

Factors Influencing Non-Adherence to Antiretroviral Therapy Among HIV Patients at Kibungo Referral Hospital, Rwanda.

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Abstract

Background: It has been demonstrated that antiretroviral therapy improves health and lengthens the life of HIV positive individuals. For those living with HIV, attaining optimal adherence is turning out to be the largest obstacle. The purpose of this research was to determine how often antiretroviral therapy non-adherence is among HIV patients who visit Rwanda's Kibungo Referral Hospital.

Methods: This study utilized a quantitative, cross-sectional design. Data collection was conducted from March 25th to April 30, 2024, with a sample size of 396 HIV patients on ART at Kibungo Referral Hospital. Inclusion criteria included patients aged 18 years and older who had been on ART for six months, while exclusion criteria included lack of consent and hospitalized patients. A structured questionnaire was used. The Fisher exact test and logistic regression were employed to analyze associations, with significance set at $p < 0.05$ and 95% CI.

Results: The findings showed that the overall non-adherence rate to ART was 13% while the adherence rate was 87%. Also, patients without tertiary education are significantly more likely to be non-adherent to ART compared to those with tertiary education (AoR: 8.232, 95% CI: 4.124-17.217, P-value: <0.001). Patients who experience stigma are more likely to be non-adherent to ART (AoR: 2.148, 95% CI: 1.032-6.689, P-value: 0.015). Patients who perceive ART as ineffective are significantly more likely to be non-adherent (AoR: 9.333, 95% CI: 2.108-20.638, P-value: <0.001).

Conclusion: The study found a high non-adherence rate to ART among HIV patients at Kibungo Referral Hospital, linked to factors such as younger age, lack of tertiary education, stigma, and perceived ineffectiveness of ART. It recommends implementing structured support systems and targeted interventions to improve adherence and health outcomes for these patients.

Keywords: Prevalence, Factor, Non-Adherence, Antiretroviral Therapy.

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INTRODUCTION

Non-adherence to antiretroviral therapy remains a major global challenge in the management of HIV/AIDS. Studies conducted across diverse regions have consistently shown that several factors contribute to poor adherence among people living with HIV [23,24]. These include forgetfulness, complex drug regimens, fear of stigma and discrimination, lack of social support, side effects of medications, and limited access to health facilities, especially during weekends or public holidays [5].

Additionally, psychosocial issues such as depression, substance abuse, and competing life priorities have been found to negatively affect patients' ability to consistently take their medication as prescribed. Globally, it is estimated that approximately 38% of people living with HIV do not achieve optimal adherence to ART, which significantly undermines treatment success and increases the risk of drug resistance and disease progression [6].

Antiretroviral therapy (ART) is the cornerstone of HIV treatment, aimed at suppressing the replication of the human immunodeficiency virus (HIV) within the body [6]. The primary purpose of ART is to reduce the viral load to undetectable levels, thereby preserving the immune system, preventing disease progression, and reducing the risk of HIV transmission. ART typically involves a combination of at least three antiretroviral drugs from different classes, which work synergistically to inhibit various stages of the HIV life cycle, such as reverse transcription, integration, and viral protease activity [5].

This combination approach not only enhances treatment effectiveness but also minimizes the likelihood of drug resistance. When taken consistently and correctly, ART can suppress the viral load to undetectable levels in over 95% of patients, enabling them to live longer,

healthier lives and significantly lowering the chance of transmitting the virus to others [6].

Universally, polypharmacy practices, social norms, inadequate prescription instruction from healthcare providers, medication knowledge and experience, poorer treatment outcomes, low demographic characteristics (e.g., young age, lower education, and income), forgetfulness, busy work schedules, distance/fare to the clinic, long lines, absence of family support, and lengthy waiting times are all factors that contribute to non-adherence [2].

The use of alcohol, male gender, traditional/herbal medicine, discontent with medical staff and facilities, depression, stigmatization and discrimination, and a lack of social support are the main factors that contribute to non-adherence in Sub-Saharan Africa [1]. Unemployment, stigma, adverse effects of ART, and single status in Rwanda [3,4].

The factors of non-adherence include disclosure, waiting time and due distance, accessibility of health facilities, lack of social support toward receiving antiretroviral, stigma have been found as general factors predispose to non-adherence in adolescent people. The prevalence of HIV/AIDS infection in East Africa, now ranges from less than 1% to 25% in rural areas and from 10–30% in urban areas, with the prevalence continuing to rise. Antiretroviral therapy adherence was hindered in this region by poverty, stigma, cultural and religious beliefs, and a lack of social support among individuals living with HIV/AIDS.

Global health concerns regarding the Human Immunodeficiency Virus (HIV) persist even with the availability of Anti-Retroviral Therapy (ART). The WHO estimates that by the end of 2022, there would be 39 million HIV-positive individuals worldwide, and there were more than 40 million HIV-related deaths [5]. Approximately 25.7 million people in Africa and 3% of people in Rwanda were HIV positive in 2022 and 2019 respectively [6,7].

