Original Article

Factors Associated with Viral Load Suppression among Human Immunodeficiency Virus (HIV) Positive Adolescents and Young Adults in Ngororero District, Rwanda

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Abstract

Background
Optimal viral load suppression results from good adherence to treatment. The viral load suppression advantages include the reduction of virus transmission. In Rwanda, however, viral load suppression among adolescents and young adults has been proven relatively low than in other age groups.

Objectives
To assess the factors associated with viral load suppression among adolescent and young adults in Ngororero district, Rwanda.

Methods
A cross sectional study that included 151 adolescents and young adults aged from 15 to 24 years was conducted in Ngororero district. Data were entered in Epi-Info version 7 software and analyzed using STATA15.

Results
Females and males were 68% and 32% respectively. Sixty percent of the participants were aged20-24 years. Multivariable analysis revealed the factors associated with viral load suppression: Ubudehe category 2, P= 0.016, AOR = 6.6, CI [1.4, 31.1]; ubudehe category 3, P= 0.004, AOR = 8.9, CI [2.01,39.8]; spending between 5 to 9 years on ART, P= 0.022, AOR = 0.16 [CI0.03, 0.89;) and often forget to take medication, P= 0.011, AOR = 0.35, CI [0.13, 0.97.]

Conclusion
Viral load suppression among adolescents and young adults was low. Improving socio-economic conditions of adolescents and young adults, as well as provision of continuous counselling to them during their whole treatment life can improve significantly their adherence.

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Keywords: suppression, viral load, adolescents, young adults, transmission.

Introduction

Viral load suppression among Adolescents remain a public health concern [1] despite the efforts like "treat all" put in place to ensure people living with HIV (PLWHIV) are identified early and put on treatment.

The goal is to suppress viral load replication by maintaining good adherence of PLWHIV to antiretroviral therapy (ART). Although HIV new infections have dramatically reduced in the general population, more than one third of all new HIV infections occur among adolescents and young adults aged between 15 to 24 years.[2]

Globally, up to 150 adolescent daily deaths are due to AIDS related illnesses, with Sub-Saharan Africa (SSA) bearing the most burden of 91% of the deaths   in 2016. [1] In 2015, HIV was the second cause of mortality among adolescents in the world and the leading cause of mortality among them in SSA, which constitutes a threat for the adolescents.[1]

From the literature review, factors associated with the viral load suppression of people living with HIV were categorized into four groups, which compose the conceptual information of this study. Those groups are socio-demographic factors, medication related factors, health care delivery related factors and socio-environment factors.[1] Some of those factors help improve viral load suppression while others hinder it.

The prevalence of HIV in adolescents and young adults aged from 15 to 24 years old in Rwanda is low when compared to other age groups. However, HIV infection is showing an increase in the age group of 20 to 24 years old. From 2010 to 2015 for example, the prevalence of HIV among women aged from 20 to 24 rose from 1.8% to 2.4% and 0.5% to 1% for men.[3]

A study conducted in two rural district hospital catchment areas in Rwanda showed that only 58% had good appointment keeping.[5] In addition, only 87% had suppressed their viral load in the past 30 days and 95% had suppressed their viral load in three days prior to the interview day. Poverty, stigma and lack of parents were the underlying factors to poor viral load suppression among adolescents.[4]

From the Health Management Information System (HMIS), viral load suppression rate in Ngororero was only 5% among under 15years of age, and 60% among those above 15years in 2018. According to HMIS, in 2019, the viral load suppression among children (under 15 years) and adults above 15 were 30% and 69% respectively. There was a need to study the factors that are negatively or positively associated with viral load suppression among adolescents and young adults living with HIV in Ngororero district. This study aimed at informing the HIV control programme about the barriers to viral load suppression among adolescents and young adults living with HIV in Ngororero district and determinants for improved viral load suppression.

Methods

Study design
This was a cross sectional study, and it assessed the predictors of viral load suppression among adolescents and young adults living with HIV on ART in the catchment area of Kabaya District Hospital (DH) from 2015 to 2019. It included all the 151 HIV positive adolescents (15 to 19 years old) and young adults (20 to 24 years Old) who were enrolled in HIV services and on ART for at least 18 months in one of public health institution in the catchment area of Kabaya DH. The participant's viral load had been recorded in their medical files. We chose 18 months because when an HIV positive person starts ART, viral load test is taken after 6 months, then every year. Therefore, at least two viral load test results were expected for every participant for analysis.

