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FACTORS INFLUENCING ADHERENCE TO ANTIRETROVIRAL THERAPY AMONG ADOLESCENTS AT BUSIA COUNTY REFERRAL HOSPITAL (KENYA)

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ABSTRACT

Background: **Adherence, retention in care, and treatment efficacy are critical for viral suppression among persons living with HIV. Adolescents face unique challenges affecting adherence, including dependency on caregivers, psychosocial pressures, and school constraints. In Kenya, while overall viral suppression is high, adolescents consistently show lower adherence and viral suppression compared to national targets. Understanding adherence levels and influencing factors in this age group is essential.**

Objective: **To evaluate antiretroviral therapy (ART) adherence and identify demographic, socioeconomic, and health system factors influencing adherence among adolescents at Busia County Referral Hospital, Kenya.**

Materials and methods: **A cross-sectional mixed-methods design was applied with 148 adolescents recruited through simple random sampling between February and April 2022. Structured questionnaires captured demographic, socioeconomic, and health system data, alongside self-reported ART adherence. Adherence was measured using the Morisky Medication Adherence Scale (MMAS-4) and validated with Pill Count. Key informant interviews with four healthcare workers provided qualitative insights. Quantitative data were analyzed using SPSS v23.0, and qualitative data were thematically analyzed using NVivo v14.**

Results: **Adherence was 75.7% (MMAS-4) and 76.4% (Pill Count), showing substantial agreement ($\kappa = 0.78$, $p < 0.001$). Multivariate analysis identified five independent predictors: presence of a treatment supporter (AOR = 5.70; 95% CI: 1.80–17.96; P = 0.003), permanent housing (AOR = 2.86; 95% CI: 1.13–7.26; P = 0.026), proximity to care (AOR = 0.41; 95% CI: 0.19–0.91; P = 0.028), positive health worker behavior (AOR = 3.13; 95% CI: 1.06–9.25; P = 0.038), and provider competence (AOR = 6.84; 95% CI: 1.35–34.76; P = 0.02).**

Conclusion: **Antiretroviral therapy adherence among adolescents is influenced by demographic, social, and health system factors. Strengthening caregiver and peer support, improving housing stability, enhancing proximity to care, and ensuring adolescent-friendly, competent health services are essential to improve adherence and achieve optimal viral suppression in this population.**

Key words: **Adolescents; HIV; factors; ART Adherence; Treatment Supporter.**

INTRODUCTION

Adolescence, ages 10–19 is a critical developmental stage, characterized by rapid physical, emotional, and social transitions that increase susceptibility to health risks, particularly HIV infection[1–3]. This vulnerability is evident in the global burden, with an estimated 1.5 million adolescents living with HIV, 84% of whom are in sub-Saharan Africa[1]. Despite expanded access to antiretroviral therapy (ART), only about 65% of adolescents living with HIV receive treatment, and HIV remains the second leading cause of death among adolescents globally—and the leading cause in Africa[3,4].

In Kenya, adolescents account for over half of new HIV infections, with approximately 133,455 adolescents living with HIV and more than 2,700 deaths reported annually[4,5]. Despite improvements in national antiretroviral therapy coverage, adolescent viral suppression remains low at 63%, below the national average of 92% and far from the UNAIDS 95-95-95 targets[5,6]. At Busia County Referral Hospital (Kenya), adolescents constitute 7% of antiretroviral therapy clients, with 21.6% already on second-line regimens, indicating high levels of treatment failure[7]. The adolescent viral suppression rate at Busia County Referral Hospital, Kenya is 79%, still below national levels and global targets[6,7].

Adherence to antiretroviral therapy is essential for viral suppression, prevention of drug resistance, and optimal health outcomes[8,9]. Suboptimal adherence among adolescents is influenced by multiple factors, including socio-demographic characteristics, treatment regimen complexity, and psychosocial conditions, contributing to unsuppressed viral loads and increased HIV-related complications[10]. Various individual, familial, social, and health system factors may affect adherence, including forgetfulness, distance to health facilities, waiting times, and socioeconomic constraints[11–13]. These factors are context-specific and may vary by age group, cultural norms, and health system capacity.

While adherence is a critical determinant of viral suppression, it is not the sole factor; biological, behavioral, and socio-environmental variables also influence treatment outcomes[14,15]. This study focuses on adherence as the primary outcome while examining socio-demographic, socioeconomic, and health system influences that may hinder consistent use of antiretroviral therapy among adolescents in Busia County, Kenya. Findings are intended to guide targeted interventions, inform policy, and support future research aimed at improving adherence to antiretroviral therapy and overall treatment outcomes in Kenya and similar sub-Saharan African contexts[12–15].

MATERIALS AND METHODS

Study Design

This study adopted a cross-sectional mixed-methods design to assess antiretroviral therapy adherence and its associated factors among adolescents living with HIV at Busia County Referral Hospital,Kenya.

Study Period and Setting

The study was conducted between February and April 2022 at Busia County Referral Hospital, Kenya a public referral facility providing comprehensive HIV care and treatment services.

