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Viral Suppression among People Living with HIV on Antiretroviral Therapy in N'Djamena: Analysis of 15 Treatment Sites

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Abstract

The aim of this study is to contribute to our understanding of HIV viral suppression in patients treated with DTG-based regimens and various other antiretroviral (ARV) regimens, and to identify associated factors. **Methods:** This is a descriptive cross-sectional study conducted at 15 HIV care sites (PEC) from February to March 2022. Viral loads (VL) in patients on ARV therapy were determined using Generic HIV (Biocentric®) kits and the Xpert HIV-1 Viral Load XC (GeneXpert®) test. Sociodemographic, therapeutic, and virological data were collected using a pre-designed questionnaire. Data processing and analysis were performed using Stata software. Observations with missing data were excluded. The significance level used for the multivariate analysis was 5%. **Results:** Of the 8852 expected HIV-positive individuals, 3259 (36.8%) had their viral load measured. Female patients were in the majority, with 1468 (98.4%) compared to 24 (1.6%) males. The 31- to 45-year-old age group was the largest compared to other age groups. The highest rates of viral suppression (VC < 1000 copies/mL) were observed with the combinations Tenofovir

+ Emtricitabine + Efavirenz (TDF + FTC + EFV) and Tenofovir + Lamivudine + Dolutegravir (TDF + 3TC + DTG), with identical results (85.1%). The best virological response was observed with the 2 NRTIs + 1 INIs (85.1%) and 2 NRTIs + 1 NNRTI (84.2%) regimens, and multivariate analysis of factors associated with viral suppression showed no significant difference between these two treatment regimens (p = 0.674). **Conclusion:** The ARV drug combinations used generally resulted in good viral load suppression. DTG is a good alternative to other ARV drugs in first-line ART.

Keywords

Antiretroviral Therapy, Viral Suppression, People Living with HIV, N'Djamena

1. Introduction

Since the advent of triple antiretroviral therapy in 1996, HIV infection has entered a new era of hope. Although no cure currently exists, antiretroviral triple therapy and prophylaxis for common opportunistic infections have helped reduce HIV-related morbidity and mortality, improve the quality of life and life expectancy of people living with HIV, and prevent HIV transmission [1]. AIDS-related deaths are estimated to have decreased by 54% since 2010, and 77% of all people living with HIV (PLHIV) are projected to have access to antiretroviral therapy (ART) by the end of 2024 [2].

To significantly reduce the viral load in the blood, initial antiretroviral therapy should ideally combine drugs that act against HIV through at least two different mechanisms of action [1]. A first-line triple therapy is a combination of two nucleoside/nucleotide reverse transcriptase inhibitors (NRTIs) with a third agent [3], which can be either a non-nucleoside reverse transcriptase inhibitor (NNRTI) or an integrase inhibitor (II). First-generation NNRTIs, namely efavirenz (EFV) and nevirapine (NVP), were the recommended first-line regimens, in combination with NRTIs such as lamivudine (3TC) and tenofovir (TDF) [4]. However, the prevalence of pre-treatment HIV resistance to efavirenz and nevirapine is gradually increasing among people starting ART. People with pre-treatment HIV drug resistance are less likely to achieve viral load suppression and have a higher probability of virologic failure, treatment discontinuation, and the acquisition of new resistance mutations if treated with NNRTI, so the use of NNRTI-sparing regimens has become a priority [5]. The WHO recommends dolutegravir (DTG)-based therapy as the preferred first-line treatment for adults living with HIV starting ART, and as the preferred second-line treatment for adults living with HIV who have failed non-DTG-based regimens, in low- and middle-income countries due to its high genetic barriers to resistance, fewer drug interactions, reduced side effects, higher viral load (VL) suppression rates, and cost-effectiveness compared to efavirenz [6] [7].

The Multiple Indicator Cluster Survey (MICS) conducted in 2014-2015 showed that Chad is experiencing a generalized epidemic with an estimated prevalence of 1.6% in 2015 among people aged 15 - 49, and according to the Spectrum model, it is estimated at 1.1% [0.8 - 1.3] in the same age group [8]. In 2007, Chad made HIV care free of charge. This coverage includes antiretroviral drugs, essential biomedical tests, and medical follow-up.

