

Prevalence of non-adherence to antiretroviral therapy among people living with HIV and mitigation used to control in Kirinda District Hospital

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DOI: <https://doi.org/10.5281/zenodo.21295618>

Published Date: 09-July-2026

Abstract: Background: Antiretroviral therapy (ART) adherence is the cornerstone of effective HIV management; suboptimal adherence undermines viral suppression, increases transmission risk, and accelerates disease progression. Rwanda reports a 3% adult HIV prevalence, yet determinants of non-adherence at facility level, particularly in western district hospitals, remain insufficiently characterized. This study determined the prevalence and multidimensional determinants of antiretroviral drug (ARD) non-adherence among people living with HIV (PLHIV) at Kirinda District Hospital, Karongi District, Rwanda.

Methods: A cross-sectional analytical mixed-methods study was conducted among 196 adult PLHIV on ART for at least six months at Kirinda District Hospital. Participants were selected through a finite-population-adjusted sample size (Fisher formula). Data were collected via structured questionnaires and five focus group discussions (n=42). Quantitative analysis used IBM SPSS v28; bivariate chi-square and multivariate logistic regression (95% CI; p<0.05) identified independent predictors of non-adherence. Qualitative data were analyzed thematically using NVivo.

Results: The overall non-adherence prevalence was 23.0% (n=45). Among non-adherent participants, 72.4% reported missing doses at least weekly; principal self-reported barriers were HIV-related stigma (16.3%), fear of status disclosure (13.3%), and drug side effects (12.8%). Knowledge gaps were prominent: 27.6% were unaware of ARV effectiveness and 41.3% did not know the risks of non-adherence. Social support was inadequate, with 51.6% uncomfortable discussing HIV status with family. Multivariate analysis identified six independent predictors of non-adherence: widowhood (aOR=2.82, 95% CI: 1.39–12.88, p=0.043), no formal education (aOR=2.61, 95% CI: 2.37–17.24, p=0.002), less than one year on ART (aOR=0.42, 95% CI: 0.05–1.68, p=0.024), experiencing drug side effects (aOR=2.56, 95% CI: 2.30–19.86, p=0.012), lacking knowledge of non-adherence consequences (aOR=2.12, 95% CI: 1.50–8.56, p=0.012), and absence of reminder tools (aOR=1.92, 95% CI: 2.92–20.67, p=0.041). Qualitative findings corroborated these determinants, revealing four major thematic domains: biomedical challenges and side-effect burden, structural and stigma-related barriers, sociocultural dynamics, and treatment literacy gaps.

Conclusion: Non-adherence at Kirinda District Hospital is driven by intersecting biomedical, structural, sociocultural, and knowledge-related determinants. Effective responses require multilevel, patient-centered interventions including enhanced side-effect management, targeted psychosocial support for widowed PLHIV, culturally adapted treatment literacy programmes, universal reminder-tool provision, and strengthened community stigma-reduction initiatives.

Keywords: antiretroviral therapy; ART adherence; non-adherence; PLHIV; HIV; Rwanda; stigma; treatment literacy; mixed methods; district hospital.

1. BACKGROUND

Globally, approximately 39.0 million people are living with HIV, with nearly two-thirds residing in sub-Saharan Africa (SSA) [1]. Antiretroviral therapy (ART) has transformed HIV from a uniformly fatal condition to a manageable chronic illness, with over 23.3 million people now accessing treatment worldwide [1]. However, the full benefits of ART are contingent upon sustained adherence: a minimum threshold of $\geq 95\%$ adherence is required for durable viral suppression, prevention of drug resistance, and reduction of onward transmission [2].

ART non-adherence defined as missing doses, delayed intake by more than two hours, or deviating from prescribed regimens represents one of the most significant modifiable barriers to HIV treatment success [3]. In SSA, where health system infrastructure, socioeconomic conditions, and sociocultural factors impose additional constraints on treatment engagement, suboptimal adherence is well documented and remains an active programmatic challenge [4]. Rwanda has made substantial investments in HIV programme delivery, achieving a 3% adult HIV prevalence and expanding ART coverage significantly since 2010 [5]; yet adherence challenges persist across facilities, with individual-level, structural, and community-level determinants operating simultaneously [6].

The determinants of non-adherence are multidimensional, encompassing drug side effects, stigma and disclosure-related fears, health system accessibility barriers, inadequate treatment literacy, low social support, and individual behavioural factors including forgetfulness and absence of reminder systems [7,8]. Widowhood and low educational attainment have been identified as significant sociodemographic vulnerability factors in prior East African studies [9,10]. Despite this body of evidence at national and regional levels, facility-specific data characterizing the prevalence and determinants of ART non-adherence at Kirinda District Hospital serving the rural and peri-urban populations of Karongi District in western Rwanda remain unpublished.

This study was therefore conducted to determine the prevalence of ARV non-adherence among PLHIV at Kirinda District Hospital, to identify the sociodemographic, biomedical, and knowledge-related determinants of non-adherence, and to evaluate the mitigation strategies in use. Findings are intended to provide an evidence base for targeted, contextually appropriate interventions to improve ART adherence and treatment outcomes in this setting.