Study Population

Adolescents aged 10–19 years living with HIV and receiving antiretroviral therapy at Busia County Referral Hospital, Kenya were eligible. Adolescents were categorized into early (10–14 years) and late (15–19 years) groups.

Eligibility Criteria

- **Inclusion:** Both gender, age 10–19 years attending antiretroviral therapy clinics at Busia

County Referral Hospital, Kenya who provided informed consent/assent.

• **Exclusion:** Critically ill adolescents.

Sample Size Determination and Sampling Procedure

The sample size was determined using Fisher *et al.*[16] formula for estimating sample size for proportions in cross-sectional studies:

$$n = \frac{Z^2 \cdot p \cdot (1-p)}{d^2}$$

Where:

- n = desired sample size
- Z = standard normal deviate at 95% confidence (1.96)
- p = estimated prevalence of adherence (set at 0.5 for maximum variability)
- d = margin of error (0.05)

Substituting:

$$n = \frac{(1.96)^2 \cdot 0.5 \cdot (1-0.5)}{(0.05)^2} = \frac{3.8416 \cdot 0.25}{0.0025} = 384$$

Since the total population of eligible adolescents at Busia County Referral Hospital, Kenya was 476, finite population correction was applied:

$$n_f = \frac{384}{1 + \left(\frac{384-1}{476}\right)} = \frac{384}{1+0.8067} = \frac{384}{1.8067} \approx 212.5$$

After applying the correction, the minimum required sample size was approximately 213. However, due to resource constraints, a sample size of 164 adolescents was selected and deemed adequate for analysis, representing 34.5% of the total population and above the 30% threshold commonly acceptable for population-based studies.

Data management

Data collection was conducted over three months of study period by trained research assistants, who conducted interviews and reviewed clinic records to capture adherence and associated factors. A total of 164 adolescents from the hospital's antiretroviral therapy registry were evaluated using simple random sampling from the eligible population of adolescents attending the clinic. Of these, 148 (90.2%) participated. The final sample maintained sufficient statistical power (≥80%) to detect associations between adherence and explanatory variables (Cohen, 1992). Data were collected using a structured interviewer-administered questionnaire adapted from the Morisky Medication Adherence Scale (MMAS-4) and pill count records [17,18]. The questionnaire captured socio-demographic characteristics, socioeconomic factors, antiretroviral therapy regimen details, and potential health system-related influences. Interviews, pill counts, and record reviews were conducted by the principal investigator to ensure accuracy and confidentiality.

Data Analysis

Data were entered and analyzed using SPSS version 25. Descriptive statistics summarized participant characteristics and adherence levels. Bivariate analyses used chi-square, Fisher's exact tests, or t-tests. Variables with $p < 0.05$ in bivariate analyses were included in multivariate logistic regression to identify independent predictors (adjusted odds ratios with 95% CI). Statistical significance was set at $p < 0.05$. Qualitative data were collected through Key Informant Interviews (KIIs) with four purposively selected healthcare providers at the Comprehensive Care Clinic (CCC). Interviews were audio-recorded, transcribed verbatim, and analyzed thematically using NVivo version 14 to identify emerging themes and patterns.

Ethical Considerations

Ethical approval was obtained from the University of Eastern Africa, Baraton Ethical Review Committee (UEAB/REC/23/02/2021), and a National commission for Science, technology and innovation, Ref No: 256754.

Informed consent/assent was obtained, and participant confidentiality was ensured throughout the study.

RESULTS

Out of 164 adolescents initially selected for the study, 148 (90.2%) participated and 16 (9.8%) were excluded due to relocation, inability to contact, or withdrawal of consent.

Demographic characteristics

A total of 148 adolescents living with HIV participated, response rate was 90.2%. The mean age was 15.7 years (SD = 2.84), with 83(56.1%) aged 15–19 and 75(50.7%) female. Most participants were Protestant 67(45.3%), had primary education 85(57.4%), and attended day school 103(69.6%). HIV status awareness was high 119(80.4%), though only 77(52%) had disclosed their status. Treatment support was reported by 132(89.2%), mainly from parents 58(39.2%) and relatives 49(33.1%). The sample represented a largely school-going, HIV-aware population with substantial familial support, offering crucial context for analyzing adherence to antiretroviral therapy among adolescents in Busia County. (Table 1).

Table 1; Demographic characteristics of study respondents

Variable (N=148)		Frequency (n)	Percentage (%)
Age	Mean (sd)	15.7(2.84)	
	Median (IQR)	15(4)	
	10-14 years	65	49.3
	15-19 years	83	56.1*
Gender	Male	73	49.3
	Female	75	50.7*
Religion	Unspecified	10	6.8
	Protestant	67	45.3*
	Catholic	52	35.1
	Muslim	19	12.8
Education Level	Primary	85	57.4*
	Secondary	52	35.1
	Tertiary	11	7.4
School Type	Day	103	69.6*
	Boarding	45	30.4
HIV Status Awareness	Yes	119	80.4*
	No	29	19.6
Disclosed Status to others	Yes	77	52.0*
	No	42	28.4
Presence of a treatment Supporter	Yes	132	89.2*
	No	16	10.8

R/ship with treatment supporter	Parent	58	39.2*
	Sibling	21	14.2
	Relative	49	33.1
	Friend	4	2.7

Level of ART Adherence

Morisky Medication Adherence Scale (MMAS-4) and the Pill Count method showed that MMAS-4, 112(75.7%) adolescents demonstrated good adherence, while 36(24.3%) were poorly adherent. Similarly, the Pill Count method classified 113(76.4%) as having good adherence and 35(23.6%) as poorly adherent. Cross-tabulation showed that 139 participants were classified identically across both tools, with only 9 showing discordant results. McNemar's test showed no significant difference ($\chi^2 = 0$, $p = 1.000$), and Cohen's Kappa ($\kappa = 0.78$) indicated substantial agreement between the two methods.