In Chad, dolutegravir-based ART was adopted as a first-line treatment in 2019. The fixed-dose combination of tenofovir (TDF), lamivudine (3TC), and dolutegravir (DTG) (TLD) was gradually introduced in 2020 for new patients and, at the same time, gradually replaced older regimens [9]. Studies have demonstrated the superiority of DTG-based regimens over efavirenz-based regimens in suppressing viral replication, both as first-line ART [10]-[12] and as second-line ART [13]. DTG has demonstrated excellent efficacy and optimal tolerability as a first-line treatment. Furthermore, switching to a DTG-based regimen from any other antiretroviral treatment has demonstrated non-inferior efficacy [14] [15]. The objective of the study is to contribute to the understanding of HIV viral suppression in patients treated with the DTG-based regimen and various other ARV treatment regimens and to identify associated factors.

2. Materials and Methods

2.1. Study Setting, Time Period, and Type

This is a descriptive cross-sectional study conducted from February to March 2022 as part of a mobile testing campaign organized by the Sectoral Program for the Fight Against AIDS, Viral Hepatitis, and Sexually Transmitted Infections (PSLSH/STI), at 15 HIV care and treatment (PEC) sites in the city of N'Djamena, namely: the Psychosocial Medical Support Center (APMS), the Diocesan Center for Information and Support for Patients (CEDIAM), Toukra District Hospital, Renaissance University Hospital, Chad-China Friendship University Hospital, National Referral University Hospital, Mother and Child University Hospital, Good Samaritan University Hospital, Our Lady of the Apostles Hospital (NDA), Peace Hospital, King Faisal Hospital, Sultan Kasser Hospital, Military Training Hospital (HMI), Union Hospital, and Gozator Hospital. The National Reference Laboratory for HIV and Viral Hepatitis, the laboratory of the National Tuberculosis Control Program, and the laboratory of the Military Training Hospital were selected to perform viral load testing.

2.2. Sampling Method

The sampling method was non-probability consecutive sampling. A target of 33% of viral load completions was set for each PEC site based on the active patient list, for a total of 8852 PLHIV.

2.3. Study Population

The study population consisted of people living with HIV (PLHIV) receiving care

at the 15 HIV treatment centers in the city of N'Djamena.

2.3.1. Inclusion Criteria

HIV-positive individuals of both sexes who had been on ART for at least 4 months with the Tenofovir-Lamivudine-Dolutegravir (TLD) regimen, and for at least 6 months with any other regimen, and who agreed to participate in the study were included in our study.

2.3.2. Exclusion Criteria

The following were excluded from the study:

- PLHIV who did not visit the PEC site during the data collection period;
- PLHIV who refused to have their data collected;
- PLHIV for whom at least one study variable was missing;
- PLHIV who did not meet the inclusion criteria.

2.4. Data Collection

Data were collected using pre-designed data collection forms and verified by trained interviewers stationed at the various PEC sites. Sociodemographic characteristics (age, sex, and marital status) were collected through individual interviews. Therapeutic data (duration of ART, treatment regimen, and drug combination) and biological parameters (plasma viral load) were collected from patient follow-up records and viral load test request forms.

2.5. Sample Collection

To measure VL, venous blood samples (5 mL) collected in EDTA tubes at various sites were sent to the laboratories designated for this purpose. The blood was centrifuged at 1500 rpm for 20 minutes. The aliquoted plasma was either used immediately or stored at 2˚C - 8˚C for 24 hours for the CV test.

2.6. Quantification of Viral Load

Viral load quantification was performed using the Generic HIV Viral Load kits (Biocentric®) and the Xpert HIV-1 Viral Load XC test (GeneXpert®), in accordance with the manufacturers' recommendations.

