

The Frequency and Predictors of Unsuppressed HIV Viral Load Among People with HIV in Nyaruguru District, Rwanda

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Background: By the end of 2015, epidemiological studies approximated 37 million people living with HIV (PLHIV) and 46.3% of them were initiated to antiretroviral therapies. From the 90-90-90 strategy, by 2020 at global level, 90% of all people living with HIV were expected to suppress viral load (VL). Although VL suppression is an important indicator of treatment success in PLHIV, studies on this indicator remain scarce in Rwanda where the prevalence of HIV is 3% with 9% for non-suppression. This work, thus, determined the prevalence of VL non-suppression and its associated predictors among PLHIV.

Methods: A cross-sectional study was conducted among 637 PLHIV enrolled in healthcare services between 2016 and 2017 in Nyaruguru district. Socio-demographic, treatment, clinical, immunological and VL data were extracted from medical records. Bivariate and multivariate logistic regression analyses were performed to determine associated factors with VL suppression considering 95% confidence intervals and statistical significance of $p < 0.005$.

Results: More than half of participants were female (57.77%). The prevalence of unsuppressed HIV VL was 8.9% and 88.7% of respondents were satisfied with the service provided. Males were more likely to be unsuppressed HIV VL [aOR = 3.02; 95% CI (1.19–7.64), $p = 0.02$] than females. Higher likelihoods of VL non-suppression were among those with history of clinical failure [aOR = 3.14; 95% CI (1.70–14.03), $p = 0.034$] or history of treatment interruption [aOR = 8.29; 95% CI (2.60–26.42) $p = 0.002$]. Those with a bad perception toward the whole life treatment were more likely to be unsuppressed [aOR = 4.32; 95% CI (1.98–18.99), $p = 0.049$] than their counterparts.

Conclusion: Sex, treatment interruption, bad perception toward the whole life treatment, clinical failure and lack of confidentiality were the major predictors of being unsuppressed. More efforts on counseling HIV patients to improve their knowledge would drop levels of VL non-suppression, so improving the quality of service should be prioritized to increase suppression.

Keywords: unsuppressed, HIV/AIDS, adherence, antiretroviral, suppression

Background

At the end of 2015, 36.7 million of people globally lived with HIV and a majority of them were from low- and middle-income countries (LMICs). Among these cases, more than 2.1 million were new infected cases on an annual basis. In that period, the antiretroviral (ART) coverage was 46.3% among all HIV-infected people.^{1,2} The number of people accessing ART therapies increased with time as ART is one of the transmission prevention measures and around 18.2 million HIV-infected people were on ART in 2016 worldwide. The number of people who accessed ART treatment in 2010 and 2015 (7.5 million and 15.8 million, respectively) kept increasing; however, people living with HIV with poor adherence to ART therapies remain a public health burden, mainly in Sub-Saharan Africa (SSA) which accounts for more than 70% for non-suppression which decimates the quality of life of those who are affected.^{2–5} Efforts were combined to decrease new infections and increase quality of life for PLHIV through suppression of VL. Despite those measures such as “test and treat”, sensitization on male circumcision, condom use and the increased access to ART therapies among PLHIV, the VL monitoring on a regular basis for PLHIV is essential for early reaction to non-suppressing among people with

HIV.^{2,3,6} To address this concern, early strategies to achieve an undetectable or suppressed VL are substantial as important ways to prevent HIV transmission and increase quality of life for PLHIV.^{7,8}

Therefore, monitoring treatment success remains the gold standard for viral load testing and control.⁹ Further, unsuppressed viral load predicts that either drugs are not taken correctly or there is a resistance somewhere.⁶ The target 90-90-90 set by the Joint United Nations Program on HIV/AIDS in 2014 says that by 2020, 90% of people PLHIV will be aware of their status, 90% of them will access treatment and 90% of them will have HIV suppressed viral load. Moreover, the viral load monitoring coverage in 2014 was only 50%. This low coverage was due to the test cost, the availability of trained staff and limited sites due to the complexity of the testing procedures. This gap in VL monitoring was challenging clinicians in decision making on what to do for HIV-infected people when on follow-up.^{9,10} Earlier studies documented a lower prevalence of HIV viral suppression and the prevalence differs between countries. A multi-country study conducted by Médecins Sans Frontières evidenced that 30% of people for whom treatment failure was suspected, had an elevated viral load, which means that 70% might have been unnecessarily switched to the second-line regimes if no VL test was done to confirm the treatment failure.^{6,11} The rate of non-suppression of VL was different depending on the country, e.g. 15% in South Africa, 9.6% in Nigeria,¹² 16% in Swaziland, 20% in Ethiopia,¹³ 29% in Uganda, 23.2% in Cambodia, 14.9% in Zimbabwe, and 27% in Los Angeles. Although VL testing has been important in following-up PLHIV, the above highlighted challenges have been identified worldwide in this strategy to the extent that it becomes difficult to determine early whether a person is suppressing or not, where challenges are still being faced.^{14–16}