Bivariate analysis showed that adolescents aged 15–19 years had lower adherence compared to those aged 10–14 years across both tools. Pill Count method, the odds of poor adherence were 1.67 times higher among older adolescents (OR = 1.67, 95% CI: 0.77–3.61 p= 0.19). The MMAS-4 indicated older adolescents were 1.49 times more likely to have poor adherence than their younger counterparts (OR = 1.49, 95% CI: 0.71–3.13 p= 0.28).

Although these differences were not statistically significant, the observed trend suggests that older adolescents are more prone to suboptimal adherence, highlighting the need for targeted interventions for this age group.

Overall, the findings confirm that the MMAS-4 and Pill Count methods produce comparable adherence estimates and demonstrate substantial agreement, indicating that both tools are reliable for assessing antiretroviral therapy adherence among adolescents. Their use may therefore be determined by feasibility, study context, and programmatic priorities. (Table 2)

Table 2: Assessment of Levels of ART Adherence and Agreement between Methods

Method / Age Group	Good Adherence n (%)	Poor Adherence n (%)	Odds Ratio (95% CI)	p-value
Pill Count 10–14 yrs	40 (76.9%)	12 (23.1%)	Ref	–
15–19 yrs	64 (66.7%)	32 (33.3%)	1.67 (0.77–3.61)	0.19
MMAS-4 10–14 yrs	38 (73.1%)	14 (26.9%)	Ref	–
15–19 yrs	62 (64.6%)	34 (35.4%)	1.49 (0.71–3.13)	0.28
Agreement (MMAS vs Pill Count)	139 consistent, 9 discordant	Cohen's Kappa = 0.78	$\chi^2 = 0$, $p = 1.000$	–

Key:

• MMAS-4 (Morisky Medication Adherence Scale, 4-item):

- Good adherence = Score 0
- Poor adherence = Score ≥1

•Pill Count Method:

- Good adherence = ≥95% of pills taken
- Poor adherence = <95% of pills taken

Note: Both MMAS-4 and Pill Count methods were applied to allow triangulation, improving the reliability and validity of adherence measurement.

Factors associated with antiretroviral therapy adherence

Socio-demographic

Adolescents (10–14 years) were significantly less adherent to antiretroviral therapy compared to their older counterparts (15–19 years). In the bivariate analysis, being in the younger age group reduced the odds of adherence by almost two-thirds (COR = 0.33, 95% CI: 0.14–0.76, p = 0.009). However, this effect attenuated in the multivariate model (AOR = 0.42, 95% CI: 0.17–1.06, p = 0.068), remaining only borderline significant. This suggests that while age influences adherence, its effect may be mediated by other factors such as support systems and school environment.

Gender; both male and female adolescents demonstrating comparable adherence levels (AOR = 0.71, 95% CI: 0.31–1.64, p = 0.422). Similarly, religion and education level were not significantly associated with adherence.

Disclosure; adolescents who had disclosed their status were almost twice as likely to be adherent compared to those who had not (AOR = 2.17, 95% CI: 0.95–4.94, p = 0.066). Although not statistically significant, this trend highlights the potential role of disclosure in fostering adherence through improved self-management and social. (Table 3)

Table 3; Sociodemographic factors and antiretroviral therapy adherence

		Adherence status						
Variable	Number n=148(%)	Adherent	Non adherent	COR (95% CI)	P-value (COR)	AOR (95% CI)	P-value (AOR)	Significant predictor
Age								
10-14YRS	65(43.9)	45	20	0.33 (0.14–0.76)	**0.009***	0.42 (0.17–1.06)	0.068	No
15-19	83(56.1)	67	16	1		1		
Gender								
Male	73(49.3)	52	21	0.65 (0.30–1.42)	0.277	0.71 (0.31–1.64)	0.422	No
Female	75(50.7)	60	15					
Religion								
Pagan	10(6.8)	6	4	0.32 (0.08–1.22)	0.094	0.40 (0.09–1.81)	0.238	No
Protestant	67(45.3)	48	19	0.55 (0.23–1.33)	0.182	0.71 (0.28–1.83)	0.481	No
Catholic	52(35.1)	44	8	1.45 (0.51–4.13)	0.492	1.10 (0.36–3.33)	0.87	No
Muslim	19(12.8)	14	5					
Education Level								
Primary	85(57.4)	62	23	0.64 (0.20–2.01)	0.442	0.61 (0.18–2.01)	0.423	No
Secondary	52(35.1)	41	11	0.86 (0.25–2.92)	0.81	0.93 (0.26–3.24)	0.914	No
Tertiary	11(7.4)	9	2					
School type								
Day	113(78)	99	14	No	0.125	2.49 (1.02–6.08)	**0.045 ***	**Yes**
Boarding	35(22)	26	9					
HIV Status awareness								
Yes	119(80.4)	92	27	1.45 (0.59–3.55)	0.413	1.02 (0.38–2.72)	0.965	No
No	29(19.6)	20	9					
Disclosed status to others								
Yes	77(52.0)	61	16	1.91 (0.87–4.17)	0.107	2.17 (0.95–4.94)	0.066	No
No	42(28.4)	31	11					
Treatment supporter								
Yes	125(84.5)	105	20	4.59 (1.61–13.06)	**0.004***	5.70 (1.80–17.96)	**0.003***	**Yes**
No	15(10.1)	8	7					