It was a quantitative research with a face-to-face interview by means of a structured and previously tested questionnaire. The questionnaire was made using the information from several reviewed literature. The questionnaire was made in Epi info version 7 and put in the smart phones of data collectors (the nurses in ART services at health facilities). The questionnaire was made by the close-ended question addressed to the participants.

Study population and sample size
The study population included all people living with HIV on ARV aged 15 to 24 years, followed up at Kabaya District Hospital or at Health centers in its catchment area. After the file review, eligible people for

participation were 151 and no one was removed from the study given their limited number, to increase the power of the study.

Inclusion and exclusion criteria
The inclusion criteria for this study were any adolescent or young adult who is HIV positive and registered at one of the public health facility HIV department in Kabaya District Hospital catchment area. To be included in the study, the eligible person were supposed to be on ART for at least 18 months so that it could be easy to have at least two viral load results for every participant.

The exclusion criteria included any adolescent or young adult who is HIV positive but not registered in one of the public health facilities located in Kabaya District Hospital catchment area or who had not yet spent at least 18 months on ART because it cannot be possible to find at least two viral load results for the participant.

Study variables
The outcome variable for this study was viral load suppression. Any adolescent or young adult with a good viral load suppression (less than 200 copies per milliliter) was considered as having a good adherence. Any adolescent or young adult with poor viral load suppression (>=200 copies per milliliter) was considered as having a poor adherence.[6]

The independent variables included socio-demographic characteristics like age, sex, education, religion, having biological parents, the fact of living with their biological parents, geographic distance from the health facility where they go for follow up, means of transport to the Health facility, ubudehe category of the patient's family, who they live with, and others.

Medication related factors also were collected such as pill burden to know if the participant had ever felt annoyed by taking pills, pill taste to know if they had issues with their pills taste,

knowing if they ever experienced drug toxicity and resistance, if they sometimes forgot to take their medication. We were also interested in knowing what they felt about the number of pills they take, the daily administration, if they ever faced the interaction of ARVs and any other drugs they may have been taking, and the length of their treatment.

Information about health care delivery system related factors also were collected and included: poor knowledge about HIV, poorly processed disclosure, dissatisfaction with health care facility, dissatisfaction with health care workers, patient provider relationship, health information education services, availability of counselling services, provision of privacy, and distance from home to health facility.

We also collected information related to social and environmental factors, like secrecy (stigma), living conditions, poverty, school attendance, financial problems, and structural social support.

Among the independent variables, clinical characteristics were included like the date of diagnosis, the date of enrollment in HIV program, date of initiation to ART, CD4 count at the beginning of the treatment, and opportunistic infections.

Data collection, storage & analysis
Data were collected from the interviewee into the Epi Info then exported to STATA version 15 for analysis. The information from the interviewee was guided by the questionnaire with close-ended questions. Data were collected not only through the guided interview but also through the review of participants' medical files, as some information could be found there.

Both descriptive and analytical methods were used in data processing. Univariate analysis (descriptive) was performed to describe the socio-demographic characteristics of the participants. The determinants of viral load suppression among young adults and adolescents living with HIV were

determined using a logistic regression that was performed for statistically significant variables from the bivariate analysis.

Statistical tests used

A 95% Confidence Interval (CI) (0.05 level of significance), frequencies, adjusted odds ratio and P-values were produced by using STATA version 15. Univariate analysis was used to describe the variables, and bivariate analysis was employed to test for associations of independent variables and the dependent variable. The variables with a P value less than 0.05 were subjected to multiple logistic regression analysis for crude odds ratio. Statistically significant variables at P value less than 0.05 were finally run in a reduced model for adjusted odds ratios, confidence intervals and P values. After the reduced model, the variables with significant P-value and confidence intervals were interpreted accordingly.

Ethical consideration

To conduct this study, the proposal was presented to the institutional review board (IRB) of the University of Rwanda, college of medicine and health sciences. Ethical clearance N°147/CMHS-IRB/2021 was provided.

For using data from ART departments, we sought permission from Kabaya District Hospital. Also, prior to the interview, an informed consent form was signed by all study participants who were 18 years and above and by care givers/parents for those who were less than 18 at every health center. Those who were aged less than 18 years signed an assent form in addition to the consent form signed by their care givers. To ensure confidentiality, each study participant was assigned a unique patient identifier (UPID) instead of using their names. Highest standards of confidentiality, quality assurance and control were maintained from data collection up to report dissemination.