2. METHODS

Study Design and Setting

A cross-sectional analytical mixed-methods study was conducted at Kirinda District Hospital, located in Karongi District, Western Province, Rwanda. Karongi District covers 993 km² with a population of 331,808, predominantly rural (93.1%), with a high poverty burden and limited healthcare infrastructure. Kirinda District Hospital is the principal public health facility serving the district's HIV programme and was selected as the study site due to the absence of facility-specific adherence data and its representativeness of resource-limited settings in western Rwanda.

Target Population, Inclusion, and Exclusion Criteria

The target population comprised adult PLHIV (≥ 18 years) enrolled in the ART programme at Kirinda District Hospital who had been on ART for at least six months at the time of data collection. Patients below 18 years of age, those with severe cognitive impairment precluding informed consent, critically ill patients, and those who refused to participate were excluded.

Sample Size and Sampling

Sample size was estimated using Fisher's formula for populations larger than 10,000: $n = Z^2pq/d^2$, where $Z=1.96$ (95% confidence), $p=0.5$, $q=0.5$, $d=0.05$. This yielded $n=384$. A finite population correction was applied ($nf = n/(1+n/N)$, $N=400$), producing an adjusted minimum sample of 196. A census approach was applied to patient files, with purposive sampling of healthcare providers for qualitative components.

Data Collection

Quantitative data were collected using structured, pre-tested semi-structured questionnaires administered by trained research assistants in Kinyarwanda. The instrument captured sociodemographic characteristics, ART adherence behavior (self-reported), knowledge, attitudes and practices (KAP) regarding ART, social support, accessibility of services, and use of adherence tools. Retroactive extraction of clinical data from ARV service files provided supplementary adherence records. Instruments were validated at Kibogora District Hospital ARV service (comparable catchment population); Cronbach's alpha and test-retest procedures confirmed acceptable reliability.

Qualitative data were generated through five focus group discussions (FGDs) involving 42 participants: 18 healthcare providers (nurses, counsellors, physicians) and 24 PLHIV. FGDs explored perceived drivers of non-adherence, patient experiences of side effects, stigma, and health system barriers, and effectiveness of existing mitigation strategies. All FGDs were audio-recorded, transcribed verbatim, and translated from Kinyarwanda where necessary.

3. DATA ANALYSIS

Quantitative data were entered and analyzed using IBM SPSS version 28.0. Descriptive statistics (frequencies, percentages) summarized participant characteristics and ARV adherence outcomes. Bivariate chi-square tests examined unadjusted associations between independent variables and the primary outcome (current ARV non-adherence). Variables with $p < 0.25$ in bivariate analysis were entered into multivariate binary logistic regression. Results are reported as adjusted odds ratios (aOR) with 95% confidence intervals (CI); statistical significance was set at $p < 0.05$.

Qualitative data were analyzed thematically using NVivo software. Analysis proceeded through open coding, axial coding, and identification of overarching themes and sub-themes. Thematic saturation was the criterion for cessation of FGD data collection. Mixed-methods integration applied a convergent triangulation design, with qualitative findings used to corroborate, explain, and contextualize quantitative results.

Ethical Considerations

Ethical clearance was obtained from the Institutional Review Board of Mount Kenya University. Administrative approval was obtained from the management of Kirinda District Hospital. Written informed consent was obtained from all participants in Kinyarwanda. Participants were assured of confidentiality through unique identifiers; no personal identifiers were retained in the research database. Participants were informed of their right to withdraw at any time without consequence.

4. RESULTS

Sociodemographic Characteristics

A total of 196 adult PLHIV participated. The sample was nearly equally distributed by gender (male: 50.5%, $n=99$; female: 49.5%, $n=97$). The predominant age group was ≥ 51 years (44.9%, $n=88$), followed by 41–50 years (20.4%, $n=40$). Marital status was distributed across married (28.1%, $n=55$), widowed (28.1%, $n=55$), divorced (27.0%, $n=53$), and single (16.8%, $n=33$). Occupationally, government employees (25.5%, $n=50$) and unemployed individuals (25.0%, $n=49$) constituted the largest groups. Educational attainment was distributed across no formal education (23.5%, $n=46$), primary (24.0%, $n=47$), secondary (24.5%, $n=48$), and university level (28.1%, $n=55$). Detailed sociodemographic data are presented in Table 1.

Table 1: Sociodemographic characteristics of participants (n=196)

Variables		Frequency	Percent
Gender	Male	99	50.5
	Female	97	49.5
Age group (years)	≤ 30 years	36	18.4
	31–40 years	32	16.3
	41–50 years	40	20.4
	≥ 51 years	88	44.9
Marital status	Single	33	16.8
	Married	55	28.1
	Divorced	53	27
	Widowed	55	28.1
Occupation			
	Cultivator/farmer	37	18.9

Education level	Student	29	14.8
	Government employee	50	25.5
	Self employed	31	15.8
	Unemployed	49	25
	No formal education	46	23.5
	Primary education	47	24
	Secondary education	48	24.5
	University	55	28.1

Prevalence of ARV Non-Adherence

The overall prevalence of ARV non-adherence was 23.0% (n=45/196), while 77.0% (n=151) reported current adherence to their antiretroviral regimen (figure 1).

