

Determinants of Sustained Antiretroviral Therapy Adherence and Behavioral Predictors Among Adults Living with HIV in Eastern Rwanda: Evidence from Kibungo Referral Hospital

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Abstract

Background: Consistent use of antiretroviral therapy (ART) is essential for achieving viral suppression, enhancing well-being, and lowering illness and death among individuals living with HIV. Although Rwanda has made significant strides toward meeting the UNAIDS 95-95-95 goals by providing universal access to free ART, gaps in adherence still hinder optimal treatment outcomes in certain groups. Exploring the behavioral, psychological, and health system-related factors that influence adherence is crucial for developing effective, targeted interventions. This study examined the magnitude of ART non-adherence and its associated determinants among patients receiving HIV care at Kibungo Referral Hospital in Eastern Rwanda.

Methods: A facility-based cross-sectional survey was carried out between March and April 2024 among 424 adults living with HIV who were on ART within the Kibungo Referral Hospital catchment area. Eligible participants were aged 18 years or older and had been receiving ART for a minimum of six months. A stratified random sampling approach was applied across 14 ART service sites. Information was gathered using a structured questionnaire adapted from previously validated instruments. Participant characteristics were summarized using descriptive statistics. Associations between variables were assessed using Fisher's exact test and multivariable logistic regression, with statistical significance set at $p < 0.05$ and 95% confidence intervals.

Results: Non-adherence to ART was observed in 13.0% of participants, while 87.0% maintained adequate adherence. Multivariate analysis indicated that individuals below 31 years had a significantly higher likelihood of non-adherence compared to older participants (AOR = 15.462; 95% CI: 3.462–19.748; $p = 0.020$). Participants without higher education were also more likely to be non-adherent (AOR = 8.232; 95% CI: 4.124–17.217; $p < 0.001$). Experiencing HIV-related stigma was associated with increased odds of non-adherence (AOR = 2.148; 95% CI: 1.032–6.689; $p = 0.015$). Negative perceptions about the effectiveness of ART significantly contributed to poor adherence (AOR = 9.333; 95% CI: 2.108–20.638; $p < 0.001$). Additionally, failure to incorporate medication intake into daily routines showed the strongest relationship with non-adherence (AOR = 11.180; 95% CI: 5.879–28.338; $p < 0.001$).

Conclusion: While adherence levels in this setting were generally high, notable gaps remain, particularly among younger individuals and those affected by educational, behavioral, and psychosocial challenges.

Interventions focusing on youth-friendly adherence support, stigma reduction, improved health education, and habit-based medication strategies are vital to sustaining treatment success and achieving national HIV control goals.

Keywords: Antiretroviral therapy, treatment adherence, HIV infection, stigma, behavioral factors, Rwanda

Introduction

Human Immunodeficiency Virus (HIV) remains a significant global public health challenge despite substantial progress in prevention, diagnosis, and treatment. Recent estimates indicate that approximately 39 million people were living with HIV worldwide in 2022, with the greatest burden concentrated in Sub-Saharan Africa (World Health Organization [WHO], 2023). The widespread implementation of antiretroviral therapy (ART) has transformed HIV infection from a life-threatening condition into a manageable chronic disease by effectively suppressing viral replication, restoring immune function, and improving life expectancy (Joint United Nations Programme on HIV/AIDS [UNAIDS], 2023).

Optimal adherence to ART is critical for achieving sustained viral suppression and favorable clinical outcomes. High levels of adherence typically above 95% are required to prevent the development of drug resistance, reduce opportunistic infections, and minimize HIV transmission (UNAIDS, 2023; World Health Organization, 2023). However, maintaining such adherence remains a persistent challenge, particularly in low- and middle-income countries, where patients often face a complex interplay of socioeconomic, behavioral, and health system-related barriers (Nachega et al., 2012; Nyblade et al., 2019). In Sub-Saharan Africa, adherence to ART is influenced by multiple factors, including HIV-related stigma, financial hardship, long distances to healthcare facilities, inadequate social support, mental health conditions, substance use, and limited knowledge about treatment (Nachega et al., 2012; Nyblade et al., 2019). Younger individuals are especially vulnerable to non-adherence due to challenges such as disclosure concerns, mobility, and inconsistent healthcare engagement. Additionally, educational attainment plays a crucial role, as it affects health literacy and the ability to understand and adhere to treatment regimens (WHO, 2023).