Results

As illustrated in Figure 1, 189 participants were expected according to the Health Information Management System (HMIS), however due to facts like being away in boarding schools, being a casual worker in different towns or being completely unreachable only 151individuals could be reached and participated in this study.
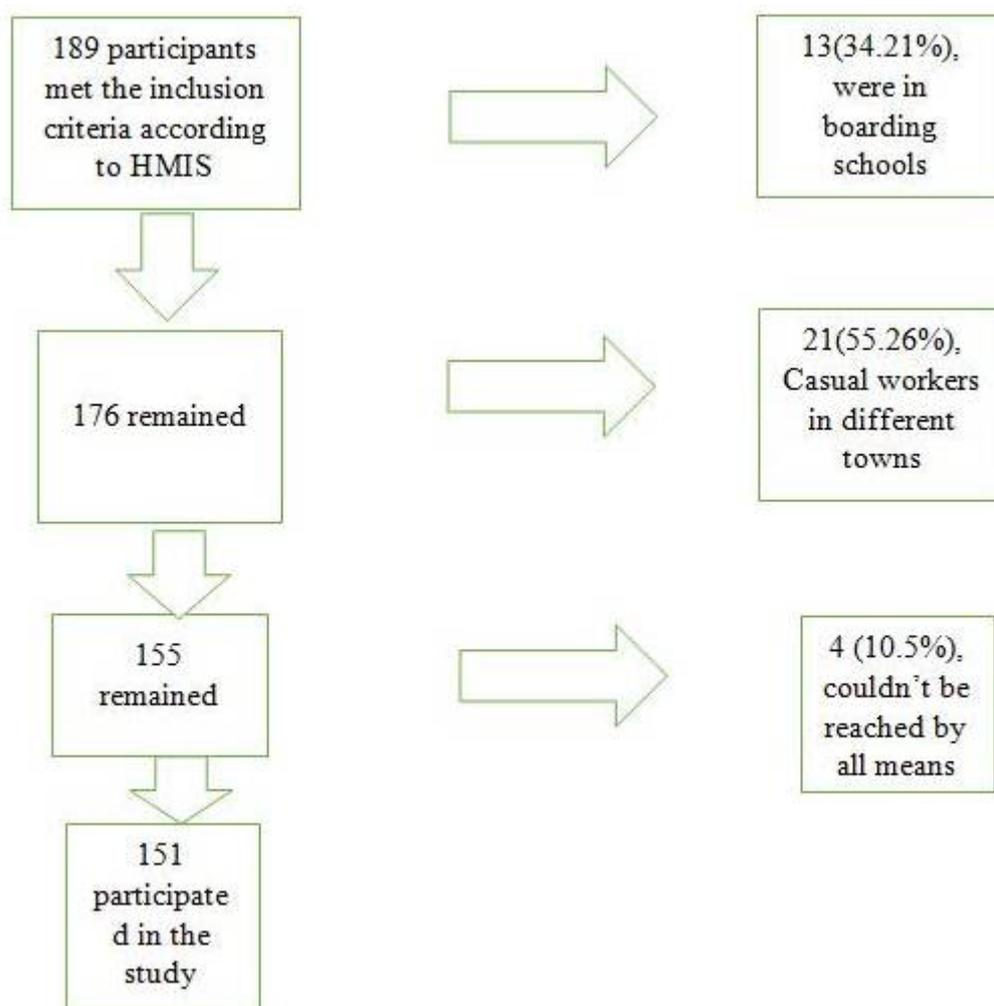
189 participants met the inclusion criteria according to HMIS

13(34.21%), were in boarding schools

176 remained

21(55.26%), Casual workers in different towns

155 remained

4 (10.5%), couldn't be reached by all means

151 participated in the study

Figure 1. Flow diagram of selection of study participants

Characteristics and undetectable viral load

After the descriptive analysis, the study included 103 (68%) of females and 48 (32%) of males. Among participants, 60 (40%) were in age group of 15 to 19 years while 91 (60%) were in age group of 20 to 24 years. Among participants, 121 (80%) were single while 30 (20%) were married or cohabiting.