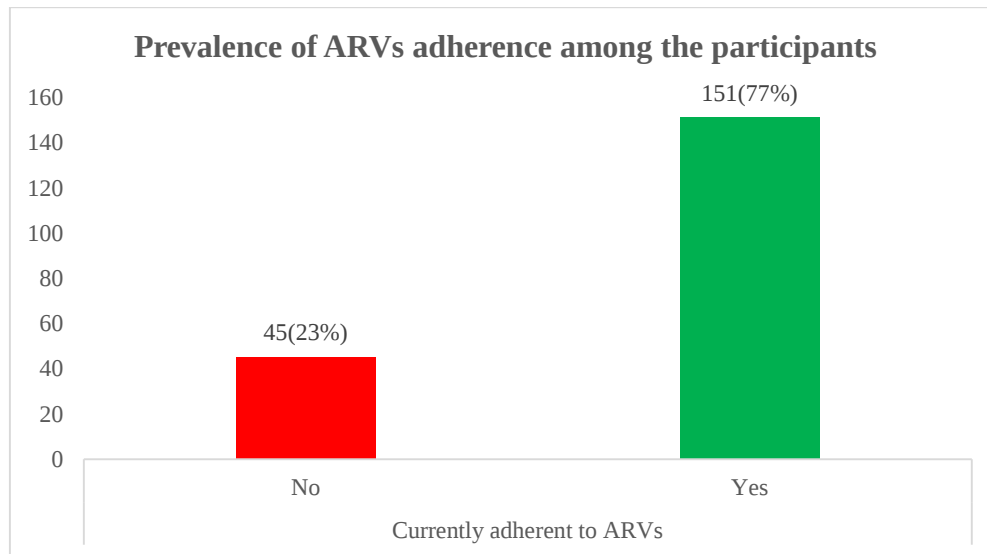


Figure 1: Prevalence of ARVs non adherence among the participants

KAP regarding ARV, social support, and accessibility of ARV among the participants

Among all participants, 72.4% reported missing doses at least once weekly; forgetfulness was the most commonly cited reason (10.2%), followed by HIV-related stigma (16.3%), fear of status disclosure (13.3%), and drug side effects (12.8%). Nearly half (49.0%, n=96) reported experiencing ARV side effects. Social support was limited: 51.6% reported discomfort discussing their HIV status with family or friends, and 50.5% reported experiencing discrimination related to their HIV status. Healthcare accessibility challenges were reported by 53.6%, attributable primarily to long clinic wait times (35.7%), medication stockouts (34.2%), and transportation costs (30.1%), (table 2).

Table 2: KAP regarding ARV, social support, and accessibility of ARV among the participants

Variables		Frequency	Percent
ARV adherence			
Years diagnosed with HIV	Below 1 year	37	18.9
	Between 1 and 3 years	24	12.2
	Between 4 and 6 years	38	19.4
	Between 7 and 9years	31	15.8
	Between 10 and 12years	33	16.8
	Above 12 years	33	16.8
Years on ARVs	Below 1 year	38	19.4
	Between 1 and 3 years	26	13.3
	Between 4 and 6 years	32	16.3
	Between 7 and 9years	26	13.3
	Between 10 and 12years	32	16.3
	Above 12 years	42	21.4
Missed ARVs doses per week	Never	54	27.6
	1-2 times	49	25

	3-4 times	42	21.4
	>= 5 times	51	26
Reason for missing to take ARVs sometime	Side effects of the medication	25	12.8
	Forgetfulness	20	10.2
	Difficulty swallowing the medication	17	8.7
	Complex dosing schedule	15	7.7
	Fear of disclosure	26	13.3
	Stigma associated with HIV	32	16.3
	Travel and busy schedule	21	10.7
	Lack of social support	26	13.3
	Other	14	7.1
Ever experienced side effects from taking ARVs	No	100	51
	Yes	96	49
Action he/she takes when he/she experiences side effects	Stop taking the medication	47	24
	Consult my doctor	50	25.5
	Self-medicate	41	20.9
	Other	58	29.6
In his/her opinion, how important is it for PLWHIV to adhere to their ARV medication	Very important	72	36.7
	Somewhat important	64	32.7
	Not important	60	30.6
Knowledge, Attitude & Practice (KAP) Regarding ARVs			
Effective he/she believes ARVs are in controlling HIV	Very effective	49	25
	Somewhat effective	44	22.4
	Not effective	49	25
	I don't know	54	27.6
Knowledge of nonadherence risks	Yes	51	26
	No	81	41.3
	I don't know	64	32.7
He/she believe it's inconvenient to take daily	Strongly agree	50	25.5
	Agree	56	28.6
	Disagree	43	21.9
	Strongly disagree	47	24
Taking ARV make him/her feel like sick person	Strongly agree	53	27
	Agree	52	26.5
	Disagree	49	25
	Strongly disagree	42	21.4
Having specific routine for taking ARVs	No	93	47.4
	Yes	103	52.6
He/she use any reminders (alarms, pillboxes) to help you take his/her ARVs on time	Yes	100	51
	No	96	49
Social Support			
Comfort talking to your family and friends about your HIV status	Very comfortable	48	24.5
	Somewhat comfortable	46	23.5
	Not comfortable	56	28.6
	Not comfortable at all	46	23.5
Feeling supported by his/her family and friends in adhering to your ARV treatment	Strongly agree	54	27.6
	Agree	41	20.9
	Disagree	46	23.5
	Strongly disagree	55	28.1
Experienced any form of discrimination due to his/her HIV status	No	97	49.5
	Yes	99	50.5
Accessibility of ARVs			
Experienced any challenges in accessing ARVs at the hospital	No	91	46.4
	Yes	105	53.6
Type of challenges	Long wait times at the clinic	70	35.7
	Stock outs of medication	67	34.2
	Transportation costs	59	30.1