Generic HIV Viral Load is an in vitro real-time RT-PCR test that quantifies HIV-1 viral RNA in human plasma. The test principle is based on the extraction of HIV-1 RNA from plasma samples using the GenoXtract® automated extractor, followed by reverse transcription, amplification, and detection using the FluoroCycler® XT [16].

Viral RNA extraction: The GXT NA Extraction kit is a 12-well cartridge that enables full automation of retroviral RNA extraction from plasma samples (EDTA, citrate) using the GenoXtract automated system. The procedure for RNA extraction and purification uses magnetic beads to capture the RNA. After lysis and precipitation, the immobilized RNA is washed several times, with the magnetic capture deactivated between each wash step. The magnetic bead/RNA complex is ul-

timately collected in the elution buffer. After reactivating the magnetic capture, the supernatant containing the purified RNA is transferred to the elution tube; it is ready to be quantified using the GENERIC HIV VIRAL LOAD test [16].

RNA Amplification: The amplification technique used in the Generic HIV CV kit is based on the principle of real-time RT-PCR, involving: 1) reverse transcription of viral RNA into complementary DNA (cDNA); and 2) PCR amplification of the target cDNA and simultaneous fluorescence measurement resulting from the hydrolysis of an HIV-1-specific oligonucleotide detection probe labeled at the 5' end with a fluorescent reporter and at the 3' end with a non-fluorescent quencher. During the combined hybridization/extension phase of the PCR, the probe is cleaved by the 5' → 3' exonuclease activity of Taq DNA polymerase; this releases and separates the "reporter" from the "quencher". This results in detectable fluorescence that is proportional to the amount of accumulated PCR products [16].

The Xpert® HIV-1 Viral Load XC: Test is an in vitro reverse transcription polymerase chain reaction (RT-PCR) test for the quantification of HIV-1 RNA in human EDTA-anticoagulated plasma using the GeneXpert® automated system. These are automated systems that integrate sample preparation, nucleic acid extraction and amplification, and detection of the target sequence in simple or complex samples via real-time RT-PCR. The systems consist of an instrument, a personal computer, and pre-installed software for running tests and displaying results. The system requires single-use, disposable GeneXpert cartridges that contain the reagents for RT-PCR and house the sample extraction and RT-PCR processes [17].

2.7. Study Variable

The primary variable in the study was viral load status, a binary variable coded as follows: 0 = viral load suppressed (VL < 1000 copies/mL) and 1 = viral load not suppressed (VL ≥ 1000 copies/mL).

Several independent variables were included in the adjustment, including treatment regimen, sex, age, duration of treatment, and treatment combination.

The duration of treatment here refers to the length of time spent on current ARV regimens.

2.8. Data Analysis

These data were entered into a Microsoft Office Excel 2016 file. Data processing and analysis were performed using Stata software. During processing, observations with missing data were excluded. The "gender" variable, which contained miscoded information, was treated in the same manner, which affected the representation of males in the sample.

Frequency measures were used to describe the distribution of the study variables. Parameter estimation was performed using binary logistic regression. In the bivariate analysis, each explanatory variable was tested against the dependent var-

iable to assess the significance of the associations prior to developing the multivariate model. The significance threshold used for the multivariate analysis was 5%.

Collinearity among the independent variables was assessed using the variance inflation factor (VIF).

The fit of the final model was assessed using McFadden's pseudo-R^2 and the Hosmer-Lemeshow test. The model's discriminatory power was evaluated using the receiver operating characteristic (ROC) curve, with an area under the curve greater than 0.7 considered acceptable.

2.9. Ethical Considerations

The data were collected as part of routine follow-up of people living with HIV at treatment sites. The use of data for this study was authorized by the National Program for the Control of AIDS, Viral Hepatitis, and Sexually Transmitted Infections (PSLSH/IST) No. 174/PT/PMT/MSPP/SE/SG/PSLSH_IST/2023. The data were collected anonymously after obtaining the patients' verbal informed consent.

