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Factors Associated with Adherence to Antiretroviral Therapy Among Individuals Living with HIV/AIDS at Chawama Level One Hospital in Lusaka, Zambia: A Cross-Sectional Study

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Abstract

Background

Sub-Saharan Africa carries over two-thirds of the global HIV burden, with adherence to antiretroviral therapy (ART) remaining a critical challenge. In Zambia, peri-urban communities face compounded barriers due to social, behavioural, and health system constraints. This study examined factors associated with ART adherence among patients at Chawama Level One Hospital in Lusaka, Zambia.

Methods

An analytical cross-sectional study was conducted over 10 working days in July 2025 among HIV-positive adults aged 18 years and above who had been on ART for at least six months. A sample size of 373 participants was determined using Cochran's formula, and 372 completed the study (response rate: 99.7%). Participants were selected using stratified random sampling by sex, age group, and ART duration. Data were collected using a structured interviewer-administered digital questionnaire and analysed in Stata version 17. Adherence was measured using the Morisky Green Levine Medication Adherence Scale and dichotomised as adherent (0–1 missed doses) or non-adherent (≥ 2 missed doses) in the past 30 days. Descriptive statistics were generated, chi-square tests were applied for associations, and binary logistic regression identified factors independently associated with non-adherence ($p < 0.05$).

Results

The study enrolled 372 participants, with slightly more females (52.4%, n = 195) than males (47.6%, n = 177). Nearly half were married (43.0%, n = 160), while 38.4% (n = 143) were single, 10.5% (n = 39) were widowed, and 8.1% (n = 30) were divorced or separated. The mean age was 36.1 years (SD = 12.1). The overall non-adherence rate in the past 30 days was 19.4% (n = 72). Divorced or separated participants had more than three times the adjusted odds of non-adherence compared to singles (AOR = 3.44, 95% CI: 1.09–10.80, p = 0.035). Slightly more than half of participants experienced stigma (54.6%, n = 203), and 41.1% (n = 153) reported that fear of stigma affected adherence. Good healthcare worker interaction was associated with lower odds of non-adherence (AOR = 0.20, 95% CI: 0.05–0.84, p = 0.027). Treatment-related behaviours were the factors most strongly associated with non-adherence: skipping ART when feeling better (20.4%, n = 76; AOR = 6.79, 95% CI: 3.11–14.86, $p < 0.001$) and forgetting doses (24.2%, n = 90; AOR = 4.70, 95% CI: 2.19–10.07, $p < 0.001$). Side effects were common (58.3%, n = 217), but regimen complexity and side effects were not independently associated with non-adherence after adjustment.

Conclusion

The findings suggest that at Chawama Level One Hospital, behavioural and relational factors were more strongly associated with ART adherence than structural barriers. Divorce or separation, stigma, misconceptions about treatment, and forgetfulness were the factors most strongly associated with non-adherence, while good patient-provider interaction was associated with adherence. Addressing these factors through patient-centred counselling, stigma reduction interventions, psychosocial support, and reminder tools may be critical to sustaining ART adherence and achieving Zambia's UNAIDS 95-95-95 targets.

BACKGROUND

Globally, an estimated 39.9 million people were living with HIV at the end of 2023, with 1.3 million new infections and 630,000 AIDS-related deaths reported that year (UNAIDS, 2023). Sub-Saharan Africa bears the greatest burden of the epidemic, accounting for approximately 25.6 million people living with HIV—more than two-thirds of the global total (UNAIDS, 2023). Although the widespread rollout of antiretroviral therapy (ART) has substantially reduced AIDS-related morbidity and mortality, sustained adherence remains essential for achieving viral suppression and preventing drug resistance, treatment failure, and onward transmission (Buh et al., 2022; WHO, 2024).

Adherence to ART is defined as the extent to which a person's behaviour—including taking medication, attending clinic visits, and following lifestyle recommendations—corresponds with agreed recommendations from a healthcare provider (WHO, 2025). In Zambia, the Consolidated Guidelines for Treatment and Prevention of HIV define optimal adherence as taking at least 95% of scheduled doses correctly and on time (MOH, 2022). Suboptimal adherence has been consistently associated with virological failure, increased risk of HIV transmission, and the emergence of drug-resistant viral strains (Buh et al., 2023; NIH, 2025).

Barriers to ART adherence are multifaceted and operate at individual, interpersonal, and structural levels. Individual-level barriers include depression, anxiety, substance use, and misconceptions about treatment necessity when symptoms are absent (Nzimakwe, 2025). Interpersonal barriers include stigma, fear of disclosure, and intimate partner violence, which may deter patients from collecting or taking medication publicly (Heestermans et al., 2016; Nzimakwe, 2025). Structural barriers include financial constraints, transportation costs, food insecurity, health system inefficiencies, and medication stock-outs (Buh et al., 2023; Hanass-Hancock et al., 2019). In sub-Saharan Africa, these barriers are compounded by resource limitations and high HIV burden, contributing to inconsistent adherence and suboptimal treatment outcomes (Heestermans et al., 2016; Buh et al., 2022).

Zambia has made substantial progress in expanding access to ART, with national efforts resulting in improved viral suppression rates and decentralised care delivery (Boyd et al., 2020). The Zambia Population-based HIV Impact Assessment (ZAMPHIA 2021) reported an ART adherence level of 86%, which remains below the 95% threshold required for optimal treatment outcomes (ZAMPHIA, 2021). Lusaka Province carries the highest HIV prevalence in the country at 15.1%, and facility-based evidence

has shown that missed appointments, treatment-related experiences, and patient-level circumstances can undermine consistent ART use (Chirwa et al., 2017; Zambia Statistics Agency, 2019). Socioeconomic barriers, transportation costs, clinic congestion, and stigma continue to impede patients' ability to maintain consistent medication schedules (Hanass-Hancock et al., 2019; Moomba & Van Wyk, 2019).

High-density urban communities in Zambia present unique challenges for ART adherence. Chawama, a densely populated low-income township in Lusaka with an estimated population of 150,000 residents across 83,000 households, is characterised by informal settlements, limited health infrastructure, and socioeconomic vulnerability (Zambian Governance Foundation, 2024). Previous studies have shown that such high-density urban areas may be especially prone to adherence difficulties due to overcrowded clinics, stigma within tight-knit communities, and elevated mental health burdens (Kanguya et al., 2022). Poor adherence in these settings can result in virological failure, the emergence of drug-resistant HIV strains, and increased risk of HIV transmission (Sangeda et al., 2018).

Although earlier studies have examined ART adherence in Zambia, recent facility-specific evidence from high-density urban communities remains limited. Understanding the locally embedded influences on adherence is essential for developing culturally appropriate and context-specific interventions. This cross-sectional study therefore examined the determinants of ART adherence among individuals living with HIV/AIDS at Chawama Level One Hospital in Lusaka, Zambia. By identifying the factors associated with non-adherence in this setting, the findings will inform targeted interventions to improve adherence and support Zambia's progress toward the UNAIDS 95-95-95 targets.

METHODS

Study Design and Setting

This analytical cross-sectional study was conducted at Chawama Level One Hospital in Lusaka, Zambia, over 10 working days in July 2025. Chawama Level One Hospital is a government-run primary healthcare facility located in Chawama Township, a densely populated, low-income urban settlement in southwestern Lusaka. The hospital provides outpatient and inpatient services, including antiretroviral therapy (ART), serving approximately 4,000 clients monthly. The facility was selected because of preliminary observations of adherence challenges and concerns about suboptimal viral suppression among patients on ART. Chawama Township has an estimated population of over 150,000 residents and is characterised by limited infrastructure, high unemployment, and inadequate healthcare resources, making it a pertinent setting for investigating ART adherence.

Study Population

The study population comprised adult patients aged 18 years and above living with HIV and receiving ART at Chawama Level One Hospital. Both males and females accessing ART services at the facility

were eligible. This population was appropriate because participants had direct experience with ART services and could provide relevant information on factors associated with adherence.

Inclusion and Exclusion Criteria

Patients were eligible for inclusion if they were HIV-positive adults aged 18 years or older, were currently receiving ART at Chawama Level One Hospital, had been on ART for at least six months, and were willing to participate and provide written informed consent. The six-month minimum was selected to ensure participants had adequate experience with ART services and that their trail of encounters was traceable.

Patients were excluded if they were critically ill or assessed as not psychologically or mentally fit to participate at the time of data collection, or if they were unwilling to provide informed consent. Ethical principles of autonomy were applied throughout; potential participants were allowed to make independent decisions, and their choice not to consent was respected.

Sample Size Determination

The minimum sample size was calculated using Cochran's formula for estimating a single population proportion. Because no reliable facility-specific estimate of ART adherence was available at the time of proposal development, a conservative expected proportion of 50% was used to generate the largest required sample. The calculation assumed a 95% confidence level and a 5% margin of error:

$n_o = Z^2 p(1 - p) / e^2$

Where n_o is the initial sample size, Z is 1.96 for a 95% confidence level, p is the expected proportion (0.50), and e is the margin of error (0.05).

$n_o = (1.96)^2 \times 0.50 \times (1–0.50) / (0.05)^2 = 384.16$.

The accessible population of ART clients during the study period was approximately 4,000. A finite population correction was therefore applied:

$n = n_o / [1 + (n_o - 1) / N]$

$n = 384.16 / [1 + (384.16–1) / 4{,}000] = 350.56$, rounded to 351 participants.

To allow for an anticipated 6% non-response or incomplete-response rate, the adjusted sample size was calculated as:

$n_{adj} = 350.56 / (1–0.06) = 372.94$.

The final minimum sample size was rounded up to 373 participants. A total of 372 participants completed the study, representing a response rate of 99.7% of the planned sample.

Sampling and Recruitment Procedure

Stratified random sampling was employed to ensure fair representation of the diverse population receiving ART at Chawama Level One Hospital. The sampling frame consisted of all ART patients enrolled at the hospital between January and March 2025, as listed in the SmartCare electronic database. The population was stratified by sex, age group, and duration on ART—characteristics widely recognised as important factors associated with ART adherence. Within each stratum, participants were randomly selected using a random number generator. This approach reduced sampling bias and improved generalisability by ensuring that all relevant subgroups were proportionally represented.

Eligible participants were identified from the medical records at the ART clinic using the predefined inclusion criteria. A list of eligible participants was generated, and participants were approached in the waiting area, where they were informed about the purpose of the study. Following their routine clinical reviews, the researcher restated the purpose of the study and obtained written informed consent. Participants were then interviewed individually in private or semi-private rooms.

Data Collection Tools

Data were collected using a structured, interviewer-administered digital questionnaire developed from previously validated instruments for assessing ART adherence and its determinants. The questionnaire comprised seven components: (1) socio-demographic information, (2) social support, (3) stigma, (4) health system factors, (5) treatment-related factors, (6) ART adherence behaviours, and (7) contextual information. Close-ended questions included yes/no options and codes of 0 to 3. An open-ended section allowed participants to add comments on barriers or facilitators of adherence; these narratives were typed verbatim by interviewers to capture nuanced information.