Bivariate Analysis: Sociodemographic Predictors

Bivariate chi-square analysis identified marital status ($\chi^2=6.184$, $p=0.005$) and education level ($\chi^2=6.917$, $p=0.035$) as significantly associated with ARV non-adherence. Divorced participants demonstrated the highest non-adherence proportion (33.3%), followed by married (31.1%) and widowed (22.2%) individuals. Among education categories, those with no formal education had the highest non-adherence rate (33.3%), compared to 20.0% among those with university-level education. Gender and age group were not significantly associated with non-adherence in bivariate analysis (Table 3).

Table 3: Bivariate analysis of sociodemographic factors and ARV non-adherence (n=196).

		Currently adherent to ARVs				Total, n(%)	Chi- square	P value
		No		Yes				
Variable		n	%	n	%			
Gender	Male	22	48.9	77	51.0	99(50.5)	0.061	0.804
	Female	23	51.1	74	49	97(49.5)		
Age group (years)	<= 30 years	5	11.1	31	20.5	36(18.4)	2.263	0.453
	31-40 years	7	15.6	25	16.6	32(16.3)		
	41-50 years	9	20	31	20.5	40(20.4)		
	>=51 years	24	53.3	64	42.4	88(44.9)		
Marital status	Single	6	13.3	27	17.9	33(16.8)	6.184	0.005
	Married	14	31.1	41	27.2	55(28.1)		
	Divorced	15	33.3	38	25.2	53(27)		
	Widowed	10	22.2	45	29.8	55(28.1)		
Occupation	Cultivator/farmer	14	31.1	23	15.2	37(18.9)	6.972	0.137
	Student	5	11.1	24	15.9	29(14.8)		
	Government employee	11	24.4	39	25.8	50(25.5)		
	Self employed	4	8.9	27	17.9	31(15.8)		
	Unemployed	11	24.4	38	25.2	49(25)		
Education level	No formal education	15	33.3	31	20.5	46(23.5)	6.917	0.035
	Primary education	14	31.1	33	21.9	48(24.5)		
	Secondary education	7	15.6	41	27.2	48(24.5)		
	University	9	20	46	30.5	55(28.1)		

Bivariate Analysis: KAP and Clinical Predictors

Additional bivariate analysis revealed significant associations between ARV non-adherence and duration of ART ($\chi^2=8.092$, $p=0.008$), duration since HIV diagnosis ($\chi^2=8.895$, $p=0.026$), experience of side effects ($\chi^2=4.099$, $p=0.043$), perceived importance of adherence ($\chi^2=5.422$, $p=0.006$), knowledge of non-adherence risks ($\chi^2=8.342$, $p=0.031$), and use of adherence reminders ($\chi^2=12.011$, $p=0.003$). Non-adherence was highest among those on ART for less than one year (Table 4).

Table 4: Bivariate analysis - KAP and clinical factors and ARV non-adherence (n=196).

Variables				Currently adherent to ARVs					Chi-square	P value
				No		Yes		Total, n(%)		
				n	%	n	%			
Years diagnosed with HIV	Below 1 year	7	15.6	30	19.9	37(18.9)	8.895	0.026		
	Between 1 and 3 years	6	13.3	18	11.9	24(12.2)				
	Between 4 and 6 years	8	17.8	30	19.9	38(19.4)				
	Between 7 and 9years	9	20	22	14.6	31(15.8)				
	Between 10 and 12years	6	13.3	27	17.9	33(16.8)				
	Above 12 years	9	20	24	15.9	33(16.8)				
Years on ARVs	Below 1 year	7	15.6	31	20.5	38(19.4)	8.092	0.008		
	Between 1 and 3 years	4	8.9	22	14.6	26(13.3)				
	Between 4 and 6 years	8	17.8	24	15.9	32(16.3)				
	Between 7 and 9years	6	13.3	20	13.2	26(13.3)				
	Between 10 and 12years	9	20	23	15.2	32(16.3)				
	Above 12 years	11	24.4	31	20.5	42(21.4)				

