



Household-Based Factors Associated with Viral Load Suppression Among Adolescents Living with HIV in Western Kenya

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Abstract

BACKGROUND

Despite global efforts to reach a 95% viral suppression rate among people with HIV on Antiretroviral therapy (ART), progress has been slower for Adolescents living with HIV (ALHIV). Therefore, identifying the household factors associated with viral suppression among ALHIV could ensure zero HIV transmission and reduce the risk of opportunistic infections, drug resistance and AIDS.

MATERIALS AND METHODS

Using a cross-sectional survey design with a quantitative approach, data was collected from 263 adolescents during their routine clinic visits at a large HIV comprehensive care clinic namely Rafiki Center and Module 4 clinic based at Academic Model Providing Access to Healthcare (AMPATH). Respondents were identified using a systematic random sampling technique. A structured questionnaire was used to assess the demographic and household factors associated with viral suppression. The viral load data was obtained from the Electronic Medical Records.

RESULTS

Of the 263 adolescents, 85.6% (n=225) were virally suppressed. Participants who talked freely with caregivers/parents about HIV status (AOR=3.10, 95%CI=1.40-8.92), getting reminders from their caregivers to take ART (AOR=2.15, 95%CI=1.59-5.22) and were getting financial support to facilitate their transport to the facility (AOR=2.33, 95%CI=1.82-6.65). Additionally, those who joined a social support group (AOR=3.82, 95%CI=1.20-12.15) and who took less than 60 minutes to reach the health facility (AOR=3.16, 95%CI=1.29-7.74) had higher odds of viral suppression. Participants whose level of education was at least secondary school (AOR=6.87, 95%CI=2.40-19.64) and who lived with both parents (AOR=5.0, 95%CI=1.66-15.09) had higher odds of viral suppression. The odds of becoming virally suppressed were lower among older adolescents (AOR=0.62, 95%CI=0.47-0.82).

CONCLUSION

Viral suppression levels approached but did not meet 2030 targets. Stable living conditions, strong family relationships, communication, and social support were linked to improved viral suppression. Integrating these household factors into HIV care is crucial for enhancing viral suppression among ALHIV. Implementing family empowerment models through further studies can inform effective policy interventions.

Keywords: ART Adherence, Viral Load Suppression, Adolescents, HIV Care and Treatment, Family Support

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Introduction

Optimal adherence to anti-retroviral treatment (ART) and retention in care are essential requirements for achieving viral suppression among people living with HIV. The Joint United Nations Programme on HIV/AIDS (UNAIDS) 95-95-95 2030 strategy targets 95% of HIV-positive persons knowing their status, 95% being on anti-retroviral treatment (ART) and 95% being virally suppressed (1). Achieving viral suppression targets is necessary to not only ensure zero HIV transmission but also, reduce the risk of complications including opportunistic infections, drug resistance and AIDS (2). Viral suppression data among HIV-positive children and adolescents on ART in resource-limited settings is not readily available (3). However, available studies point to a suppression rate below 75%, way below the set 95% target (3).

Adherence to ART is crucial to attaining viral suppression (VS). Although a 95% adherence rate is an indicator of successful treatment and prevention of ART resistance, adherence levels as low as 80%, have also been linked with treatment success (2). Whereas there are many types of intervention approaches to ART adherence which in turn leads to viral suppression, there is still a lack of consensus on the effectiveness of various interventions to improve ART adherence, with some showing waning effects over time (4). It is important to understand why adolescents living with HIV may be having difficulty in achieving VS and specifically, the barriers related to adherence, and how these interventions perform among adolescents.

Globally, various obstacles to ART adherence have been identified including pill burden, forgetfulness, death of parents, lack of resources and support from adults, work and family responsibilities, challenges in disclosing HIV status, and health system delays (5). On the other hand, facilitators of ART adherence include the use of technology and tools for reminders,

uncomplicated ARV regimen, robust health support systems, strong peer and family support systems, intact family, parents' ART adherence, and adherence reward systems(5). In sub-Saharan Africa (SSA), studies have consistently shown suboptimal medication adherence, low retention in care and viral suppression among ALHIVs (6), (4). These studies have also revealed different adherence factors across contexts, with some factors acting concurrently in synergy (7). However, despite the extensive research on adherence factors, there is still no consensus on their relative contributions to viral load suppression among ALHIV in SSA.