The United Nations Programme on HIV/AIDS, or UNAIDS, aims to end AIDS as a threat to public health by 2030. By 2025, ninety-five percent of those living with HIV should be aware of their status, ninety-five percent of those who are aware should be receiving medication, and ninety-five percent of those receiving medication need to have achieved suppression of the virus [6]. Rwanda has been making progress toward these objectives; in 2022, the Ministry of Health in Rwanda reported that these numbers were 94%, 94.6%, and 91% [8].

Overall, Rwanda's HIV/AIDS prevalence is modest and constant, although it is considerably higher in two important groups: men who have sex with males (6.5%) and female sex workers (35.5%). Cultural and religious views, poverty, and stigma are some of the variables that lead to non-adherence to antiretroviral therapy [9].

Even if it was confirmed that ART improves health and prolongs lives of HIV patients, achieving optimal adherence is a major challenge for people living with HIV. The prevalence of ART non-adherence varies considerably and is multifactorial across populations and settings [10,11]. A web-based survey that included people from 25 countries worldwide found a suboptimal adherence to antiretroviral therapy ranging between 10% and 62% with the overall suboptimal adherence of 24.1% [11].

Although, some factors were found to be associated with non-adherence, there's still a challenge to close the gap of the persistent problem of non-adherence to ART [12]. In Rwanda, recent studies found that 10.2% of HIV patients in Ruhengeri Referral Hospital and 16% in Nyaruguru District are sub optimally adhered to their ART treatment [13,14].

Despite Rwanda's commendable efforts in providing universal access to antiretroviral therapy (ART), including free treatment and early initiation protocols, non-adherence to

ART remains a persistent challenge [7]. Although national and regional studies have examined factors influencing adherence [11,13], there is a scarcity of research specifically focused on Kibungo Referral Hospital and its catchment area. Furthermore, the specific barriers and facilitators influencing ART adherence among HIV patients in this region remain poorly understood. This study seeks to fill that gap by exploring the prevalence of ART non-adherence and identifying the underlying factors that influence patients' adherence behaviors at Kibungo Referral Hospital. By focusing on this particular setting, the study aims to provide context-specific insights that can inform targeted interventions and improve adherence outcomes in the region.

The add value of this study to the science

This study:

- Provides context-specific empirical evidence on the prevalence and determinants of antiretroviral therapy (ART) non-adherence among HIV patients in eastern Rwanda, addressing limited localized data on adherence in referral hospital settings.
- Identifies key socio-educational and psychosocial determinants-including education level, stigma, and perceived effectiveness of ART, thereby strengthening the understanding of behavioral and structural factors influencing treatment adherence in low- and middle-income countries.
- Generates actionable evidence to inform targeted, patient-centered interventions and adherence support strategies within HIV care programs, contributing to improved treatment outcomes and the optimization of ART programs in similar healthcare contexts.

METHODS

Study design.

In this study, the researcher used a cross-sectional research design with quantitative research approach.

Study setting and population

The study population consisted of HIV-positive patients receiving antiretroviral therapy (ART) at any ART service delivery point within the catchment area of Kibungo Referral Hospital. The total target population was 3,508 individuals, including 1,315 males and 2,193 females. Inclusion criteria were: HIV-positive individuals aged 18 years and above, who had been on ART for at least six months, and who provided informed consent to participate in the study. Exclusion criteria included individuals who were critically ill or hospitalized during the data collection period, as well as those who declined to participate.

Sample size and Sampling Technique

The study sample size (n) was computed based on the following Yamane sample size formula [15].

Where: n is the sample size, N is estimated at 3,508 HIV patients attending Kibungo referral hospital and e is the error, which is 5%.

Therefore, $n = 3,508 / (1 + 3,508(0.05)^2) = 399.8 \sim 400$, $n = 399.8 \approx 400$

The largest possible sample size is 440 when the predicted 10% non-response rate is taken into account. However, the response rate was counted to be 424.

This study employed a stratified random sampling technique followed by simple random sampling to ensure fair representation of HIV patients across all ART service delivery points in the catchment area of Kibungo Referral Hospital. Stratified random sampling is a probability sampling method in which the population is divided into distinct subgroups or "strata" based on a specific characteristic [15], in this case, the health facility attended. Each of the 14 health facilities (comprising 13 health centers and 1 referral hospital) was treated as a separate stratum.

Within each stratum, the number of participants to be selected was determined proportionally based on the number of HIV-positive patients on ART at each facility. This approach ensured that all health facilities were represented in the final sample in proportion to their ART patient load.

After stratification, simple random sampling was conducted within each stratum. Lists of eligible patients (those aged 18 years or older, on ART for at least six months, and not critically ill) were obtained from each facility. Using these lists as sampling frames, random selection of participants was performed using a computer-generated random number list to avoid bias and ensure that every eligible patient had an equal chance of being selected.

The combination of stratified and simple random sampling was chosen to enhance the representativeness of the sample, reduce sampling bias, and ensure that findings would be generalizable across all health facilities in the study area. Stratification helped capture facility-level variations, while simple random sampling ensured unbiased participant selection within each stratum.