The quality of service is among elements that contribute to a good treatment adherence mainly for patients on long-term treatment or whole life treatment. Indicators of the quality of service include confidentiality and short waiting time. It has been seen that the adherence to ART can depend on how a client is satisfied with the service delivery in relation to healthcare providers with professional guiding principles including keeping patients' personal information confidential and a good treatment outcome. A previous study in Vietnam conveyed that only 42.4% of patients on ART treatment were satisfied with the quality of service. In the same study, only few patients (18.8%) were satisfied with the treatment outcome.¹⁷ But in some key aspect of services, this was slightly different; 16% of HIV patients reported to lack privacy when discussing with clinicians about their illness. As far as confidentiality is concerned, the majority of patients (96%) reported to be comfortable with the mechanisms involved in their information keeping in terms of confidentiality and secrecy.¹⁸

Preceding studies stated that PLHIV have almost normal life expectancy when suppressing their VL.¹⁹ Studies in Vietnam stated that 93% of patients with HIV/AIDS were suppressing and the predictors were sustainability and uninterrupted ARV treatment during the first year of treatments.²⁰ Later studies in South Africa indicated that 85% of patients were suppressing after six months of treatment and the major factors were providing of counseling, appropriate healthcare services, good adherence to ART therapies and psychosocial support.²¹ Besides, the important factors of lack of suppression were substance use (e.g. alcohol and tobacco) in first month of initiating ART therapies, pregnancies, mental health outcomes (e.g. depression), lack of psychosocial support, side effects of ART therapies, and prior ART exposure.^{20–22}

The main target of initiating ART treatment is to improve someone's immune system and suppress HIV VL. Although the importance of utilizing effectively ART therapies was documented, factors leading to low suppression of HIV VL are the barriers leading to poor quality of life of the patients with HIV. Socio-demographic characteristics, prolonged intake of alcohol in the first month of treatment initiation, pregnancies, mental health disorders, substance abuse, weak social support, depressive symptomatology, side effects of medications, prior ART exposure, stress, patients' bad perception towards the illness and treatment, low baseline CD₄, ARV regimen, previous treatment failures, long period on ART therapies, drug resistance, drug toxicity, weak social support, sexually transmissible infections (STIs), awareness of viral suppression, comorbidities, poor adherence to treatment, patient relationship with their clinicians and poor diet were documented as the major factors.^{23,24} Further, all of these factors associated with unsuppressed VL can easily lead to poor adherence, thus, unsuppressed VL.^{20,25} Indeed, the factors such as low community-based supports mainly in young people or adolescents, co-infections, poor nutrition, social stigma, mismanagement of opportunistic infection, poor quality of healthcare service in term of waiting time, service delivery and irregularity in adherence are important factors that increase the risk to experience non-suppression.^{26,27}

The prevalence of HIV in Rwanda is around 3% across the country and females (3.7%) are at a higher risk for HIV than males (2.2%). While 83% of Rwandan people live in rural zones, HIV is more prevalent in urban (7.1%) compared

with rural settings (2.3%).^{28–30} The VL suppression rate among people living with HIV in Rwanda has been projected to be 9%.^{26,27} While unsuppressed HIV VL refers to having more than 200 copies of HIV nucleic acids per milliliter of blood after at least one year of treatment,³¹ only 91% of people with HIV experienced VL suppression. This indicated that 9% of PLHIV have unsuppressed HIV VL. Despite the efforts of the government of Rwanda to manage HIV and its impact on well-being of PLHIV and their caregivers or family members, unsuppressed HIV VL remains a public health burden in Rwanda. There are few studies conducted on the prevalence of non-suppression of VL and its associated predictors in Rwanda. This study, therefore, determined the prevalence of unsuppressed HIV VL and its associated predictors among PLHIV in Nyaruguru District.

Methods

Study Design

This retrospective hospital-based cross-sectional study design was conducted at Nyaruguru District Hospital using the medical records of 637 PLHIV under ART treatments.