Adherence Measurement

Adherence was measured using the 4-item Morisky Green Levine Medication Adherence Scale. The four items were: (1) "Do you ever forget to take your medication?" (2) "Are you careless at times about taking your medication?" (3) "Do you sometimes stop taking your medication when you feel better?" and (4) "Do you sometimes stop taking your medication when you feel worse?" Each item was scored as 0 (No) or 1 (Yes). Total scores ranged from 0 to 4, with higher scores indicating poorer adherence. For analysis, adherence was dichotomised as adherent (0–1 "Yes" responses) or non-adherent (≥ 2 "Yes" responses). This scoring approach is consistent with the original Morisky Green Levine Scale and has been validated in similar settings.

Validity and Reliability

Content validity was ensured through expert review of the questionnaire before fieldwork. A pre-test was conducted at Kanyama Level One Hospital with 20 patients on ART following ethical clearance. The pre-

test assessed clarity, question flow, language appropriateness, and average completion time. Based on feedback, minor wording and sequencing adjustments were made. The internal consistency of the adherence scale was assessed using Cronbach's alpha, which was 0.72, indicating acceptable reliability.

Data Collection Methods

Data were captured electronically using an interviewer-administered digital questionnaire hosted on Google Forms, which eliminated paper use, reduced manual entry errors, and improved data management efficiency. Before fieldwork, research assistants were trained on study objectives, eligibility screening, informed consent procedures, participant privacy, and the operation of the Google Forms platform. Training included mock interviews to standardise procedures and ensure inter-rater consistency. Trained assistants approached clients in waiting areas, introduced the study, screened for eligibility, and recruited participants.

Structured, face-to-face interviews were conducted one-on-one using the digital platform. The questionnaire was interviewer-administered; research assistants read each item aloud in the participant's preferred language and entered responses directly into the Google Form, offering support to participants with limited literacy or digital familiarity. Each interview took an average of 10 minutes and was completed in a single sitting. The form used close-ended items with drop-down or tick-box options to minimise entry errors and speed completion. Built-in completeness checks minimised missing responses. Completed records were transmitted securely to the study database immediately after each interview.

Data collection was completed over 10 working days, with 372 interviews completed, averaging approximately 37 interviews per working day. No participant displayed signs of psychological distress; however, the approved referral pathway to the hospital's psychosocial counselling team remained available throughout data collection. All submissions were transmitted to a secure password-protected Google Drive repository restricted to the principal investigator and designated data manager. Data quality was monitored in real time; completeness checks were conducted at submission, and daily reviews identified anomalies, missing responses, or device-related issues. Daily encrypted backups were created, and an audit log of data access and changes was maintained. Confidentiality was safeguarded by assigning unique study identity numbers, omitting personally identifying information, and conducting interviews in private or semi-private spaces. Field supervision included routine spot checks, end-of-day debriefs, and corrective feedback to maintain fidelity to protocol and ethical standards.

Variables and Definitions

The dependent variable was adherence to ART—the degree to which patients correctly follow ART prescription guidelines in terms of timing, dosage, and frequency. Adherence was measured using the Morisky Green Levine Medication Adherence Scale and dichotomised as adherent (0–1 missed doses) or non-adherent (≥ 2 missed doses) in the past 30 days.

Independent variables included:

- **Socio-demographic factors**: age, sex, marital status, education level, employment status, monthly income
- **Social factors**: social support networks (family, friends, community-based organisations), perceived stigma (self and public), disclosure of HIV status
- **Healthcare system-related factors**: provider-patient communication, patient education, ART stock-outs, clinic waiting time
- **Treatment-related factors**: regimen complexity, availability of medication, medication side effects

Statistical Analysis

Data were exported from Google Forms into Microsoft Excel for initial cleaning and coding, then imported into Stata version 17 for analysis. The analysis proceeded in two stages: descriptive and inferential.

For the descriptive stage, categorical variables (e.g., sex, marital status, education, employment) were summarised using frequencies and percentages. Continuous variables (e.g., age, duration on ART) were described using means and standard deviations. These summaries provided an overall profile of participants and showed the distribution of characteristics relevant to ART adherence.

For the inferential stage, bivariate associations between each independent variable and the dependent variable (ART adherence, coded adherent vs non-adherent) were assessed using chi-square tests (χ^2) for categorical predictors and t-tests where appropriate for continuous predictors. Variables with statistical significance at $p < 0.05$ (and those of strong conceptual relevance) were considered for multivariable modelling.

Binary logistic regression was fitted using a backward stepwise elimination approach. This method begins with all candidate variables entered simultaneously and then sequentially removes those that do not contribute significantly to the model's predictive ability, based on the likelihood ratio test. This approach balances the need to control for potential confounders while maintaining model parsimony—particularly important given the sample size and the need to avoid overfitting. The number of variables initially entered was limited to ensure an adequate events-per-variable (EPV) ratio of at least 10 events per variable. Adjusted odds ratios (AORs) with 95% confidence intervals were reported.

Prior to model fitting, multicollinearity was assessed using the variance inflation factor (VIF); all values were below 2.0, indicating no significant multicollinearity. Model adequacy was evaluated using the Hosmer-Lemeshow goodness-of-fit test and overall likelihood-ratio statistics. Discrimination was explored using the area under the receiver operating characteristic (ROC) curve, and classification performance was reviewed with standard classification tables. Influential observations were checked using standard diagnostics (e.g., Pearson and deviance residuals and leverage measures).

Missing data were examined for extent and pattern; the proportion of missing data was less than 3% for all variables. Missingness was handled using pairwise deletion for bivariate analyses and complete-case analysis for regression. All tests were two-sided, and statistical significance was set at $p < 0.05$. This analytic approach provided a robust basis for identifying factors associated with ART adherence.

Ethical Considerations

Ethical clearance was obtained from the Chreso University Research Ethics Committee (CUREC REF. No. 22515-08-2025) and the National Health Research Authority (NHRA Ref. No. 3870/20/07/2026). Administrative permissions were granted by the Lusaka Provincial Health Office, Lusaka District Health Office, and Chawama Level One Hospital. All participants provided informed consent electronically through the Google Form prior to participation. For participants with limited literacy, the consent form was read aloud in their preferred language, and a witness confirmed understanding before consent was provided. Participation was voluntary, and participants could withdraw at any time without penalty or loss of services. Confidentiality was maintained by using unique study identity numbers, omitting personally identifying information, and storing data in a password-protected repository accessible only to the principal investigator and designated data manager. A referral pathway to the hospital's psychosocial counselling team was available for any participant who experienced distress.

RESULTS

Participant Flow and Response Rate

A total of 373 eligible ART patients were identified from the SmartCare electronic database and invited to participate in the study. Of these, 372 participants completed the questionnaire, yielding a response rate of 99.7%. One participant did not complete the questionnaire due to time constraints. No participants were excluded after consenting, and all 372 completed questionnaires were included in the final analysis. There were no missing data for the primary outcome variables; missing data for any variable were minimal (< 3%) and were handled by complete case analysis.

Demographic Characteristics

The participants comprised slightly more females (52.4%, n = 195) than males (47.6%, n = 177). Nearly half of the participants were married (43.0%, n = 160), while 38.4% (n = 143) were single, 10.5% (n = 39) were widowed, and 8.1% (n = 30) were divorced or separated. In terms of education, most participants had completed secondary school (44.4%, n = 165), followed by primary (23.7%, n = 88) and tertiary education (19.1%, n = 71), while 12.9% (n = 48) had no formal schooling.

Over half of the participants were unemployed (51.3%, n = 191), with 24.7% (n = 92) formally employed and 23.9% (n = 89) informally employed. Almost one-third reported no income (29.0%, n = 108), while 30.1% (n = 112) earned less than K1,000, 21.5% (n = 80) earned between K1,000 and K2,500, and 19.4% (n = 72) earned more than K2,500. The mean age was 36.1 years (SD = 12.1), with a median of 34 years

and a range of 16 to 76 years. Table 1 presents the sociodemographic characteristics of the study participants.

Table 1
Socio-Demographic Characteristics of Study Participants (n = 372)

Variable	Category	Frequency (n)	Percentage (%)
Sex	Male	177	47.6
	Female	195	52.4
Marital Status	Single	143	38.4
	Married	160	43.0
	Divorced/Separated	30	8.1
	Widowed	39	10.5
Education Level	No formal education	48	12.9
	Primary	88	23.7
	Secondary	165	44.4
	Tertiary	71	19.1
Employment Status	Unemployed	191	51.3
	Informally employed	89	23.9
	Formally employed	92	24.7
Monthly Income	No income	108	29.0
	< K1,000	112	30.1
	K1,000 – K2,500	80	21.5
	> K2,500	72	19.4
Age (Years)	Mean (SD)	36.1 (12.1)	
	Median (Range)	34 (16–76)	

Adherence and Related Behaviours

As regards ART adherence in the past 30 days, most participants were adherent (80.6%, n = 300), while nearly one in five were non-adherent (19.4%, n = 72). On the number of ART doses missed, among all participants, 2.7% (n = 10) missed one dose, 1.9% (n = 7) missed two, 1.3% (n = 5) missed three, and 1.1% (n = 4) missed four. Within the non-adherent subgroup (n = 72), several participants reported that they had missed only one dose (13.9%, n = 10 of 72). Table 3 shows the distribution of adherence-related behaviours among participants.

Sometimes skipping ART when feeling better: One in five participants (20.4%, n = 76) reported skipping ART when they felt better, while 79.6% (n = 296) did not. Ever forget to take ART medications: Nearly a quarter (24.2%, n = 90) reported forgetting to take ART, whereas 75.8% (n = 282) did not.

Table 3
Adherence and Related Behaviours Among Study Participants (n = 372)

Variable	Category	Frequency (n)	Percentage (%)
ART adherence in past 30 days	Adherent	300	80.6
	Non-adherent	72	19.4
Number of ART doses missed	1 dose	10	2.7
	2 doses	7	1.9
	3 doses	5	1.3
	4 doses	4	1.1
Sometimes skip ART when feeling better	No	296	79.6
	Yes	76	20.4
Ever forget to take ART medications	No	282	75.8
	Yes	90	24.2

Association Between Socio-Demographic Characteristics and ART Non-Adherence

Marital status was the only socio-demographic variable with a borderline significant association with ART non-adherence (p = 0.050). Non-adherence was highest (50.0%, n = 36) among singles compared to married participants (36.1%, n = 26), while widowed participants had the lowest rate (4.2%, n = 3).

Sex was not significantly associated with adherence (p = 0.263), though females recorded higher non-adherence (58.3%, n = 42) compared to males (41.7%, n = 30). Education level also showed no significant relationship (p = 0.285), but non-adherence was more prevalent among those with secondary education (51.4%, n = 37). Employment status did not significantly influence adherence (p = 0.622), though formally employed participants had slightly higher non-adherence (29.2%, n = 21). Income distribution revealed no significant difference (p = 0.110), but non-adherence was relatively more common among those earning between K1,000 and K2,500 (29.2%, n = 21). The mean age was similar between adherent (36.4 years) and non-adherent (35.1 years) groups, with no significant difference (p = 0.402). Table 2 presents the association between socio-demographic characteristics and ART non-adherence.

