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Determinants of adherence to antiretroviral therapy among people living with HIV receiving care in health facilities in Tamale Metropolis, Ghana

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Abstract

Background Strictly following antiretroviral therapy (ART) is essential in managing HIV and AIDS and attaining viral suppression. However, adherence to ART remains a complex challenge among persons living with HIV (PLHIV) and it is influenced by various individual and socio-cultural factors. Also, there is limited data as far as the studies on determinants of ART adherence in the Tamale Metropolis is concerned. This highlights a critical knowledge gap that needs to be addressed to improve adherence rates. This study therefore aims to examine the determinants of ART adherence among PLHIV in the Tamale Metropolis, Ghana.

Methods A facility-based cross-sectional study design was conducted from November 2023 to February 2024 to recruit 418 PLHIV using consecutive sampling from three healthcare facilities located in the Tamale Metropolis. Data were collected on demographic characteristics, adherence behaviours and socio-cultural beliefs. Every element impacting adherence to ART underwent assessment using a 4-point Likert scale, with data entry and coding executed using Microsoft Excel, followed by statistical analyses using SPSS version 21. Fisher's exact test, Chi-square test and multiple logistic regression analyses were utilized to ascertain autonomous indicators of ART adherence while accounting for the impact of other factors. Determinants of ART were considered statistically significant at a p -value of less than 0.05 with a 95% confidence interval.

Results A total of 418 PLHIV were studied, yielding a 100% response rate and an ART adherence rate of 93%, with a 95% confidence interval ranging from 90.6% to 95.4%. Clients who were educated (AOR = 6.80, 95% CI: 1.57–29.42, $p = 0.010$), retentive (AOR = 10.73, 95% CI: 4.24–27.15, $p < 0.001$), had aversion for alternative treatment modalities (AOR = 8.04, 95% CI: 2.90–22.29, $p < 0.001$) and involved with peer support groups (AOR = 3.73, 95% CI: 1.02–13.56, $p < 0.05$) exhibited markedly higher rates of adherence to ART, as relative to those who did the opposite.

Conclusion The study identified a sub-optimal adherence rate of 93% among PLHIV with key determinants of ART adherence. Among individual factors, educational attainment and forgetfulness played a significant role in influencing adherence levels. In terms of sociocultural factors, inclinations toward alternative therapies, such as traditional or herbal remedies, and active engagement in peer support networks were found to impact adherence. The Ghana AIDS Commission and its partners should implement targeted educational programs, interventions such as reminder systems

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(e.g., mobile phone alerts, pill organizers) should be developed and promoted, develop culturally sensitive outreach programs that respect traditional beliefs while promoting the benefits of ART and strengthen peer support networks.

Keywords Adherence, Antiretroviral Therapy, HIV and AIDS, Ghana, Tamale Metropolis, Socio-cultural factors, Peer support

Introduction

Acquired Immunodeficiency Syndrome (AIDS) results from the progression of untreated Human Immunodeficiency Virus (HIV), a retrovirus belonging to the Lenti-virus genus, which replicates slowly. It is a condition that affects people and is defined by a compromised immune system, which encourages the development of opportunistic and deadly infections as well as cancer [1]. Between the onset of the epidemic and the conclusion of 2021, the HIV epidemic has affected 84.2 million individuals worldwide, resulting in the loss of 40.1 million lives [2]. Moreover, after peaking in 1996, there has been a notable decline of 54% in the incidence of HIV infections as of 2021, possibly attributed to heightened ART coverage and adherence. However, this decline has gradually decelerated over time, underscoring the necessity for sustained prevention initiatives [3]. Inequalities persist, with the WHO African region continuing to report the highest rates of prevalence and mortality linked to HIV and AIDS [4]. As of 2021, 25.8 million people in Africa were having HIV, but only 20.1 million of them were receiving ART, and there were 425,100 AIDS-related fatalities [2].