Study Settings

The study took place in Nyaruguru district. This district is one of 30 districts of Rwanda, located in the Southern province and counting 323,624 inhabitants. It is a district bordering Burundi. Further, Nyaruguru district borders Huye, Gisagara and Nyamagabe districts. Nyaruguru is composed by 14 sectors where you find 16 health centers and 22 health posts. Nyaruguru district is irrigated by some of Rwanda main rivers such as Akanyaru and Mwogo. Four sectors of this district are bordering Nyungwe National Park. The whole zone of Nyaruguru district is served by Munini District Hospital that has 72 beds with full functional minimum district package. ART therapy is provided in all Nyaruguru health facilities.

Study Population

The study population was 2325 people living with HIV in Nyaruguru district, under antiretroviral therapy who were alive during our study period and who were willing to participate voluntarily in this study. The study included the participants with HIV who were aged 18 years or above. It also included the respondents who had at least one VL result in the period between July 2017 and at the time of conducting this study. The participants who received ART therapies at the health facilities in the period from July 2016 to June 2017 were exhaustively included in the research. People with lack of at least one VL result in period of July 2017 up to the period of data collection were excluded. This research also excluded the people who were not on ART therapies in the period of July 2016 to June 2017.

Sampling Method and Study Sample

A sample size was computed using the formula of Cochran ($n_0 = \frac{z^2 * p(1-p)}{e^2}$) based on the recent unsuppressed HIV VL in Rwanda of 9% that was documented in 2018. The parameters from this formula are “ n_0 ” stands for the minimal sample size, “ z ” for the confidence intervals (this equals to 95% or 1.96), “ p ” for the updated proportion of depression ($p = 0.09$) and “ e ” stands for the margin error ($e = 0.05$). Using this formula ($n = \frac{1.96^2 * 0.09(1-0.09)}{0.05^2} = 579$), a minimum sample size of 579 was found. Then, we added 10% for missing data from medical records and thus the study enrolled 637 medical records.

Study Variables

Outcome variable was unsuppressed HIV viral load. Thus, primary outcome was virological suppression, defined as having ≤ 1000 copies of viral RNA/mL of blood plasma. This classification was provided by the National guideline for treatment and control of HIV/AIDS in 2018. Independent variables comprised socio-demographic and clinical variables. Socio-demographic variables were of age, sex, marital status, occupation, religion, Ubudehe category, residence sector, residence cell, health insurance, level of education and family attitude. Clinical variables included duration of antiretroviral therapy, HIV clinical stage, immunological failure, adherence on treatment, clinical failure, opportunistic disease, physical status, sexual transmission infection, mental health status, pregnancy status, side effects of medications, prior

ART exposure and disability. Environmental and behavior factors were variables such as tobacco use, alcohol use, lifestyle, sexual behavior, social stigma, depressive symptomatology, family discrimination, social isolation, drugs use, geographic accessibility and diet.

Data Collection

Data collection was performed by the data clerks and ART therapy providers using close-ended questions in a developed questionnaire. Data were collected using a structured data-abstraction tool customized from Federal Ministry of ARV-therapy patient-intake forms, follow-up charts, and registers. A retrospective review of routinely collected HIV information and viral load test data for patients from March 1 to 20, 2019 was done. Four supervisors and a principal investigator monitored all activity on a daily basis throughout. Data collection included basic patient information, such as socio-demographic characteristics of ARV-therapy patients, clinical and treatment characteristics, laboratory results, information, and comorbidities: STIs, TB infection, and medically diagnosed in communicable disease. All patient files were labeled with numeric numbers and by using Excel, these were a random selection of numbers. After the random selection of numbers, files with selected numbers were picked up to be reviewed for data collection and patients to which files were selected, were interviewed to gain any additional information which could not be found in the file.

Statistical methods

Data were checked, coded, and entered into EpiData Entry Client 3.1 and then cleaned for statistical analyses. Both descriptive and analytical analyses were performed using STATA software version 13.0. In descriptive analyses, statistical parameters such as mean, standard deviation, proportion and frequency were utilized. Univariate analysis was used to describe the respondents and determine the prevalence of non-suppression and quality of adherence to treatments. For analytical analyses, bivariate logistic regression analyses were employed to find out the associated predictors of non-suppression of HIV VL. Then, multivariate logistic regression models were performed based on odds ratios (ORs) to determine associated predictors of unsuppressed HIV VL. Hence, 95% for the confidence intervals, significance levels of $p < 0.05$ and odds ratio were used to identify significant variables and factors associated with unsuppressed HIV VL. Based on the adjusted odds ratio, all significant predictors with unsuppressed HIV VL were stated as significant confounders of unsuppression.