We saw that 37 (24.5%) were experiencing stigma and 114 (76%) were not supported by people they live with. Among participants, 10 (7%) were not comfortable with the number of pills and 31 (20.54% were having a negative perception towards the whole life treatment. The analysis showed that the rate viral load suppression was 51 (34%). Table 1

Table 1.Participants'characteristics and undetectable viral load

Variable	Participants characteristics		Undetectable viral load	
	n	%	n	%
Gender				
Female	103	68.2	33	32.0
Male	48	31.8	18	37.5
Age group				
15-19 years	60	39.7	17	28.3
20-24 years	91	60.3	34	37.4
Education				
none	25	16.6	11	44.0
primary	99	65.6	34	34.3
secondary	27	17.9	6	22.2
Occupation				
employed/farmer	78	51.7	25	32.1
student	38	25.2	9	23.7
unemployed	35	23.2	17	48.6
Ubudehe Category				
category 1	40	26.5	7	17.5
category 2	34	22.5	15	55.1
category 3	77	51.0	29	37.7
Time on ART(n=124)				
below 2 years	39	31.5	20	51.3
2-5 years	25	20.2	12	48.0
5-9 years	17	13.7	2	11.7
10 + years	43	34.7	13	30.2
Working distance(n=149)				
< 2 km	45	30.2	14	31.1
2-4 Km	71	47.7	25	35.2
5+ Km	33	22.2	12	36.4
Living with parents				
no	64	42.4	32	66.4
yes	87	57.6	29	33.3
Live with PLHIV at home				
yes	84	55.6	28	33.3
no	67	44.4	23	34.3
Perception toward the taking ARVs: Pill is a burden				
yes	31	20.5	9	29.0
no	120	79.5	42	35.0
Have issue with the pill taste				
yes	31	20.5	5	16.1
no	120	79.5	46	38.3

Bivariate analysis

According to the bivariate analysis (Table 2), participants in Ubudehe Category 2, AOR = 3.7, CI [1.29,10.74], were 3.7 times more likely to suppress viral load than those in Ubudehe Category 1, and those in Ubudehe Category 3, AOR = 2.8,CI[1.12, 7.27], were found to be 2.8 times more likely to suppress viral load than those in Ubudehe Category 1. Participants who had spent five to nine years on ART,AOR = 0.13,CI [0.02, 0.63], were 0.13 times likely to suppress viral load than those who had spent less than two years; those who had issues with pill taste, AOR = 0.31,CI [0.11, 0.86],were 0.31 times likely to suppress viral load than those who did not have issues with pill taste; while those who often forgot to take medication, AOR = 0.32, CI[0.14, 0.73], were 0.32 likely to suppress viral load than those who did not, and those who experienced scheduling issues, AOR = 0.17,CI [0.04, 0.78], were 0.17times likely to suppress viral load than those who did not experience scheduling issues.

Table 2. Bivariate analysis

Variable	OR	95% Confidence Interval
Age category		
15-19	1.00	
20-24	1.51	[0.75, 3.05]
Gender		
Female	1.00	
Male	1.27	[0.62, 2.60]
Marital status		
Single	1.00	
Married/cohabitating	1.40	[0.61, 3.19]
Education		
None	1.00	
Primary	0.66	[0.27,1.62]
Secondary	0.36	[0.11, 1.21]
Occupation		
Farmer	0.94	[0.08,10.90]
Student	0.62	[0.05 ,7.67]
Unemployed	1.89	[0.16 ,22.79]
Ubudehe Category		
category 1	1.00	
category 2	3.72*	[1.29, 10.74]
category 3	2.84*	[1.12, 7.27]
Time on ART		
below 2 years	1.00	
2-5 years	0.87	[0.32, 2.39]
5-9 years	0.13*	[0.02, 0.63]
10 + years	0.41	[0.16, 1.02]
Working distance		
< 2 km	1.00	
2-4 Km	1.2	[0.54, 2.67]
5+ Km	1.26	[0.49, 3.27]
Living with parents		
No	1	
Yes	0.96	[0.48 1.88]
Have issue with the pill taste (ref: no)	0.31*	[0.11, 0.86]
Often forget to take medication (ref: no)	0.32**	[0.14, 0.73]
Experience scheduling issue (ref: no)	0.17*	[0.04, 0.78]

*P-value < 0.05, ** P-value <0.01

Multivariable analysis

In the multivariate analysis, participants belonging in Ubudehe category 2 and 3 were seen to be 6.6 and 8.9 times more likely to suppress viral load respectively compared to those in Ubudehe Category1.

Participants who had spent five to nine years on ART were 0.16 times likely to have suppressed viral load in comparison with those who had spent less than 2 years. Those who often forgot to take medication were 0.35 times likely to suppress viral load than those who did not forget (Table 3).