Dependent and independent variables

This study used non-adherence to antiretroviral therapy (ART) as the dependent variable. Adherence status was assessed using a single-item measure in which participants were asked whether they adhered to their prescribed ART regimen; responses were dichotomized as "Yes" indicating adherence and "No" indicating non-adherence. The independent variables included key sociodemographic, system-related, disease- and treatment-related, and individual factors. Sociodemographic variables comprised: age, gender, education level, employment status, marital status, household size, religion, and number of sexual partners.

System-related factors included distance to ART services and waiting time. Disease- and

treatment-related variables covered time since HIV diagnosis, pill burden, duration on ART, and side effects. Individual-related factors included perceived risks and benefits of ART, barriers to adherence, self-efficacy, cues to action such as reminders, disclosure of HIV status, duration on ART, and the use of tobacco and alcohol.

Study instruments.

To fulfill the study objectives, a structured questionnaire was developed through the adaptation and contextual modification of items from previous studies [4,16]. Data collection was conducted from 25th of March and the 30th of April 2024.

Section 1 consisted of sociodemographic and participant behavior-related items. Age, gender, marital status, size of the home, education, work status, religion, and system-related factors (such as distance to the nearest ART service and waiting time to receive care) were included. Section 2 consisted of disease- and treatment-related factors (including time since HIV diagnosis, number of pills taken per day, duration under ART, and ART side effects). Section 3 consisted of individual-related factors (such as number of sexual partners, tobacco and alcohol usage, and HIV-positive status disclosure to friends and family).

However, the reliance on a single self-reported item to classify adherence is a significant limitation of the study. This approach may introduce response bias and measurement error, as participants may overreport adherence due to social desirability or inaccurately recall their medication-taking behavior. This limitation was taken into account when interpreting the study's findings.

Validity and reliability of the instrument Validity

The validity of the study was enhanced by the reliability of the research instruments. Mount Kenya research supervisors reviewed the

research instrument for content and face validity and approve it before usage in data collection. Respecting the phrasing and item order in the research questionnaire also helped to ensure the study's validity. The content validity index was carried out with a valid result of 0.81.

Reliability

Before the real research was done, an initial investigation was carried out to evaluate the questionnaire. This pilot study took place at the Kabarondo Health Center in Kayonza District, also located in the Eastern Province, Rwanda. During the pilot study, 10% of the study participants of adult HIV patients were randomly recruited and interviewed using a research questionnaire. The reliability analysis for internal consistency was conducted using the data obtained from the pilot study. The Cronbach's α score was calculated. The research instrument was considered reliable after getting the Cronbach's α score result of 0.71. The experience gained from the pilot study was used to correct any ambiguities in the questions.

Data analysis procedure

The data collected were transcribed into a Microsoft Excel spreadsheet and securely stored for further processing. The data were then coded and analyzed using Statistical Package for Social Sciences (SPSS) version 21. Categorical variables were summarized using frequencies and percentages, and the results were presented in both text and tables. The adherence status was assessed using a single-item measure, where participants were asked whether they adhered to their ART regimen. Responses were coded as "Yes" (coded as 1, indicating adherence) and "No" (coded as 0, indicating non-adherence). The association between ART non-adherence and various independent variables was examined using Fisher's exact test. To control potential confounding factors, logistic regression analysis was used at 95%CI with $p < 0.05$.

RESULTS

The findings revealed that the overall non-adherence rate to ART was 13% (55 patients),

while the adherence rate was 87% (369 patients) among HIV patients within the catchment area of Kibungo Referral Hospital, Rwanda.