Ethics

This study was approved by the committee of the Institutional Review Board of the College of Medicine and Health Sciences at the University of Rwanda with the reference number (CMHS/IRB/289/2019). All methods of this study were applied in accordance with the standards and regulations of the Declaration of Helsinki.³⁷ The confidentiality in relation to patient information, data management and storage was secured. As the present study used secondary data from medical records, consent forms were not sought from the patients but the hospital provided the authorization to conduct this study.

Results

Socio-Demographic Characteristics of the Study Participants

Nearly two out of three study participants were female (57.77%). Further, the majority was between 38–47 years (36.26%), 71.59% were married, 55.57% had no formal education, 93.72% had health insurance, 44.43% were in Ubudehe category 3, and 86.1% of study participants had family members who were aware of the serologic status (Table 1).

Prevalence of Unsuppressed VIH Viral Load and Clinical History

Our result showed that 8.95% of PLHIV were unsuppressed HIV VL while 91.05% were suppressed. Only 55.26% of PLHIV experienced more than 10 years under ART treatment, 83.83% for good adherence, 90.42% for not having interrupted their treatment, 94.03% for having no history of clinical failure, 78.81% for those who received 1 tablet

Table 1 Description of Socio-Demographic Characteristics (n = 637)

Variables	Frequency	Percentage
Age group		
18–27 years	60	9.42
28–37 years	94	14.76
38–47 years	231	36.26
48–57 years	186	29.2
58–67 years	66	10.36
Gender		
Female	368	57.77
Male	269	42.23
Marital status		
Divorced	45	7.06
Married	456	71.59
Single	77	12.09
Widower	59	9.26
Education level		
No formal education	354	55.57
Primary education	253	39.72
Secondary education	30	4.71
Health insurance		
No	40	6.28
Yes	597	93.72
Ubudehe category		
Category 1	116	18.21
Category 2	238	37.36
Category 3	283	44.43
Awareness of family member on the participant		
HIV status		
Not aware	89	13.9
Aware	548	86.1

per day, 72.21% for those with no history of having opportunistic diseases, and 89.95% for not having sexual transmitted disease in their history. A majority (95.92%) of the PLHIV indicated that they had no history of mental disease. More than half (54.89%) of females living with HIV experienced no pregnancy during the treatment period while 99.69% of the PLHIV were not exposed to ART before becoming HIV positive (Table 2).

Behavioral Changes and Satisfaction for the Patients

Among the study participants, 57.14% were consuming vegetables 1–3 days in a week while 62.64% of participants were drinking milk for 1–3 days in a week, 98.74% had no physical disability, 57.46% were taking 30–60 minutes to reach the health facility, 56.04% were alcohol users, 70.64% had no history of having more than one sexual partner, 78.18% had a good perception towards an incurable disease, 88.7% of participants were satisfied with the service delivery while 86.03% and 83.83% were satisfied with the clinician confidentiality and had a positive attitude toward a whole life treatment, respectively (Table 3).

Relationship Between Socio-Demographic, Behavior and Environment Factors and Viral Non-Suppression

At the end of the analysis of socio-demographic, behavior and environment factors, variables were seen to be probably associated with unsuppressed HIV viral load such as age ($p < 0.001$), gender ($p = 0.013$), level of study ($p < 0.002$), awareness

Table 2 Prevalence of Unsuppressed HIV Viral Load and Clinical History

Variables	Frequency	Percentage
Suppression		
No	57	8.95
Yes	580	91.05
HIV status of the participant sexual partner		
HIV negative	15	2.4
HIV positive	467	73.3
Have no partner	155	24.3
ARV treatment duration for the participant		
1–5 years	162	25.43
5–10 years	123	19.31
>10 years	352	55.26
Quality of adherence		
Good	534	83.83
Fair	81	12.72
Poor	22	3.45
History of treatment interruption since ARV initiation		
No	576	90.42
Yes	61	9.58
Number of tablets per day		
1 tablet	502	78.81
2 tablets	124	19.47
3 tablets	11	1.73
History of opportunistic disease since the HIV positivity		
No	460	72.21
Yes	177	27.79
History of sexual transmitted disease since the HIV positivity		
No	573	89.95
Yes	64	10.05
History of mental disease since the HIV positivity		
No	611	95.92
Yes	26	4.08
History of pregnancy since ARV initiation		
No	202	31.7
Yes	166	26.1
Not applicable	269	42.2
History of ARV exposure before HIV positivity		
No	635	99.69
Yes	2	0.31
Any other chronic disease		
No	612	96.08
Yes	25	3.92
History of depression since HIV positivity		
No	579	90.89
Yes	58	9.11

