

Assessment of Viremia Level in Patients Living with HIV Followed at Yaoundé University Hospital: A Retrospective and Prospective Cross-Sectional Study

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Abstract: Viral load (VL) suppression is a key indicator of antiretroviral therapy (ART) efficacy in infected patients. This study aimed to assess VL trends and identify factors associated with unsuppressed viremia among patients followed at the Yaoundé University Teaching Hospital (YUTH). This was a descriptive and analytical study—combining retrospective and prospective approaches—conducted from February to May 2025 on a sample of 197 HIV-1 infected patients receiving ART between 2022 and 2025. Data collected included sociodemographic, clinical, and therapeutic characteristics, as well as virological variables. VL changes were measured using RT-PCR on the Abbott M2000sp/rt platform at months 6 (T6), 12 (T12), and 18 (T18) following ART initiation. Data were analyzed using SPSS software (version 22.0), with the significance threshold set at $p < 0.05$. Regarding treatment, 93.91% of patients were on a 2NRTI+1INSTI regimen; the TDF+3TC+DTG combination (88.83%) resulted in undetectable VL rates of 67.5% at T6 and 72.59% at T12. This regimen showed significant improvement between T6 and T12 ($p = 0.042$), whereas the change between T12 (72.59%) and T18 (73.1%) was not significant ($p = 0.275$). Among the factors associated with unsuppressed VL, strict non-adherence to treatment proved to be the most significant determinant ($OR = 48.3$; $p < 0.001$). Alcohol consumption and a lack of regular physical activity were also significantly associated with persistent viremia ($p < 0.05$). Dolutegravir-based treatment effectively improves viral load in patients followed at CHUY. However, adherence remains the determining factor. Targeted interventions focusing on adherence and health behaviors are essential to optimize long-term outcomes.

Keywords: Assessment, HIV-1, Infected Patients, Antiretroviral Treatment, Adherence, YUTH.

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I. INTRODUCTION

The human immunodeficiency virus (HIV) remains a major public health problem worldwide. According to UNAIDS, approximately 39 million people were living with HIV in 2022, of whom 25.6 million were receiving antiretroviral therapy (ART) [1]. In sub-Saharan Africa, the most affected region, HIV represents a persistent health challenge despite progress made in access to treatment.

In Cameroon, the prevalence of HIV is estimated at 2.1% in the general population, with significant regional disparities [2; 3]. Efforts to combat the epidemic have led to a significant improvement in access to ART, enabling more than 80% of people living with HIV to receive treatment [3].

Viral load (VL) suppression is the primary goal of antiretroviral therapy (ART) and a key indicator of therapeutic efficacy [4; 5]. An undetectable VL (<50 copies/ml) is associated with immune reconstitution, reduced morbidity and mortality, and a decreased risk of

viral transmission [6; 7]. However, several factors can compromise treatment efficacy, including treatment adherence, comorbidities, socioeconomic factors, and viral resistance [8; 9].

The introduction of integrase inhibitors, particularly dolutegravir (DTG), has revolutionized HIV management due to their superior efficacy, favorable tolerability profile, and high genetic barrier to resistance [10; 11]. Cameroon has progressively adopted DTG-based treatment regimens in accordance with WHO recommendations [4].

Although several studies have evaluated the virological efficacy of ART in different settings, specific data on viral load (VL) evolution and factors associated with virological failure in Cameroon remain limited, particularly in the context of the increasing use of DTG-based regimens. This study aims to address this gap by evaluating viremia evolution in HIV-1-infected patients on ART at the Yaoundé University Hospital Center (YUTH) and identifying factors associated with unsuppressed viremia.

II. METHODOLOGY

➤ Type and Framework of Study

This was a cross-sectional study with retrospective and prospective components (2022-2025), with descriptive and analytical aims, conducted at the Approved Treatment Center (ATC) of the Yaoundé University Hospital Center (YUTH) over a three-month period (February to May 2025). The CHUY is one of the main referral centers for HIV/AIDS care in Cameroon.

The Yaoundé University Hospital's Treatment Center (ATC) is located in the heart of Yaoundé. Built on a 20,301 m² site, it is located in the Biyemassi Health District, in the Yaoundé VI sub-Division, in the Melen neighborhood of Yaoundé (Central Region). It is bordered on both sides by:

- The Chantal Biya International Research Centre (CBIRC), in the North;
- The University of Yaoundé I, in the East;
- The Faculty of Medicine and Biomedical Sciences, in the South;
- Mandela Pharmacy, in the West.