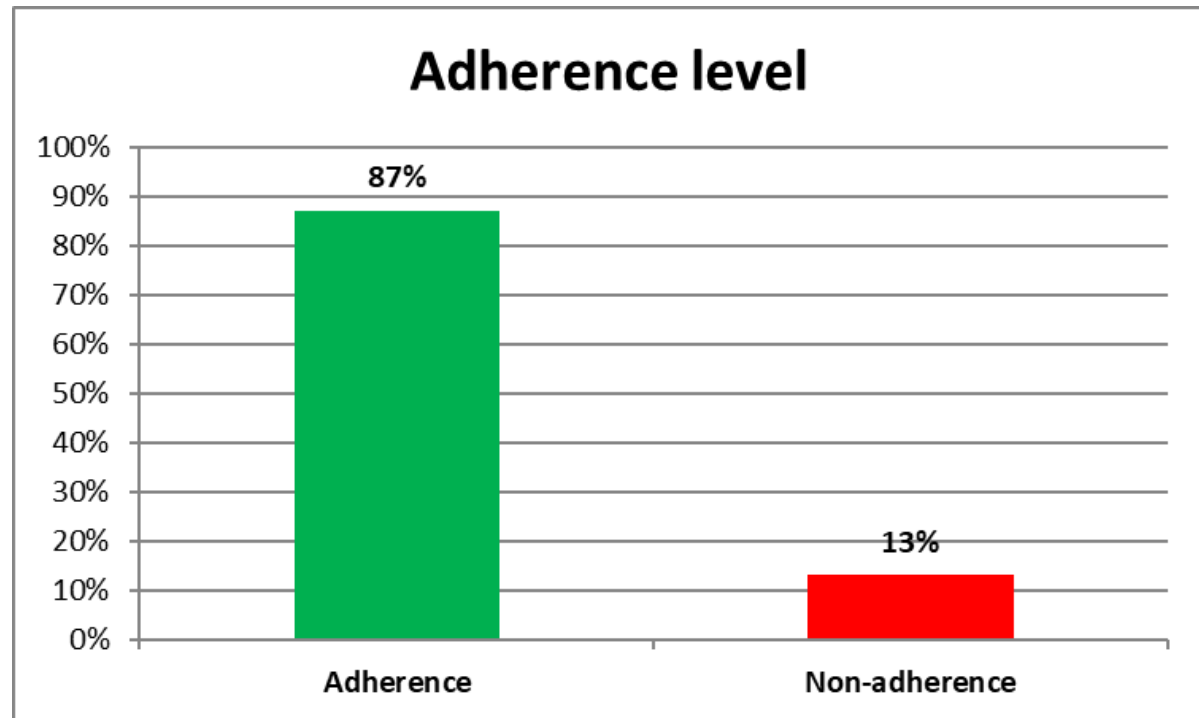


Figure 1. Prevalence of non-adherence to antiretroviral therapy among HIV patients in the catchment of Kibungo referral hospital, Rwanda.

The bivariate analysis indicated that age was significantly associated with ART non-adherence ($p < 0.001$), with higher proportions of non-adherence observed among participants aged 31–40 and 41–50 years. Gender was not significantly associated with non-adherence ($p = 0.524$), as both males and females had relatively similar adherence patterns. Marital status showed a borderline association ($p = 0.087$), with non-adherence slightly higher among divorced and married individuals compared to singles. Education level was significantly associated with non-adherence ($p = 0.014$), where participants with secondary education or above had a higher proportion of non-adherence than those with only primary education.

Employment status was not significantly associated with non-adherence ($p = 0.083$),

though the employed group had a higher proportion of non-adherence. The number of people living in the household was significantly associated with ART non-adherence ($p < 0.001$), with higher non-adherence observed among participants living in households with four or more members. (Table.1)

Table 2 presents the bivariate analysis of HAART (Highly Active Antiretroviral Therapy) taking and behavioral factors associated with non-adherence to antiretroviral therapy (ART). Indeed, it revealed a significant association between having more than one sexual partner and ART non-adherence ($p = 0.046$), with non-adherence being higher among individuals with multiple partners. Travel time to the ART center was significantly associated with non-adherence ($p < 0.001$); participants traveling between 16 to

60 minutes had higher non-adherence rates, while none of those traveling less than 15 minutes were non-adherent.

Waiting time at the ART service center was also significantly associated with non-adherence ($p =$

0.045), with those waiting between 15 to 30 minutes reporting higher non-adherence than those waiting longer. Smoking showed a significant association ($p = 0.002$), where smokers had a higher rate of non-adherence compared to non-smokers.

Table 1. Bivariate analysis of socio-demographic factors associated with non-adherence to antiretroviral therapy among HIV patients in the catchment of Kibungo referral hospital.

Variables	Factors associated to ART Non-Adherence			P-value
	Adherent n(%)	Non-adherent n(%)	Total(%)	
Age				<0.001
1-30 Years Old	30(1.7)	8(1.9)	38(8.9)	
31-40 Years Old	66(15.6)	16(3.8)	82(19.3)	
41-50 Years Old	117(27.6)	16(3.8)	133(31.4)	
51-80 Years Old	156(36.8)	15(3.5)	171(40.2)	
Total	369(87.0)	55(13.0)	424(100.0)	
Gender				0.524
Male	191(45.0)	31(7.3)	222(52.4)	
Female	178(42.0)	24(5.7)	202(47.6)	
Total	369(87.0)	55(13.0)	424(100.0)	
Marital status				0.087
Single	47(11.1)	8(1.9)	55(13.0)	
Married	217(51.2)	24(5.7)	241(56.8)	
Divorced	105(24.8)	23(5.4)	128(30.2)	
Total	369(87.0%)	55(13.0)	424(100.0)	
Education				0.014
Primary education	150(35.4)	24(5.7)	174(41.0)	
>=Secondary Education	219(51.7)	31(7.3)	250(59.0)	
Total	369(87.0)	55(13.0)	424(100.0)	
Employment status				0.083
Employed	276(65.1)	47(11.1)	323(76.2)	
Unemployed	93(21.9)	8(1.9)	101(23.8)	
Total	369(87.0)	55(13.0)	424(100.0)	
Number of people in one's home				<0.001
1-2	41(9.7)	8(1.9)	49(11.6)	
Three	125(29.5)	8(1.9)	133(31.4)	
>=Four	203(47.9)	39(9.2)	242(58.1)	
Total	369(87.0)	55(13.0)	424(100.0)	

Source: Primary data, 2024.