Missed ARVs doses per week	Never	11	24.4	43	28.5	43(27.6)	1.721	0.632
	1-2 times	9	20	40	26.5	49(25)		
	3-4 times	12	26.7	30	19.9	42(21.4)		
	>= 5 times	13	28.9	38	25.2	51(26)		
Reason for missing to take ARVs sometime	Side effects of the medication	9	20	16	10.6	25(12.8)	8.593	0.378
	Forgetfulness	3	6.7	17	11.3	20(10.2)		
	Difficulty swallowing the medication	5	11.1	12	7.9	17(8.7)		
	Complex dosing schedule	5	11.1	10	6.6	15(7.7)		
	Fear of disclosure	8	17.8	18	11.9	26(13.3)		
	Stigma associated with HIV	6	13.3	26	17.2	32(16.3)		
	Travel and busy schedule	2	4.4	19	12.6	21(10.7)		
	Lack of social support	5	11.1	21	13.9	26(13.3)		
	Other	2	4.4	12	7.9	14(7.1)		
Ever experienced side effects from taking ARVs	No	17	37.8	83	55	100(51)	4.099	0.043
	Yes	28	62.2	68	45	96(49)		
Action he/she takes when he/she experiences side effects	Stop taking the medication	9	20	38	25.2	47(24)	0.716	869
	Consult my doctor	12	26.7	38	25.2	50(25.5)		
	Self-medicate	9	20	32	21.2	41(20.9)		
	Other	15	33.3	43	28.5	58(29.6)		
In his/her opinion, how important is it for PLWHIV to adhere to their ARV medication	Very important	12	26.7	60	39.7	72(36.7)	5.422	0.006
	Somewhat important	21	46.7	43	28.5	64(32.7)		
	Not important	12	26.7	48	31.8	60(30.6)		
Effective he/she believes ARVs are in controlling HIV	Very effective	15	33.3	34	22.5	49(25)	3.827	0.281
	Somewhat effective	11	24.4	33	21.9	44(22.4)		
	Not effective	7	15.6	42	27.8	49(25)		
	I don't know	12	26.7	42	27.8	54(27.6)		
Knowledge of nonadherence risks	Yes	8	17.8	43	28.5	51(26)	8.342	0.031
	No	22	48.9	59	39.1	81(41.3)		
	I don't know	15	33.3	49	32.5	64(32.7)		
He/she believe it's inconvenient to take daily	Strongly agree	12	26.7	38	25.2	50(25.5)	0.347	0.951
	Agree	12	26.7	44	29.1	56(28.6)		
	Disagree	11	24.4	32	21.2	43(21.9)		
	Strongly disagree	10	22.2	37	24.5	47(24)		
Taking ARV make him/her feel like sick person	Strongly agree	9	20	44	29.1	53(27)	3.634	0.304
	Agree	14	31.1	38	25.2	52(26.5)		
	Disagree	9	20	40	26.5	49(25)		
	Strongly disagree	13	28.9	29	19.2	42(21.4)		
Having specific routine for taking ARVs	No	24	53.3	69	45.7	93(47.4)	0.811	0.368
	Yes	21	46.7	82	54.3	103(52.6)		
He/she use any reminders (alarms, pillboxes) to help you take his/her ARVs on time	Yes	20	44.4	80	53	100(51)	12.011	0.003
	No	25	55.6	71	47	96(49)		

Multivariate Logistic Regression: Independent Predictors of Non-Adherence

After adjusting for confounders, six variables remained independently associated with ARV non-adherence (Table 5). Widowhood (aOR=2.82, 95% CI: 1.39–12.88, p=0.043), no formal education (aOR=2.61, 95% CI: 2.37–17.24, p=0.002), experience of ARV side effects (aOR=2.56, 95% CI: 2.30–19.86, p=0.012), and lacking knowledge of non-adherence risks

(aOR=2.12, 95% CI: 1.50–8.56, p=0.012) were independently associated with higher odds of non-adherence. Absence of reminder tools was also independently associated with non-adherence (aOR=1.92, 95% CI: 2.92–20.67, p=0.041).

Table 5: Multivariate logistic regression - independent predictors of ARV non-adherence (n=196).

Variable		Currently adherent to ARVs		P value
		aOR	95% CI	
Marital status	Single	Ref		
	Married	0.833	[0.832-2.817]	0.084
	Divorced	0.953	[0.998-2.126]	0.072
	Widowed	2.82	[1.392-12.876]	0.043
Education level	University	Ref		
	No formal education	2.612	[2.373-17.239]	0.002
	Primary education	1.245	[0.234-0.938]	0.063
	Secondary education	1.678	[0.396-0.798]	0.071
Years diagnosed with HIV	Above 12 years	Ref		
	Below 1 year	1.298	[0.359-4.229]	0.283
	Between 1 and 3 years	0.067	[0.784-1.938]	0.836
	Between 4 and 6 years	0.261	[0.396-2.798]	0.595
	Between 7 and 9years	0.932	[0.274-6.459]	0.368
	Between 10 and 12years	0.838	[0.231-0.846]	0.453
Years on ARVs	Above 12 years	Ref		
	Below 1 year	0.423	[0.052-1.679]	0.24
	Between 1 and 3 years	1.251	[0.124-2.623]	0.063
	Between 4 and 6 years	1.827	[0.277-1.212]	0.085
	Between 7 and 9years	0.816	[0.102-2.771]	0.213
	Between 10 and 12years	0.917	[0.937-4.196]	0.373
Ever experienced side effects from taking ARVs	No	Ref		
	Yes	2.56	[2.301-19.864]	0.012
In his/her opinion, how important is it for PLWHIV to adhere to their ARV medication	Very important	Ref		
	Somewhat important	0.839	[1.257-16.562]	0.089
	Not important	0.268	[0.564-1.953]	0.093
Knowledge of nonadherence risks	Yes	Ref		
	No	2.123	[1.495-8.562]	0.012
	I don't know	1.92	[1.858-4.815]	0.067
He/she use any reminders (alarms, pillboxes) to help you take his/her ARVs on time	Yes	Ref		
	No	1.92	[2.916-20.672]	0.041