3. Results

3.1. Patient Characteristics

Of the 8852 expected HIV-positive individuals, 36.8% (3259/8852) had their viral load measured, meaning that 45.8% (1492/3259) had complete data. Female patients were in the majority, with 1468 (98.4%) compared to 24 (1.6%) males. The 31- to 45-year-old age group was the largest compared to other age groups (Table 1).

Table 1. Patient characteristics.

Characteristics	Frequency	Proportion
Data study		
Viral load measured	3259	36.8%
Complete data	1492	45.8%
Viral load		
Viral load not suppressed	249	16.69
Viral load suppressed	1243	83.31
Treatment regimens		
2 NRTIs + 1 NNRTI	980	65.68
2 NRTIs + 1 PI	97	6.50
2 NRTIs + 1 INIs	415	27.82
Gender		
Female	1468	98.39
Male	24	1.61

Continued

Age		
<14 years	36	2.41
15 - 30 years	464	31.10
31 - 45 years	775	51.94
46 - 60 years	204	13.67
>60 years	13	0.87
Duration of treatment		
<1 year	28	1.88
1 - 5 years	746	50
>5 years	718	48.12
Therapeutic combination		
TDF + FTC + EFV	895	60
TDF + 3TC + DGT	415	27.8
AZT + 3TC + NVP	72	4.8
TDF + FTC + ATV/R	42	2.8
TDF + FTC + LPV/R	18	1.2
ABC + 3TC + LPV/R	25	1.7
ABC + 3TC + EFV	13	0.9
ABC + 3TC + ATV/R	12	0.8

Legend: TDF + FTC + EFV (Tenofovir + Emtricitabine + Efavirenz), TDF + 3TC + DGT (Tenofovir + Lamivudine + Dolutegravir), AZT + 3TC + NVP (Zidovudine + Lamivudine + Nevirapine), TDF + FTC + ATV/R (Tenofovir + Emtricitabine + Atazanavir/Ritonavir), TDF + FTC + LPV/R (Tenofovir + Emtricitabine + Lopinavir/Ritonavir), ABC + 3TC + LPV/R (Abacavir + Lamivudine + Lopinavir/Ritonavir), ABC + 3TC + EFV (Abacavir + Lamivudine + Efavirenz), ABC + 3TC + ATV/R (Abacavir + Lamivudine + Atazanavir/Ritonavir).

The study population consisted mainly of adults aged 31 to 45 (51.9%). Children and adolescents under 14 years of age accounted for 2.4%, while individuals over 60 years of age were rare (0.9%). Half of the patients (50%) had been on treatment for 1 to 5 years, 48.1% for more than 5 years, and only 1.9% for less than one year (Table 1).

Virologically, 83.3% of patients had viral suppression, compared with 16.7% who did not.

The most common treatment regimen was the 2 NRTIs + 1 NNRTI combination, used by 65.7% of patients, followed by 2 NRTIs + 1 INIs (27.8%) and 2 NRTIs + 1 PI (6.5%). In terms of specific drug combinations, the most commonly prescribed was Tenofovir + Emtricitabine + Efavirenz (TDF + FTC + EFV) (60%), followed by Tenofovir + Lamivudine + Dolutegravir (TDF + 3TC + DTG) (27.8%). Other regimens remained in the minority (Table 1).

3.2. Viral Suppression by Patient Characteristics

Analysis of viral load by treatment and demographic characteristics showed good virologic suppression in the majority of cases.

Regarding specific treatment regimens, the highest rates of viral suppression were achieved with TDF + FTC + EFV (85.1%) and TDF + 3TC + DTG (85.1%). Similar results were observed with AZT + 3TC + NVP and ABC + 3TC + ATV/R (75% each). In contrast, the proportions were lower with ABC + 3TC + LPV/R (60%) and TDF + FTC + ATV/R (66.7%). Depending on the treatment regimens, the best virologic response was observed with 2 NRTIs + 1 INIs (85.1%) and 2 NRTIs + 1 NNRTI (84.2%), while patients on 2 NRTIs + 1 PI had lower suppression (67%) (Table 2).

Table 2. Viral suppression by patient characteristics.