Alcohol intake, duration under ART, history of ART-related side effects, and disclosure of HIV status to family were not significantly associated with ART non-adherence ($p > 0.05$). However, disclosure of HIV status to friends was strongly associated with ART non-adherence ($p < 0.001$), where all non-adherent participants had disclosed their status to friends,

and none of the adherent participants had done so. (Table.2) Multivariate analysis of the factors associated with non-adherence to antiretroviral therapy (ART) among HIV patients at Kibungo Referral Hospital showed that patients younger than 31 years old are significantly more likely to be non-adherent to ART compared to those with 31 years and older

(AoR 15.462, CI 3.462-19.748, P-value: 0.02).
Patients without tertiary education are
significantly more likely to be non-adherent to

ART compared to those with tertiary education
(AoR: 8.232, 95% CI: 4.124-17.217, P-value:
=0.001).

Table 2. Bivariate analysis of HAART taking, and behavioral factors associated with non-adherence to antiretroviral therapy among HIV patients in the catchment of Kibungo referral hospital.

Variable	Factors associated to ART Non-Adherence.			P-value
	Adherent n (%)	Non-adherent n (%)	Total (%)	
>=2 sexual partner				0.046
Yes	100(23.6)	8(1.9)	108(25.5)	
No	269(63.4)	47(11.1)	316(74.5)	
Total	369(87.0)	55(13.0)	424(100.0)	
Time to travel to the ART service center (Minutes)				<0.001
<15min	72(17.0)	0(0.0)	72(17.0)	
16 to 45 min	95(22.4)	32(7.5)	127(30.0)	
46 to 60 min	202(47.6)	23(5.4)	225(53.1)	
Total	369(87.0)	55(13.0)	424(100.0)	
Waiting time for ART care service				0.045
15 to 30 min	220(51.9)	39(9.2)	259(61.1)	
31 to >1hour	149(35.2)	16(3.8)	165(38.9)	
Total	369(87.0)	55(13.0)	424(100.0)	
Smoking				0.002
Yes	49(11.6)	16(3.8)	65(15.3)	
No	320(75.5)	39(9.2)	359(84.7)	
Total	369(87.0)	55(13.0)	424(100.0)	
Alcohol intake				0.903
Yes	56(13.2)	8(1.9)	64(15.1)	
No	313(73.8)	47(11.1)	360(84.9)	
Total	369(87.0)	55(13.0)	424(100.0)	
Time-period under ART				0.546
1-2 years	86(20.3)	15(3.5)	101(23.8)	
3-5 years	242(57.1)	32(7.5)	274(64.6)	
>5 years	41(9.7)	8(1.9)	49(11.6)	
Total	369(87.0)	55(13.0)	424(100.0)	
Ever had ART-related side effect				0.543
Yes	66(15.6)	8(1.9)	74(17.5)	
No	303(71.5)	47(11.1)	350(82.5)	
Total	369(87.0)	55(13.0)	424(100.0)	
Having disclosed one's status to one's family				0.431
Yes	314(74.1)	49(11.6)	363(85.6)	
No	55(13.0)	6(1.4)	61(14.4)	
Total	369(87.0)	55(13.0)	424(100.0)	
Having disclosed one's status to their friends				<0.001
Yes	0(0.0)	55(13.0)	55(13.0)	
No	369(87.0)	0(0.0)	369(87.0)	
Total	369(87.0)	55(13.0)	424(100.0)	

Source: Primary data,2024.

Table 3. Multivariate analysis of factors associated with non-adherence to antiretroviral therapy among HIV patients in the catchment of Kibungo referral hospital.

Variables	Factors associated with non-adherence to antiretroviral drugs among HIV patients at Kibungo referral Hospital		P-value
	AoR	95%CI	
Age≥31 years old			
Yes	Ref		
No	15.462	3.462-19.748	0.02
Tertiary Education			
Yes	Ref		
No	8.232	4.124-17.217	<0.001
Stigma interferes with adherence			
No	Ref		
Yes	2.148	1.032-6.689	0.015
Effective ART			
Yes	Ref		
No	9.333	2.108-20.638	<0.001
ART integration in Everyday activity			
Yes	Ref		
No	11.180	5.879-28.338	<0.001
Setting alarm as reminder			
Yes	Ref		
No	1.139	0.112-4.412	0.9

Source: Primary data,2024.

Patients who experience stigma are more likely to be non-adherent to ART (AoR: 2.148, 95% CI: 1.032-6.689, P-value: 0.015). Patients who perceive ART as ineffective are significantly more likely to be non-adherent (AoR: 9.333, 95% CI: 2.108-20.638, P-value: =0.001). Patients who do not integrate ART into their daily routines are significantly more likely to be non-adherent (AoR: 11.180, 95% CI: 5.879-28.338, P-value: =0.001). There is no significant association between not setting an alarm and non-adherence. In sum, the findings indicate that younger age, lack of tertiary education, stigma, perceived ineffectiveness of ART, and failure to integrate ART into daily activities are significant factors associated with non-adherence to ART among HIV patients at Kibungo Referral Hospital. Setting an alarm as a reminder does not significantly impact adherence. (Table.5).