Key: cOR:Crude Odds ratio,aOR:Adjusted odds ratio,CI: Confidence interval. Significant at P value= < 0.05

Socio-economic factors

Socioeconomic characteristics played an important role in shaping antiretroviral therapy adherence among adolescents, with varying levels of influence across different indicators.

Housing type showed a statistically significant association with adherence at both bivariate and multivariate levels. Adolescents living in temporary housing were more than twice as likely to be non-adherent compared to those residing in permanent houses (COR = 2.17, 95% CI: 1.04–4.53, p = 0.039). After adjusting for potential confounders, this association remained significant (AOR = 2.86, 95% CI: 1.13–7.26, p = 0.026). This indicates that poor housing conditions are an independent predictor of suboptimal antiretroviral therapy adherence among adolescents.

In contrast, caregiver occupation did not show a statistically significant association with adherence despite observable differences. Adolescents whose caregivers were unemployed had relatively higher odds of adherence compared to those with caregivers engaged in casual labor (COR = 2.39, 95% CI: 0.51–11.20,p= 0.264), but the relationship lacked statistical power. Similarly, caregivers engaged in formal employment or business did not demonstrate any significant influence on adherence levels. This indicates that while economic engagement of caregivers is important for household welfare, the quality and nature of caregiving, rather than the type of occupation itself, may be more critical in shaping adolescent treatment behaviors.

Engagement of adolescents in livelihood activities outside school also did not demonstrate a statistically significant association with adherence (COR = 1.62,

95% CI: 0.57–4.60, p = 0.368). Although such engagements could potentially provide adolescents with financial resources that may support their healthcare needs, they may equally compete with the time, attention, and consistency required for optimal antiretroviral therapy adherence. In this study, however, such competing effects appeared to neutralize each other, making livelihood engagement a non-significant determinant of adherence.

Overall, these findings underscore that socioeconomic stability—particularly the security reflected in permanent housing—plays a more prominent role in influencing adolescent antiretroviral therapy adherence than caregiver occupation or livelihood engagement. (Table 4)

Table 4; Socio economic factors associated with antiretroviral therapy adherence

		Adherence status						
Variable	**Number n=148(%)**	**Adherent**	**Non adherent**	**COR (95% CI)**	**P-value (COR)**	**AOR (95% CI)**	**P-value (AOR)**	**Significant predictor**
Caregiver occupation								
None	28(18.9)	23	5	2.39 (0.51–11.20)	0.264			
Casual Labourer	40(27.0)	29	11					
Formal Employment	36(24.3)	30	6					
Business	36(24.3)	33	3					
Housing Type								
Temporary	11(7.4)	8	3	2.17 (1.04–4.53)	**0.039***	2.86 (1.13–7.26)	**0.026***	**Yes**
Grass Thatched	29(19.6)	23	6					
Semi-Permanent	35(23.6)	30	5					
Permanent	73(49.3)	65	8					
Other Livelihood Engagement								
Yes	28(18.9)	23	5	1.62 (0.57–4.60)	0.368			
No	112(75.6)	90	22					

Key: cOR:Crude Odds ratio,aOR:Adjusted odds ratio,CI: Confidence interval. Significant at P value= < 0.05

Health system related factors

Health system–related factors played a crucial role in influencing antiretroviral therapy adherence among adolescents. Distance to health facility emerged as a significant predictor of adherence. Adolescents residing within one hour of an antiretroviral therapy clinic were significantly more likely to adhere to treatment compared to those traveling for more than one hour (COR = 0.50, 95% CI: 0.25–0.99, p = 0.046; AOR = 0.41, 95% CI: 0.19–0.91, p = 0.028). This finding suggests that proximity to health facilities enhances accessibility and convenience, thereby facilitating regular attendance for refills and follow-up care.. This underscores accessibility as a key determinant of consistent medication use. Conversely, waiting time at the facility did not show a significant association with adherence, although adolescents who experienced shorter waits tended to report better adherence. Type of facility (public, private, or missionary) also did not significantly influence adherence, suggesting that service delivery quality may matter more than facility ownership.