Table 2
Association Between Socio-Demographic Characteristics and ART Non-Adherence (n = 372)

Variable	Category	Adherent n (%)	Non-Adherent n (%)	χ^2/t-statistic	p-value
Sex	Male	147 (49.0)	30 (41.7)	$\chi^2(1) = 1.25$	0.263
	Female	153 (51.0)	42 (58.3)		
Marital Status	Single	107 (35.7)	36 (50.0)	$\chi^2(3) = 7.79$	0.050
	Married	134 (44.7)	26 (36.1)		
	Divorced/Separated	23 (7.7)	7 (9.7)		
	Widowed	36 (12.0)	3 (4.2)		
Education Level	No formal education	43 (14.3)	5 (6.9)	$\chi^2(3) = 3.79$	0.285
	Primary	70 (23.3)	18 (25.0)		
	Secondary	128 (42.7)	37 (51.4)		
	Tertiary	59 (19.7)	12 (16.7)		
Employment Status	Unemployed	156 (52.0)	35 (48.6)	$\chi^2(2) = 0.95$	0.622
	Informally employed	73 (24.3)	16 (22.2)		
	Formally employed	71 (23.7)	21 (29.2)		
Monthly Income	No income	87 (29.0)	21 (29.2)	$\chi^2(3) = 6.05$	0.110
	< K1,000	89 (29.7)	23 (31.9)		
	K1,000 – K2,500	61 (20.3)	21 (29.2)		
	> K2,500	63 (21.0)	7 (9.7)		
Age (Years)	Mean (SD)	36.4 (12.3)	35.1 (11.4)	t = 0.84	0.402

Social Support and Stigma

The results show that less than half of the participants had someone reminding them to take their medication (45.4%, n = 169), while the majority (54.6%, n = 203) did not. These highlight potential gaps in treatment support systems. With respect to emotional support, slightly more than half of the participants reported receiving such support (54.3%, n = 202), while 45.7% (n = 170) did not. This indicates that although emotional support is available for many, a substantial proportion remains without this

assistance. Disclosure of HIV status was common among participants, with nearly three-quarters (73.9%, n = 275) having disclosed their status, compared to 26.1% (n = 97) who had not. High disclosure rates suggest potential avenues for social reinforcement in adherence.

Experiences of stigma were reported by more than half of the participants (54.6%, n = 203), while 45.4% (n = 169) had not experienced stigma. The prevalence of stigma highlights its persistence as a barrier in the HIV care continuum. Finally, 41.1% (n = 153) of participants indicated that fear of stigma affected their ART adherence, whereas 58.9% (n = 219) stated it did not. This finding underscores the role of stigma in influencing adherence behaviour among a significant proportion of the population. Table 4 shows the social support and stigma-related characteristics of participants.

Table 4
Social Support and Stigma Among Study Participants (n = 372)

Variable	Category	Frequency (n)	Percentage (%)
Someone reminds you to take medication	No	203	54.6
	Yes	169	45.4
Receive emotional support for HIV treatment	No	170	45.7
	Yes	202	54.3
Disclosed HIV status to someone close	No	97	26.1
	Yes	275	73.9
Experienced stigma due to HIV status	No	169	45.4
	Yes	203	54.6
Fear of stigma affects ART adherence	No	219	58.9
	Yes	153	41.1

Health System and Treatment Factors

Most participants reported good interaction with healthcare providers (96.2%, n = 358), while only a small proportion (3.8%, n = 14) described their interactions as poor. This indicates generally positive patient-provider relationships in the study setting. A total of 81.2% (n = 302) reported receiving adherence counselling during clinic visits, whereas a few (18.8%, n = 70) did not. This suggests that counselling services are widely available but still not universally accessed. Regarding the ART stock-outs, 44.6% (n = 166) of participants reported experiencing stock-outs, while 55.4% (n = 206) did not. Stock-outs remained a critical barrier that may interrupt consistent treatment adherence.

In terms of waiting time at clinics, more than half (57.3%, n = 213) reported waiting for the service between 30–60 minutes, 26.1% (n = 97) waited more than one hour, and only 16.7% (n = 62) were

attended to under 30 minutes. Extended waiting times discouraged timely clinic attendance and medication collection. When asked about treatment complexity, some participants (37.1%, n = 138) reported that their ART regimen was difficult to follow, while others (62.9%, n = 234) did not experience any. Complexity in regimens remains a barrier for a sizeable proportion of participants. Side effects were widely reported, with 58.3% (n = 217) experiencing at least one, compared to 41.7% (n = 155) who did not. Among specific side effects, nausea was most common (45.7%, n = 170), followed by dizziness (30.7%, n = 114), fatigue (28.2%, n = 105), and skin rash (19.1%, n = 71).

Finally, over a third of participants (34.4%, n = 128) reported that side effects caused them to skip or stop taking ART, while 24.7% (n = 92) stated that side effects did not affect their adherence. The other participants (40.9%, n = 152) indicated this was not applicable. These findings underscore the importance of effective management of treatment-related side effects in supporting adherence. Table 5 shows the distribution of health system and treatment-related factors among study participants.

Table 5
Health System and Treatment Factors Among Study Participants (n = 372)

Variable	Category	Frequency (n)	Percentage (%)
Interaction with healthcare providers	Poor	14	3.8
	Good	358	96.2
Received adherence counseling during clinic visits	No	70	18.8
	Yes	302	81.2
Experienced ART stock-outs	No	206	55.4
	Yes	166	44.6
Clinic waiting time	< 30 minutes	62	16.7
	30–60 minutes	213	57.3
	> 60 minutes	97	26.1
Regimen complexity	No	234	62.9
	Yes	138	37.1
Experienced side effects	No	155	41.7
	Yes	217	58.3
Type of side effects (n = 217)*	Nausea	170	45.7
	Dizziness	114	30.7
	Fatigue	105	28.2
	Skin rash	71	19.1
Side effects caused skipping/stopping ART	Not applicable	152	40.9
	No	92	24.7
	Yes	128	34.4

*Multiple responses allowed.

Logistic Regression Analysis

Unadjusted Logistic Regression Model

The unadjusted logistic regression models assessing factors associated with ART non-adherence in the past 30 days was conducted. The analysis covered socio-demographic, social support and stigma,

healthcare system, and treatment-related factors. Variables significant at the 5% level in the unadjusted models were considered for inclusion in the adjusted logistic regression model.

Age and sex were not significantly associated with ART non-adherence in the unadjusted analysis ($p = 0.402$ and $p = 0.264$ respectively). Marital status showed that widowed participants had significantly lower odds of adherence relative to singles (UOR = 0.25, 95% CI: 0.07–0.85, $p = 0.027$). Married and divorced/separated categories were not significant at the 5% level. Education, employment status, and monthly income did not demonstrate statistically significant associations with non-adherence at the 5% threshold. Having someone who provides medication reminders was associated with higher odds of non-adherence (UOR = 1.78, 95% CI: 1.06–2.99, $p = 0.030$).

Emotional support, disclosure of HIV status, and reported experiences of stigma were not statistically significant at 5% in the unadjusted models. Fear that stigma affects adherence was a strong and significant predictor of non-adherence (UOR = 4.02, 95% CI: 2.32–6.96, $p < 0.001$), highlighting stigma-related concerns as a key barrier.

Good interaction with healthcare workers was protective, being associated with lower odds of non-adherence (UOR = 0.22, 95% CI: 0.08–0.65, $p = 0.006$). Adherence counseling, ART stock-outs, and clinic waiting time were not significant at the 5% level. Treatment-related behaviours were the strongest predictors: skipping ART when feeling better (UOR = 15.92, 95% CI: 7.87–32.19, $p < 0.001$) and forgetting to take ART (UOR = 12.29, 95% CI: 6.46–23.37, $p < 0.001$) markedly increased the odds of non-adherence. Reporting that the regimen is complex or difficult was also significant (UOR = 2.58, 95% CI: 1.51–4.41, $p < 0.001$). Experiencing side effects in general and side effects leading to treatment interruption were not statistically significant at the 5% level in the unadjusted analysis.

These unadjusted findings identify variables to be carried forward into the adjusted model—specifically: widowed marital status, reminder support, fear that stigma affects adherence, good HCW interaction (protective), skipping ART when feeling better, forgetting to take ART, and regimen complexity. Table 6 shows the unadjusted logistic regression results for predictors of ART non-adherence among participants.

Table 6
Unadjusted Logistic Regression Results for ART Non-Adherence Among Participants (n = 372)

Variable	Level	UOR (95% CI)	p-value
Socio-demographic factors			
Age	Continuous	0.99 (0.97–1.01)	0.402
Sex	Male (ref)	1.00	
	Female	1.35 (0.80–2.26)	0.264
Marital status	Single (ref)	1.00	
	Married	0.57 (0.32–1.01)	0.054
	Divorced/Separated	0.90 (0.36–2.25)	0.824
	Widowed	0.25 (0.07–0.85)	0.027*
Education	No formal (ref)	1.00	
	Primary	2.21 (0.77–6.33)	0.138
	Secondary	1.29 (0.67–2.47)	0.445
	Tertiary	1.69 (0.85–3.35)	0.133
Employment	Unemployed (ref)	1.00	
	Informally employed	1.03 (0.48–2.20)	0.942
	Formally employed	1.78 (1.06–2.99)	0.030*
Monthly income	No income (ref)	1.00	
	< K1,000	1.18 (0.70–1.98)	0.536
	K1,000 – K2,500	1.36 (0.74–2.49)	0.323
	> K2,500	1.16 (0.69–1.95)	0.574
Social support and stigma			
Someone reminds you to take medication	No (ref)	1.00	
	Yes	1.78 (1.06–2.99)	0.030*
Receive emotional support	No (ref)	1.00	
	Yes	1.18 (0.70–1.98)	0.536
Disclosed HIV status	No (ref)	1.00	
	Yes	1.36 (0.74–2.49)	0.323

Variable	Level	UOR (95% CI)	p-value
Socio-demographic factors			
Experienced stigma	No (ref)	1.00	
	Yes	1.16 (0.69–1.95)	0.574
Fear of stigma affects adherence	No (ref)	1.00	
	Yes	4.02 (2.32–6.96)	< 0.001*
Healthcare system factors			
Interaction with HCWs	Poor (ref)	1.00	
	Good	0.22 (0.08–0.65)	0.006*
Received adherence counseling	No (ref)	1.00	
	Yes	0.65 (0.35–1.21)	0.173
Experienced ART stock-outs	No (ref)	1.00	
	Yes	1.22 (0.73–2.04)	0.447
Clinic waiting time	< 30 min (ref)	1.00	
	30–60 min	0.75 (0.37–1.54)	0.437
	> 60 min	1.04 (0.46–2.34)	0.925
Treatment-related factors			
Skip ART when feeling better	No (ref)	1.00	
	Yes	15.92 (7.87–32.19)	< 0.001*
Forget to take ART	No (ref)	1.00	
	Yes	12.29 (6.46–23.37)	< 0.001*
Regimen complexity	No (ref)	1.00	
	Yes	2.58 (1.51–4.41)	< 0.001*
Experienced side effects	No (ref)	1.00	
	Yes	1.42 (0.83–2.42)	0.198
Side effects caused skipping	No (ref)	1.00	
	Yes	0.86 (0.50–1.48)	0.583

*Significant at 5% level

Adjusted Logistic Regression Model

In the adjusted model, marital status emerged as a significant sociodemographic predictor of non-adherence. Participants who were divorced or separated had significantly higher odds of being non-adherent compared to single individuals (AOR = 3.44, 95% CI: 1.09–10.80, p = 0.035). This finding suggests that separation or divorce may disrupt social stability and weaken the ART adherence support systems, leading to increased vulnerability to treatment interruptions. In contrast, being married or widowed was not significantly associated with non-adherence after adjustment for other factors.