Discussion

The primary aim of this study was to assess the prevalence of non-adherence to antiretroviral therapy (ART) among HIV patients at Kibungo Referral Hospital, Rwanda. The results revealed a non-adherence rate of 13%, while 87% of patients adhered to their ART regimen. This level of non-adherence presents a slight public health concern, particularly when compared to findings from other regions.

In Ethiopia, a study found a non-adherence rate of 22.9%, which is notably higher than the non-adherence rate observed at Kibungo[16]. Despite the higher non-adherence rate in Ethiopia, the significant proportion of adherent patients in Kibungo suggests that a larger segment of the Kibungo population successfully adheres to their ART regimen compared to other studies. This indicates that while non-adherence is a concern,

the adherence rate in Kibungo is comparatively strong.

Conversely, a study in Nigeria reported a non-adherence rate of 30.4% [17]. Despite Nigeria's similar resource constraints, Kibungo's adherence rate surpasses this figure, highlighting potentially effective local strategies or support systems contributing to higher adherence.

In Uganda, the non-adherence rate was approximately 25% [18]. Although this rate is higher than the 13% observed in Kibungo, it underscores that while Kibungo has achieved a relatively low non-adherence rate, other regions still face substantial challenges in improving ART adherence. A South African study noted a non-adherence rate of about 28% [19]. Despite having more developed ART programs and support mechanisms, South Africa's rate remains higher than Kibungo's. This suggests that Kibungo's non-adherence rate is relatively low in comparison.

When compared to more developed regions, such as the United States and Europe, where non-adherence rates typically range from 15% to 25% [20], Kibungo's 13% non-adherence rate appears relatively favorable. The disparity in non-adherence rates across different regions in Rwanda further highlights the variability in ART adherence. For example, Ruhengeri Referral Hospital reported a lower non-adherence rate of 10.2% [13], and Nyaruguru District observed an adherence rate of 83.8%, with only 12.7% showing fair adherence and 3.45% demonstrating poor adherence [14]. These variations suggest that while certain areas in Rwanda achieve relatively high adherence rates, Kibungo faces significant challenges that may stem from differences in healthcare access, patient education, socioeconomic conditions, and support systems.

The study conducted at Kibungo Referral Hospital identifies several significant factors associated with non-adherence among HIV patients, including age, education level, stigma, perception of ART efficacy, and integration of ART into daily routines. The study findings highlight that younger age (below 31 years) is

strongly associated with non-adherence to ART (Adjusted Odds Ratio [AoR] 15.462, 95% Confidence Interval [CI] 3.462-19.748, P-value: 0.02). This aligns with existing literature that suggests younger individuals may face unique challenges such as lifestyle disruptions, psychological stressors, or competing priorities that hinder adherence [21]. Moreover, patients without tertiary education are also at higher risk of non-adherence (AoR: 8.232, 95% CI: 4.124-17.217, P-value: =0.001), underscoring the role of educational attainment in health literacy and treatment adherence [22].

Stigma associated with HIV/AIDS continues to be a significant barrier to adherence (AoR: 2.148, 95% CI: 1.032-6.689, P-value: 0.015), as evidenced by the study's findings. Patients who perceive stigma are more likely to be non-adherent to ART, reflecting the profound impact of social attitudes and discrimination on healthcare-seeking behaviors [23]. Additionally, the perception of ART ineffectiveness (AoR: 9.333, 95% CI: 2.108-20.638, P-value: =0.001) emerges as a critical factor influencing adherence, highlighting the importance of patient education and counseling in addressing misconceptions about treatment efficacy [24].

Integrating ART into daily routines is identified as a protective factor against non-adherence (AoR: 11.180, 95% CI: 5.879-28.338, P-value: =0.001). Patients who fail to incorporate ART into their daily activities are significantly more likely to be non-adherent, emphasizing the role of habit formation and structured treatment plans in promoting adherence [25]. Strategies that facilitate routine integration, such as reminder systems or patient education programs, are crucial in supporting long-term adherence [26].

Interestingly, the study found that setting an alarm as a reminder did not significantly impact adherence. This suggests that while reminders play a role in treatment adherence strategies, they may not be sufficient on their own to address the complex behavioral and socio-economic factors influencing adherence behaviors [27]. Future research could explore alternative reminder

methods or combined interventions to enhance effectiveness.

Study limitations

Despite its valuable insights, the study at Kibungo Referral Hospital has several limitations that deserve consideration. Firstly, its cross-sectional design limits causal inference, making it challenging to establish temporal relationships between the identified factors and adherence behaviors. Secondly, the study's reliance on a single self-reported item to classify ART adherence presents a significant limitation, as it may introduce both response bias and measurement error. Self-reported adherence is often subject to social desirability bias, where participants may overstate their adherence levels to align with perceived expectations of healthcare providers or researchers [15]. This can lead to an underestimation of non-adherence rates.