Rwanda has made remarkable progress in combating HIV by expanding universal access to free ART, decentralizing HIV services, and integrating HIV care into primary healthcare systems. National reports indicate that the country is approaching global HIV targets, with high levels of diagnosis, treatment coverage, and viral suppression (Ministry of Health Rwanda, 2023; UNAIDS, 2023). Despite these achievements, adherence gaps persist among certain population groups, particularly in rural and semi-urban settings, where structural and psychosocial barriers remain prevalent.

Kibungo Referral Hospital plays a central role in delivering HIV care services in Eastern Rwanda, serving a large and diverse patient population. However, there is limited empirical evidence regarding long-term ART adherence and its determinants within this setting. Identifying context-specific factors influencing adherence is essential for designing targeted and effective interventions. Therefore, this study aimed to assess the prevalence of ART non-adherence and to identify key behavioral and psychosocial determinants of poor adherence among adults living with HIV receiving care at Kibungo Referral Hospital.

Methods

Study Design

This investigation employed a quantitative cross-sectional design conducted within a healthcare facility setting to evaluate factors influencing adherence to ART among HIV-positive individuals.

Study Setting

The research took place at Kibungo Referral Hospital and its 13 affiliated health centers located in Rwanda's Eastern Province. The hospital functions as a central hub for HIV treatment services and coordinates ART delivery across multiple surrounding facilities.

Study Population

The study targeted adults aged 18 years and above who were living with HIV and had been on ART for at least six months. During the study period, a total of 3,508 patients were enrolled in ART services, including both male and female patients.

Participants were eligible if they met the age and treatment duration criteria and consented to participate. Individuals who were critically ill, hospitalized, or unwilling to take part were excluded.

Sample Size Determination

The sample size was calculated using Yamane's formula (Yamane, 1967) with a 5% margin of error and the total population ($N = 3,508$): $n = \frac{N}{1 + N(e)^2} = \frac{3,508}{1 + 3,508(0.05)^2} \approx 400$. To account for an anticipated 10% non-response rate, the final target sample was increased to 440 participants. The achieved response rate yielded 424 completed interviews.

Sampling Technique

A stratified random sampling approach was used to ensure representation across all ART service delivery points. Each facility served as a stratum, and participants were selected proportionally based on the number of patients receiving ART at each site. Within each stratum, simple random sampling was applied.

Data Collection Instrument

Data were collected using a structured questionnaire adapted from established and validated tools used in ART adherence research. The instrument captured information on demographic characteristics, clinical factors, behavioral patterns, psychosocial influences, stigma, and adherence behaviors. Prior to the main study, the questionnaire was piloted among a subset of participants at a nearby health center to ensure clarity and reliability. The internal consistency was confirmed with a Cronbach's alpha value of 0.71, while validity was supported by a content validity index of 0.81.

Measurement of Outcome Variable

Adherence to ART was assessed through self-reported responses regarding medication-taking behavior over the previous month. Participants were categorized as either adherent or non-adherent based on their responses.

Data Analysis

Collected data were entered into Microsoft Excel and subsequently analyzed using SPSS version 21. Descriptive statistics such as frequencies and percentages were used to summarize the data. Associations between independent variables and non-adherence were evaluated using Fisher's exact test. Variables showing statistical significance were further analyzed using multivariable logistic regression to identify independent predictors. Adjusted odds ratios, confidence intervals, and p-values were reported, with significance set at $p < 0.05$.

Ethical Considerations

Ethical clearance was obtained from the Mount Kenya University Ethics Review Board. Authorization to conduct the study was also granted by Kibungo Referral Hospital. All participants provided informed consent prior to participation. Confidentiality was maintained by using coded identifiers, and no personal information was recorded.