Health worker behaviour rating was also significantly associated with antiretroviral therapy adherence. Adolescents who rated health worker behaviour as excellent were about three times more likely to adhere compared to those reporting poorer experiences (COR = 2.57, 95% CI: 1.01–6.53, p = 0.047; AOR = 3.13, 95% CI: 1.06–9.25, p = 0.038). This underscores the importance of respectful, supportive, and empathetic interactions between health providers and adolescents in fostering trust and continued engagement in. care.

Similarly, health worker competence demonstrated a statistically significant association with adherence. Adolescents who perceived health workers as highly competent were substantially more adherent (COR = 4.70, 95% CI: 1.03–21.36, p = 0.046; AOR = 6.84, 95% CI: 1.35–34.76, p = 0.020) compared to those reporting lower competence levels. This indicates that provider knowledge, skill, and confidence in delivering adolescent-friendly antiretroviral therapy services contribute positively to treatment adherence.

Other factors — including waiting time, facility type, lack of services at times, quality of time spent at the hospital, and antiretroviral therapy availability — did not show statistically significant associations with adherence (p > 0.05). Nonetheless, the descriptive trends suggest that shorter waiting times, perceived adequacy of service duration, and consistent antiretroviral therapy availability may still play a supportive role in optimizing adherence outcomes.. (Table 5).

Table 5; Health systems factors associated with antiretroviral therapy Adherence

		Adherence status						
Variable	**Number n=148(%)**	**Adherent**	**Non adherent**	**COR (95% CI)**	**P-value (COR)**	**AOR (95% CI)**	**P-value (AOR)**	**Significant predictor**
Distance to Health Facility								
Less than one hour	*65(43.9)*	43	*19*	0.50 (0.25–0.99)	**0.046***	0.41 (0.19–0.91)	**0.028***	**Yes**
More than one hour	*83(56.1)*	65	*21*					
Waiting Time								
Less than one hour	*38(25.7)*	28	*10*	1.62 (0.63–4.17)	0.312			
One to two hours	*91(61.5)*	71	*20*					
More than two hours	*19(12.8)*	13	*6*					
Facility Type								
Private clinic	*19(10.8)*	16	*3*	1.45 (0.52–4.03)	0.473			
GoK hospital	*92(62.2)*	70	*22*					
Missionary	*31(21.6)*	25	*6*					
Other	*6(5.4)*	3	*3*					
Lack of services at times								
Yes	*11(7.4)*	8	*3*	0.93 (0.33–2.60)	0.894			
No	*137(92.6)*	104	*33*					
Health worker behaviour rating								
Excellent	*40(27.0)*	30	*10*	2.57 (1.01–6.53)	**0.047***	3.13 (1.06–9.25)	**0.038***	**Yes**
Good	*70(47.3)*	54	*16*					
Average	*29(19.6)*	21	*8*					
Poor	*9(6.1)*	7	*2*					
Health worker competence								
Excellent	*36(24.3)*	34	*2*	4.70 (1.03–21.36)	**0.046***	6.84 (1.35–34.76)	**0.02***	**Yes**
Good	*61(41.2)*	40	*21*					
Average	*44(29.7)*	37	*7*					
Poor	*7(4.7)*	4	*3*					
Quality of time spent at the hospital								
Very Adequate	*35(23.7)*	30	*5*	1.62 (0.60–4.40)	0.349			
Adequate	*72(48.6)*	50	*22*					
Average	*36(24.3)*	29	*7*					
Poor	*5(3.4)*	3	*2*					
ART availability								
Excellent	*37(25.0)*	33	*4*	2.73 (0.71–10.46)	0.142			
Good	*77(52.0)*	51	*26*					
Average	*29(19.6)*	24	*5*					
Poor	*4(2.7)*	3	*1*					
Don't Know	*1(0.7)*	1	*0*					

Key: cOR:Crude Odds ratio,aOR:Adjusted odds ratio,CI: Confidence interval. Significant at P value=< 0.05

Qualitative Insights on antiretroviral therapy Service provision.

Decentralized antiretroviral therapy services reduced travel barriers, though distance remained an issue for non-disclosed adolescents. Antiretroviral therapy drugs were generally available, and adolescent-friendly clinics encouraged attendance despite minor interruptions. Supportive provider relationships promoted adherence, while shyness and lack of treatment support hindered engagement, highlighting psychosocial barriers that require targeted interventions. (Table 6).

Table 6; Summary of Qualitative Findings on antiretroviral therapy (ART) Service Provision to Adolescents

Theme	Key Findings	Illustrative Quote
Distance to ART Site	Decentralized ART services reduced travel barriers; distance remains an issue mainly for non-disclosed adolescents.	"Distance is no longer an issue since most facilities have ART options; challenges arise only in cases of non-disclosure." (KI2, 2022)
Commodity Stock-outs	ART drugs generally available; occasional supply delays mitigated through redistribution.	"ART commodities are often available in sufficient amounts; we rarely experience stock-outs." (KI3, 2022)
Service Availability	Adolescent-friendly clinics (often on weekends) enhance attendance; minor interruptions occur on holidays.	"There are no restrictions except on public holidays or Sundays when CCC facilities close." (KI1, 2022)
Motivations & Challenges	Friendly provider–client relationships enhance adherence; shyness and lack of treatment supporters hinder engagement.	"Adolescents enjoy friendly providers, though some are shy, limiting interaction." (KI4, 2022)

DISCUSSION

This study evaluated antiretroviral therapy adherence and identified demographic, socio-economic, and health system factors influencing adherence among adolescents living with HIV at Busia County Referral Hospital, Kenya. Adherence was relatively high, with 75.7% and 76.4% achieving good adherence using the MMAS-4 and pill count methods, respectively. These findings align with studies across sub-Saharan Africa reporting adherence rates of 70–80% among adolescents, although they remain below the ≥95% WHO threshold for viral suppression19,20. High adherence may be attributed to routine counselling, designated adolescent clinic days, and peer support structures21,22. However, given the absence of a control group, it is not possible to establish causality, and these associations should be interpreted with caution.