In Kenya, it is estimated that ALHIV are about 110,000 (8) with 40% unable to achieve viral suppression (9). Though the benefits of increased ART usage are still evident in the prevention of more than 635,000 AIDS-related deaths between 2004 and 2017, there is still a need for more effective interventions targeting the group at higher risk of not adhering to ART treatment. The current study identified and explored household factors to understand potential elucidative factors for the non-achievement of 95% viral suppression goals among ALHIV in Uasin-Gishu County, Kenya.

Materials and methods

Study area

This study was conducted at AMPATH's adolescent clinics also referred to as Module 4 and Rafiki Centre clinics respectively based in Moi Teaching and Referral Hospital (MTRH), in Uasin Gishu County, Kenya. AMPATH provides HIV care to approximately 85,000 patients, with over 7500 being children and it offers one of Africa's most successful HIV prevention and treatment programs (10). Rafiki Center and Module 4 clinics provide comprehensive HIV care and treatment services to over 830 adolescents in Uasin Gishu County.

Study design

The study employed a cross-sectional study design with a quantitative approach. A



validated questionnaire was used to assess the demographic and household factors while the viral suppression data was abstracted from the Electronic Medical Records (EMR).

Study population

The study population comprised 263 consenting adolescents aged 10-19 years who were visiting Rafiki Center and Module 4 clinics for routine care. To be eligible for inclusion, these adolescents had to meet criteria such as full disclosure of their status, they should have been actively on care for at least 6 months, with available viral load records in the EMR and had consented to participate in the study. The most current viral load PCR results of the adolescents that were no more than six months old from the date of testing were considered valid.

Sample size and sampling technique

The desired sample size was calculated using the Cochran statistical formula for a population of less than 10,000 (11). Pretested questionnaires were used (Cronbach's $\alpha = 0.74$).

Adolescents were sampled using a systematic random sampling technique. Every third adolescent in the clinics for routine care was approached until the sample size was accrued. The Nth interval was determined by dividing the total population of 830 ALHIVs registered in the clinic by the sample size of 263, giving an interval of every 3rd adolescent.

Data collection instruments and procedures

A pre-test to assess the performance of the survey instruments, including the length of the interviews and the understanding of different questions by the respondents was conducted among 28 adolescents at Uasin Gishu District Hospital. Specifically, the pretest aimed at testing familiarity with the design of the instruments, evaluating potential issues entailed in the study settings, affirming the validity and reliability of the instruments and familiarising the data collection staff with the questionnaires and procedures. Data generated from the pre-test was

used to improve the instruments and processes for the main study. The outcome variable was viral suppression obtained from PCR test results that were abstracted from the facility's EMR. Viral load data was considered valid when it was within 6 months from the testing date. Viral suppression was defined as having a viral load of <200 copies/ml of blood as adopted by the program. A structured questionnaire was used to assess the demographic and household-based support data.

Research Assistants, who were peer mentors at the respective adolescent clinics conducted face-to-face interviews.

Data analysis

STATA software version 17.0 was used for statistical analyses. Descriptive statistics were used to characterize the demographic variables. Bivariate analysis was employed to determine the significance and strength of associations between the household factors and the viral suppression status. To find variables that were independently linked to viral suppression, we included the demographic characteristics in the multivariate logistic regression model to reduce the possibility of their confounding effect on viral suppression. Adjusted odds ratios (AOR) along with corresponding 95% confidence intervals and *p-values* were computed.

Ethical considerations

Ethical approval to conduct the study was sought from and granted by the MTRH/Moi University (MU) - Institutional Research and Ethics Committee [IREC/349/2022], the Moi Teaching and Referral Hospital [ELD/MTRH/R&P/10/2/V.2/2010] and the Board of Postgraduate Studies at Jaramogi Oginga Odinga University of Science and Technology (JOOUST) [JOOUST/DVC-RIO/ERC/E4]. Permission to conduct the study was granted by the National Commission for Science, Technology & Innovation (NACOSTI) [NACOSTI/P/23/22748] and AMPATH [RES/STUD/1/2023].



Results

Socio-demographic characteristics of the respondents and their caregivers

The median age of the study participants was 17 years (IQR, 15- 18) with an almost equal male: female ratio (n= 263) with at least 71.5% (n= 188) having attained secondary level of education. The majority (98.8%, n=260) of participants were of Christian faith. About 35.8% (n= 94) of the participants did not know their caregiver's literacy levels.