Characteristics	n	Viral load	
		Viral load suppressed	Proportion
Therapeutic combination			
ABC + 3TC + EFV	13	9	69.23
AZT + 3TC + NVP	72	54	75
TDF + FTC + EFV	895	762	85.14
ABC + 3TC + ATV/R	12	9	75
ABC + 3TC + LPV/R	25	15	60
TDF + FTC + ATV/R	42	28	66.67
TDF + FTC + LPV/R	18	13	72.22
TDF + 3TC + DTG	415	353	85.06
Treatment regimens			
2 NRTIs + 1 NNRTI	980	**825**	**84.18**
2 NRTIs + 1 PI	97	65	67.01
2 NRTIs + 1 INIs	415	353	85.06
Gender			
Female	1 468	1 224	83.38
Male	24	**19**	**79.17**
Age			
<14 years	36	22	61.11
15 - 30 years	464	**389**	**83.84**
31 - 45 years	775	648	83.61
46 - 60 years	204	172	84.31
>60 years	13	**12**	**92.31**

Continued

Duration of treatment			
<1 year	28	24	85.71
1 - 5 years	746	633	84.85
>5 years	718	586	81.62

By gender, women showed slightly higher viral suppression (83.4%) than men (79.2%). Analysis by age group showed that viral suppression increased with age: 61.1% among those under 14, approximately 83% - 84% among those aged 15 to 60, and up to 92.3% among those over 60. Finally, based on treatment duration, viral suppression was higher among patients treated for less than one year (85.7%) or 1 to 5 years (84.9%), while it was slightly lower among those treated for more than 5 years (81.6%) (Table 2).

3.3. Multivariate Analysis

Multivariate analysis of factors associated with viral suppression showed that the type of treatment regimen significantly influenced the virologic response. Compared with the standard regimen (2 NRTIs + 1 NNRTI), patients on 2 NRTIs + 1 PI had a lower probability of viral suppression (ORa = 0.47; 95% CI: 0.28 - 0.80; p = 0.006). In contrast, no significant difference was observed with the 2 NRTIs + 1 INIs regimen (ORa = 1.07; 95% CI: 0.77 - 1.47; p = 0.674).

With regard to sex, men showed a non-significant trend toward lower viral suppression compared with women (ORa = 0.67; 95% CI: 0.23 - 1.93; p = 0.461) (Table 3). With regard to age, a trend toward better viral suppression was observed with increasing age. Compared to those under 14 years of age, the odds ratios increased progressively: 15 - 30 years (ORa = 1.89; p = 0.123), 31 - 45 years (ORa = 2.0; 95% CI: 0.90 - 4.46; p = 0.088), 46 - 60 years (ORa = 2.3; 95% CI: 0.99 - 5.48; p = 0.050), and over 60 years (ORa = 5.2; 95% CI: 0.58 - 46.5; p = 0.140). Statistical significance was only marginally achieved for the 46 - 60 age group.

Table 3. Multivariate analyses.

Characteristics	OR. adj	IC 95%	P
Treatment regimens			
2 NRTIs + 1 NNRTI	Ref.		
2 NRTIs + 1 PI	0.47	[0.28 - 0.80]	0.006
2 NRTIs + 1 INIs	1.07	[0.77 - 1.47]	0.674
Gender			
Female	Ref.		
Male	0.67	[0.23 - 1.93]	0.461
Age		[0.84 - 4.28]	
<14 years	Ref.		

Continued

15 - 30 years	1.89		0.123
31 - 45 years	2.0	[0.90 - 4.46]	0.088
46 - 60 years	2.3	[0.99 - 5.48]	0.050
>60 years	5.2	[0.58 - 46.5]	0.140
Duration of treatment		[0.27 - 2.65]	
<1 year	Ref.		
1 - 5 years	0.85		0.787
>5 years	0.67	[0.21 - 2.10]	0.495
Constant	3.49	[0.87 - 14.0]	0.077

With regard to duration of treatment, no significant association was found. Compared to patients who had been on treatment for less than one year, those treated for 1 to 5 years (ORa = 0.85; p = 0.787) or more than 5 years (ORa = 0.67; 95% CI: 0.21 - 2.10; p = 0.495) did not show a statistically significant difference (Table 3).