Healthcare system interactions also played an important role. Participants who reported good interaction with healthcare workers were significantly less likely to miss ART doses compared to those with poor interactions (AOR = 0.20, 95% CI: 0.05–0.84, p = 0.027). This protective association underscores the critical role of respectful, supportive, and informative relationships between patients and healthcare providers foster trust, motivation, and continuity of adherence.

Treatment-related behaviours remained the strongest predictors in the adjusted model. Participants who reported skipping ART when feeling better had markedly higher odds of non-adherence compared to those who did not (AOR = 6.79, 95% CI: 3.11–14.86, p < 0.001). Similarly, those who forgot to take their medication also had significantly higher odds of non-adherence (AOR = 4.70, 95% CI: 2.19–10.07, p < 0.001). These findings highlight how behavioural factors, rooted in misconceptions and practical challenges, strongly undermine adherence even when access to treatment is assured. By contrast, perceiving the ART regimen as complex was not significantly associated with non-adherence (AOR = 1.70, 95% CI: 0.85–3.40, p = 0.132), suggesting that behavioural and relational factors have a stronger influence than treatment complexity in this population. Table 7 shows the adjusted logistic regression results for predictors of ART non-adherence among participants.

Table 7
Adjusted Logistic Regression Results for ART Non-Adherence Among Participants (n = 372)

Variable	Level	AOR (95% CI)	p-value
Socio-demographic factors			
Marital status	Single (ref)	1.00	
	Married	1.15 (0.53–2.47)	0.727
	Divorced/Separated	3.44 (1.09–10.80)	0.035*
	Widowed	0.50 (0.12–2.01)	0.996
Social support and stigma			
Someone reminds you to take medication	No (ref)	1.00	
	Yes	1.34 (0.64–2.83)	0.436
Fear of stigma affects adherence	No (ref)	1.00	
	Yes	1.84 (0.89–3.80)	0.098
Healthcare system factors			
Interaction with HCWs	Poor (ref)	1.00	
	Good	0.20 (0.05–0.84)	0.027*
Treatment-related factors			
Skip ART when feeling better	No (ref)	1.00	
	Yes	6.79 (3.11–14.86)	< 0.001*
Forget to take ART	No (ref)	1.00	
	Yes	4.70 (2.19–10.07)	< 0.001*
Regimen complexity	No (ref)	1.00	
	Yes	1.70 (0.85–3.40)	0.132

*Significant at 5% level

Goodness-of-Fit Test for the Logistic Model

To assess the adequacy of the final logistic regression model, the Hosmer-Lemeshow goodness-of-fit test was conducted. The Hosmer-Lemeshow test produced a χ^2 value of 14.41 with 8 degrees of freedom and a p-value of 0.072. Since the p-value exceeds the 0.05 threshold, the null hypothesis of adequate model fit cannot be rejected. This indicates that the model provides an acceptable fit, with

predicted probabilities closely matching the observed outcomes of ART non-adherence. The results are summarized in Table 8.

Table 8
Hosmer-Lemeshow Goodness-of-Fit Test Statistics for ART Non-Adherence (n = 372)

Statistic	Value
Number of observations	372
Number of groups	10
Hosmer-Lemeshow χ^2 (8)	14.41
p-value	0.072

Hypothesis Testing

The study's null hypothesis stated that there is no statistically significant relationship between socio-demographic, social support, healthcare system, and treatment-related factors and the level of ART adherence among patients at Chawama Level One Hospital. However, based on the adjusted logistic regression results, this null hypothesis was rejected. This is because of the four of the adjusted results as each had p value that was smaller than the significance level of 0.05. The statistically significant relationships were established between ART non-adherence and being divorced or separated (AOR = 3.44, p = 0.035), good interaction with healthcare workers (AOR = 0.20, p = 0.027), skipping ART when feeling better (AOR = 6.79, p < 0.001), and forgetting to take medication (AOR = 4.70, p < 0.001). The null hypothesis is rejected for each of these four tests.

The alternative hypothesis, which holds that these factors are significantly associated with the level of ART adherence, was therefore accepted. It is worth noting that not every factor was significant: sex, age, education, employment, and income showed no independent association. This indicated that the rejection of the null hypothesis was driven mainly by behavioural, relational, and health-system factors rather than broad socio-demographic characteristics.

DISCUSSION

Statement of Principal Findings

This cross-sectional study examined factors associated with adherence to antiretroviral therapy among patients attending Chawama Level One Hospital in Lusaka, Zambia. The findings revealed that 80.6% of patients were adherent, while 19.4% were non-adherent in the past 30 days. The most common reasons for non-adherence were skipping ART when feeling better (20.4%), forgetting to take medication (24.2%), and experiencing side effects (58.3%). Marital status (divorce or separation) was the only socio-demographic factor independently associated with non-adherence, while good interaction with

healthcare workers was strongly associated with lower odds of non-adherence. Treatment-related behaviours, including skipping ART when feeling better and forgetting doses, were the strongest factors associated with non-adherence. Health system barriers including ART stock-outs (44.6%) and long waiting times (26.1% waited >60 minutes) were prevalent but not independently associated with non-adherence after adjustment. These findings suggest the need for multi-level interventions addressing patient, provider, and health system factors.

Level of Adherence to Antiretroviral Therapy

The finding of 80.6% adherence is comparable to findings from other Zambian studies but shows some variation. The ZAMPHIA 2021 report showed an ART adherence level of 86%, which remains below the level generally required for optimal treatment outcomes, while Lusaka Province continues to carry the highest HIV prevalence in the country at 15.1% (ZAMPHIA, 2021; Zambia Statistics Agency, 2019). A study conducted by Seketi, Mayimbo, and Maimbolwa (2021) among pregnant and breast-feeding mothers attending Chawama Level One Hospital found a 32% non-adherence rate (68% adherence) using pharmacy records and the ART defaulter register. The current study found a lower non-adherence rate (19.4%) compared to the Seketi et al. (2021) study, which may reflect differences in study populations (pregnant and breastfeeding mothers vs. general adult ART patients) and adherence measurement methods (pharmacy records vs. self-report). Recent Zambian evidence shows that adherence and viral suppression outcomes are not uniform across settings. Kafwanka et al. (2023) reported poor adherence and detectable viral load among adults on ART during the COVID-19 period at the University Teaching Hospital, while Lamba et al. (2025) reported high viral suppression among adults at a Lusaka district hospital.

Regionally, the adherence rate of 80.6% falls within the range reported in sub-Saharan African studies. A systematic review by Heestermans et al. (2016) identified depression, stigma, poor social support, alcohol use, and dissatisfaction with healthcare services as recurrent factors associated with non-adherence. Buh et al. (2023) concluded that adherence is influenced by an interplay of individual, social and structural factors, and that counselling, education, reminder tools and peer or community support are among the most effective facilitators. Similarly, a scoping review by Nzimakwe (2025), undertaken in the context of the UNAIDS 95-95-95 targets, synthesised evidence published between 2020 and 2025 and grouped barriers into individual-level issues such as mental illness and substance use, social barriers such as stigma and intimate partner violence, economic barriers such as food insecurity and transport costs, and structural barriers such as health-system fragmentation and drug stock-outs.

Analysis of adherence-related behaviours revealed that skipping ART when feeling better (20.4%) and forgetting to take medication (24.2%) were the most common behavioural barriers. This distinction is important because unintentional non-adherence (forgetting) may respond to interventions such as reminder systems, pill organisers, multi-month dispensing, and patient education about planning ahead for travel, while intentional non-adherence (skipping when feeling better) may require more intensive counselling and shared decision-making. The finding that skipping ART when feeling better was the

strongest factor associated with non-adherence (AOR=6.79) is consistent with the Health Belief Model, which posits that health behaviours are influenced by individuals' perceptions of disease threat and evaluation of the benefits versus barriers to taking preventive action (Janz & Becker, 1984; Glanz et al., 2015). Patients who skip treatment when feeling better may perceive themselves as less susceptible to HIV progression and may not fully appreciate the benefits of sustained adherence even in the absence of symptoms.

Socio-Demographic Factors Associated with Adherence

Marital Status

Marital status was the only socio-demographic variable significantly associated with non-adherence in the adjusted model. Participants who were divorced or separated had more than three times the adjusted odds of non-adherence compared with single participants (AOR=3.44, 95% CI: 1.09-10.80, p=0.035). This finding is consistent with evidence accumulated over time showing that adherence is shaped by the stability of close relationships and the practical and emotional support available within them. Similar findings were recorded about relationships such as unsupportive husbands (Seketi, Mayimbo and Maimbolwa, 2021). Further, the systematic review by Heestermans et al. (2016) identified weak social support and psychosocial difficulties as recurring barriers across sub-Saharan Africa, while Moomba and Van Wyk (2019) found that family support, disclosure and social acceptance influenced treatment-taking among Zambian adults. More recent population-based evidence from Tanzania also demonstrated adherence disparities by marital status (Adam & Balan, 2025), and qualitative evidence from the study showed that dependable family and caregiver relationships remain central to sustaining ART routines (Moomba et al., 2026). Taken together, these studies support the interpretation that divorce or separation may be associated with non-adherence through loss of practical reminders, emotional support, shared resources and treatment encouragement.

Age, Sex, Education, Employment, and Income

Sex, age, education, employment, and income were not significantly associated with non-adherence after adjustment. This differs from earlier studies in which demographic and socioeconomic characteristics were associated with treatment outcomes. For example, Mangal et al. (2019) demonstrated age, sex and geographical inequalities in long-term outcomes among people receiving ART in Brazil, while Mabunda et al. (2019) reported that age and education jointly influenced adherence among young adults in South Africa. Recent evidence also continues to show demographic variation in some settings (Adam & Balan, 2025; Tarkang et al., 2024). The absence of similar independent associations at Chawama Level One Hospital may reflect the relatively standardised and largely free ART services available to enrolled patients, which can reduce some differences related to income or educational background. It may also indicate that the immediate behavioural and relational circumstances captured in this study were more influential than broad socioeconomic categories.

The practical implication is that adherence-risk assessment at Chawama Level One Hospital should not rely only on conventional markers such as unemployment, low income or limited education. These characteristics remain relevant to patients' wider living conditions, but they did not identify the individuals at greatest independent risk in the present analysis. A brief assessment of recent divorce, separation, bereavement or disruption of household support may provide a more direct basis for offering intensified counselling, peer support or a trusted treatment supporter. This interpretation is consistent with recent reviews showing that, once ART is accessible, psychosocial and relational disruptions can become more immediate factors associated with day-to-day treatment-taking than socioeconomic status alone (Nzimakwe, 2025).