Results

Socio-Demographic Characteristics of Respondents

A total of 424 HIV-positive adults receiving ART participated in the study. The majority of respondents were middle-aged, with 36.8% aged 51–60 years (n = 156), followed by 31.4% aged 41–50 years (n = 133), and 19.3% aged 31–40 years (n = 82). Younger participants were fewer, with only 5.4% aged 21–30 years (n = 23), while those above 60 years represented 3.5% (n = 15). Male participants constituted 52.4% (n = 222), while females accounted for 47.6% (n = 202), indicating a relatively balanced gender distribution. Most respondents were married (56.8%, n = 241), followed by divorced participants (30.2%, n = 128), while single participants represented 13.0% (n = 55). Regarding educational attainment, 47.4% (n = 201) had secondary education, 41.0% (n = 174) had primary education, and only 11.6% (n = 49) had tertiary education. Employment status showed that the majority were employed (76.2%, n = 323), while 23.8% (n = 101) were unemployed. These findings indicate that the study population was predominantly composed of middle-aged, married, and employed individuals with primary or secondary education, reflecting the socio-demographic structure of ART service users in the Kibungo Referral Hospital catchment area.

Table 1. Socio-Demographic Characteristics of Respondents (N = 424)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	21–30	23	5.4
	31–40	82	19.3
	41–50	133	31.4
	51–60	156	36.8
	>60	15	3.5
Gender	Male	222	52.4
	Female	202	47.6
Marital Status	Single	55	13.0
	Married	241	56.8
	Divorced	128	30.2
Education Level	Primary	174	41.0
	Secondary	201	47.4
	Tertiary	49	11.6
Employment Status	Employed	323	76.2
	Unemployed	101	23.8

Prevalence of ART Non-Adherence

The first objective of the study was to determine the prevalence of non-adherence to ART among HIV patients attending ART services within the catchment area of Kibungo Referral Hospital. The findings

revealed that 55 participants were non-adherent to ART, representing a prevalence of 13.0%, while 369 participants (87.0%) were adherent to treatment

Table 2. Prevalence of ART Adherence and Non-Adherence (N = 424)

Adherence Status	Frequency (n)	Percentage (%)
Adherent	369	87.0
Non-adherent	55	13.0
Total	424	100

Although the overall adherence level was relatively high, the observed proportion of non-adherent patients remains clinically important because even small adherence gaps may compromise viral suppression, increase the risk of drug resistance, and negatively affect long-term treatment outcomes.

Bivariate Analysis of Socio-Demographic Factors Associated with ART Non-Adherence

Age was significantly associated with ART non-adherence (Chi-square = 32.078, $p < 0.001$). The highest non-adherence rates were observed among participants aged 41–50 years and 51–80 years, while younger age groups showed lower levels of non-adherence. Educational level was also significantly associated with ART adherence ($p = 0.014$). Non-adherence was higher among participants with primary and secondary education, while no cases of non-adherence were reported among those with tertiary education. Household size showed a strong association with adherence ($p < 0.001$). Participants living in households with three or more members demonstrated higher levels of non-adherence compared to those living in smaller households. Gender ($p = 0.524$), marital status ($p = 0.087$), and employment status ($p = 0.083$) were not significantly associated with ART non-adherence

Table 3. Bivariate Analysis of Socio-Demographic Factors Associated with ART Non-Adherence

Variable	Category	Adherent n (%)	Non-Adherent n (%)	Total n (%)	Statistical Test	p-value
Age	≤30 years	30 (7.1%)	8 (1.9%)	38 (8.9%)	$\chi^2 = 32.078$	<0.001
	31–40 years	66 (15.6%)	16 (3.8%)	82 (19.3%)		
	41–50 years	117 (27.6%)	16 (3.8%)	133 (31.4%)		
	≥51 years	156 (36.8%)	15 (3.5%)	171 (40.2%)		
Gender	Male	191 (45.0%)	31 (7.3%)	222 (52.4%)	Fisher's Exact	0.524
	Female	178 (42.0%)	24 (5.7%)	202 (47.6%)		
Marital Status	Single	47 (11.1%)	8 (1.9%)	55 (13.0%)	Fisher's Exact	0.087
	Married	217 (51.2%)	24 (5.7%)	241 (56.8%)		