The University Hospital Center of Yaoundé fulfills several missions, including prevention, diagnosis, treatment, monitoring, and training. The CTA (Center for Treatment and Assessment) trains healthcare professionals on the latest advances in HIV/AIDS care. It thus contributes to strengthening the capacity of those involved in the fight against this epidemic in Cameroon.

➤ Study Population

The target population consisted of HIV-1 infected patients, aged 18 years and older, followed at the YUTH's Treatment Center (ATC) and receiving antiretroviral therapy. A comprehensive sampling was conducted, including all patients meeting the inclusion criteria during the study period. A total of 197 patients were included.

Inclusion criteria were any HIV-1 infected patient, aged 18 years and older, on ART for at least 6 months, regularly followed at the YUTH's CTA, and who consented to participate in the study. We excluded all patients co-infected with HIV-1/HIV-2, pregnant or breastfeeding women, patients with incomplete medical records, and patients who did not provide informed consent.

➤ Data Collection

This study will be conducted among people living with HIV receiving care at the Yaoundé University Hospital. Historical viral load data will be retrospectively extracted from patient records at baseline (T0) and at T6, T12, and prospectively at T18 months. Sociodemographic and other relevant patient-related data will be collected prospectively through direct interviews with participants during their routine follow-up visits.

The variables collected included: sociodemographic characteristics (age, sex, education level, marital status, sector of activity), clinical characteristics (WHO stage, comorbidities, CD4⁺ count), therapeutic characteristics (initial and current treatment regimen, duration on ART, adherence), and virological parameters (viral load at T0, T6, T12 and T18).

➤ Laboratory Procedure

HIV-1 viral load quantification was performed by real-time RT-PCR on the Abbott M2000sp/rt platform. Blood samples were collected in EDTA tubes and centrifuged to obtain plasma. Viral RNA extraction, reverse transcription, and amplification were performed according to the manufacturer's standardized procedures. The detection threshold was 40 copies/mL. A viral load <50 copies/mL was considered suppressed (undetectable).

➤ Statistical Analysis

Data were entered and analyzed using SPSS version 22.0. Quantitative variables were expressed as means $\pm$ standard deviations or as medians with interquartile ranges, depending on their distribution. Qualitative variables were expressed as counts and percentages. The Wilcoxon signed-rank test was used to compare changes in viral load between different follow-up time points. Factors associated with unsuppressed viral load were identified using logistic regression. A significance level of $p < 0.05$ was used.

➤ Ethical Considerations

The study was approved by the institutional ethics committee, and research authorization was obtained from the YUTH management. Written informed consent was obtained from all participants. Data confidentiality and anonymity were guaranteed throughout the study.

III. RESULTS

➤ Sociodemographic Characteristics

The mean age of participants was 39.7 ± 11.8 years, with a range of 18 to 70 years. The most represented age group was 40-49 years (28.43%). Women constituted the majority of the sample (62.94% versus 37.06% men). In

terms of education, 48.73% of participants had a secondary education, 34.52% a higher education, 15.74% a primary education, and 1.02% had no formal education. The majority of participants were single (52.79%), while 41.79% were married, cohabiting, divorced, or widowed. Regarding the sector of activity, 41.12% worked in the informal sector,

30.46% in the formal sector, 9.64% were pupils/students and 18.78% were unemployed or retired.