Social Support, Perceived Stigma and ART Adherence

Less than half of participants had someone who regularly reminded them to take medication (45.4%, n=169) and 45.7% (n=170) reported no emotional support. These findings indicate that a substantial proportion of patients were managing lifelong treatment with limited practical or emotional assistance. Earlier regional evidence identified poor social support as a persistent adherence barrier (Heestermans et al., 2016; Gonah & Mukwirimba, 2016), and subsequent studies have continued to show that family, peer, and provider support strengthens treatment motivation and continuity (Gebreagziabher & Woldemariam, 2020; Tuot et al., 2023; Nzimakwe, 2025). In Zambia, the importance of supportive relationships has been documented among adults, pregnant women, adolescents and caregivers (Moomba & Van Wyk, 2019; Kanguya et al., 2022; Buh et al., 2022; Moomba et al., 2026). This entails that the disclosure of status, unemployment, lack of transportation to the health facility for ART, and insufficient feeding could be tackled when there are supportive relationships within families and community.

Disclosure of HIV status was comparatively high, with 73.9% (n=275) of participants reporting that they had disclosed. This creates an important opportunity for adherence support because disclosure can enable trusted family members or partners to provide reminders, transport assistance, emotional encouragement and help during illness. The finding is consistent with earlier Zambian evidence linking disclosure and social acceptance to better treatment-taking (Moomba & Van Wyk, 2019) and with more recent regional evidence showing that safe disclosure is associated with improved ART adherence (Mengesha et al., 2023; Luwaya et al., 2024). However, disclosure should not automatically be interpreted as evidence of effective support. Some of the participants disclosed in environments where relationships remain unsupportive, and nearly half of the study population still lacked emotional assistance despite the high disclosure level.

Stigma remained widespread: 54.6% (n=203) reported having experienced stigma, and 41.1% (n=153) stated that fear of stigma affected their adherence. The persistence of stigma at Chawama is consistent with evidence spanning both earlier and recent literature. Heestermans et al. (2016) and Gonah and Mukwirimba (2016) identified stigma and self-stigma as barriers to adherence in sub-Saharan Africa, while Campbell et al. (2020) showed that stigma weakens household support by promoting secrecy and

social isolation. More recent studies continue to document the adverse effects of stigma on adherence (Mengesha et al., 2023; Nzimakwe, 2025; Moomba et al., 2026). The current study indicated that expanded ART access has not removed the social conditions that can make patients conceal medication use or avoid taking doses in the presence of others.

In the unadjusted analysis, having someone who provided medication reminders was associated with higher odds of non-adherence (UOR=1.78, 95% CI: 1.06-2.99, p=0.030), while fear that stigma affected adherence was strongly associated with non-adherence (UOR=4.02, 95% CI: 2.32-6.96, p<0.001). These associations did not emerge among the independent factors associated with non-adherence reported in the final adjusted model and should therefore be interpreted cautiously. The apparently adverse association with reminder support is unlikely to mean that reminders cause non-adherence. It may reflect reverse directionality, whereby patients already known to forget or miss doses are more likely to be assigned a treatment supporter. It may also indicate that informal reminders alone are insufficient when the underlying difficulties include treatment fatigue, stigma, depression, or unstable daily routines.

This interpretation reconciles the results of this current study with evidence that structured reminder interventions can improve adherence. Memory aids were associated with better adherence in the study by Banagi Yathiraj et al. (2016). Systematic evidence identified reminder tools as useful when they were combined with counselling, education, and social support rather than used as isolated prompts (Buh et al., 2022). The finding therefore supports a more individualised approach: patients who require reminders should first be assessed for the reasons behind missed doses, after which reminder tools can be paired with psychosocial support, stigma-sensitive counselling, and practical problem-solving.

Overall, the findings showed that weak practical support and stigma were common and programmatically important, even though they were not retained as independent factors in the final multivariable model. Chawama Level One Hospital can build on the relatively high disclosure level by helping willing patients identify safe treatment supporters, strengthening peer or community adherence groups, and ensuring that disclosure is voluntary and does not expose patients to discrimination. Community and facility-level stigma reduction interventions remain necessary because social acceptance determines whether disclosed status translates into useful support.

Healthcare System Factors and ART Adherence

Most participants reported good interaction with healthcare workers (96.2%, n=358) and 81.2% (n=302) received adherence counselling during clinic visits. These findings suggest that the ART clinic generally provided a supportive interpersonal environment. Nevertheless, 18.8% (n=70) did not receive counselling, 44.6% (n=166) reported ART stock-outs, and 83.4% waited at least 30 minutes for services, including 26.1% (n=97) who waited for more than one hour. The health system was, therefore, characterised by strong patient-provider relationships alongside persistent operational pressures.

The high prevalence of stock-outs and the prolonged waiting time is consistent with literature showing that service availability, clinic organisation, and treatment convenience can influence continuity of care.

Earlier regional reviews identified dissatisfaction with health facilities and access constraints as barriers to adherence (Heestermans et al., 2016), while Zambian qualitative evidence described poor communication, transport difficulties and service experiences as obstacles to sustained treatment (Moomba & Van Wyk, 2019). Recent studies continue to show that ART adherence is affected by the organisation of services, provider interaction, and structural barriers such as stock-outs and fragmented care (Tarkang et al., 2024; Nzimakwe, 2025). Although these operational factors were not independently associated with non-adherence at Chawama Level One Hospital, their frequency remains important because repeated inconvenience can undermine retention over time even when a short recall period does not detect an immediate statistical effect.

Counselling, stock-outs, and waiting time did not remain significant in the final model. This should not be interpreted as evidence that they have no effect. The cross-sectional design measured adherence over the preceding 30 days and may not fully capture cumulative effects of repeated stock-outs, missed clinic visits, or dissatisfaction. In addition, most participants reported good provider interaction, which may have buffered some of the frustration associated with clinic delays and supply interruptions. The findings, therefore, distinguish between statistical independence in this dataset and operational relevance to service quality.

Good interaction with healthcare workers was the only healthcare-system factor independently associated with adherence. Participants reporting good interaction had approximately 80% lower adjusted odds of non-adherence than those reporting poor interaction (AOR=0.20, 95% CI: 0.05-0.84, p=0.027). This result is coherent with both earlier and newer evidence. Dissatisfaction with healthcare services was a recurrent barrier in the review by Heestermans et al. (2016), and Moomba and Van Wyk (2019) found that negative communication and treatment experiences discouraged adherence among Zambian patients. More recent evidence has linked patient-provider trust, respectful communication, and supportive care with better adherence and durable viral suppression (Trepka et al., 2023; Tarkang et al., 2024). The consistency across time and settings strengthens the interpretation that the quality of the therapeutic relationship is not merely a marker of satisfaction but an important mechanism through which patients gain confidence, knowledge, and the motivation to remain on treatment. Further, the daily volume of clinic visits and average clinic wait times for services could deter patients from attending their clinical appointments and picking up their medications (McCarthy et al., 2017). Therefore, it becomes imperative for the healthcare services to put interventions that could cause satisfaction among users to enhance medication adherence.

The practical value of this finding is considerable because patient-provider interaction is modifiable. Unlike marital status or long-standing socioeconomic circumstances, communication can be improved through staff training, supportive supervision, privacy, respectful care, clear explanations and opportunities for patients to raise concerns. Maintaining these positive interactions should therefore be treated as a core adherence intervention at Chawama Level One Hospital, while clinic management simultaneously addresses counselling gaps, stock management and service flow.

Treatment-Related Factors and ART Adherence

More than one third of participants perceived their regimen as difficult to follow (37.1%, n=138), 58.3% (n=217) experienced at least one side effect, and 34.4% (n=128) reported that side effects had previously caused them to skip or stop treatment. Nausea, dizziness, fatigue and skin rash were the most frequently reported symptoms. These findings show that treatment burden was common, although the strongest independent factors were not the regimen or side effects themselves but the behaviours through which patients responded to treatment.

Skipping ART when feeling better was associated with almost seven times the adjusted odds of non-adherence (AOR=6.79, 95% CI: 3.11-14.86, p<0.001), while forgetting medication was associated with nearly five times the adjusted odds (AOR=4.70, 95% CI: 2.19-10.07, p<0.001). These results fit a consistent body of evidence rather than representing a new or isolated pattern. Banagi Yathiraj et al. (2016) found that memory aids supported adherence, Basti et al. (2017) identified forgetfulness as a major obstacle during longitudinal follow-up, and Sangeda et al. (2018) showed that patient- and treatment-related behaviours were associated with non-adherence in an urban African clinic. More recent studies have continued to identify forgetfulness and competing daily routines as leading explanations for missed doses (Isika et al., 2022). Additionally, Masika et al. (2024) demonstrated that forgetting to take medication was associated with detectable viral load. Therefore, the findings of the current study confirm that simple behavioural lapses can have major implications for treatment continuity.

Perceived regimen complexity was associated with non-adherence in the unadjusted analysis but was not significant after adjustment (AOR=1.70, 95% CI: 0.85-3.40, p=0.132). Similarly, side effects were common but did not independently predict non-adherence in the final model. This contrasts with studies in which adverse effects and regimen burden remained important factors (Gebrezgabher et al., 2017; Suryana et al., 2019), but it does not mean that side effects are unimportant at Chawama Level One Hospital. Their association may operate indirectly by encouraging intentional dose skipping, particularly when patients do not receive timely reassurance or symptom management. The stronger adjusted association of skipping ART when feeling better suggests an additional misconception: some patients may interpret the absence of symptoms as recovery and therefore view continued treatment as unnecessary. This pattern is consistent with recent reviews that state adherence depends on treatment knowledge, self-efficacy, and the ability to integrate lifelong medication into daily life (Buh et al., 2022; Nzimakwe, 2025).

The most appropriate response is therefore not limited to simplifying regimens. Patients require repeated, clear counselling that ART remains necessary even when they feel well, practical reminder strategies tailored to their routines, and prompt assessment and management of side effects. Reminder technologies such as pill boxes, treatment calendars, and trusted supporters may be useful. They should be selected according to the patient's circumstances and combined with education that addresses intentional as well as unintentional non-adherence. Treatment beliefs and everyday medication

management therefore emerge as the most immediate modifiable priorities for the Chawama Level One Hospital ART programme.

The findings of this study can be compared with those of Sikantongwe et al. (2026), who examined adherence to anti-hypertensive medication at Railway Surgery Urban Health Centre in Ndola, Zambia, and reported a much lower adherence rate (41.4%) than the 80.6% observed here, a difference likely explained by the comparative maturity of HIV programmes—free ART, single-tablet TLD regimens, multi-month dispensing, and established counselling infrastructure—against the out-of-pocket costs, polypharmacy, and weaker counselling systems that characterise hypertension care in Zambia. Despite this difference in overall adherence, the two studies identified strikingly similar behavioural and health-system factors: both found that forgetting doses, being away from home or routine, and running out of pills were the most common reasons for missed medication, and both highlighted good patient-provider interaction as protective while inadequate counselling time, medication stock-outs, and long waiting times remained prevalent operational barriers.