Over the past two decades, significant strides have been achieved in the quest against the HIV scourge, largely due to the recognition of compliance with ART as pivotal in transforming HIV into a long-term, controllable disease [5]. Patients undergoing ART ought to be counselled to aim for a medication adherence rate exceeding 95%. This recommendation stems from findings in a meta-analysis indicating that maintaining adherence at a level deemed “adequate” (80–90%) did not consistently yield favourable virologic outcomes in contrast to achieving “ideal” (100%) or “almost ideal” (95%) adherence [6]. In addition, a meta-analysis of ART adherence studies conducted in sub-Saharan Africa highlighted a compliance rate of 77%, indicating a shortfall from the recommended adherence range of 95–100% [7]. This low compliance rate is mainly due to cost of seeking care, not disclosing status to a loved one or fear of being stigmatized, as well as difficulty in following complex drug regimens [8].

Over 28% of PLHIV in Ghana, remain unaware of their HIV status due to lack of testing [9]. Also, Ghana is currently facing a significant public health challenge, as the Ghana AIDS Commission has reported severe financial constraints, leading to the rationing of ART drugs. With a funding gap of 66% and insufficient government

support, the distribution of ART to PLHIV now lasts only 2–3 months per refill, rather than the intended 6 months [10]. The rationing of ART in Ghana highlights the absence of a dedicated budget for HIV programs, which is likely to result in increased HIV-related morbidity and mortality due to limited and inconsistent access to treatment. Irregular or interrupted ART access also raises the risk of developing drug-resistant HIV strains, further complicating treatment efforts. Additionally, the strain on the healthcare system could intensify due to the need for more frequent medical attention and hospitalizations for AIDS-related illnesses, exacerbating the burden on already limited healthcare resources, and increasing the risk of HIV transmission.

While there is no universally accepted definition of treatment adherence, it generally refers to the consistent following of prescribed dietary guidelines, schedules, and dosage recommendations. Non-adherence is widely recognized as a major factor contributing to treatment failure among PLHIV, as it significantly increases the risk of developing drug resistance due to insufficient viral suppression [11, 12]. The Joint United Nations Program on HIV and AIDS (UNAIDS) introduced the Fast-Track plan in June 2021, setting ambitious targets for 95% of PLHIV to know their status, 95% of those diagnosed to be on ART, and 95% of those on ART to achieve viral suppression [13]. However, global progress has been uneven, with the 95–95–95 targets achieving 81%, 67%, and 59% respectively, while Ghana's figures are 58%, 77%, and 68% as of 2019, hindered by stigma, discrimination, and alternative treatment beliefs of 2019 [14, 15].

Numerous studies in Ghana identify factors contributing to nonadherence including side effects of ART, distance to the ART centre, stigma, discrimination, substance use, nondisclosure of status, male sex, more than once daily dosing ART regimens, education, busy schedule, inadequate support, stock-outs/privacy at the clinic, and alternative herbal remedies [11, 14, 16–18]. A gap in the majority of the previously cited studies in Ghana, including those conducted on an international scale, is the adoption of only self-report as the primary approach for assessing adherence to ART among PLHIV [2, 19, 20]. This study addresses this gap by evaluating ART adherence through self-reports, with findings validated against clinical records. However, adherence in these studies was favourably correlated with self-efficacy, reminders and

regular follow-ups from health professionals, family support, and self-perceived healthiness.

Despite observed adherence patterns, there are no comprehensive studies on determinants of ART adherence in the Tamale Metropolis, with only one existing research focusing primarily on children [14]. The Ghana AIDS Commission (2019) reported an HIV prevalence of 0.31% in the Northern Region, with the Tamale Metropolis showing the highest prevalence at 0.68%, surpassing the other 15 districts in the region. Geographically, Tamale is the capital and largest city of the Northern Region, serving as its commercial and administrative hub. This urban center likely experiences different social dynamics, including higher population density, potential gaps in healthcare infrastructure and outreach specific to the urban context as well as varied risky behaviors, which may contribute to the increased prevalence. While improving knowledge about HIV and adherence to treatment is crucial, addressing the higher prevalence in Tamale may also require targeted interventions that consider these local factors, including enhanced preventive strategies and better access to healthcare services. Several PLHIVs are not adhering to ART, and the situation has resulted in their death, with 13,616 AIDS-related mortality recorded annually in Ghana [21]. This study therefore seeks to identify PLHIV's adherence to treatment and its associated factors in health facilities in northern Ghana.