	Divorced	105 (24.8%)	23 (5.4%)	128 (30.2%)		
Education Level	Primary	148 (34.9%)	26 (6.1%)	174 (41.0%)	Fisher's Exact	0.014
	Secondary	178 (42.0%)	23 (5.4%)	201 (47.4%)		
	Tertiary	43 (10.1%)	6 (1.4%)	49 (11.6%)		
Employment Status	Employed	284 (67.0%)	39 (9.2%)	323 (76.2%)	Fisher's Exact	0.083
	Unemployed	85 (20.0%)	16 (3.8%)	101 (23.8%)		
Household Size	≤3 members	95 (22.4%)	8 (1.9%)	103 (24.3%)	Fisher's Exact	<0.001
	4–6 members	185 (43.6%)	18 (4.2%)	203 (47.9%)		
	≥7 members	89 (21.0%)	29 (6.8%)	118 (27.8%)		

Behavioral and Psychosocial Factors Associated with ART Non-Adherence

Bivariate analysis further demonstrated that behavioral and psychosocial factors played an important role in ART adherence. Smoking status, disclosure of HIV status to friends, stigma, perceived ART effectiveness, forgetfulness, and failure to integrate ART into daily routines were significantly associated with non-adherence. Patients who reported stigma were less likely to maintain adherence, suggesting that fear of discrimination and social judgment negatively affected treatment consistency. Similarly, participants who perceived ART as ineffective were significantly more likely to miss treatment, indicating the importance of treatment beliefs and patient understanding. Failure to integrate ART into daily routines emerged as one of the strongest behavioral predictors of poor adherence. Patients who lacked routine medication-taking practices were substantially more likely to be non-adherent, highlighting the importance of habit formation and structured adherence support. Although reminder strategies such as setting alarms were commonly used, the association between alarm use and adherence was not statistically significant.

Table 4 Behavioral and Psychosocial Factors Associated with ART Non-Adherence

Variable	Category	Adherent n (%)	Non-Adherent n (%)	Total n (%)	Statistical Test	p-value
Smoking Status	Smoker	38 (9.0%)	15 (3.5%)	53 (12.5%)	Fisher's Exact	0.002
	Non-smoker	331 (78.1%)	40 (9.4%)	371 (87.5%)		
Disclosure to Friends	Disclosed	205 (48.3%)	17 (4.0%)	222 (52.4%)	Fisher's Exact	0.011

	Not disclosed	164 (38.7%)	38 (9.0%)	202 (47.6%)		
HIV-related Stigma	Experienced stigma	142 (33.5%)	36 (8.5%)	178 (42.0%)	Fisher's Exact	0.015
	No stigma	227 (53.5%)	19 (4.5%)	246 (58.0%)		
Perceived ART Effectiveness	Perceived ineffective	28 (6.6%)	19 (4.5%)	47 (11.1%)	Fisher's Exact	<0.001
	Perceived effective	341 (80.4%)	36 (8.5%)	377 (88.9%)		
Forgetfulness	Yes	96 (22.6%)	41 (9.7%)	137 (32.3%)	Fisher's Exact	<0.001
	No	273 (64.4%)	14 (3.3%)	287 (67.7%)		
Integration into Daily Routine	Not integrated	74 (17.5%)	43 (10.1%)	117 (27.6%)	Fisher's Exact	<0.001
	Integrated	295 (69.6%)	12 (2.8%)	307 (72.4%)		
Use of Alarms	Uses alarms	138 (32.5%)	14 (3.3%)	152 (35.8%)	Fisher's Exact	0.218
	Does not use alarms	231 (54.5%)	41 (9.7%)	272 (64.2%)		

Multivariable Logistic Regression Analysis

Multivariable logistic regression identified five independent predictors of ART non-adherence. Patients younger than 31 years were significantly more likely to be non-adherent compared to older patients (AOR = 15.462; 95% CI: 3.462–19.748; $p = 0.020$). Participants without tertiary education had significantly higher odds of non-adherence compared to those with tertiary education (AOR = 8.232; 95% CI: 4.124–17.217; $p < 0.001$). Patients experiencing HIV-related stigma were more likely to be non-adherent than those without stigma (AOR = 2.148; 95% CI: 1.032–6.689; $p = 0.015$). Participants who perceived ART as ineffective had significantly higher odds of non-adherence (AOR = 9.333; 95% CI: 2.108–20.638; $p < 0.001$). Failure to integrate ART into daily routines was the strongest predictor of ART non-adherence (AOR = 11.180; 95% CI: 5.879–28.338; $p < 0.001$). Not setting alarms for medication reminders was not significantly associated with non-adherence, indicating that reminder systems alone may be insufficient without broader behavioral adherence strategies.