Prevalence of viral suppression among ALHIV

In Table 2, the majority of the adolescents receiving care at the Rafiki centre and Module 4 clinics (85.6%, n=225) were virally suppressed (< 200 copies/ml). Only the participant's level of education had an association with viral suppression (p-value = 0.017).

Factors associated with viral suppression

Bivariate analysis was performed to determine the association between household support and viral suppression and the results are presented in Table 3. Talking freely with the caregiver/parent, getting reminders from the caregiver to take medicine, financial support to facilitate picking of ART, joining a social support group, age, level of education, time taken to travel to facility and type of caregiver were significantly associated with viral suppression.

In multivariate analysis, participants who talked freely with caregivers/parents about HIV status (AOR=3.10, 95%CI=1.40-8.92, *p-value*= 0.042) and those who were getting reminders from their caregivers to take ART (AOR=2.15, 95% CI=1.59-5.22, *p-value*= 0.037) had higher odds of viral suppression.

Table 1:
Socio-Demographic Characteristics of the Participants

Characteristics	Frequency N	Percentage n (%)
Age		
Median (IQR) = 17 (15,18)		
Gender		
Male	124	47.1
Female	139	52.9
Religion		
Christian	260	98.8
Other	3	1.2
Participant's level of education		
None/primary	75	28.5
At least secondary	188	71.5
Caregiver's level of education		
None	10	3.8
Primary	44	16.7
Secondary	64	24.3
University/ college	51	19.4
Don't know	94	35.8
Participant's caregiver		
Both parents	107	40.7
Single parent	90	34.2
Guardian	57	21.7
Other	9	3.4



Participants who were getting financial support (AOR=2.33, 95%CI=1.82-6.65, *p-value*= 0.034) and those who joined a social support group had higher odds of being virally suppressed (AOR=3.82, 95%CI=1.20-12.15, *p-value*= 0.23).

The odds of becoming virally suppressed were lower among older adolescents (AOR=0.62, 95%CI=0.47-0.82, *p-value* =0.001). Participants who lived with both parents were 5 times more likely to be virally suppressed as compared to those who lived with single parents (AOR=5.0, 95%CI=1.66-15.09, *p-value* =0.004). About time taken by the participant to reach the facility, those who took less than 60 minutes were 3.09 times more likely to be virally suppressed as compared to those who took at least 60 minutes (AOR=3.16, 95%CI=1.29-7.74, *p-value*= 0.012). Participants whose level of education was at least secondary school were found to be 6.87 times more likely to be virally suppressed than those with Primary/no elementary education (AOR=6.87, 95%CI=2.40-19.64, *p-value* <0.001). Other factors such as mode of transport to the facility, caregivers' HIV

status and caregivers' level of education were not statistically significant.

Discussion

The study found that 85.6% of adolescents were virally suppressed. This was higher than the national prevalence of Viral suppression at 70% (12) but lower than the UNAIDS 95% viral suppression goal of people living with HIV by 2030. A nationally representative study conducted by Onyango *et al.*, (2023) across 34 counties in Kenya also obtained a relatively higher viral suppression of 85.9 % among children and adolescents living with HIV (CALHIV). Comparatively, a study conducted in Homa Bay County, a high HIV-burden region in Kenya, observed a viral suppression of 80% (13). Such high viral suppression rates across high HIV burden regions may reflect extensive efforts towards achieving the UNAIDS global target of 95% viral suppression by 2030.

Table 2:

Prevalence of Viral Suppression among Adolescents Living with HIV

	Virally suppressed n (%)	Virally not suppressed n (%)	<i>p-value</i>
Overall	225(85.6)	38(14.4)	
Gender			0.703 ^a
Male	105(46.7)	19(50.0)	
Female	120(53.3)	19(50.0)	
Participant's level of education			0.017 ^a
None/Primary	58(25.8)	17(44.7)	
At least secondary	167(74.2)	21(55.3)	
Caregiver's level of education			0.825 ^b
None	9(4.0)	1(2.6)	
Primary	36(16.0)	8(21.1)	
Secondary	54(24.0)	10(26.3)	
University/ college	46(20.4)	5(13.2)	
Don't know	80(35.6)	14(36.8)	
Age group			0.088 ^b
<15	53(23.6)	4(10.5)	
15-19	172(76.4)	34(89.5)	