Additionally, recall bias may affect participants' ability to accurately remember and report their medication-taking behaviors, particularly over extended periods. Therefore, the findings related to adherence levels and their associated factors should be interpreted with caution, and future studies would benefit from using validated multi-item adherence scales or triangulating self-report data with pharmacy refill records, pill counts, or electronic monitoring. Lastly, the findings are specific to the study site and may not fully generalize to other settings with different socio-economic or cultural contexts. Future research should employ longitudinal designs and diverse methodologies to further validate these findings and inform targeted interventions on a broader scale.

Policy and Practice Implications

The findings of the study at Kibungo Referral Hospital highlight several critical implications for HIV/AIDS management and public health initiatives. Firstly, targeting interventions towards younger patients and those with lower educational attainment is essential to improve ART adherence rates. These groups were identified as being more vulnerable to non-adherence, likely due to a

combination of limited understanding of the long-term benefits of ART, fear of stigma, and competing socio-economic priorities. Implementing tailored educational programs that address common misconceptions about HIV treatment, the importance of consistent medication intake, and the reduction of stigma could significantly improve adherence. These programs should use simple, culturally appropriate language and delivery methods, such as peer educators, community health workers, or mobile-based platforms, to ensure accessibility and effectiveness.

Secondly, integrating ART into daily routines and providing support systems beyond simple reminders can foster long-term adherence behaviors. For instance, adherence clubs, peer support groups, or structured treatment buddy systems can offer emotional encouragement and practical assistance, which are crucial for individuals facing isolation or psychosocial distress. Additionally, digital tools such as SMS reminders, mobile applications, and community-based follow-up mechanisms may serve as supplementary aids to reinforce adherence habits.

Health systems should also prioritize comprehensive care models that go beyond the clinical provision of antiretroviral therapy and instead emphasize patient empowerment, social support, and holistic care. This includes ensuring that ART services are accessible in terms of distance and waiting time, streamlining service delivery, and training healthcare providers in patient-centered communication and counseling techniques. By addressing the multifaceted barriers, ranging from socio-demographic and behavioral factors to health system inefficiencies, public health programs can foster an environment where sustained adherence becomes the norm rather than the exception.

CONCLUSION

In conclusion, this study has revealed that the overall non-adherence rate to ART was slightly high among HIV patients attending Kibungo Referral Hospital. Key factors significantly associated with non-adherence included younger

age, lack of tertiary education, perceived stigma, doubts about the effectiveness of ART, and difficulty in integrating ART into daily routines. These findings underscore the need for targeted interventions that address educational gaps, reduce stigma, and provide supportive mechanisms to help patients establish consistent treatment habits. However, it is important to acknowledge that the cross-sectional nature of this study limits the ability to infer causal relationships between the identified factors and non-adherence. Future longitudinal studies are recommended to better understand the directionality and long-term impact of these associations.

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Author contributions:

Mukezamfura Niyonsenga Phocas carried out the conceptualization and data curation of the study. The formal analysis was conducted by Mukezamfura Niyonsenga Phocas in collaboration with Dr. Charles Nsanzabera. The methodology was developed by Mukezamfura Niyonsenga Phocas and Dr. Habimana Amos. The original draft of the manuscript was written by Mukezamfura Niyonsenga Phocas and Habimana Amos, while the review and editing were undertaken by Mukezamfura Niyonsenga Phocas, Dr. Habimana Amos (MPH, PhD), and Dr. Charles Nsanzabera (MPH, PhD).

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Data availability

All data were shared within this study.

Declarations

Ethics approval and consent to participate

This research was carried out in accordance with the Declaration of Helsinki and received approval from the Mount Kenya University Ethical Review Board (Reference number: MKU/ETHICS/23/01/2024(1)). Additionally, Kibungo Referral Hospital has provided the authorization for conducting the study. Participants were informed about ethical considerations, including confidentiality, voluntary participation, the right to withdraw from the study, and potential risks and benefits. Informed consent was also obtained and signed from each participant selected for the study. The study ID number was used to identify participants. Interviews were conducted privately, and participants could withdraw at any time. There was no personal benefit or risk associated with taking part in this study. Data were stored securely and reported only in aggregate form.

Competing interests

The authors declare no competing interests.

REFERENCES

1. Buh A, Deonandan R, Gomes J, Krentel A, Oladimeji O, Yaya S. Prevalence and factors associated with HIV treatment non-adherence among people living with HIV in three regions of Cameroon: A cross-sectional study. *PLoS One*. 2023;18: e0283991.
2. Atinga RA, Yarney L, Gavu NM. Factors influencing long-term medication non-adherence among diabetes and hypertensive patients in Ghana: A qualitative investigation. *PLoS One*. 2018;13: e0193995.
3. Ross J, Ingabire C, Umwiza F, Gasana J, Munyaneza A, Murenzi G, et al. How early is too early? Challenges in ART initiation and engaging in HIV care under Treat All in Rwanda-A qualitative study. *PLoS One*. 2021;16.
4. Ntabanganyimana D, Rugema L, Omolo J, Nsekuye O, Malamba SS. Incidence and factors associated with being lost to follow-up among people living with HIV and receiving

antiretroviral therapy in Nyarugenge the central business district of Kigali city, Rwanda. *PLoS One*. 2022;17.