Table 3 Behavior and Patient Satisfaction

Variables	Frequency	Percentage
Number of days of vegetables consumption per week		
1–3 days	364	57.14
4–7 days	151	23.70
Every day	56	8.79
0 days	66	10.36
Number of days of milk drinking per week		
1–3 days	399	62.64
4–7 days	56	8.79
Every day	7	1.10
0 days	175	27.47
Any physical disability		
No	629	98.74
Yes	8	1.26
Time spent to reach health facility		
1–2 hours	171	26.84
30–60 minutes	366	57.46
<30 minutes	40	6.28
>2 hours	60	9.42
History of alcohol consumption		
No	280	43.96
Yes	357	56.04
History of having more than one sexual partner		
No	450	70.64
Yes	187	29.36
Clients' perception toward the incurable disease		
Bad	139	21.82
Good	498	78.18
Clients' perception toward the whole life treatment		
Bad	103	16.17
Good	534	83.83
Level of satisfaction on service delivery		
Bad	72	11.30
Good	565	88.70
Level of satisfaction on the secret across the whole process of treatment		
Bad	88	13.81
Good	549	86.03

of family member on the participant HIV status ($p < 0.001$), history of having more than one sexual partner ($p = 0.029$), client perception towards incurable illness ($p < 0.001$), client perception towards whole life treatment ($p < 0.001$), level of satisfaction on the service delivery ($p = < 0.005$), level of satisfaction on confidentiality across the whole process of treatment ($p = < 0.016$). The findings after bivariate analysis of socio-demographic, behavior and environmental factors are shown in [Table 4](#).

Bivariate Analysis for the Associations Between Non-Suppression and Clinical Characteristics

The analysis of clinical characteristics has shown some variables significantly associated with unsuppressed HIV viral load such as: HIV status of the participant sexual partner ($p = 0.007$), ARV treatment duration of 1–5 years ($p = 0.047$), history of clinical failure ($p < 0.001$), history of treatment interruption since ARV initiation ($p < 0.001$), fair quality of adherence ($p < 0.001$), poor quality of adherence ($p < 0.001$), taking 2 or 3 ARV tablets per day ($p < 0.001$), history of opportunistic disease since the HIV positivity ($p < 0.001$) and history of depression since HIV positivity ($p < 0.001$) ([Table 5](#)).

Table 4 Bivariate Analysis of Socio-Demographic, Behavior and Environment Factors

Variables	Suppressed VL		Unsuppressed VL		Odds Ratio (CI at 95%)	p-value
	Number	%	Number	%		
Age						
31–67 years	39	7.04	515	92.96	I	
18–30 years	18	21.69	65	78.31	3.65 (1.97–6.76)	<0.001**
Gender						
Female	24	6.52	344	93.48	I	0.012*
Male	33	12.27	236	87.73	2.00 (1.15–3.41)	0.013*
Education level						
None	21	5.93	333	94.07	I	0.060
Primary	34	13.44	219	86.56	2.46 (1.39–4.35)	0.002**
Secondary	2	6.67	28	93.33	1.13 (0.25–5.08)	0.871
Health insurance						
Yes	52	8.71	545	91.29	I	0.416
No	5	12.50	35	87.50	1.49 (0.56–3.98)	0.419
Marital status						
Divorced	6	13.33	39	86.67	I	<0.001***
Married	30	6.58	426	93.42	0.45 (0.17–1.16)	0.102
Single	17	22.08	60	77.92	1.84 (0.66–5.07)	0.238
Widower	4	6.78	55	93.22	0.47 (0.12–1.78)	0.270
Ubudehe category						
Category 1	11	9.48	105	90.52	I	
Category 2	18	7.56	220	92.44	0.78 (0.35–1.71)	0.537
Category 3	28	9.89	255	90.11	1.04 (0.50–2.18)	0.900
Awareness of family member on the participant HIV status						
Aware	43	7.85	505	92.15	I	
Not aware	13	22.41	45	77.59	3.39 (1.69–6.77)	<0.001***
Number of days for vegetables consumption per week						
Every day	3	5.36	53	94.64	I	
4–7 days	8	4.03	143	95.97	0.98 (0.25–3.86)	0.987
1–3 days	45	1.88	319	88.12	2.49 (0.74–8.31)	0.137
0 day	1	1.52	65	98.48	0.27 (0.02–2.68)	0.265
Number of days of milk drinking per week						
Every day	0	0	7	100	I	
4–7 days	19	33.93	37	66.07	I	
1–3 days	27	6.77	372	93.23	0.38 (0.09–1.61)	0.191
0 day	11	6.29	164	93.71	0.23 (0.06–1.03)	0.053
Physical disability						
No	55	8.74	574	91.26	I	
Yes	2	25.00	6	75.00	3.47 (0.68–17.64)	0.132
Time spent to reach health facility						
<30 minutes	6	15.00	34	85.00	I	
30–60 minutes	31	8.47	335	91.53	0.54 (0.19–1.50)	0.180
1–2 hours	15	8.77	156	91.23	0.52 (0.20–1.34)	0.242
>2 hours	5	8.33	55	91.67	0.51 (0.14–1.81)	0.303
History of alcohol consumption						
No	24	8.57	256	91.43	I	0.768
Yes	33	8.95	324	90.76	1.08 (0.62–1.88)	