^a Pearson's chi-square

^b Fisher's exact



The use of household reminders was positively associated with viral suppression. This intervention has been consistently observed in studies across Africa to be effective in improving adherence to uptake of program services. A study conducted in Nigeria similarly observed that adolescents whose caregivers had an alarm

reminder device had better suppressed viral loads (14). Evidence suggests that daily reminders such as the use of alarms help adolescents to adhere to ART. The use of alarms, just like cell phones is a popular tool for monitoring adherence to ART thus it becomes easier for ALHIV to maintain an ART schedule (15).

Table 3:
Logistic Regression for Factors Associated with Viral Load Suppression

	Not suppressed	Suppressed	Bivariate analysis OR(95%CI)	Multivariate analysis	
	N=38 n (%)	N=225 n (%)		AOR (95%CI)	p-value
Talk freely with parent/caretaker					
No	15(39.5)	28(12.4)	Ref	-	-
Yes	23(60.5)	191(84.9)	4.45(2.08-9.53)	3.10(1.74-5.91)	0.042
Sometimes	0(0.0)	6(2.7)	1.00	1.00	
Get reminders from your caregiver to take your medications					
No	15(39.5)	41(18.2)	Ref	-	-
Yes	21(55.3)	174(77.3)	3.03(1.44-6.38)	2.15(1.59-5.22)	0.037
Sometimes	2(5.3)	10(4.4)	1.83(0.36-9.33)	0.90(0.08-10.34)	0.931
Family members aware of HIV status					
No	12(31.6)	34(15.1)	Ref	-	-
Yes	25(65.8)	191(84.9)	2.70(1.74-5.88)	1.33(0.47-3.82)	0.591
Don't know	1(2.6)	0(0.0)	1.00	1.00	
Get financial support					
No	14(36.8)	34(15.1)	Ref	-	-
Yes	21(55.3)	162(72.0)	3.18(1.47-6.87)	2.33(1.82-6.65)	0.034
Sometimes	3(7.9)	29(12.9)	3.98(1.04-15.23)	3.02(0.62-14.71)	0.171
Joined social support group					
No	33(86.8)	152(67.6)	Ref	-	-
Yes	5(13.2)	73(32.4)	3.17(1.19-8.46)	3.82(1.20-12.15)	0.023
Age, median(IQR)	18(16,19)	17(15,18)	0.75(0.63-0.91)	0.62(0.47-0.82)	0.001
Level of education					
None/Primary	58(77.3)	17(22.7)	Ref	-	-
At least secondary	167(88.8)	21(11.2)	2.33(1.15-4.73)	6.87(2.40-19.64)	<0.001
Time to facility					
0-60 minutes	160(88.9)	20(11.1)	2.22(1.10-4.46)	3.16(1.29-7.74)	0.012
>60 minutes	65(78.3)	18(21.7)	Ref		
Caregiver					
Single parent	75(82.4)	16(17.6)	Ref	-	-
Both parents	102(92.7)	8(7.3)	2.72(1.11-6.69)	5.0(1.66-15.09)	0.004
Guardian	39(73.6)	14(26.4)	0.59(0.26-1.34)	1.77(0.61-5.20)	0.296
Other	9(100.0)	0(0.0)	1.00	1.00	

KEY: OR-odds ratio; AOR-adjusted odds ratio; CI-Confidence interval; IQR-Interquartile range; HIV-human immunodeficiency virus; Ref-Reference category



Similarly, the importance of family support through the use of repeated reminders has been shown to help adolescents stick to their treatment plans, foster optimism and enhance healthy behaviour (16). This finding is important because it addresses ‘forgetting to take medication’ shown to be a major barrier to good adherence among adolescents in various studies (17). Participants may not take their medication because of forgetting. To eliminate this, participants can use several methods as a reminder to take medications such as the use of alarms or mobile phones (15).

The type of caregiver was significantly associated with viral suppression. A recent systematic review showed that living with a relative who was not the biological parent was observed to reduce the odds of viral suppression (18). Additionally, a study conducted in Jamaica reported that adolescents who had parents as the primary caregivers were likely to have higher adherence levels as compared to those who stayed with relatives (5), and this is further supported by another study which was conducted in Cambodia (19). Parental support, family togetherness, information sharing and emotional support have all been reported to improve adolescents' behaviour toward taking medication (20). Caregivers are the key mediators of adherence among ALHIVs yet, their impact may vary considerably across the context of care and disease conditions, signaling the need to further explore this household-level phenomenon.