The studies diverged, however, in the socio-demographic and clinical factors associated with adherence: Sikantongwe et al. (2026) found age, education, income, comorbidities, side effects, and regimen complexity to be significant factors, whereas the present study found these factors largely nonsignificant after adjustment, suggesting that when structural and cost barriers are minimised—as in Zambia's ART programme—behavioural and relational factors such as forgetfulness, misconceptions about treatment, stigma, and the quality of the therapeutic relationship become the dominant factors associated with adherence. This comparison reinforces the conclusion that adherence interventions must be tailored to the treatment context, and that integrated chronic disease care models sharing adherence-support infrastructure across HIV, hypertension, and other non-communicable diseases could improve outcomes efficiently across conditions in Zambia.

Integration of Findings with Conceptual Framework

Taken together, the findings support the combined use of the Health Belief Model and the Social Ecological Model in understanding ART adherence. Skipping treatment when feeling better reflects individual perceptions of susceptibility, benefits, and barriers, while forgetfulness represents a practical challenge in translating treatment intention into consistent behaviour (Janz & Becker, 1984; Glanz et al., 2015). At the same time, the associations of marital disruption, stigma, social support, and healthcare-worker interaction demonstrate that adherence is embedded within interpersonal, community, and institutional environments, as proposed by the Social Ecological Model (McLeroy et al., 1988; Bronfenbrenner, 1994). The results therefore show that individual counselling alone is unlikely to be sufficient unless supported by respectful services and enabling social relationships.

Programmatically, the strongest priorities are repeated adherence education, personalised reminder support, psychosocial assessment following divorce or separation, stigma reduction, and continued strengthening of patient-provider communication. Earlier studies already identified memory aids, counselling, family support, and acceptable health services as important facilitators (Heestermans et al.,

2016; Banagi Yathiraj et al., 2016; Moomba & Van Wyk, 2019), and recent evidence confirms that these interventions remain relevant when adapted to patients' current social and treatment circumstances (Buh et al., 2022; Trepka et al., 2023; Nzimakwe, 2025; Moomba et al., 2026). At healthcare facility level, these measures should be complemented by dependable drug supplies and more efficient clinic flow, even though stock-outs and waiting time were not independent factors in the present model.

These priorities are directly relevant to Zambia's national HIV response and the UNAIDS 95-95-95 targets (MOH 2022; UNAIDS, 2023; WHO, 2024). Expanding diagnosis and ART initiation is insufficient if a substantial minority of patients continue to miss doses because of misconceptions, forgetfulness, disrupted support or negative service experiences. Interventions that simultaneously strengthen patient knowledge, everyday treatment routines, social support and therapeutic relationships can improve sustained viral suppression (Luwaya et al., 2024) and reduce the risk of treatment failure and onward transmission.

The findings of this study are consistent with recent research in similar Zambian settings. Mapiki et al. (2023) conducted a study on adherence to antihypertensives in HIV clients at Chanyanya Rural Health Center in Kafue, Zambia, and reported an adherence rate of 35.7%, which is lower than the 80.6% found in the current study. The difference may be attributed to the different study populations (HIV clients on antihypertensives vs. HIV clients on ART) and the different medication adherence measurement tools used. However, both studies highlight the importance of health system factors, including medication availability and access to healthcare facilities, as significant contributors to non-adherence. Mapiki et al. (2023) found that practical barriers such as medication availability and access to healthcare facilities were significant contributors to non-adherence among HIV patients. This convergence of findings across different Zambian settings suggests that medication supply chain issues may be a widespread problem affecting adherence across the country.

Furthermore, Mapiki et al. (2026) found a high prevalence of central obesity risk factors among adults in Kamakonde, Kitwe, with low awareness levels, mirroring our observation of limited health literacy as a barrier to adherence. These studies collectively highlight that method-specific fears, inadequate health knowledge, and health system challenges are cross-cutting barriers to adherence across both antihypertensive therapy and ART in Zambia's peri-urban settings.

WHAT IS ALREADY KNOWN ON THIS TOPIC

- Sub-Saharan Africa carries over two-thirds of the global HIV burden, with adherence to ART remaining a critical challenge (UNAIDS, 2023; WHO, 2026).
- In Zambia, ART adherence levels remain suboptimal, with the ZAMPHIA 2021 report showing an adherence level of 86%, below the 95% required for optimal treatment outcomes (ZAMPHIA, 2021).
- Barriers to adherence include stigma, psychosocial stressors, economic hardship, side effects, and complex medication regimens (Nzimakwe, 2025).

- Facility-specific evidence on ART adherence factors in high-density urban primary-care settings in Zambia remains limited (Kafwanka et al., 2023; Lamba et al., 2025; Moomba et al., 2026).

WHAT THIS STUDY ADDS

- Adherence to ART at Chawama Level One Hospital is suboptimal, with 19.4% of patients classified as non-adherent in the past 30 days.
- Most non-adherence is behavioural, driven by skipping ART when feeling better and forgetting to take medication, rather than structural barriers.
- Marital instability (divorce or separation) is the only socio-demographic factor independently associated with non-adherence.
- Good interaction with healthcare workers is strongly associated with lower odds of non-adherence.
- Stigma remains widespread, affecting over half of participants, and fear of stigma affects adherence in 41.1% of patients.
- Health system barriers including ART stock-outs and long waiting times persist despite high counselling coverage.

CONCLUSION

This study assessed the factors associated with adherence to antiretroviral therapy among patients attending Chawama Level One Hospital in Lusaka, Zambia. The findings reveal that adherence is suboptimal, with 19.4% of patients classified as non-adherent in the past 30 days. The majority of non-adherence is behavioural, driven by skipping ART when feeling better and forgetting to take medication, rather than structural barriers. Marital instability (divorce or separation) is the only socio-demographic factor independently associated with higher non-adherence, while good interaction with healthcare workers is strongly associated with lower odds of non-adherence. Stigma remains widespread, affecting over half of participants, and fear of stigma affects adherence in 41.1% of patients. Health system barriers including ART stock-outs and long waiting times persist despite high counselling coverage. Addressing these barriers requires a multi-level response including patient-centred counselling, stigma reduction interventions, psychosocial support, reminder tools, and continued strengthening of patient-provider communication. Without such targeted efforts, the burden of suboptimal ART adherence at Chawama Level One Hospital is likely to persist, with consequences for individual patients, the healthcare system, and society.

The study, therefore, concludes that in peri-urban contexts like Chawama, ART adherence is associated more with behavioural and relational factors than structural barriers. Divorce or separation, stigma, misconceptions about treatment, and forgetfulness were the factors most strongly associated with non-adherence, while good patient-provider interaction was associated with adherence. Addressing these through patient-centred counselling, stigma reduction, psychosocial support and simple reminder tools

may be critical to sustaining adherence and advancing Zambia's progress toward the UNAIDS 95-95-95 targets.

STRENGTHS AND LIMITATIONS

Strengths

This study has several strengths. First, the use of the Morisky Green Levine Medication Adherence Scale provided a standardised measure of adherence that has been widely used in similar settings, facilitating comparability with other studies. Second, the sample size of 372 participants was adequate to detect associations between multiple independent variables and adherence status, with an events-per-variable ratio exceeding the recommended minimum. Third, the use of stratified random sampling from the clinic's patient register reduced selection bias and enhanced the representativeness of the sample. Fourth, the study employed both bivariate and multivariable analytical methods, allowing for the identification of factors independently associated with adherence while controlling for potential confounders. Fifth, the inclusion of social support, stigma, and health system factors provided a comprehensive understanding of adherence barriers beyond individual-level characteristics. Sixth, the high response rate of 99.7% reduced the likelihood of non-response bias, although social desirability bias cannot be excluded. Seventh, the study focused on a public primary healthcare facility, providing evidence that is relevant to similar settings across Zambia and the region. Eighth, the use of interviewer-administered questionnaires with trained research assistants and translation into the local language ensured comprehension and accurate data collection across diverse literacy levels. Ninth, the integration of the Health Belief Model and Social Ecological Model provided a conceptual framework for interpreting the findings. Tenth, the use of digital data collection improved efficiency and reduced manual entry errors.

Limitations

Several limitations should be considered when interpreting these findings. First, the cross-sectional design precludes causal inference; the associations identified should be interpreted as correlates rather than determinants of adherence. Second, reliance on self-reported adherence may be subject to social desirability bias, as patients may overreport adherence due to perceived expectations. The high response rate (99.7%) may also reflect social desirability or selection bias. Third, the study was confined to one urban health centre in Lusaka, which limits the generalisability of findings to other settings in Zambia, particularly rural areas where access to care and health system resources may differ. Fourth, the study did not include objective measures of adherence such as pill counts, pharmacy refill records, or viral load data, which could have provided more accurate adherence estimates. Fifth, the sampling procedure had inconsistencies: stratified random sampling from the SmartCare database was described, but participants were approached in the waiting area, which may have introduced selection bias. Sixth, the adherence definition was inconsistent: the methods defined non-adherence as ≥ 2 missed doses, but the results mentioned non-adherent participants who missed only one dose. Seventh, the study did not

include qualitative components to explore patients' lived experiences and perceptions in depth, which could have provided richer insights into the factors associated with adherence. Eighth, the study did not assess the effect of adherence on clinical outcomes such as viral load suppression, which would have strengthened the clinical relevance of the findings. Ninth, the study did not include healthcare provider perspectives, missing an opportunity to understand systemic barriers from the provider's viewpoint. Tenth, the study did not measure mental health (depression, anxiety) or alcohol/substance use, which are known barriers to adherence.

RECOMMENDATIONS

Based on the findings of this study, the following eight recommendations are made:

1. Establish Targeted Psychosocial Support for Divorced and Separated Patients

Given that divorced or separated participants had more than three times the adjusted odds of non-adherence (AOR = 3.44, 95% CI: 1.09–10.80, p = 0.035), Chawama Level One Hospital should establish weekly peer-support circles facilitated by trained peer counsellors, with attendance tracked by a designated focal counsellor and follow-up of missed sessions by phone. This intervention directly targets the subpopulation identified as most at risk in this study, providing structured social support to replace the household reinforcement that divorced and separated patients often lack.

2. Implement Focused Education to Correct Misconceptions About ART

Given that skipping ART when feeling better was the strongest factor associated with non-adherence (AOR = 6.79, 95% CI: 3.11–14.86, p < 0.001), the hospital should deliver brief, structured education sessions in waiting areas every clinic day, focusing on two key messages: "continue ART even when you feel well" and "what to do if you miss a dose." Take-home leaflets in English and local languages should be provided, and a two-minute "teach-back" step should be incorporated into consultations to confirm patient understanding. Because this misconception was the single strongest factor associated with non-adherence, correcting it is likely to produce the largest improvement in day-to-day adherence at the facility.