4. Discussion

The study shows that 36.8% of the expected target population underwent viral load testing. This result indicates low engagement among people living with HIV (PLHIV) in ART monitoring and could be attributed to insufficient communication between care sites and PLHIV and/or low enthusiasm among PLHIV for ART monitoring. Viral load testing is considered the preferred method for monitoring the effectiveness of ART, enabling early diagnosis of potential treatment failure and providing information on the development of resistance [18]. The study included 45.8% of PLHIV who underwent viral load testing during the study period. This result could be attributed to incomplete data provided by the investigators, which may have resulted from errors during data collection or entry, leading to the exclusion of incomplete cases and thereby reducing the sample size. Females were the dominant group (98.4%) compared to males (1.6%) in this study. Our finding can be explained, first and foremost, by the fact that the "gender" variable—which contained miscoded data, including missing values—was removed, thereby affecting the representation of males in the sample. Second, our result may be explained by the fact that women are more likely to seek care at health facilities when ill compared to men. Our result is comparable to that of Zhong *et al.* [19], where 89.1% of the study population was female. The 31 - 45 age group (51.9%) was the most represented. Similar results have been observed in other African studies [12] [20] [21]. This finding could be explained by the fact that young adults in this age group are sexually active and are at higher risk of HIV infection if preventive methods are not used properly; they are also more likely to undergo HIV testing during routine medical visits, thereby increasing their participation in the

care protocol compared to younger and older populations. The most commonly prescribed treatment regimens were TDF + FTC + EFV (60%), followed by TDF + 3TC + DTG (27.8%). Our findings are comparable to those of the study by WHO (2014) [18], in which 33.3% of patients were on a DTG regimen and 66.7% on an EFV regimen. Our results differ from those of Ayal and Behra [22] and Dorward *et al.* [23], where, respectively, 77.1% and 68.9% were on a DTG regimen and 32.8% and 31.1% were on an EFV regimen. This finding may be explained by the fact that the TDF + FTC + EFV combination was a first-line ARV regimen prescribed as first-line treatment for HIV ART in Chad and was still widely prescribed at the start of the transition to TLD.

Overall, 83.3% of patients had viral suppression (viral load < 1000 copies/mL). Our result is higher than those reported by Asbagui [24] *et al.* and Fatoumata *et al.* [25], who achieved viral suppression rates of 54.60% and 73.8%, respectively, but lower than those reported by Analu *et al.* [26], in which 89.1% of patients achieved viral suppression. Moloko *et al.* [7] reported a viral load undetectability rate of 87.7%. When patients adhere to their treatment, antiretrovirals prevent HIV from replicating by disrupting the various phases of its replication cycle, resulting in viral load suppression.

The highest rates of viral suppression were achieved with the combinations TDF + FTC + EFV (85.1%) and TDF + 3TC + DTG (85.1%). The viral suppression rate observed with TDF + FTC + EFV (85.1%) is higher than the rates observed with AZT + 3TC + NVP and ABC + 3TC + ATV/R (75% each), ABC + 3TC + LPV/R (60%), and TDF + FTC + ATV/R (66.7%). Our results are comparable to those of the NAMSAL study [27], Ayal and Behra [22], Dorward *et al.* [23], and Zhong *et al.* [19], who found viral suppression rates of 74.5%, 69%, 83%, and 100% with the DTG regimen and 69.0%, 66%, 81.4%, and 97.3% with the EFV regimen without DTG. As shown in several other studies, our results demonstrated that regimens containing DTG and EFV lead to better viral suppression compared to other ARV regimens. This finding indicates that DTG was a viable alternative to EFV as a first-line ART.

