TDF-based combinations.[17,18] In contrast, our findings contradict the NADIA study which was done in Zambia, where the first group showed lower viral suppression with TAFED (86% vs. 88%), but the second group indicated higher viral suppression with TAFED (95% vs. 93%). Overall, the study concluded that TAFED was not inferior to TLD in assessing viral suppression.[19] This was also supported by the VISEND study.[20] The choice of TAFED or TLD regimens is mainly based on the patient's clinical profile[21] whereas those on regimens other than TLD were 77.3% less likely to be virally suppressed. This finding is in line with findings from a multinational African cohort study.[22] Additionally, second-line antiretrovirals (ARVs), administered on an individualized basis, address unique circumstances.[23] However, these regimens may carry a pill burden,[17] and determining the optimal combination for specific individual circumstances can be complex and speculative.[24] The outcome has the potential to impact the likelihood of achieving viral suppression, either enhancing or diminishing the chances.[25]

The study revealed a strong association between longer treatment durations and higher odds of achieving viral suppression. Participants on treatment for one year had three times higher odds, and those on treatment for two years were five times more likely to achieve viral suppression. These findings align with a study done in the USA[26] and Kenya[27] but contrary to a study in Ethiopia.[28]

Participants receiving three to five months of medication were initially 19 times more likely to achieve viral suppression compared to those not on MMD. After adjustments, this likelihood decreased slightly, with participants on three to five months of dispensation being 18 times more likely to achieve viral suppression. Similarly, those on six months or more dispensation were initially nine times more likely to be virally suppressed, which increased to 22 times more likely after adjusting for other factors. Various studies were consistent with our findings, that MMD improved VLS among adolescents living with HIV, and PLWHIV during the pandemic, and participants accessing community-based ART, respectively.[29,30]

Strengths and Limitations of the Study

Strength: This study shed light on important aspects of viral load suppression (VLS).

Limitation: Absence of control over external factors like socio-economic status, education, mental health and co-morbidities, which are known to impact VLS.

Recommendations for Further Research

Further studies should focus on exploring barriers to achieving targets, understanding factors influencing specific populations, identifying strategies to mitigate loss to follow-up, and developing interventions based on identified risk factors. By filling these gaps, we can inform evidence-based interventions and policies to improve HIV care and outcomes.

CONCLUSION AND IMPLICATIONS FOR TRANSLATION

This study revealed that gender had no significant impact on viral suppression, while age emerged as a crucial predictor, with older individuals showing higher suppression rates. The choice of an antiretroviral regimen, especially TAFED, was linked to improved suppression. Additionally, longer treatment durations were strongly associated with higher suppression rates. MMD strategies were also notably effective in enhancing VLS. Tailored interventions are essential, particularly for different age groups, with a focus on younger individuals. Anti-retroviral regimen selection should consider its influence on VLS, with emphasis on treatment adherence. Healthcare providers should explore MMD strategies to improve viral suppression, especially among adolescents and individuals living with HIV during pandemics. It is crucial to acknowledge that further research is needed to comprehend the impact of socio-economic demographics on VLS.

Key Messages

1. Nearly all participants achieved viral suppression, surpassing the targets set by the joint United Nations Programme on HIV/AIDS. 2. The study examined the influence of sex on viral suppression and found no significant difference between males and females. 3. The duration of treatment was strongly associated with viral suppression, as longer treatment periods corresponded to higher odds of achieving viral suppression. 4. Individuals on regimens other than tenofovir disoproxil fumarate and tenofovir alafenamide were found to be less likely to attain viral suppression, a noteworthy observation for further investigation.

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COMPLIANCE WITH ETHICAL STANDARDS

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