➤ *Clinical and Therapeutic Characteristics*

• *The Therapeutic Regimen at Initiation*

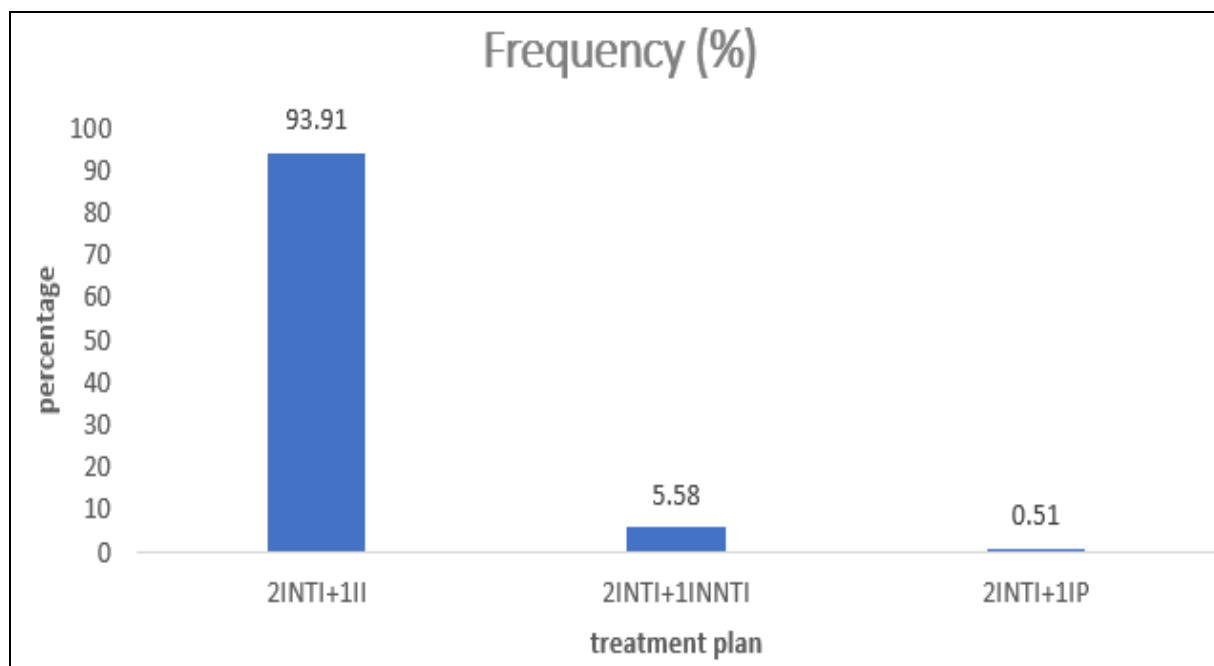


Fig 1 Distribution of the Population According to the Therapeutic Regimen at Initiation

According to Figure 1, 93.91% started with the 2NRTI+1II regimen (2 nucleoside reverse transcriptase inhibitors + 1 integrase inhibitor), which is in line with current WHO recommendations.

• *The Number of Years Under Treatment*

Table 1 Distribution of the Population According to the Number of Years Under Treatment

Duration of treatment (years)	Number (n)	Frequency (%)
0	1	0.51
1	46	23.59
2	136	69.74
3	14	6.15
TOTAL	197	100.00

According to Table 1, the majority of participants in our study (69.74%) had been on treatment for 2 years

• *The Immunological Status*

Table 2 Distribution According to Immunological Status

Immunological status (CD4):	Number (n)	Frequency (%)
≥ 500 cells/mm ³	174	88.32
200-499 cells/mm ³	23	11.68
TOTAL	197	100.00

Reading Table 2, 88.32% of participants have a CD4 count ≥ 500 cells/mm³, which indicates a good immune response to treatment.