Viral suppression was similar among patients who had been on treatment for less than one year (85.7%) and those who had been on treatment for 1 to 5 years (84.9%). Devendra *et al.* [28] reported a rate of 82.9% among children who had been on treatment for less than one year. This result is explained by the fact that at the start of ART, the viral load drops dramatically, demonstrating the potency and efficacy of ARVs in treatment-adherent patients. Non-adherence and potential HIV resistance to ARVs are thought to be responsible for the increase in viral load observed in PLHIV with a long duration of treatment.

By gender, women showed a slightly higher viral suppression rate (83.4%). Our result is comparable to that of Dorward *et al.* [23], who also observed significant viral suppression (84%) in women. However, our result is higher than those of Semengue *et al.* [12], Mmatsoku *et al.* [7], and Coulibaly *et al.* [29], who obtained results slightly lower than ours in women, but differs from that of Analu´ *et al.*,

where high viral suppression was observed in men (66.4%). Several hypotheses may explain the high viral load suppression in women: Women may have better access to ART than men; according to UNAIDS, women are more likely to adhere to HIV treatment than men; from a virological perspective, some studies highlight that women have a lower viral load in the early stages of infection, unlike men [30].

Our results show that viral suppression increased with age, reaching 92.3% among those over 60. Our results are higher than those of Dorward *et al.* [23], who observed a viral suppression rate of 84.2% among those over 55, but lower than those of Ayal and Behra [22], who found 100% viral suppression among PLHIV over 45. Our result can be explained by the fact that older adults have a better understanding of the disease, leading to good treatment adherence compared to children and adolescents, for whom adherence to ART may be challenging.

Depending on the treatment regimens, the best virologic response was observed with 2 NRTIs + 1 INIs (85.1%) and 2 NRTIs + 1 NNRTI (84.2%), and the multivariate analysis of factors associated with viral suppression showed no significant difference between these treatment regimens. However, compared to the 2 NRTIs + 1 NNRTI regimen, patients on 2 NRTIs + 1 PI had a lower probability of viral suppression. This result could be explained by the fact that PIs can cause gastrointestinal (diarrhea, abdominal discomfort) and metabolic side effects in patients on ART [31], and thus may lead to poor viral suppression in cases of poor adherence. Furthermore, PIs are no more effective than efavirenz, a NNRTI widely prescribed in our study, as shown in the study by Riddler *et al.* [32], in which the number of patients with an undetectable viral load after 96 weeks of treatment is higher with efavirenz than with lopinavir/r when each of these drugs is prescribed with two NRTIs [33].

5. Conclusion

Following Chad's adoption of dolutegravir-based ART—specifically the TLD regimen—as first-line therapy, we set out to compare virologic responses among people living with HIV (PLHIV) between the new ARV regimen and the older ones. Our study showed that 83.3% achieved viral suppression; only 27.8% were treated with the TLD regimen; the viral suppression rate between TDF + 3TC + DTG and TDF + FTC + EFV was identical (85.1%) but higher than that of other ARV regimens. Regarding factors associated with viral suppression, no significant difference was observed between the 2 NRTIs + 1 INIs and 2 NRTIs + 1 INI regimens ($p = 0.674$), unlike the 2 NRTIs + 1 NNRTI and 2 NRTIs + 1 IP regimens ($p = 0.006$). DTG is a good alternative to other first-line antiretroviral therapy (ART) drugs, and it is necessary to assess virologic response in patients receiving a regimen that includes this drug.

Limitations of the Study

Our study has certain limitations:

- The cross-sectional nature of our study does not allow us to establish a cause-and-effect relationship, but rather statistical associations.
- Participants were included based on their presence in the collection areas during the study period, and incomplete data were excluded; consequently, our conclusions cannot be generalized to the entire PLVIH population.
- Data collection took place over a defined period and therefore does not allow for observation of changes in patients' conditions over time.
- Initial data collection on viral load, measurement of treatment adherence, measurement of CD4 T-cell counts, and determination of ARV resistance profiles were not performed during this study and will be the subject of further investigations for the follow-up of PLHIV on ART at a later date.

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Conflicts of Interest

The authors declare that they have no potential conflicts of interest regarding the research, writing, and publication of this article.

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