(Continued)

Table 4 (Continued).

Variables	Suppressed VL		Unsuppressed VL		Odds Ratio (CI at 95%)	p-value
	Number	%	Number	%		
History of having more than one sexual partner						
No	33	7.33	417	92.67	I	0.029*
Yes	24	12.83	163	87.17	1.86 (1.06–3.24)	
Client perception towards incurable illness						
Good	25	5.02	473	94.98	I	<0.001***
Bad	32	23.02	107	76.98	5.65 (3.22–9.94)	
Client perception towards whole life treatment						
Good	29	5.43	505	94.57	I	<0.001***
Bad	28	27.18	75	72.82	6.50 (3.66–11.53)	
Level of satisfaction on the service delivery						
Good	44	7.79	521	92.21	I	0.005*
Bad	13	18.06	59	81.94	2.60 (1.32–5.12)	
Level of satisfaction on the secret across the whole process of treatment						
Good	43	7.84	506	92.16	I	0.016*
Bad	14	15.91	74	84.09	2.22 (1.16–4.26)	

Notes: *Statistically significant at $p < 0.05$, **Statistically significant at $p < 0.01$; ***Statistically significant at $p < 0.001$.

Multivariate Logistic Regression Models for the Predictors of Unsuppression Among PLHIV

Our results indicated that males were more likely to have unsuppression [aOR = 3.02, 95% CI (1.19–7.64), $p = 0.02$] than females. Participants who experienced treatment interruptions were more prone to be unsuppressed [aOR = 8.29, 95% CI (2.60–26.42), $p = 0.002$] than their counterparts. Those with no good perceptions toward the confidentiality across the treatment processes had greater odds to be unsuppressed [aOR = 1.11; 95% CI (0.82–1.40), $p = 0.006$] than their counterparts. Respondents with negative perception toward the whole life treatment [aOR = 4.32, 95% CI (1.98–18.99), $p = 0.049$], history of treatment interruption [aOR = 8.29, 95% CI (2.60–26.42), $p = 0.002$], history of clinical failure [aOR = 3.14; 95% CI (1.70–14.03), $p = 0.034$], negative perception toward the confidentiality across the treatment process [aOR = 1.11, 95% CI (0.02–0.53), $p = 0.006$] were more likely to be unsuppressed than their counterparts (Table 6).

Discussion

The purpose of this study was to determine the prevalence of unsuppressed HIV VL and the factors associated with uncontrolled viral load among people living with HIV in the Nyaruguru district of Rwanda. Our results revealed that the majority (57.77%) of the participants were females. This increased number of females is expected since in Rwanda the prevalence of HIV is higher in females than in males. According to this, it is expected to have so many females living with HIV than males among HIV-infected people on follow up in any health facility.³² This is comparable to previous studies that reported 39.8% were males while 60.2% were females,^{12,33} although Basavaprabhu et al found 69% of males and 31% of females in their study.²⁴

In this study, the prevalence of unsuppressed HIV viral load among our participants was 8.95%. This is comparable to the findings of Rangarajan et al that reported 7% for unsuppressed HIV VL in PLHIV.²⁰ But our findings are slightly different from the findings of Limmade et al that documented 20% for not suppressing HIV VL.²¹ This good suppression