3. Provide Reminder Solutions for Forgetfulness

Given that forgetting to take ART was the second strongest factor associated with non-adherence (AOR = 4.70, 95% CI: 2.19–10.07, p < 0.001), the hospital should offer low-cost pill boxes at pharmacy pick-up points and enroll patients into opt-in SMS reminders using existing Ministry of Health platforms. For patients without phones, a designated treatment supporter should be identified and their contact recorded for weekly check-ins. This intervention builds an external prompt into patients' routines rather than relying on memory alone.

4. Establish Same-Day Side-Effect Management

Given that 58.3% of participants experienced at least one side effect and 34.4% reported that side effects caused them to skip or stop treatment, the hospital should establish a same-day "adverse effects desk" staffed by a trained nurse during clinic hours. A simple triage algorithm should be developed for immediate symptomatic relief, with clear guidance on when to escalate to a clinician. Patient cards listing red-flag symptoms and a clinic hotline number should be provided. Prompt symptom relief prevents side effects from becoming a reason to interrupt treatment, protecting adherence during the early, higher-risk period when many patients are tempted to stop.

5. Implement Structured Stigma-Reduction Initiatives

Given that more than half of participants (54.6%) experienced stigma and 41.1% reported that fear of stigma affected their adherence, the hospital should co-design quarterly community dialogues with faith leaders, market associations, and youth groups to normalize lifelong ART, safe disclosure, and support seeking. Anti-stigma messages should be integrated into local radio programmes and school health clubs, with change monitored through periodic community feedback forums. Normalising lifelong ART at community level is essential to make disclosure and sustained treatment socially safer.

6. Deliver Patient-Centred Communication Training for Healthcare Workers

Given that good interaction with healthcare workers was the strongest protective factor (AOR = 0.20, 95% CI: 0.05–0.84, p = 0.027), the hospital should deliver annual refresher courses on motivational interviewing, respectful care, and brief adherence counselling. Training should include role-plays based on real clinic scenarios. New staff should be paired with "adherence champions" for on-the-job coaching, and communication quality should be included in performance appraisals. Since good provider interaction was the strongest protective factor identified, investing in communication skills strengthens the very lever most likely to keep patients engaged in care.

7. Improve Clinic Flow and Access

Given that 83.4% of participants waited at least 30 minutes for services, the hospital should introduce appointment spacing for stable patients, dedicated fast-track refills, and staggered clinic hours one evening per week to reduce waiting times for working clients. Simple dashboard tracking of average wait time and missed-appointment rates should be used to guide adjustments. Shorter, better-organised visits reduce the practical friction that discourages timely refills, particularly for working patients who would otherwise miss appointments.

8. Strengthen ART Supply Chains

Given that 44.6% of participants reported experiencing ART stock-outs, the hospital should implement electronic stock monitoring at facility and district levels with monthly audits and early warning thresholds. Contingency redistribution within the district should be established when stock dips below set minimums. Supply chain key performance indicators should be included in management reviews.

Reliable stocks remove one of the structural triggers of treatment interruption, ensuring that patients who come to collect their medicines are never turned away empty-handed.