aOR = Adjusted Odds Ratio; CI = Confidence Interval; Ref = Reference; *p<0.05

Qualitative Findings

Five FGDs with 42 participants generated four overarching thematic domains that converged with and contextualized the quantitative findings.

Theme 1: Biomedical Challenges and Side-Effect Burden

Side effects were consistently identified as a primary driver of non-adherence across all FGDs. Gastrointestinal disturbances, neurological symptoms, and dermatological reactions were most commonly described. A 34-year-old female PLHIV stated: "When I started taking the drugs, I had terrible nausea and dizziness... I stopped for two weeks because I thought the medicine was making me sicker than the virus itself." Healthcare providers acknowledged inadequate resources for proactive side-effect management, with one nurse observing: "We counsel patients about side effects, but we don't have enough medications to manage them properly." Vulnerable sub-populations including pregnant women and orphaned children under caregiver supervision demonstrated heightened adherence difficulties within this domain.

Theme 2: Structural Barriers and HIV-Related Stigma

Geographic distance, transportation costs, and clinic wait times constituted structural barriers, particularly for rural participants. A 41-year-old male stated: *"The hospital is 15 kilometres away... when I don't have money, I miss my appointment and sometimes run out of drugs."* Stigma operated at internalized, interpersonal, and community levels and significantly shaped adherence behaviour: *"I cannot take my drugs in front of them because they will know my status. Sometimes I skip the evening dose because I have no privacy"* (28-year-old female, sharing accommodation). Healthcare providers identified stigma as the most pervasive challenge to sustained adherence, noting that even patients with years of stable treatment had defaulted following community disclosure.

Theme 3: Sociocultural Dynamics and Gender Inequity

Traditional healing practices, religious beliefs about curative prayer, and male partner control over women's health-seeking behaviour constituted key sociocultural determinants. A 45-year-old male described stopping ART for three months following advice from a traditional healer. A married woman explained: *"My husband doesn't know my status. If he finds the drugs, he will divorce me and take the children."* Healthcare providers observed that male partners frequently restricted women's ANC and HIV programme attendance, contributing to non-adherence among female PLHIV.

Theme 4: Treatment Literacy Gaps and Behavioural Determinants

Significant knowledge deficits regarding HIV pathophysiology, ART mechanisms, and consequences of missed doses were prevalent. A PLHIV participant stated: *"I take the drugs because the doctor said so, but I don't really understand how they work. When I feel fine, I think maybe I don't need them anymore."* Healthcare providers acknowledged that time constraints severely limited the quality of patient education. Conversely, successful adherers demonstrated deliberate behavioural integration linking medication-taking to daily routines and leveraging phone alarms and trusted social networks underscoring the potential of structured adherence support tools.

5. DISCUSSION

This study documents a 23.0% ARV non-adherence prevalence at Kirinda District Hospital below the 95% threshold required for durable viral suppression and treatment success established by WHO [2]. This finding is broadly comparable to the 26% non-adherence rate reported in a multi-country SSA analysis [11], and aligns with a Ugandan facility-level study reporting 26% non-adherence in a comparable district hospital setting [12]. Rwanda's national HIV programme characterized by decentralized care delivery, community health worker networks, and sustained government investment in universal health coverage likely contributes to the relatively lower non-adherence observed compared to some West African settings, where non-adherence rates exceeding 35% have been documented [13]. Nevertheless, the 23% figure represents a substantive gap requiring targeted programmatic response, as even modest non-adherence can precipitate viral rebound, clinical deterioration, and increased community transmission.

Widowhood was a significant independent predictor of non-adherence (aOR=2.82, p=0.043), consistent with findings from Ethiopia by Gebrezgabher and colleagues [9], who identified bereavement-related social isolation, loss of caregiver support, and economic hardship as compounding vulnerabilities among widowed PLHIV. The qualitative data from this study powerfully corroborate this association: an orphaned participant described the absence of anyone to provide reminders or transport support, stating *"I wish I had someone who cared."* These findings support the prioritization of targeted psychosocial interventions including bereavement counselling, peer support linkage, and community adherence clubs for widowed PLHIV [14].