• *The Current ARV Treatment*

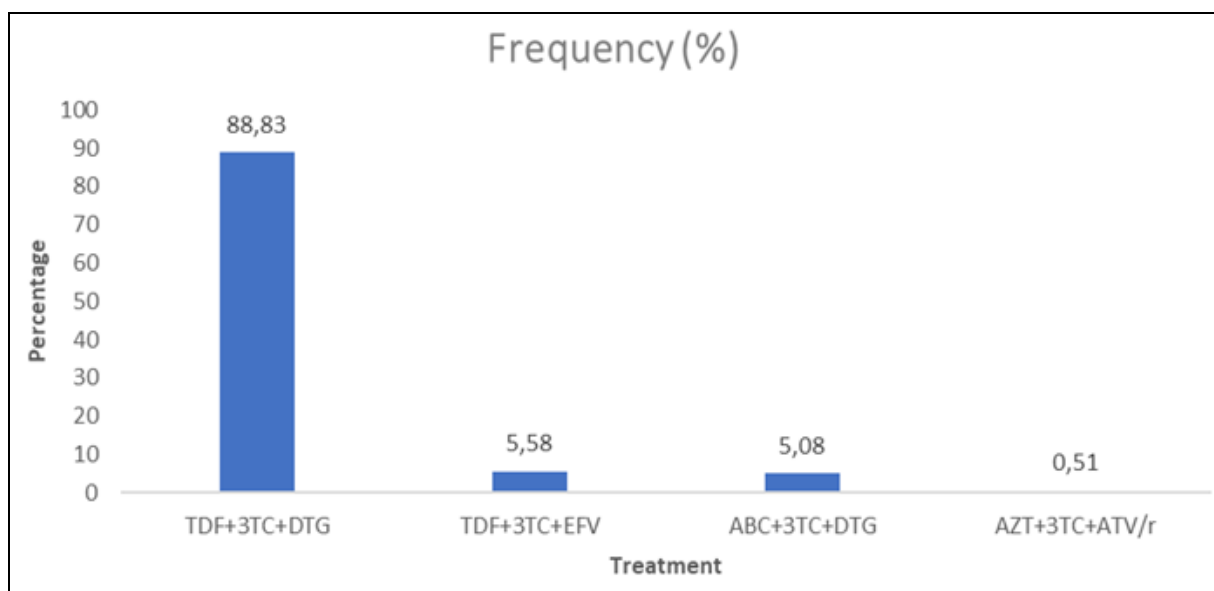


Fig 2 Distribution of the population according to current ART treatment

93.91% started with the 2NRTI+1INSTI regimen (2 nucleoside reverse transcriptase inhibitors + 1 integrase inhibitor), which is consistent with current WHO recommendations.

➤ *Assessment of the Evolution of HIV-1 Viremia*

Table 4 Evolution of Viral Load Between T0 and T18

Viral Load Status	T0(%)	T6(%)	T12(%)	T18(%)
Undetectable (<50 copies/ml)	0(0)	133(67.51)	143(72.59)	144(73,1)
Removed (50-1000 copies/ml)	0(0)	46(23,35)	45(22.84)	29(14,72)
Not suppressed (>1000 copies/ml)	6(3.05)	18(9,14)	9(4.57)	24(12,18)
N / A	191(96,95)	0(0)	0(0)	0(0)

*NA=Not Assigned (in Practice, Patients are Not Systematically asked to have a Blood Test at the Start of Treatment at the CTA).

According to Table 4, at T6, 67.5% (133/197) had become undetectable, this rate increased slightly to 73.1% at T18.

Table 5 Wilcoxon Non-Parametric Statistical Test

	Wilcoxon Ranking Test	
	T12 VS T6:	T18 VS T12
Z	-2.030 ^b	-1.092 ^c
P-value	0.042	0.275
<i>b. Based on positive ranks.</i>		
<i>c. Based on negative ranks.</i>		

According to the Wilcoxon test (Table 5), there was a significant difference between viral loads at T6 and T12 (p=0.042), with viral loads decreasing significantly. There were no significant differences between T12 and T18.

Table 6 Impact of the Initial Treatment Regimen on Viremia

Therapeutic approaches at the initiation stage	Viral load status			p
	Undetectable	Deleted	Not deleted	
A T6				0.316
2INTI+1II	127	42	16	
2INTI+1INNTI	6	3	2	
2INTI+1IP	0	1	0	
A T12				0.882
2INTI+1II	133	43	9	
2INTI+1INNTI	9	2	0	

2INTI+1IP	1	0	0	0.967
A T18				
2INTI+1II	135	27	23	
2INTI+1INNTI	8	2	1	
2INTI+1IP	1	0	0	

At T6, T12, and T18, no statistically significant difference was observed ($p > 0.05$). This suggests comparable efficacy of the different regimens at initiation (Table 6).

Table 7 Impact of the Current Treatment Regimen on Viremia

Therapeutic approaches at the initiation stage	Viral load status			p
	Undetectable	Deleted	Not deleted	
A T6				0.148
ABC+3TC+DTG	10	0	0	
AZT+3TC+ATV/r	0	1	0	
TDF+3TC+DTG	117	42	16	
TDF+3TC+EFV	6	3	2	
A T12				0.882
ABC+3TC+DTG	9	1	0	
AZT+3TC+ATV/r	1	0	0	
TDF+3TC+DTG	124	42	9	
TDF+3TC+EFV	9	2	0	
A T18				0.862
ABC+3TC+DTG	6	3	1	
AZT+3TC+ATV/r	1	0	0	
TDF+3TC+DTG	129	24	22	
TDF+3TC+EFV	8	2	1	

Upon observation of Table 7, at each period (T6, T12, T18), no significant association between the current regimen and the viral load status was observed ($p > 0.05$ at each point).