Table 5. Multivariable Logistic Regression of Predictors of ART Non-Adherence

Variable	Category	AOR	95% CI	p-value
Age	<31 years vs ≥31 years (Ref)	15.46	3.46–19.75	0.020
Education Level	No tertiary vs tertiary (Ref)	8.23	4.12–17.22	<0.001
HIV-related Stigma	Yes vs No (Ref)	2.15	1.03–6.69	0.015
Perceived ART Effectiveness	Ineffective vs Effective (Ref)	9.33	2.11–20.64	<0.001

Integration into Daily Routine	Not integrated vs Integrated (Ref)	11.18	5.88–28.34	<0.001
Use of Alarm Reminder	No vs Yes (Ref)	1.14	0.11–4.41	0.900

Discussion

This study assessed the prevalence of antiretroviral therapy (ART) non-adherence and its associated factors among adults living with HIV attending Kibungo Referral Hospital in Eastern Rwanda. The findings showed that 13.0% of participants were non-adherent to ART, while 87.0% maintained adherence to treatment. Although this adherence level is relatively high compared to many settings in Sub-Saharan Africa, the remaining proportion of non-adherent patients remains clinically significant because even minor lapses in adherence can compromise viral suppression, increase the risk of drug resistance, and contribute to HIV-related morbidity and mortality. The observed adherence level is consistent with Rwanda's strong national HIV program performance and progress toward achieving the UNAIDS 95-95-95 targets. Similar adherence levels have been reported in previous studies conducted in Rwanda and neighboring East African countries where decentralized ART services, community-based follow-up, and universal treatment access have strengthened continuity of care (Ministry of Health Rwanda, 2023; UNAIDS, 2023). However, the persistence of non-adherence among 13% of patients suggests that structural access alone is insufficient and that behavioral and psychosocial barriers remain important determinants of treatment outcomes.

Age emerged as a significant predictor of ART non-adherence, with patients younger than 31 years being substantially more likely to miss treatment compared to older adults. This finding aligns with studies from Uganda, Kenya, and South Africa showing that younger patients often experience greater challenges in maintaining long-term adherence due to mobility, unstable employment, disclosure concerns, stigma, and inconsistent health-seeking behaviors (Bulsara et al., 2021; Haas et al., 2022). Younger adults may also experience treatment fatigue and reduced perceived vulnerability to HIV-related complications, leading to poor adherence behaviors. In contrast, older patients often demonstrate greater treatment discipline due to increased health awareness and more stable daily routines. These findings highlight the importance of youth-centered adherence interventions, including peer support, digital reminder systems, and age-specific counseling approaches.

Educational attainment was another strong predictor of adherence. Participants without tertiary education had significantly higher odds of non-adherence compared to those with higher education levels. This finding is consistent with evidence suggesting that education improves health literacy, treatment understanding, and patient engagement in long-term care (Kalichman et al., 2020). Patients with limited education may experience difficulties understanding dosing schedules, recognizing the consequences of missed doses, and interpreting treatment instructions. Similar findings have been reported in Ethiopia and Tanzania, where lower educational attainment was associated with poor ART adherence and delayed treatment outcomes (Tola et al., 2021; Mmbaga et al., 2022). Strengthening patient education using simplified counseling tools and local-language adherence support may therefore improve outcomes among vulnerable populations.

HIV-related stigma remained a significant psychosocial barrier to adherence in this study. Participants who reported stigma were more likely to be non-adherent than those without stigma. This finding supports extensive literature demonstrating that perceived and enacted stigma negatively affect treatment retention, disclosure, clinic attendance, and medication consistency (Nyblade et al., 2019; Katz et al., 2023). Fear of discrimination often leads patients to hide medication, avoid clinic visits, or discontinue treatment entirely.

In rural and close-knit communities such as those served by Kibungo Referral Hospital, social visibility may intensify these challenges. Addressing stigma therefore requires both individual-level counseling and broader community-based interventions that normalize HIV treatment and reduce discrimination.