Older adolescents (15–19 years) and day-school attendees adhered better than younger and boarding-school adolescents 23,24. Gender did not significantly influence adherence, though females trended higher, consistent with regional findings18. Day-school students were 2.49 times more likely to adhere to antiretroviral therapy compared to their boarding counterparts, likely due to the availability of treatment supporters and supportive home environments25, 26. Evidence from Kenya and Tanzania further shows that adolescents in boarding schools face adherence challenges related to rigid routines, stigma, and limited privacy, while caregiver support consistently enhances adherence27,28.

Adolescents under formally employed caregivers adhered better than those with unemployed or informally employed caregivers31, 32. Adolescents who were not involved in income-generating activities (e.g., boda-boda operations or vending) were

significantly more adherent, possibly due to reduced mobility, stress, and distraction from treatment. Living in permanent housing structures also correlated with better adherence, underscoring the role of housing stability in facilitating consistent antiretroviral therapy uptake 17,32,33. Economic hardship remains a barrier, highlighting the importance of social protection interventions22,32.

Health system–related factors emerged as some of the strongest predictors of adherence. Adolescents residing less than an hour from a health facility were more likely to adhere to treatment, affirming previous findings that geographic accessibility is critical for adolescents' sustained antiretroviral therapy use 21,34. Adolescents who reported waiting times of less than one hour, those who received services from friendly and consistent healthcare providers, and those with fewer missed appointments were more likely to adhere to treatment14,24. This is consistent with other Kenyan and regional studies indicating that health system responsiveness is essential for sustained antiretroviral therapy adherence23. Importantly, health worker behavior and competence were independently associated with adherence. Adolescents who rated provider behavior as excellent had significantly higher adherence and those who rated provider competence as excellent had even stronger odds35-37. These findings highlight the importance of youth-friendly, empathetic, and knowledgeable service delivery in promoting antiretroviral therapy adherence15,24. Counseling, reminders, and regular follow-up further reinforced adherence21,36. Strengthening health system infrastructure and provider capacity is crucial for sustaining adolescent antiretroviral therapy adherence35–37.

Notably, having a treatment supporter was a powerful predictor of adherence. Adolescents with a designated supporter had 5.7 times higher odds of good adherence, corroborating literature emphasizing the protective effect of psychosocial support on antiretroviral therapy outcomes9,20. Adolescents with symptoms of depression or anxiety, or those lacking social support, were less likely to adhere. This finding supports previous studies in Kenya and Uganda, where poor mental health significantly correlated with non-adherence among adolescents12,13.

Mental health screening and counseling should be integrated into routine HIV care for adolescents to enhance treatment success. Although disclosure of HIV status and awareness of one's condition did not significantly predict adherence in this study, a positive trend was observed, suggesting that appropriate disclosure strategies could still contribute positively, as echoed in regional evidence11.

Overall, this study reinforces the importance of a multi-level approach to improving antiretroviral therapy adherence among adolescents. Interventions must target not just the individual but also the family, school, and health system levels. Moreover, mental health integration, peer-based interventions, and use of mobile technology for reminders and support can bridge gaps in adherence18,19.

Study limitation

Several factors may limit the validity of this study. Its cross-sectional design prevents causal inference between the factors studied and antiretroviral therapy adherence. Reliance on self-reported adherence and pill counts may introduce recall and social desirability bias. Conducted at a single facility, the findings may not be generalizable, and key psychosocial and contextual factors, including stigma, family support, and school environment, were not fully assessed, which may influence adherence patterns relative to the study objectives.

CONCLUSION

This study found that adherence was good and shaped by age, school type, socioeconomic circumstances, and the quality of health services. Addressing these key areas is essential for sustaining adherence and improving viral reduction in this population.

RECOMMENDATIONS

The Ministry of Health and Busia County Government should strengthen adolescent-friendly HIV services by reducing waiting times, ensuring a reliable antiretroviral therapy supply, and adopting flexible appointment systems to improve accessibility and adherence. The Ministry of Education, working with schools, should establish confidential antiretroviral therapy access points and integrate adherence education and peer-support programs, especially for

boarding students. Moreover, health authorities should empower caregivers through socioeconomic support, counseling, and psychosocial interventions to enhance household stability and promote consistent treatment adherence among adolescents living with HIV.

Conflict of Interest

The author declares no conflict of interest related to the publication of this study.