- *Factors Associated with Unsuppressed Viral Load after 18 Months of ART Sociodemographic Characteristics and Unsuppressed Viral Load at T18*

Table 8 Relationship between sociodemographic characteristics and unsuppressed viral load at T18

Clinical characteristics	Viral load not removed at T18		OR(IC)	P
	Yes (N=24)	No (N=173)		
	n (%)	n (%)		
Age				
<20	0	4	0(0-8,20)	0.452
[20 - 30[	5	35	1.03(0.32-2.87)	0.945
[30 - 40[	6	49	0.84(0.29-2.20)	0.734
[40 - 50[	10	46	1.96(0.79-4.76)	0.125
≥ 50	3	39	0.49(0.11-1.60)	0.261
Sex				
Female	16	108	1.20(0.49-3.12)	0.687
Male	8	65	-	0.687
Residence				
Bertoua	0	2	0(0-25.35)	0.597
Douala	2	2	0.80(0.08-7.81)	0.830
Yaoundé	22	169	0.26(0.04-2.15)	0.108
Education level				
Primary	5	26	1.48(0.45-4.20)	0.465
Without education	1	1	7.34(0.18-293)	0.101
Secondary	7	89	0.39(0.14-0.97)	0.041
Superior	11	57	1.71(0.70-4.12)	0.214

Occupation				
Pupil/Student	1	18	0.37(0.01-2.22)	0.333
Housewife/Unemployed	6	23	2.16(0.71-5.92)	0.130
Retirement	0	8	0(0-3.31)	0.283
Informal Sector	8	73	0.68(0.26-1.67)	0.409
Private sector	7	26	2.31(0.82-6.08)	0.082
Public sector	2	25	0.53(0.08-2.14)	0.415
Marital status				
Bachelor	15	89	1.56(0.65-3.93)	0.310
Divorced/Widowed	1	10	0.74(0.03-4.78)	0.786
Living together	2	20	0.69(0.10-2.81)	0.638
Bride	6	54	0.73(0.25-1.91)	0.536
Religion				
None	2	14	1.03(0.15-4.34)	0.967
Christian	20	148	0.84(0.27-3.10)	0.774
Muslim woman	2	11	1.33(0.19-5.83)	0.715

Secondary education level is significantly associated with a lower viral load at T18 (OR = 0.39; p = 0.041). No other sociodemographic factor (age, sex, occupation, religion, etc.) is significantly associated with unsuppressed viremia (Table 8).

- Clinical Characteristics and Unsuppressed Viral Load*

Table 9 Relationship Between Clinical Characteristics and Unsuppressed Viral Load at T18

Clinical characteristics	Viral load not removed at T18		OR(IC)	P
	Yes (N=24)	No (N=173)		
	n (%)	n (%)		
Therapeutic approach at initiation				
2INTI+1II	23	162	1.55(0.24-35.32)	0.674
2INTI+1INNTI	1	10	0.70(0.03-4.50)	0.743
2INTI+1IP	0	1	0(0-136.95)	0.709
ARV treatment in progress				
ABC+3TC+DTG	1	9	0.79(0.03-5.16)	0.828
AZT+3TC+ATV/r	0	1	0(0-136.95)	0.709
TDF+3TC+DTG	22	153	1.43(0.34-9.65)	0.658
TDF+3TC+EFV	1	10	0.70(0.03-4.53)	0.747
Comorbidities				
Viral hepatitis (B and C)	1	2	3.67(0.12-49.99)	0.260
Tuberculosis	0	5	0(0-6.03)	0.400
Side effects related to treatment				
No	22	148	1.85(0.46-12.32)	0.415
Yes	2	25	-	0.415
Strict adherence to treatment				
No	16	3	48.3 (27.33-531.02)	<0.001
Yes	8	170	-	<0.001
Alcohol consumption				
No	2	111	0.05(0.01-0.19)	<0.001
Yes	22	62	19.43 (5.09-126.13)	<0.001
Smoking				
No	24	172	-1(0.01--1)	0.709
Yes	0	1		0.709
Regular physical activity:				
No	23	96	18.27 (3.28-388.62)	<0.001
Yes	1	77	-	<0.001

Adherence to treatment is the major factor; non-adherent patients have a very high probability of having an unsuppressed viral load (OR = 48.3; p < 0.001). Alcohol consumption (OR = 19.43; p < 0.001) and lack of regular

physical activity (OR = 18.27; p < 0.001) are also strongly associated with poor viral suppression. No treatment regimen (initial or current) or comorbidity has a significant impact (Table 9).