5. World Health Organization. Global update on HIV/AIDS statistics. Geneva; 2023.

6. UNAIDS. UNAIDS data 2022. Joint United Nations Programme on HIV/AIDS [Internet]. 2022. Available from: https://www.unaids.org/en/resources/documents/2023/2022_unaids_data

7. Nsanzimana S, Semakula M, Ndahindwa V, Remera E, Sebuho D, Uwizihiwe JP, et al. Retention in care and virological failure among adult HIV+ patients on second-line ART in Rwanda: a national representative study. *BMC Infect Dis*. 2019; 19:312.

8. Ministry of Health. Annual health sector performance report. Fiscal year 2021-2022. [Internet]. 2023. Available from: <https://www.moh.gov.rw/index.php?eID=dumpFile&t=f&f=69777&token=c6595d564dd66742bfe4d887df3a3a7ef9652e68>

9. RBC. HIV/AIDS program report: ART adherence and non-adherence in Rwanda. Kigali-Rwanda; 2023.

10. Gast A, Mathes T. Medication adherence influencing factors—an (updated) overview of systematic reviews. *Syst Rev*. 2019; 8:112.

11. De los Rios P, Okoli C, Puneekar Y, Allan B, Muchenje M, Castellanos E, et al. Prevalence, determinants, and impact of suboptimal adherence to HIV medication in 25 countries. *Prev Med (Baltim)*. 2020; 139:106182.

12. Becker N, Cordeiro LS, Poudel KC, Sibiya TE, Sayer AG, Sibeko LN. Individual, household, and community level barriers to ART adherence among women in rural Eswatini. *PLoS One*. 2020;15: e0231952.

13. Itanga I, Ndagijimana A, Claudine Simbi CM, Ntaganira J. Opportunistic Infections and Associated Factors among HIV-Infected Adult Persons on Antiretroviral Therapy at Ruhengeri Referral Hospital, Rwanda: A cross-sectional

study. *Rwanda Journal of Medicine and Health Sciences*. 2022; 5:323–31.

14. Hakizayezu F, Biracyaza E, Niyompano H, Umubyeyi A. The Frequency and Predictors of Unsuppressed HIV Viral Load Among People with HIV in Nyaruguru District, Rwanda. *HIV/AIDS - Research and Palliative Care*. 2022; Volume 14:381–95.

15. Uakarn C. Guidelines for Sample Size Calculation in Health Research. *Journal of Health Statistics*. 2021; 18:102–10.

16. Belayneh Y, Asmamaw Y, Amsalu M. Non-adherence to antiretroviral therapy and its determinants among HIV-infected patients in Ethiopia. *Journal of HIV/AIDS & Infectious Diseases*. 2017; 8:113–21.

17. Nwauche CA, Nwabueze CF, Umeh MI. ART non-adherence and associated factors among HIV-positive patients in a Nigerian hospital. *African Journal of Medical Research*. 2019; 12:98–104.

18. Kebede A, Mesfin A, Tadesse G. Prevalence of ART non-adherence and associated factors among HIV patients in Uganda. *East African Health Journal*. 2019; 6:230–8.

19. South African Bureau of Medical Epidemiology (SABME). ART adherence and non-adherence rates in South Africa: A national overview. *South African Medical Journal*. 2016; 106:410–5.

20. Barclay TR, Houser BL, Foulks K. ART non-adherence trends in developed regions: The US and Europe. *International Journal of HIV Medicine*. 2017; 13:58–67.

21. Smith L, Jones M, Diaz H. Factors influencing ART adherence among young adults. *Journal of Adolescent Health*. 2023; 72:124–31.

22. Johnson MO, Neilands TB, Dilworth SE, Morin SF, Remien RH, Chesney MA. The Role of Self-Efficacy in HIV Treatment Adherence: Validation of the HIV Treatment Adherence Self-Efficacy Scale (HIV-ASES). *J Behav Med*. 2007; 30:359–70.

23. Parker R, Aggleton P. HIV/AIDS-related stigma and discrimination: A conceptual framework and an agenda for action. *AIDS Care*. 2021; 19:233-239.

24. Le PM, Nguyen PT, Nguyen H V, Bui DH, Vo SH, Nguyen N V, et al. Adherence to highly active antiretroviral therapy among people living with HIV and associated high-risk behaviours and clinical characteristics: A cross-sectional survey in Vietnam. *Int J STD AIDS*. 2021; 32:911–8.

25. Martin S, Bennett D, Campbell K. Shifts in smoking prevalence among young adults: A global perspective. *Tob Induc Dis*. 2023;21.

26. Brown MJ, Bogart LM. The role of structured treatment plans in enhancing ART adherence. *Global Health Studies*. 2024; 8:45-54.

27. Lewis S, Ross J, Sen D. Examining the efficacy of reminder methods in ART adherence. *American Journal of Public Health*, .2022; 111:1675-1683.

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