Materials and methods

Description of study setting

The study was conducted in three major ART units within the Tamale Metropolis, the capital and main commercial centre of the Northern Region of Ghana. As of the 2021 census, the metropolis has a population of 374,744, with 80.08% residing in urban areas and 19.1% in rural areas [22]. In 2019, the HIV prevalence in the region was recorded at 0.31% (3,697 cases), with the Tamale Metropolis reporting a higher prevalence of 0.68% [21]. As of June 2023, this prevalence increased to 0.7% (6,072 cases), with PLHIV receiving care at 24 ART facilities across the region [23].

Study design and study population

A facility-based cross-sectional design with a quantitative approach was conducted from November 2023 to February 2024. The research involved a cohort of PLHIV aged 18 years or older receiving antiretroviral therapy at three public hospitals in Tamale; these included a tertiary facility, namely the Tamale Teaching Hospital (TTH), alongside two secondary level hospitals, namely Tamale West Hospital (TWH) and Tamale Central Hospital (TCH). These establishments function as crucial referral points for the five northern regions

of Ghana, as well as neighbouring countries like Togo, Ivory Coast, and Burkina Faso. Furthermore, they serve as pivotal training grounds for students and provide a comprehensive array of both inpatient and outpatient healthcare services [14]. Based on the local database, it is estimated that approximately 1,816, 961 and 873 PLHIV receive treatment at the TTH, TCH, and TWH, respectively.

Inclusion and exclusion criteria

Eligibility encompassed PLHIV, aged 18 years or older, receiving ART at the TTH, TWH, or TCH facilities for a minimum duration of six months, willing to participate, and maintaining a state of robust physical and mental health. Among those excluded were PLHIV who were in a critical medical condition during the data-gathering process, including clients with speech or hearing impairments.

Sample size determination

The study's sample size was calculated utilizing the Cochran formula;

$$n = \frac{z^2 \times pq}{d^2}$$

Where $z=1.96$ at 95% confidence level, $d=0.05$, $d=5\%$, $q=1-p$ and $p=44.6\%$ [The approximate percentage of PLHIV who complied with ART based on a study carried out in the Ga West Municipality, Ghana (44.6%) [16],

The calculated estimated sample size was determined in the following manner:

$$\frac{n = 1.96^2 \times 0.446(1 - 0.446)}{0.05^2} = \frac{1.96^2 \times 0.446(0.554)}{0.05^2}$$

$$n = 379.68$$

The smallest required sample size for the research is calculated as $379.68 + 37.97 = 417.65$ taking into consideration a 10% non-response rate (10% of $379.68 = 37.97$). As a result, 418 people were included in the study's sample.

Sampling technique

The selection of hospitals for the study was conducted using purposive sampling; a deliberate selection that encompassed the three foremost hospitals in the Tamale Metropolis due to their substantial contribution to delivering ART services to a considerable segment of PLHIV. Consecutive sampling was utilized to enrol participants in the study which entailed selecting PLHIV who met specific inclusion criteria during their visits to the ART clinic till the desired sample size was attained. If a chosen

individual declined participation, another participant who met the criteria was selected to maintain the desired sample size.

Data collection procedures, tools, and data management

This research utilized a questionnaire adapted from previous research [16, 20, 24–27], as its primary data collection tool. The questionnaire, originally written in English and printed on paper, was pre-tested (achieving a Cronbach's alpha of 0.96 for reliability and refined for content validity by modifying three items to better capture ART adherence factors.) utilizing a convenience sample of three PLHIV receiving treatment at TCH. Feedback from these participants was used to refine the questionnaire, ensuring its accuracy, efficiency, and ease of use. The estimated completion time for the questionnaire ranged from 20 to 45 min, depending on the participants' varying levels of comprehension. Data collection was conducted through face-to-face interviews in a private room over five clinic days per week, from November 2023 to February 2024, spanning a total of 70 working days. The estimated sample size of 418 participants was proportionally allocated across each facility using the proportional allocation formula $n_i = (N_i/N) \times n$. This approach resulted in the engagement of 208 participants at TTH, 110 at TCH, and 100 at TWH, utilizing convenience sampling methods. Participants were fully informed about the study, and consent was obtained through signature or thumbprint, with interpreters and witnesses involved when necessary. Collaboration was established with seven ART providers (three males and four females), each with over four years of experience in conducting similar studies from three facilities: 1 from Tamale West Hospital (TWH), 2 from Tamale Central Hospital (TCH), and 4 from Tamale Teaching Hospital (TTH). These providers underwent a one-day training session at their respective facilities, conducted by the principal investigator, before the commencement of data collection. The training focused on familiarizing them with the study questionnaire and enhancing their data collection skills in both English and Dagbani. This approach enabled efficient data collection and minimized participant attrition (minimizing the dropout rate of participants during the study) by promoting clear communication and fostering trust between the ART providers and participants. The use of culturally and linguistically aligned providers, who were already known to the participants, increased comfort and engagement, thereby improving their willingness to remain in the study until its completion. Data were securely stored on password-protected computers, with physical questionnaire materials to be retained for five years before disposal following data retention policies. The integrity of the data was maintained through a