IV. DISCUSSION

➤ Sociodemographic Characteristics

Our study population is characterized by a female predominance (62.94%), with a mean age of 39.7 years. The most represented age groups are [30-40[(27.92%) and [40-50[(28.43%), with the extreme age range: min = 18 years; max = 70 years.

This profile is similar to that reported by Telly *et al.* (2022) in Bamako (69.9% women, average age 44 years) and Essomba *et al.* (2015) in Douala (61.9% women, mean age 43 years) [12; 13]. This overrepresentation of women in African cohorts is explained by a greater vulnerability of women to infection, but also by their better attendance at healthcare facilities, as also highlighted by Maiga *et al.* (2024) [14].

The educational level of our participants was relatively high: 34.52% had a higher education and 48.73% a secondary education, meaning that over 80% had reached at least a secondary level. This rate is higher than those reported in several West African studies [15; 16], where the proportion of patients with little education remains significant. Contrary to Miller *et al.* (2020) [17], 66% of primary school students reported this, but it is close to the observations of Telly *et al.* (2022) [13]. This factor could partly explain the good adherence and high virological suppression observed in our cohort.

The majority of patients were single (52.79%), contrary to Miller *et al.* (2020) [17] where 57% were married. They worked in the informal sector (41.12%). Contrary to what Telly *et al.* (2022) [13] observed, the majority are housewives (37.4%), reflecting the urban socio-economic structure of Yaoundé. Almost all (96.95%) reside in urban areas, which facilitates access to healthcare and information, higher than that observed in rural or prison cohorts in Gado *et al.*'s research (51.3%) [15]. The majority of participants were Christian (85.28%), which corresponds to the urban demographics of Cameroon, an observation corroborated by the research of Miller *et al.* in 2020 (84%) [17].

➤ Clinical and Therapeutic Characteristics

Nearly all patients (93.91%) started with a 2NRTI+1NRTI regimen (2 nucleoside reverse transcriptase inhibitors + 1 integrase inhibitor), with a combination of TDF+3TC+DTG (88.83%) or TDF+3TC+EFV (5.58%), in accordance with current WHO and national recommendations. This trend is also reported by Koné (2024) [18] in Mali and Gado *et al.* (2022) [15] in Niger, who show a predominance of regimens based on 2NRTI + 1NRTI (94%) and 2NRTI+1NRTI (17%), and TDF+3TC+EFV (65.1%) and TDF+3TC+DTG (13.2%), with excellent viral suppression rates. The evolution of treatment regimens towards simpler and better tolerated combinations, such as TDF+3TC+DTG, has improved patient adherence and quality of life as mentioned by WHO in 2024 [19].

The majority of our participants (69.74%) had been receiving treatment for 2 years, demonstrating good retention in care. This result is consistent with recent African cohorts, where early access to and retention in care were improving [14].

Immunologically, 88.32% of patients had a CD4 count ≥ 500 cells/mm³, indicating an excellent response to treatment. This result is superior to that observed in most African cohorts, where immune reconstitution remains a challenge, particularly in patients diagnosed late [15; 16]. Gado *et al.* (2022) observed an average gain of 298 cells/mm³ over one year in prisoners, confirming the positive impact of ART on immune reconstitution [15].

The vast majority (88.83%) were currently following the TDF+3TC+DTG regimen, considered the recommended first-line treatment due to its potency, tolerability, and high genetic barrier to resistance. This choice is consistent with WHO recommendations and trends observed in the sub-region [18].

Comorbidities were rare in our population: tuberculosis (2.54%) and hepatitis B & C (1.52%). These rates were lower than those reported in other African cohorts [15; 20], probably due to regular follow-up and integrated care at the ACT

➤ Evolution of Viral Load

• Virological Suppression

At 6 months (T6), 67.5% of patients were undetectable, and this rate increased to 73.1% at 18 months (T18). The improvement was significant between T6 and T12 ($p=0.042$), but then stabilized (no significant difference between T12 and T18). This trend is comparable to that observed by Koné (2024) in Mali [18], where viral suppression increased from 0% at initiation to 89.9% at 12 months, and by Gado *et al.* (2022) in Niger (78% suppression at 12 months) [15]. In children in Burkina Faso, Agapit (2012) found a suppression rate of nearly 70% under treatment, regardless of the regimen [21].