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Figures

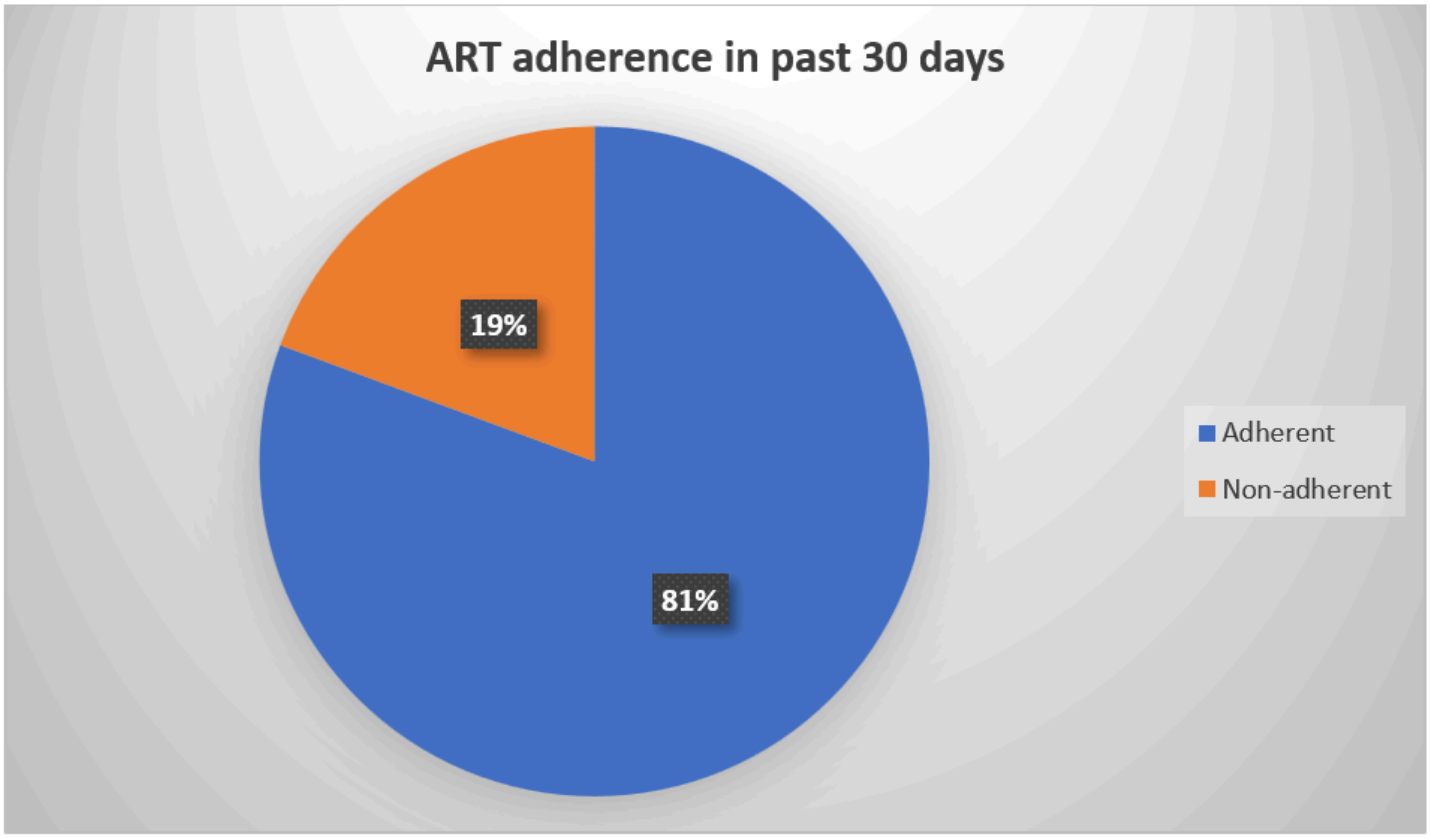


Figure 1

ART adherence in past 30 days

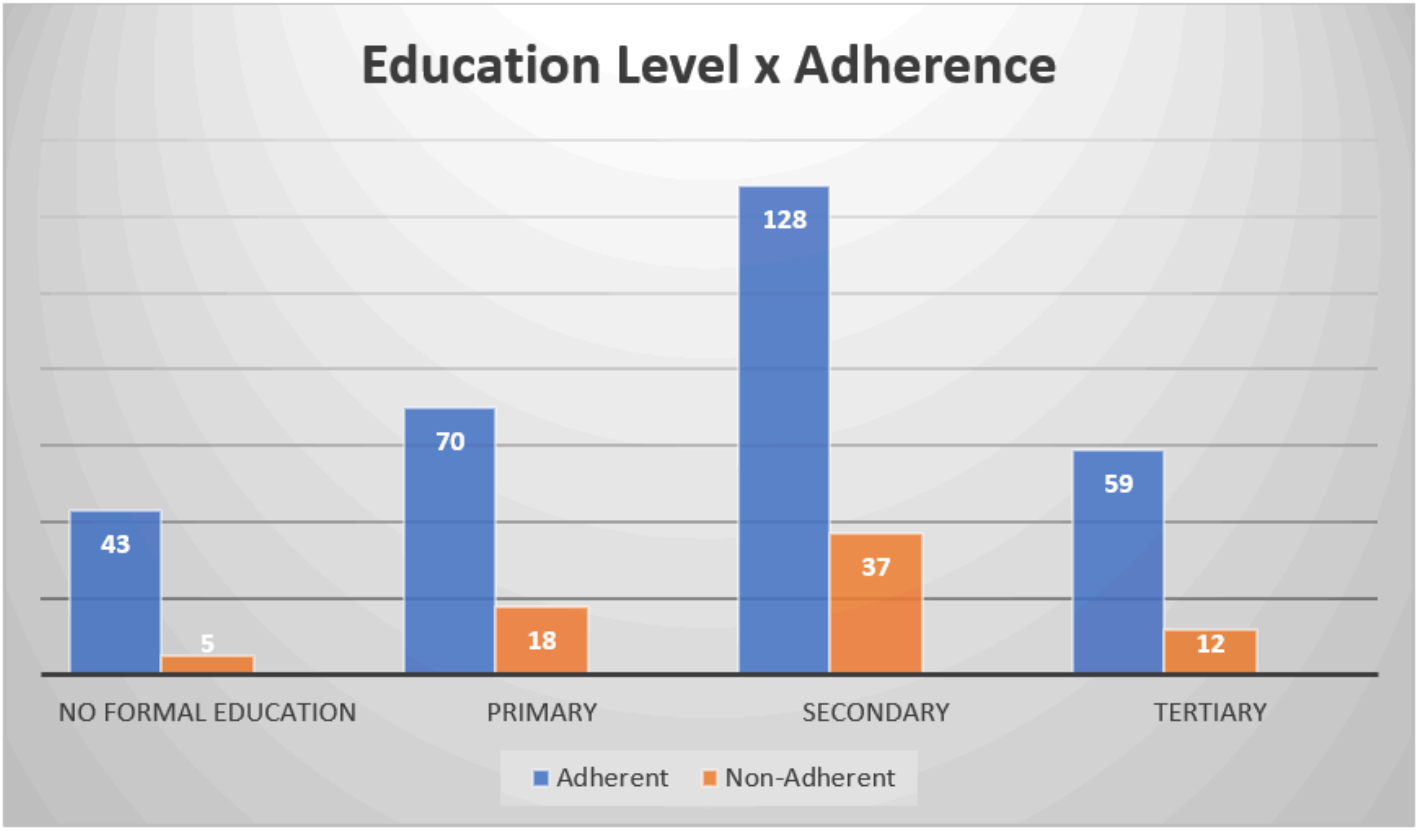


Figure 2

Education level and adherence outcome

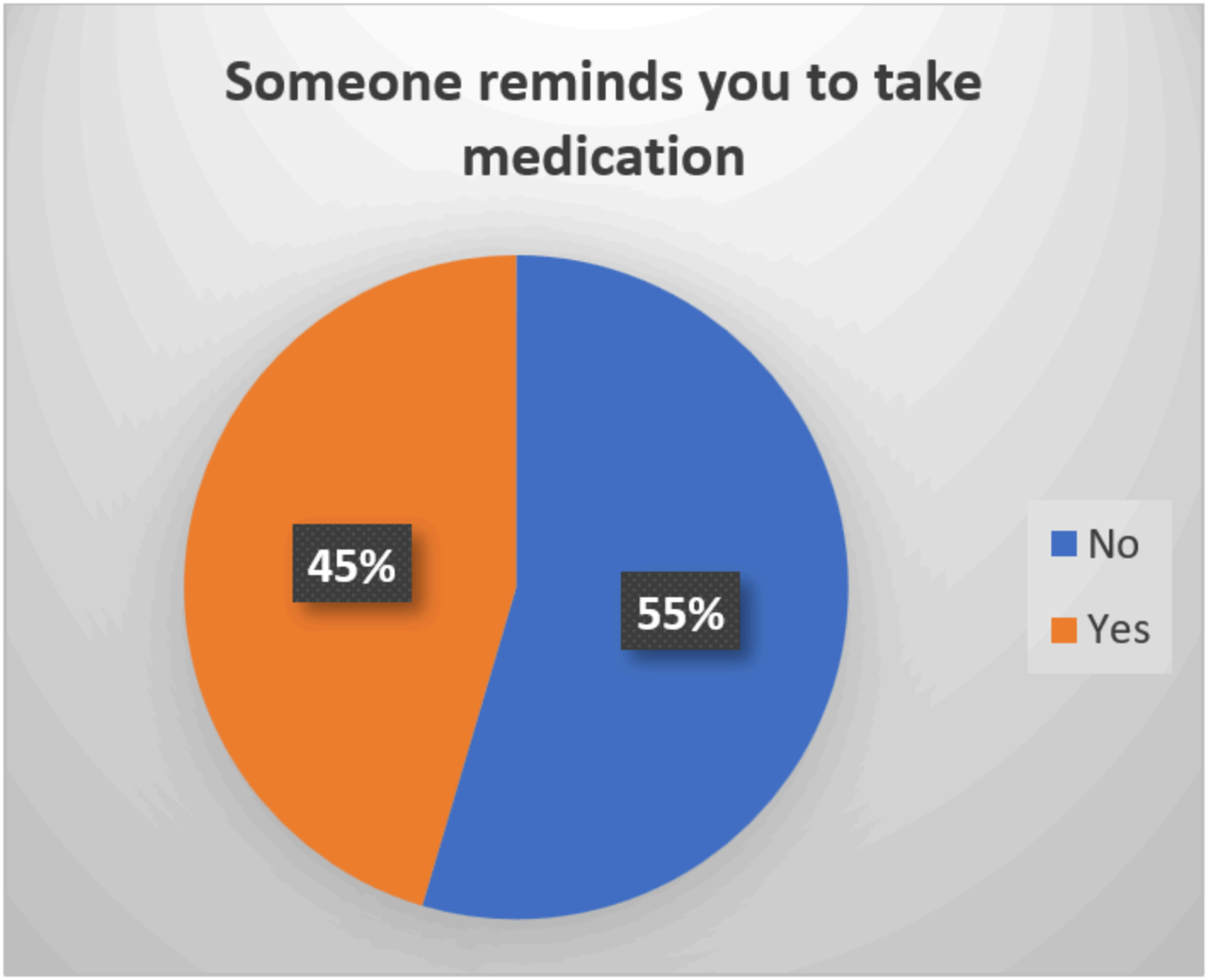


Figure 3

Medication reminding support

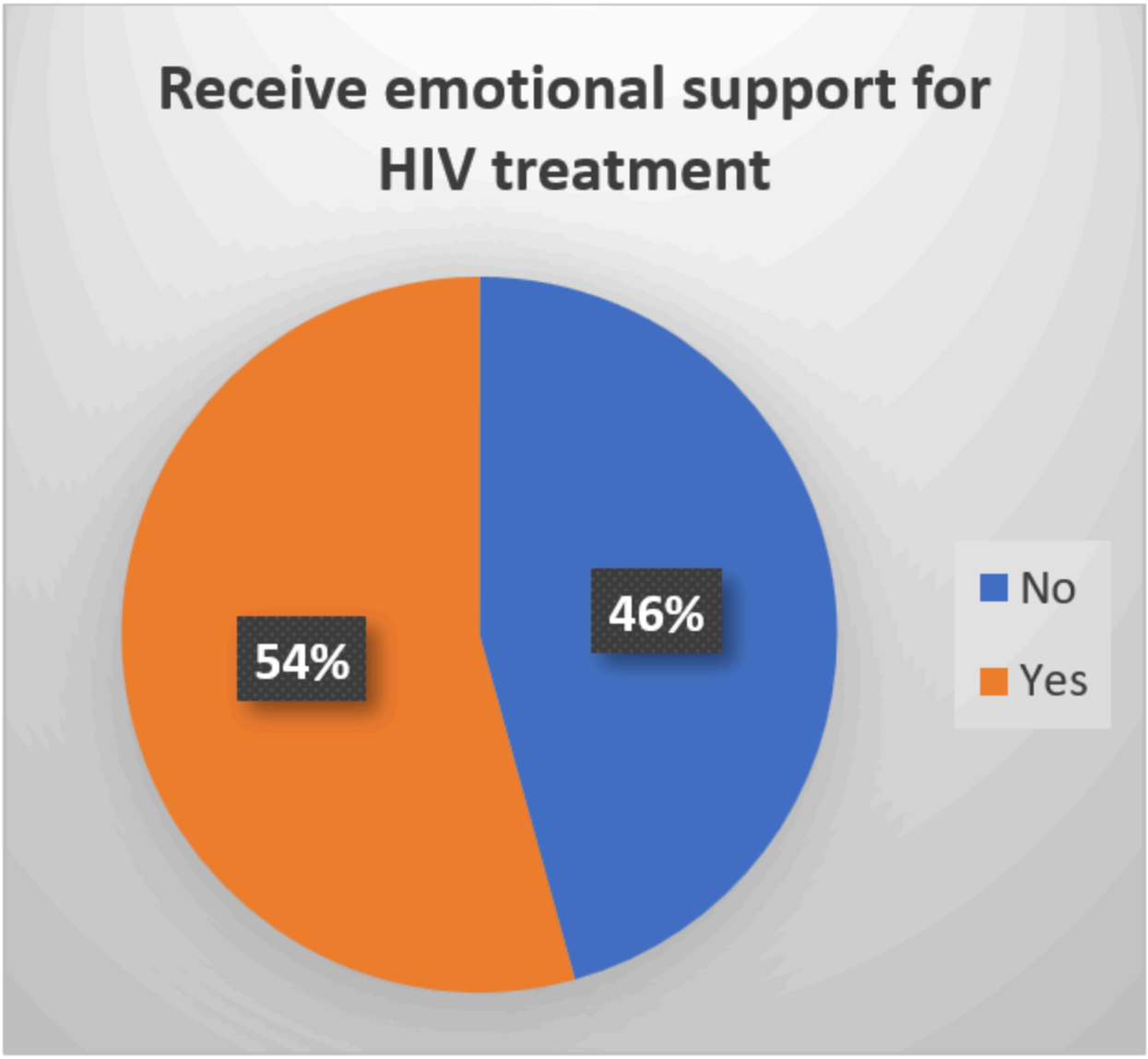


Figure 4

Emotional support

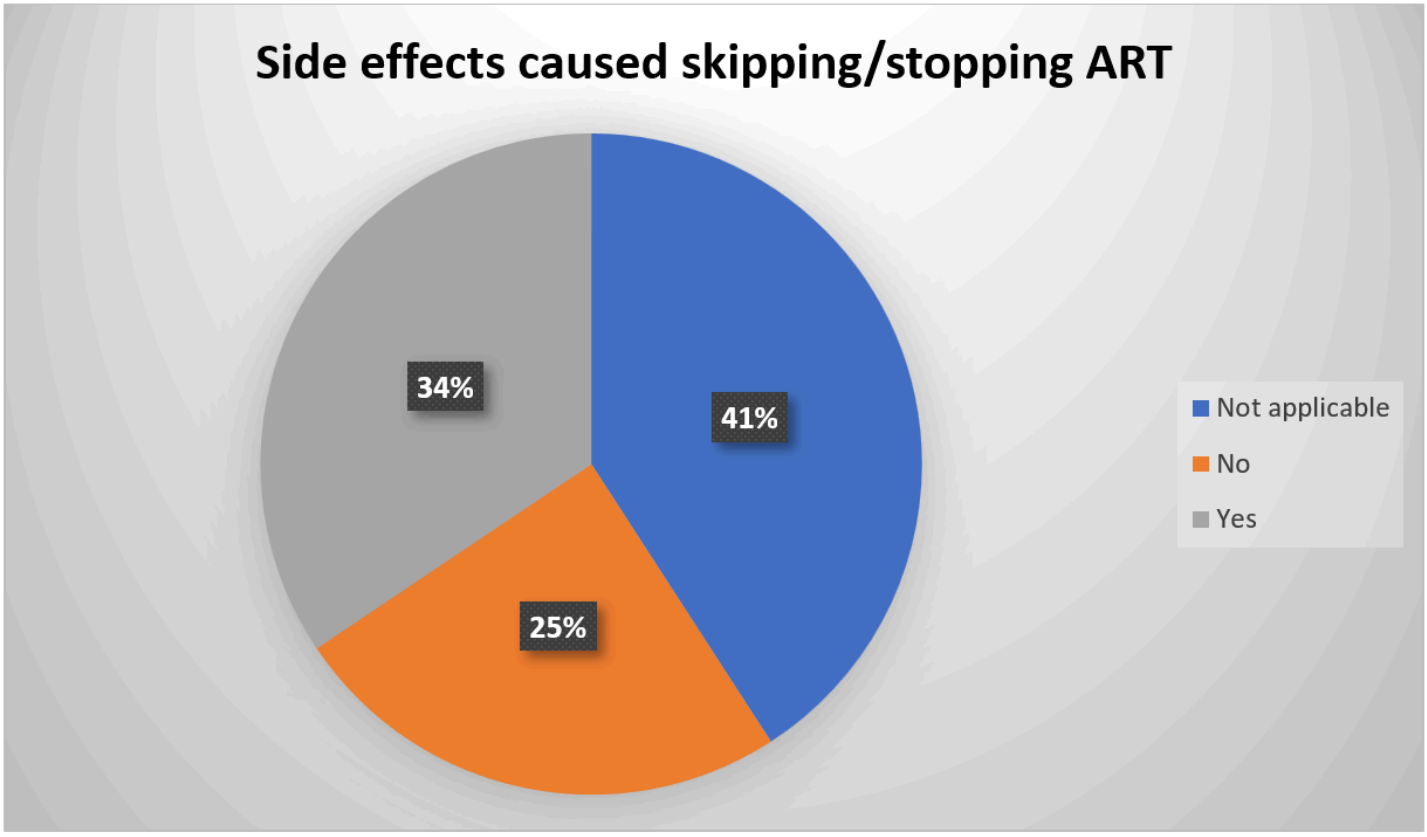


Figure 5

Side effects caused skipping/stopping ART