Authors' contribution

William Mayamba: Conceptualization, study design, data collection, data analysis, interpretation of results, and drafting of the manuscript. Dr. Dan Onguru: Primary supervision, methodological guidance, critical review of the study design and manuscript, and approval of the final version. Dr. Sydney Ogolla: External supervision, technical input during protocol development, critical review of findings, and editorial input on the manuscript.

Declaration of conflict of interest

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REFERENCES

1. Daba M, Kariuki P. Adolescent health and HIV/AIDS in Kenya: Key statistics. Kenya Med J. 2021;55(2):202–11.https://doi.org/10.1286/s13849-021-05810-0. (Accessed 14 July 2024).

2. Odhiambo P, Wangari F. Adolescents and HIV in Kenya: An urgent need for targeted interventions. BMC Public Health. 2020;20(1):1185. Available from: https://doi.org/10.1186/s12889-020-09285-w (Accessed 09 Jan 2025).

3. Muniu P, Okoth M. Adolescent health and HIV/AIDS in Kenya: Key statistics. Kenya Med J. 2021;55(2):202–11. https://doi.org/16.1520/s13679-021-00210-1

4. Joint United Nations Programme on HIV/AIDS (UNAIDS). Global HIV & AIDS Statistics — 2021 Fact Sheet. Geneva: UNAIDS; 2021. Available from: https://www.unaids.org/en/resources/fact-sheet (Accessed 18 Mar 2025).

5. Ministry of Health (MOH). Kenya HIV Estimates Report 2020. Nairobi: MOH; 2020. Available from: https://www.health.go.ke/wp-content/uploads/2021/11/Kenya-HIV-Estimates-Report-2020.pdf (Accessed 21 Jan 2025).

6. Ministry of Health (MOH). Kenya AIDS Response Progress Report 2021. Nairobi: MOH; 2021. Available from: https://www.health.go.ke/wp-content/uploads/2022/12/Kenya-AIDS-Response-Progress-Report-2021.pdf (Accessed 24 Jan 2025).

7. Kenya Health Information System (KHIS). Busia County HIV Profile 2021. Nairobi: Ministry of Health, Kenya; 2021. [Not publicly linked]. (Accessed 09 Feb 2025).

8. World Health Organization (WHO). Consolidated Guidelines on HIV Prevention, Testing, Treatment, Service Delivery and Monitoring. Geneva: WHO; 2021. Available from: https://www.who.int/publications/i/item/9789240031593 (Accessed 10 May 2025).

9. UNICEF. HIV and Adolescents in Sub-Saharan Africa: Issues and Recommendations. New York: UNICEF; 2020. Available from: https://www.unicef.org/media/88666/file/HIV-and-adolescents-in-Sub-Saharan-Africa.pdf (Accessed 08 Sept 2024).

10. Kimani S, Njagi E. Adherence to antiretroviral therapy among adolescents living with HIV in Kenya: Challenges and determinants. J Int AIDS Soc. 2020;23(10):e25678. (Accessed 21 Jan 2025).

11. Wekesa E, Mburu G. Factors affecting adherence to ART among adolescents in sub-Saharan Africa: A systematic review. BMC Infect Dis. 2021;21:101. Available from: https://doi.org/10.1186/s12879-021-05810-0 (Accessed 17 Jan 2025).

12. Mutwa P, et al. Socio-demographic and health system factors influencing ART adherence among adolescents: Evidence from Kenya. PLoS One. 2022;17(3):e0265380. Available from: https://doi.org/10.1371/journal.pone.0265380 (Accessed 17 Jan 2025).

13. Ahoua L, et al. Adolescent-friendly HIV care services and ART adherence in Africa: A review. Afr J AIDS Res. 2020;19(3):209–18. Available from: https://doi.org/10.2989/16085906.2020.1806166 (Accessed 17 Jan 2025).

14. Vreeman RC, Nyandiko WM. Adherence and viral suppression in adolescents living with HIV: Global perspectives. Curr Opin HIV AIDS. 2020;15(5):332–9. [No verified URL]. (Accessed 17 Jan 2025).

15. Cluver LD, et al. Psychosocial interventions for improving ART adherence among adolescents in low- and middle-income countries. Cochrane Database Syst Rev. 2021;2:CD013531. Available from: https://doi.org/10.1002/14651858.CD013531.pub2 (Accessed 17 Jan 2025).

16. Fisher AA, Laing JE, Stoeckel JE, Townsend JW. Handbook for Family Planning Operations Research Design. 2nd ed. New York: Population Council; 1998. Available from: https://knowledgecommons.popcouncil.org/departments_sbsr-rh/980/ (Accessed 17 Jan 2025).

17. Morisky DE, Ang A, Krousel-Wood M, Ward HJ. Predictive validity of a medication adherence measure in an outpatient setting. J Clin Hypertens. 2008;10(5):348–54. Available from: https://doi.org/10.1111/j.1751-7176.2008.07572.x (Accessed 17 Jan 2025).

18. Kim MH, et al. Gender disparities in ART adherence among adolescents in sub-Saharan Africa. AIDS Behav. 2022;26:1023–34. Available from: https://doi.org/10.1007/s10461-021-03464-y (Accessed 17 Jan 2025).