Our 18-month virological suppression rate (73.1%) is encouraging, but remains below the WHO's 95-95-95 target. However, it is higher than that observed in some contexts of non-adherence or precarious living conditions: in Douala, Essomba *et al.* (2015) reported virological suppression in 51% of adhering patients [12], and Maiga *et al.* (2024), in Bamako reported 63.5% non-adherence with a detectable viral load >1000 copies/ml [14].

• Impact of the Treatment Regimen

At T6, T12, and T18, no statistically significant difference was observed between the regimens at initiation or ongoing treatment and virological suppression ($p > 0.05$). This suggests comparable efficacy of the different recommended regimens, provided adherence is good and there are no major resistance mutations. This finding is consistent with Agapit (2012) and Koné (2024), who report

similar efficacy of first-line regimens, regardless of the combination used (Agapit, 2012; Koné, 2024) [21; 18].

➤ Factors Associated with Unsuppressed Viral Load

• Sociodemographic Factors

Secondary education level is associated with better viral suppression at 18 months (OR=0.39; $p=0.041$). This result aligns with the observations of Essomba et al. (2015) and Maiga et al. (2024), who emphasize that education promotes treatment understanding and adherence [12; 14]. No other sociodemographic factor (age, sex, occupation, religion, etc.) is significantly associated with unsuppressed viremia, a finding also reported in recent literature [16; 13], where age and sex are no longer systematically associated with virological failure, especially in urban and medically intensive settings.

• Clinical and Behavioral Factors

Adherence to treatment is the major factor: non-adherent patients are 48 times more likely to have an unsuppressed viral load (OR=48.3; $p<0.001$). This finding is actually consistent with several recent studies [12; 16; 14]. The main causes of non-adherence are forgetfulness, fatigue, stockouts, and lack of psychosocial support.

Alcohol consumption (OR=19.43; $p<0.001$) and lack of regular physical activity (OR=18.27; $p<0.001$) are also strongly associated with poor viral suppression. These behavioral factors are well backed namely by Essomba et al. (2015) whose study found an association between stimulant use and non-adherence [12], Maiga et al. (2024) and Telly et al. (2022) who emphasize on the importance of psychosocial support and addiction treatment [14; 13].

No therapeutic regimen (initial or current) or comorbidity has a significant impact on virological suppression, which confirms that the efficacy of current regimens is excellent provided adherence is maintained.

The situation in Cameroon remains marked by a high HIV prevalence (2.7% in 2024), but testing efforts, expanded access to antiretroviral therapy (ART), and simplified treatment regimens have led to significant progress. Our study confirms the effectiveness of current ART regimens (particularly TDF+3TC+DTG) in virological suppression and immune enhancement of HIV-1 patients in Yaoundé, consistent with regional and international data.

The main limitation to viral suppression remains adherence to treatment, which is influenced by education level, alcohol consumption, physical activity, and psychosocial support. Drug shortages, stigma, and difficulties accessing care remain challenges, as highlighted by Keita et al. (2023), Telly et al. (2022), and Essomba et al. (2015) [16; 13; 12].

V. CONCLUSION

The study conducted at the Yaoundé University Hospital on the evolution of viral load reveals that the

majority of patients infected with HIV-1 are women (62.94 %) relatively young with an average age of 39.7 years, educated (83.25%), and urban (96.95%) and of Christian religion (85.28%).

After 18 months of treatment with the 2NRTI+1II therapeutic regimen (93.91%) and the TDF+3TC+DTG combination (88.83%), 73.1 % achieved an undetectable viral load, an encouraging result but below the 95% target set by the WHO.

Adherence to treatment is the most significant factor, followed by alcohol consumption (OR=19.43; $p<0.001$) and lack of physical activity, which are associated with non-suppression viremia. A secondary education level improves viral suppression at 18 months (OR=0.39; $p=0.041$).

RECOMMENDATIONS

- To strengthen therapeutic education to meet the WHO goal
- To improve early screening and virological monitoring
- To implement a monitoring and evaluation system
- To order viral load testing at the start of treatment
- To strengthen monitoring of patients with behavioral risk factors (alcohol consumption, physical activity)
- To strictly adhere to treatment
- To undergo regular medical follow-up

LIMITS OF THE STUDY

Our study had its limitations, especially the lack of funds for research, so we only did a quantitative study.

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➤ Conflict of Interest

The authors declare that they have no affiliation with or involvement in any organization or entity with a financial interest in the subject matter.

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