Joining a social support group was positively associated with viral suppression. This finding is consistent with a systematic review (18) and a study conducted in South West Uganda (21) which found a significant association between viral load and social support group. Peer support groups have been observed as one of the successful methods for improving ART adherence and ultimately, viral suppression as it scales up the uptake of health services by adolescents. Peer supporters and social workers

who provide psychosocial support to adolescents can be used to keep them in care to improve ART adherence which results in viral suppression (21). Additionally, support groups allow the exchange of coping strategies and create bonds between members and this is important for building self-perceived health status. Family, caregivers for young people living with HIV and support groups can be essential to ensure better adherence and prognosis, resulting in viral suppression and improved quality of life (18).

Notably, younger adolescents were likely to be virally suppressed. A study conducted at Kenyatta National Hospital in Kenya showed that adolescents (10-14 years) were more likely to be virally suppressed compared to those 15-19 years (22). In contrast, several studies conducted in different parts of Africa and other regions report younger age to be associated with poor adherence (23), (13). Whereas this issue was not further interrogated, different factors could explain the high viral suppression rate in the younger age group including methodological issues; and process of care such as close monitoring by their parents or caregivers to ensure they rarely miss their ART intake and visits to the health facilities for routine reviews and intervention (22). Viral non-suppression among older adolescents could be associated with the period of transition from child care to adult ART care from the age of 14 years (24) and the fact that they may decide to not take the medication in a fight for autonomy or when in high school (25). As a result, transitioning adolescents are at higher risk of discontinuation of or irregular access to ART (7). This necessitates the need for a more comprehensive approach designed to assess and improve adherence and VS among these older adolescents. Data from the current study have generated important household factors that contribute to better viral suppression outcomes.

A higher level of education was positively associated with viral suppression among the adolescents. A study conducted in the



Netherlands by Weijnsfeld and colleagues (26) linked lower education levels to suboptimal virological outcomes. Lower levels of education may lead to a lower comprehension of the HIV infection itself and the ART. Thus, adolescents are more likely to irregularly utilize ART, leading to poor adherence, which may contribute to virological failure (18). Living close to the facility as well as financial support were significantly associated with viral suppression. Psychological and economic theories show that financial motivation can promote care engagement, consistent with the current study finding of effectiveness in enabling adherence to ART and viral suppression (27). Young adults may encounter difficulties in covering the expenses associated with accessing HIV-related care, such as covering regular transportation costs to reach HIV facilities for ARV medication refills. Some resort to undertaking strenuous manual labour jobs to afford the ongoing costs of care. In extreme cases, certain adolescents delay taking their medication until they can afford transportation expenses (28). Studies conducted in Ethiopia (7) and Uganda (21) among young adolescents receiving ART, similarly observed better ART adherence outcomes among those living near a treatment centre compared to those who walked longer distances, the latter group were likely to miss appointments. Whereas geographic access to health facilities is important, maximizing service delivery function along the entire care cascade for ALHIVs is critical given that service use and delivery effectiveness are contingent on multiple factors acting differentially across levels (17), (29).

Conclusion

The viral suppression level was relatively high in this group. The findings highlight stable living family relationships, communication among family members, and social support as key household factors that significantly accounted for better improvement of viral suppression. Therefore, the programmatic interventions should

integrate these household-level factors into HIV care and treatment to improve viral suppression among ALHIV. Additionally, implementation studies should be explored to include family empowerment models for effective policy interventions.

Limitations of the study

This study was conducted in the context of a well-resourced HIV care and treatment program different from the public health care system. Additionally, it was conducted in a high-volume facility covering wide catchment areas but located in an urban setting. Hence, the findings may not reflect on the situation in the rural settings. Thirdly, this study estimated VS only among ALHIV who had received treatment for at least six months from initiation and may not be extrapolated to all ALHIV in the country. However, the study findings reflect what would be expected in an ideal treatment and care program and may only be generalizable to similar contexts. Future implementation research studies should focus on a public health care system to explore appropriate models for scale-up.

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Conflict of interest. None declared.

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