Table 5 Bivariate Analysis of Clinical Characteristics of the Study Participants

Variable	Suppression		Unsuppression		95% CI Adjusted Odds Ratio	p-value
	N	%	N	%		
HIV status of the participant sexual partner (n=482)						
HIV Positive	30	6.42	437	93.58	1	0.003**
HIV negative	11	73.33	4	26.67	5.29 (1.59–17.63)	<0.007***
ART treatment duration						
>10 years	18	5.11	334	94.89	1	
5–10 years	23	18.70	100	81.30	0.84 (0.91–2.21)	0.667
1–5 years	16	9.88	146	90.12	2.03 (2.21–8.22)	0.047*
Quality of adherence						
Good	18	3.37	516	96.63	1	
Fair	25	30.86	56	69.14	12.79 (6.57–24.90)	<0.001***
Poor	14	63.64	8	36.36	50.16 (18.68–134.69)	<0.001***
Treatment interruption						
No	21	3.65	555	96.35	1	
Yes	36	59.02	25	40.98	38.05 (19.45–74.44)	<0.001***
Number of ARV tablet per day						
1 tablet	11	2.19	491	97.81	1	
2 tablets	43	34.68	81	65.32	23.69 (11.73–47.84)	<0.001***
3 tablets	3	27.27	8	72.73	16.73 (3.90–71.73)	<0.001***
History of opportunistic disease since the HIV positivity						
No	19	4.13	441	95.87	1	
Yes	38	21.47	139	78.53	6.34 (3.54–11.36)	<0.001***
History of sexual transmitted disease since the HIV positivity						
No	47	8.20	526	91.80	1	
Yes	10	15.63	54	84.38	2.07 (0.99–4.33)	0.053
History of mental disease since the HIV positivity						
No	55	9	556	91	1	
Yes	2	7.69	24	92.31	0.84 (0.19–3.65)	0.819
History of pregnancy since ARV initiation						
No	18	0.97	184	96.03	1	
Yes	15	9.04	151	90.96	0.95 (0.54–1.75)	0.878
Any other chronic disease						
No	52	8.50	560	91.50	1	
Yes	5	20	20	80	2.69 (0.97–7.46)	0.057
History of depression since HIV positivity						
No	40	6.91	539	93.09	1	
Yes	17	29.31	41	70.69	5.58 (2.91–10.70)	<0.001***

Notes: *Statistically significant at $p < 0.05$, **Statistically significant at $p < 0.01$; ***Statistically significant at $p < 0.001$.

prevalence is due to extensive efforts of the Rwandan Ministry of Health and Rwanda Biomedical Center in following up closely people living with HIV and by implementing the principle of “test and treat” where people are tested and put on ARVs directly after being identified as HIV positive.³²

We measured the patient satisfaction toward the service delivery, where we found that 88.7% were positively satisfied with the quality of the service. The satisfaction rate is good due to daily sensitization on good service delivery which is included in all levels of public and private sectors to meet the customer’s need. In agreement with preceding studies, our findings revealed that males were more likely to be unsuppressed PLHIV when compared with females. Hence, in our study males were almost five times more likely to have unsuppressed HIV VL than females. These findings corroborate with findings from previous studies.³⁵ Due to their lifestyle, such as alcohol consumption, sexually active, movement into

Table 6 Multivariate Logistic Regression Models for the Factors of Viral Load Suppression

Variables	95% Confidence Intervals Adjusted Odds Ratio	p-value
Gender		
Female	1	0.02*
Male	3.02 (1.19–7.64)	
Age category		
31–67 years	1	0.994
18–30 years	0.99 (0.30–3.25)	
HIV status of the sexual partner		
Positive	1	
Negative	0.29 (0.29–2.99)	0.303
Family member awareness on participant HIV status		
Yes	1	
No	0.50 (0.21–1.14)	0.102
Education level		
None	1	
Primary	1.97 (0.87–4.02)	0.061
Secondary	3.02 (0.17–67.65)	0.058
Treatment duration		
>10 years	1	
5–10 years	0.72 (0.20–2.52)	0.482
1–5 years	1.19 (0.69–5.42)	0.209
Adherence quality		
Good	1	
Fair	1.34 (0.37–4.79)	0.651
Poor	3.23 (0.55–19.03)	0.194
History of treatment interruption		
No	1	
Yes	8.29 (2.60–26.42)	0.002*
History of having opportunistic infection		
No	1	
Yes	0.95 (0.77–6.14)	0.139
History of having depression		
No	1	
Yes	2.21 (0.73–13.60)	0.061
Perception toward incurable diseases		
No	1	
Yes	0.35 (0.10–1.20)	0.098
Having more than one sexual partner		
No	1	
Yes	2.33 (0.90–6.01)	0.052
Number of ART tablet per day		
1 tablet	1	
2 tablets	12.63 (0.93–51.87)	0.061
3 tablets	5.71 (0.52–62.38)	0.153
Good perception toward the whole life treatment		
Yes	1	
No	4.32 (1.98–18.99)	0.049*
Good perception toward the quality of the service		
Yes	1	
No	3.14 (0.85–11.62)	0.080

(Continued)

Table 6 (Continued).