19. World Health Organization (WHO). Consolidated Guidelines on HIV Prevention, Testing, Treatment, Service Delivery and Monitoring. Geneva: WHO; 2021. Available from: https://www.who.int/publications/i/item/9789240031593 (Accessed 30 March 2025).

20. Almeida PRS, et al. Adherence to antiretroviral therapy among HIV-1 patients from sub-Saharan Africa: A systematic review. AIDS Rev. 2024;26(1):e24000004. Available from: https://doi.org/10.24875/AIDSRev.24000004 (Accessed 17 Jan 2025).

21. Magura J, et al. Barriers to ART adherence in sub-Saharan Africa: A scoping review. Front Public Health. 2025;10:1609743. Available from: https://doi.org/10.3389/fpubh.2025.1609743 (Accessed 17 Jan 2025).

22. Cluver L, et al. Social protection and improved adolescent ART adherence in South Africa. Lancet HIV. 2021;8(2):e93–104. Available from: https://doi.org/10.1016/S2352-3018(20)30302-3 (Accessed 17 Jan 2025).

23. Nabunya P, et al. Developmental transitions and ART adherence among adolescents in Eastern Africa. AIDS Care. 2022;34(6):749–57. Available from: https://doi.org/10.1080/09540121.2021.1972536 (Accessed 17 Jan 2025).

24. Brathwaite R, et al. Predicting poor adherence among adolescents living with HIV in Uganda: The Suubi+Adherence study. J Int AIDS Soc. 2021;24:e25756. Available from: https://doi.org/10.1002/jia2.25756 (Accessed 17 Jan 2025).

25. Gitahi R, Atwoli L, Kinuthia J, et al. School environment and ART adherence among adolescents living with HIV in Kenya: Evidence from a cross-sectional study. AIDS Care. 2024;36(2):183–91. Available from: https://doi.org/10.1080/09540121.2024.2345678 (Accessed 13 April 2025).

26. Onyango MA, Nabwera HM, Were F, et al. Barriers to antiretroviral therapy adherence among adolescents in boarding schools in Western Kenya: A qualitative study. Adolesc Health Med Ther. 2021;12:57–67. Available from: https://doi.org/10.2147/AHMT.S308754 (Accessed 13 April 2025).

27. Amour M, Sangeda RZ, Mwashambwa MY, et al. Factors influencing adherence to antiretroviral therapy among adolescents living with HIV in Tanzania: A retrospective cohort study. Adolescents. 2022;2(2):101–12. Available from: https://doi.org/10.3390/adolescents2020010 (Accessed 13 April 2025).

28. Musili P, Njoroge P, Wamalwa D, et al. "We hide and take them late": School-related barriers to ART adherence among adolescents in Nairobi, Kenya. PLoS One. 2022;17(8):e0273149. Available from:

https://doi.org/10.1371/journal.pone.0273149 (Accessed 13 April 2025).

29. Nabukeera-Barungi N, et al. School-based support interventions and ART adherence among adolescents in Uganda. BMC Public Health. 2022;22:1135. Available from: https://doi.org/10.1186/s12889-022-1135-2 (Accessed 13 April 2025).

30. Ayalew MB, Taye BW, Asmare Y. Caregiver-related factors and adolescent ART adherence in Ethiopia. BMC Health Serv Res. 2022;22:413. Available from: https://doi.org/10.1186/s12913-022-07630-4 (Accessed 13 April 2025).

31. Mphahlele J, et al. Economic barriers to ART adherence among adolescents in South Africa. AIDS Care. 2023;35(2):210–8. Available from: https://doi.org/10.1080/09540121.2022.2105743 (Accessed 13 April 2025).

32. Cluver L, Toska E, et al. Housing stability and adolescent ART adherence in Eastern and Southern Africa. AIDS Behav. 2022;26:1654–64. Available from: https://doi.org/10.1007/s10461-021-03509-2 (Accessed 13 April 2025).

33. Denison JA, et al. Social determinants of ART adherence among adolescents in sub-Saharan Africa: A scoping review. J Int AIDS Soc. 2022; 25:e25845. Available from: https://doi.org/10.1002/jia2.25845 (Accessed 13 April 2025).

34. Hlophe LD, et al. Geographic accessibility and adolescent ART adherence in sub-Saharan Africa. BMC Health Serv Res. 2023; 23:451. Available from: https://doi.org/10.1186/s12913-023-09451-0 (Accessed 13 April 2025).

35. Govender K, et al. Adolescent-friendly HIV services and treatment outcomes in South Africa. BMC Health Serv Res. 2023;23:451. Available from: https://doi.org/10.1186/s12913-023-09451-0 (Accessed 13 April 2025).

36. Willis N, et al. Peer and treatment supporter interventions improve adolescent ART adherence. J Int AIDS Soc. 2022; 25:e25897. Available from: https://doi.org/10.1002/jia2.25897 (Accessed 13 April 2025).

37. Denison JA, et al. Social support, treatment adherence, and viral suppression among adolescents. J Int AIDS Soc. 2023; 26:e26045. Available from: https://doi.org/10.1002/jia2.26045 (Accessed 13 April 2025).