No formal education was the second most powerful independent predictor of non-adherence (aOR=2.61, p=0.002), consistent with a seminal meta-analysis by Mills and colleagues [10], which demonstrated that lower educational attainment is a consistent correlate of suboptimal ART adherence across SSA. The mechanism appears mediated through health literacy: less-educated patients demonstrate lower comprehension of viral suppression concepts, medication schedules, and the clinical significance of missed doses [15]. The qualitative finding that healthcare providers lacked sufficient time for comprehensive patient education *"I have 50 patients to see in one morning"* further highlights the structural insufficiency of current counselling delivery for patients with limited educational backgrounds. Peer educator programmes and visual, simplified treatment literacy materials have demonstrated efficacy in comparable settings and warrant implementation [16].

Drug side effects were independently associated with non-adherence (aOR=2.56, p=0.012), replicating findings from Langebeek and colleagues' meta-analysis [17] and a South African study by Yakob and Ncama [18], which identified

adverse drug reactions as among the most common reasons for treatment discontinuation. The qualitative data from this study provide compelling illustrative evidence: participants who experienced severe nausea, dizziness, or dermatological reactions during early treatment reported treatment cessation without healthcare provider consultation, in some cases for weeks. The inadequacy of reactive side-effect management systems at the facility level driven by resource constraints and patient-to-provider ratios represents a critical structural gap [19]. Establishment of dedicated rapid-response pathways for side-effect management and proactive switch protocols could substantially reduce adherence failure attributable to this modifiable cause.

The strong protective association of reminder tool use (aOR=1.92, $p=0.041$) confirms evidence from a meta-analysis by Finitsis and colleagues [20] demonstrating that structured adherence support tools including phone alarms, pillboxes, and SMS reminder systems significantly improve medication-taking behaviour in resource-limited settings. Crucially, in the qualitative analysis, successful long-term adherers described deliberate, self-designed behavioural integration strategies, such as linking medication-taking to morning coffee and evening prayers. These findings suggest that evidence-based adherence tools are both acceptable and effective in this population, and that their universal provision at ART initiation represents a high-yield, low-cost intervention opportunity [21].

The association between knowledge deficits regarding non-adherence consequences and greater non-adherence (aOR=2.12, $p=0.012$) is theoretically grounded in the Health Belief Model [22], which posits that perceived severity of and susceptibility to health threats are necessary antecedents of preventive health behaviour. The finding that 41.3% of participants were unaware of non-adherence risks despite being enrolled in a structured HIV programme underscores a persistent and clinically significant treatment literacy gap, and identifies enhanced patient education delivered through multiple modalities as an urgent priority.

Strengths and Limitations

This study is strengthened by its mixed-methods design, enabling both statistical quantification and contextual interpretation of non-adherence determinants. The concurrent qualitative component, involving healthcare providers and PLHIV, provides explanatory depth that purely quantitative studies cannot achieve. Limitations include the cross-sectional design, which precludes causal inference; reliance on self-reported adherence data, which may be subject to social desirability bias; and restriction to a single facility, limiting external generalizability. Future studies should employ longitudinal designs and objective adherence measures including pharmacy refill records and viral load data.

6. CONCLUSION

ARV non-adherence at Kirinda District Hospital is driven by a complex and intersecting array of biomedical, structural, sociocultural, and knowledge-related determinants. Independent predictors widowhood, absence of formal education, recent ART initiation, drug side effects, treatment literacy deficits, and lack of reminder tools map closely onto themes identified in qualitative data, providing a coherent and actionable portrait of the multi-level challenges to sustained adherence. Effective programmatic responses require multilevel, patient-centred interventions that simultaneously address psychosocial support for vulnerable PLHIV including widowed individuals, culturally adapted and educationally appropriate treatment literacy programmes, proactive and resource-adequate side-effect management systems, universal provision of adherence reminder tools at ART initiation, and comprehensive community-level stigma-reduction strategies. Rwanda's strong health system infrastructure and community health worker network provide important existing platforms through which such interventions can be delivered at scale.

Abbreviations

ART: Antiretroviral Therapy

ARV: Antiretroviral Drug

aOR: Adjusted Odds Ratio

CI: Confidence Interval

FGD: Focus Group Discussion

HIV: Human Immunodeficiency Virus

KAP: Knowledge, Attitude, and Practice

PLHIV: People Living with HIV

SPSS: Statistical Package for Social Sciences

SSA: Sub-Saharan Africa

WHO: World Health Organization

Declarations

Conflict of interest: The authors declare no conflict of interest.

Funding: This study received no external funding.

Availability of data and materials: Data are available from the corresponding author upon reasonable request.

Acknowledgements: The authors acknowledge the management and staff of Kirinda District Hospital for their cooperation, the study participants for their time and trust, the faculty of Mount Kigali University for academic support, and Dr. Maurice Silari for his expert supervision and scholarly mentorship throughout this research.