Perceived ART ineffectiveness was strongly associated with non-adherence. Patients who believed that ART was not effective were significantly more likely to interrupt treatment. This finding reflects the critical role of patient beliefs and treatment perceptions in long-term adherence. Similar evidence from Nigeria and Malawi indicates that negative perceptions about ART effectiveness, often influenced by misinformation or delayed clinical improvement, reduce motivation for sustained treatment engagement (Adejumo et al., 2022; Moucheraud et al., 2021). Patients who do not observe immediate health improvements may incorrectly conclude that medication is unnecessary or ineffective. Strengthening routine counseling, viral load feedback, and clinician–patient communication can improve treatment confidence and reinforce adherence behaviors.

Failure to integrate ART into daily routines was the strongest predictor of non-adherence in this study. Patients who did not consistently incorporate medication-taking into their daily lives were significantly more likely to be non-adherent. This finding is supported by behavioral adherence models that emphasize habit formation and routine consistency as critical determinants of long-term treatment success (Sabaté, 2003; WHO, 2023). Similar studies in Zambia and South Africa have shown that routine-based adherence strategies outperform simple reminder tools alone because they promote automatic medication-taking behaviors rather than relying solely on memory (Mody et al., 2021). This may explain why setting alarms was not independently associated with adherence in the present study. Reminder systems are useful, but without strong behavioral integration, their long-term effectiveness may be limited.

Interestingly, gender, marital status, and employment status were not significantly associated with ART adherence after adjustment. This finding differs from some studies that report financial dependence and social support as important adherence determinants (Nachega et al., 2012), but is consistent with other studies suggesting that psychosocial and behavioral factors may have stronger influence than demographic characteristics once ART access is universal (Haas et al., 2022). Rwanda’s relatively equitable HIV service delivery system may reduce disparities related to socioeconomic status, thereby shifting the primary adherence challenges toward stigma, beliefs, and routine behaviors.

The findings of this study have important policy implications for HIV program strengthening in Rwanda. While national ART coverage remains strong, sustained viral suppression requires greater investment in differentiated adherence support, particularly for younger adults and patients facing psychosocial barriers. Integrating stigma reduction programs, adherence counseling, peer support systems, and behavioral routine reinforcement into routine HIV care may improve long-term treatment outcomes. Health facilities should also prioritize individualized adherence assessments rather than relying solely on medication refill patterns or appointment attendance.

This study contributes important local evidence for strengthening ART adherence interventions in Eastern Rwanda. By identifying behavioral and psychosocial predictors rather than focusing solely on structural barriers, the findings support a more patient-centered approach to HIV care that aligns with current global recommendations for differentiated service delivery and sustained treatment success.

Acknowledgements

The principal author sincerely acknowledges the guidance and support provided by the lecturers of Mount Kenya University. Special appreciation is extended to my supervisor, Dr. Habimana Amos, MPH, PhD,

for his invaluable mentorship, dedication, and continuous support throughout this study. I also express my heartfelt gratitude to all individuals who contributed to the successful completion and overall quality of this work.

Conclusion

This study assessed the prevalence of antiretroviral therapy (ART) non-adherence and its associated factors among adults living with HIV receiving treatment within the catchment area of Kibungo Referral Hospital in Eastern Rwanda. The findings revealed that 13.0% of participants were non-adherent to ART, while 87.0% maintained adherence, indicating relatively strong treatment performance within the study setting. Although this adherence level reflects Rwanda's continued progress toward national HIV control targets, the remaining proportion of non-adherent patients remains clinically important because even small treatment interruptions can compromise viral suppression, increase the risk of opportunistic infections, promote antiretroviral resistance, and negatively affect long-term health outcomes. The study identified several significant predictors of ART non-adherence, including younger age, lower educational attainment, HIV-related stigma, perceived ineffectiveness of ART, and failure to integrate medication-taking into daily routines. Among these, poor integration of ART into daily life emerged as the strongest predictor, highlighting the importance of behavioral consistency and routine formation in sustaining long-term adherence. Psychosocial barriers such as stigma and negative treatment beliefs further demonstrate that access to ART alone is insufficient to guarantee successful treatment outcomes. These findings emphasize the need for patient-centered adherence interventions that go beyond medication provision and address behavioral, educational, and psychosocial challenges affecting long-term treatment success. Strengthening differentiated HIV care, particularly for younger adults and vulnerable populations, is essential for sustaining viral suppression and achieving national and global HIV treatment goals.

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