Variables	95% Confidence Intervals Adjusted Odds Ratio	p-value
Good perception toward the secrecy across the treatment process		
Yes	1	
No	1.11 (0.82–1.40)	0.006*
Good perception towards incurable disease		
Yes	1	
No	4.02 (1.00–16.19)	0.051

Note: *Statistically significant at $p < 0.05$.

or outside the country for economic issues, low level of using health services, etc, males are more likely to interrupt the treatment and finally have poor adherence which can lead them to have higher rates of unsuppressed HIV VL compared with females. These results are relevant to previous studies.³⁴

Regarding the consumption of medication, patients with interrupted treatment were almost eight times more likely to have unsuppressed HIV compared with those who are having all prescribed doses without interruption. These findings are relevant to preceding studies conducted in SSA countries such as Kenya which reported that patients interrupting treatment were almost three times more likely to have unsuppressed HIV VL compared with their counterparts.³⁶ Regarding attitudes towards whole life treatments, negative perception to the whole life treatment was significantly associated with unsuppressed HIV VL. This finding fitted with prior studies that found that a bad perception toward the whole life treatment was significantly associated with non-suppressed viral load in adolescents. As with other drugs, ARV have a limited duration in someone's body. Any drug interruption decreases the synergic capacity of ARV then the virus can perform its metabolism so that new viruses are produced.

Our results revealed that a poor quality of service such as regarding confidentiality was significantly associated with unsuppressed HIV VL. Thus, our result proved that PLHIV with poor quality of services were more likely to be unsuppressed while PLHIV with bad perception toward keeping of confidentiality were more likely to have unsuppressed HIV VL when compared with those with a good perception toward secrecy regarding the illness. When the patient does not believe in the clinician in terms of secret keeping and confidentiality, the adherence becomes poor and the motivation of attending the health facility is not good and all of these can even lead to periodic treatment interruption. This finding corroborates with preceding research which established that confidentiality and disease secrecy are key in quality of service where lack of confidentiality increased the risk to be unsuppressed HIV VL.²⁵ In cases of poor quality of service mainly when confidentiality is not respected, some patients will have poor adherence characterized by irregular ART intake and as said above, this can lead to poor treatment outcome.

This study is not without limitations. First, we reviewed records of patients with viral load test results, which may have resulted in underestimation of the actual proportion of patients on ARV therapy with unsuppressed viral loads. In addition, such adherence as on-time drug pickups, pill counts, and other factors that could affect adherence, such as alcohol consumption, mental health status, and psychosocial factors, (depression and stigma) were not included in the medical records. Despite these limitations, this study has some strengths. First, the results are novel because a number of additional factors, such as the number of days of vegetable and milk consumption, were explored in the study. Second, this study has implications for nutritional and dietary modifications for improving the health outcomes in this population.

Conclusion

Our study found that the prevalence of viral non-suppression among the people with HIV was 8.95%. Given factors identified as being associated with unsuppressed HIV VL such as male gender, treatment interruption, whole life

treatment, confidentiality of health care provider and clinical failure, improving adherence and quality of service will help in having suppressed VL, and patients' continuous education is needed to sensitize on adherence so that they will avoid drugs interruption which was highlighted as a cause of unsuppressed VL. Psychological support is also needed to be involved in patient follow up given that lack of confidentiality and negative perception toward the whole life treatment were found to be associated with unsuppressed VL. Based on the findings from this study, the Rwanda Ministry of Health through the Rwanda Biomedical Center should reinforce the regular monitoring of peripheral health facilities and try to do a regular analysis of data from those health facilities for early tracking of some factors associated with unsuppressed HIV VL such as irregular adherence and treatment failure. Further, the District Hospital supervision and HIV mentor team should intervene early at all levels of the catchment area in cases of irregular adherence and treatment interruption as well as any other suspected factor. Lastly, health care providers should increase their capacity in terms of confidentiality management and good service delivery. Information, Education and Communication (IEC) from all health care providers to people living with HIV, should focus on how to live with incurable disease and whole life treatment.

Data Sharing Statement

All relevant data are included in this manuscript. Data may be shared upon reasonable request to the corresponding author.

Ethics approval

The ethical approval was obtained from the Institutional Review Board, the College of Medicine and Health Sciences (IRB/CMHS) at the University of Rwanda with the reference number (CMHS/IRB/289/2019). Confidentiality and privacy of the participants were kept. All data were anonymously collected and kept. All methods were conducted in accordance with the standards and regulations of the Declaration of Helsinki.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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