REFERENCES

- [1] UNAIDS. Global HIV & AIDS statistics — Fact sheet. UNAIDS; 2024. Available from: <https://www.unaids.org/en/resources/fact-sheet>
- [2] WHO. Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection: Recommendations for a public health approach. 2nd ed. World Health Organization; 2016.
- [3] Lantche MW, Fokam J, Cheudjui AJN, Tchatchueng JBM, Noumsi TSJ, Ateba FN, et al. Factors associated with non-adherence to antiretroviral therapy among HIV-infected adolescents aged 15–19 years. *Pan Afr Med J*. 2021;39:154.
- [4] Boadu I, Manu A, Aryeetey RNO, Kesse KA, Abdulai M, Acheampong E, et al. Adherence to antiretroviral therapy among HIV patients in Ghana: A systematic review and meta-analysis. *PLOS Glob Public Health*. 2023;3(11):e0002448.
- [5] Kawuki J, Nuwabaine L, Namulema A, Asiimwe JB, Sserwanja Q, Gatasi G, et al. Prevalence of risk factors for human immunodeficiency virus among sexually active women in Rwanda: A nationwide survey. *BMC Public Health*. 2023;23(1):2222.
- [6] Habumugisha E, Nyishimirente S, Katende G, Nkurunziza A, Mukeshimana M, Ngerageze I, et al. Factors influencing adherence to antiretroviral therapy among adolescents living with HIV in Rwanda. *Rwanda J Med Health Sci*. 2022;5(3):251–263.
- [7] Bartlett Ellis RJ, Haase JE, Ruppar TM. Understanding processes, outcomes, and contexts in medication adherence: The Medication Adherence Context and Outcomes (MACO) Framework. *Patient Prefer Adherence*. 2023;17:239–248.
- [8] Tuot S, Sim JW, Nagashima-Hayashi M, Chhoun P, Teo AKJ, Prem K, et al. What are the determinants of antiretroviral therapy adherence among stable people living with HIV? A cross-sectional study in Cambodia. *AIDS Res Ther*. 2023;20(1):47.
- [9] Gebrezgabher BB, Kebede Y, Kindie M, Tetemke D, Abay M, Gelaw YA. Determinants to antiretroviral treatment non-adherence among adult HIV/AIDS patients in northern Ethiopia. *AIDS Res Ther*. 2017;14:16.
- [10] Mills EJ, Nachega JB, Buchan I, Orbinski J, Attaran A, Singh S, et al. Adherence to antiretroviral therapy in sub-Saharan Africa and North America: A meta-analysis. *JAMA*. 2006;296(6):679–690.
- [11] 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. *PLOS ONE*. 2023;18(4):e0283991.
- [12] Adrawa N, Alege JB, Izudi J. Alcohol consumption increases non-adherence to ART among people living with HIV enrolled to the community-based care model in rural northern Uganda. *PLoS ONE*. 2020;15(11):e0242801.

- [13] Sasaki Y, Kakimoto K, Dube C, Sikazwe I, Moyo C, Syakantu G, et al. Adherence to antiretroviral therapy during the early months of treatment in rural Zambia: Influence of demographic characteristics and social surroundings. *Ann Clin Microbiol Antimicrob.* 2012;11:34.
- [14] Kalichman SC, Hernandez D, Cherry C, Kalichman MO, Grebler T. Food insecurity and other poverty indicators among people living with HIV/AIDS: Effects on treatment and health outcomes. *J Community Health.* 2014;39(6):1133–1139.
- [15] Neupane S, Dhungana GP, Ghimire HC. Adherence to antiretroviral treatment and associated factors among people living with HIV and AIDS in Chitwan, Nepal. *BMC Public Health.* 2019;19(1):720.
- [16] Mbuagbaw L, Sivaramalingam B, Navarro T, Hobson N, Keepanasseril A, Wilczynski NJ, et al. Interventions for enhancing adherence to antiretroviral therapy: A systematic review of high quality studies. *AIDS Patient Care STDs.* 2015;29(5):248–266.
- [17] Langebeek N, Gisolf EH, Reiss P, Vervoort SC, Hafsteinsdóttir TB, Richter C, et al. Predictors and correlates of adherence to combination antiretroviral therapy for chronic HIV infection: A meta-analysis. *BMC Med.* 2014;12:142.
- [18] Yakob B, Ncama BP. Perceived quality of HIV treatment and care services in Wolaita Zone of southern Ethiopia: A cross-sectional study. *BMJ Open.* 2015;5(12):e010026.
- [19] Dibaba D, Kajela G, Chego M, Ermeko T, Zenbaba D, Hailu S, et al. Antiretroviral treatment adherence level and associated factors among adult HIV-positive patients. *HIV AIDS (Auckl).* 2021;13:1067–1078.
- [20] Finitsis DJ, Pellowski JA, Johnson BT. Text message intervention designs to promote adherence to antiretroviral therapy: A meta-analysis of randomised controlled trials. *PLoS One.* 2014;9(2):e88166.
- [21] Wakibi SN, Ng'ang'a ZW, Mbugua GG. Factors associated with non-adherence to highly active antiretroviral therapy in Nairobi, Kenya. *AIDS Res Ther.* 2011;8(1):43.
- [22] Rosenstock IM. Historical origins of the Health Belief Model. *Health Educ Monogr.* 1974;2(4):328–335.