Table 3.Multivariable analysis

Variable	AOR	95% Confidence Interval
Ubudehe Category		
category 1	1.00	
category 2	6.6*	1.40, 31.1
category 3	8.9*	2.01,39.8
Time on ART		
below 2 years	1.00	
2-5 years	1.14	0.38, 3.41
5-9 years	0.16*	0.03, 0.89
10 + years	0.49	0.19, 1.31
Have issue with the pill taste (ref: no)	0.65	0.18, 2.30
Often forget to take medication (ref: no)	0.35*	0.13, 0.97
Experience scheduling issue (ref: no)	0.84	0.12, 5.69

*P value < 0.05

Discussion

This study aimed at assessing the predictors of viral load suppression among adolescents and young adults living with HIV in Ngororero district (catchment area of Kabaya District Hospital (DH). Our specific objectives were to assess the status of viral load suppression among young adults and adolescent on ART treatment and to investigate factors that improve or hinder the viral load suppression among young adults and adolescents on ART treatment.

The majority of our study participant were female (68%), we think this is due to the fact that among all PLWHIV in Ngororero, there are more female than male; and our findings are similar with the characteristics of the sample of the study on determinant of viral load suppression among adolescent in Ehlanzeni District in South Africa, by Emeka F.Okonji which had 55.43% of female.[6] The rate of viral load suppression(<200 copies per millilitre) among our participants was 51(34%), however, a study on factors associated with viral load suppression among adolescent in Homa Bay County in Kenya by Anne Mwangi found that 80% of their participants had viral load suppression(<1000 copies per milliliter).[7]

Our study findings showed that Ubudehe Category on ART was associated with viral load suppression among young adults and adolescents in Ngororero. We think that this is because those in Ubudehe Category 2 and 3 who are relatively richer than those in Ubudehe Category 1 could have access to life's primary needs like food and clean water, which may help them take well their ARVs. Spending 5 to 9 years and often forgetting to take medication were found to hinder viral load suppression. The possible explanation for this may be the fact that as they take ARVs for a long time they feel healthier and fall into laxity in taking their medication as recommended.

Different studies have had similar findings like, among which is a study in Ethiopia on socio-economic conditions and poor

viral load suppression among adults and adolescents receiving anti-retroviral therapy, in which it was found out that those who were poor and those with suboptimal wealth conditions were 3.14 and 3.32 times more likely to suppress than those with excellent wealth conditions respectively.[8]

Our findings are similar with those of a study titled incidence and factors associated with viral suppression or rebound among HIV patients on combination antiretroviral therapy in three counties in Kenya, which found that those who had spent 36 months on ART were less likely to suppress (more likely to rebound) compared to those who had spent only 6 months on ART. This Kenyan study also found that adherence was associated with viral load suppression, a finding that supports ours that often forgetting to take medication hinders viral load suppression.[9] Furthermore, a study on viral load non-suppression among adolescents in Mbale district, rural eastern Uganda, had similar findings as ours, that spending above 5 years on ART was associated with viral load non-suppression.[10]

Study Limitation

Among the limitation, we may site that our study was conducted at Ngororero district only, while the adolescents and young adults living with HIV in this district cannot represent those in the whole country.

Time was also a limitation because if time was in our favor we could have waited to conduct this study in the holidays so that those in boarding schools could also participate to have their version of the story. Finally, we had a challenge to face some wrong answers from respondents in front of their health care providers with whom they had a particular relationship. We had not enough choices because it is only through their healthcare provider that we could reach them as most of them did not have mobile phones

Conclusion

Viral load suppression remains primordial in the management of HIV to avoid AIDS related diseases and for PLWHIV to live a normal life. Our study aimed at assessing factors that promote or hinder viral load suppression among adolescents and young adults in Ngororero. Viral load suppression among adolescents and young adults still on very low prevalence and the improved socio-economic status may contribute in its improvement. Thus, there is a need of close follow up of these adolescent and young adults so that the irregularity in taking medication may be overcome to strengthen good adherence over the period of whole life medication.HIV mentors and ART services at the district hospital level, adolescents and young adults peer educators and local authorities should work together, to educate how to improve feeding in adolescents and young adults.Further studies that cover the whole country are recommended so that the sample will be representative and better to be conducted in the holydays so that students in boarding schools can also participate.

Author contributions

AN, and FB have made a study conceptualization especially for methodology, collection of data and drafting the manuscript. JN contributed to the findings interpretation and provided the paper's intellectual content. ER and FH participated in the data analysis and gave input to the manuscript in general. AN as principal investigator, managed data collect and analysis. All authors accepted this manuscript to be submitted in this journal and are accountable for the whole content. Therefore, they accepted that this version should be published.

Conflict of interests

Authors certify that no any type relationship that can lead to the conflict of interest was involved in this study.

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