thorough review process to ensure validity and completeness throughout the study.

Study variables

This study focused on adherence to ART as the dependent variable, which serve as the primary measure of outcome. This adherence is affected by manipulating predictor variables, including individual (such as sociodemographic factors, psychological factors and health status) and socio-cultural factors (such as stigma and discrimination, disclosure, social support, use of other alternative medications and perception of treatment and wellbeing). The assessment of ART adherence in this study was based on patients' retrospective recall or self-report regarding their medication adherence over the 30 days preceding the interview, with this information validated against their clinical records. The "Adherent" group included those with adherence levels of 95% or higher (< 2 doses of 30 doses missed), while the "non-adherent" group comprised adherence levels below 95% (≥ 3 doses of 30 doses missed).

Statistical analyses

After compiling the questionnaire and thoroughly analysing the responses to ensure thoroughness and resolve any internal issues, each socio-cultural factor affecting adherence to ART was assessed using a satisfaction scale, specifically, a 4-point Likert scale. "Strongly Agree" and "Agree" responses were interpreted as indicating agreement, while "Strongly Disagree" and "Disagree" responses were seen as indicating disagreement. By combining "Strongly Agree" and "Agree" responses, we measured the overall level of agreement with a given statement. Similarly, combining "Strongly Disagree" and "Disagree" allowed for measuring the overall level of disagreement. This approach simplified data interpretation by reducing the scale to two primary categories (agreement vs. disagreement), making it easier to identify trends and patterns in the data. Data entry and coding procedures were executed using Microsoft Excel, followed by data transfer to the SPSS version 21 software program, where all subsequent statistical analyses were conducted. Simple frequencies and percentages were computed for all variables to provide a comprehensive overview of the data, facilitating a descriptive summary.

Binary and multiple logistic regression analyses were utilized to ascertain autonomous indicators of ART adherence while accounting for the impact of other factors. The relationships between the independent variables and the dependent variable were examined by Fisher's and Chi-square statistics. Statistical significance was determined at a threshold of less than 0.05, with a confidence interval of 95%. Following adjustment for potential confounding

variables (example, monthly income, travel, belief in spiritual healing for the disease) through multivariable logistic regression analysis, certain factors retained significant associations with adherence to antiretroviral therapy. The reliability of respondents' feedback regarding the factors impacting their adherence to ART was assessed through Cronbach's Alpha analysis and a Cronbach's Alpha coefficient of 0.9 was yielded, signifying outstanding internal consistency among the survey items. This high degree of reliability provides strong evidence that the measurement tool is dependable and that the respondents' answers are consistent. Consequently, the results derived from this tool can be considered reliable for assessing the factors affecting ART adherence. This reliability measure is crucial for ensuring the validity of subsequent analyses and interpretations in this research study.

Results

Socio-demographic characteristics of respondents

A total of 418 participants were interviewed, achieving a 100% response rate. The mean age of the respondents was 37.74 (SD=8.92) with 306 (73.2%) being females. Moreover, 259 (62.0%) were wedded, 299 (71.5%) adhered to the Muslim faith, and 270 (64.4%) were identified ethnically as Dagomba (Table 1). It is worth noting that 305 (73.0%) are urban dwellers with 379 (90.7%) abstaining from alcohol consumption, and smoking.

Level of adherence to antiretroviral therapy

Out of 418 participants, 93% ($n=388$) demonstrated good adherence to ART and 7% had poor adherence to ART.

Table 2 illustrates that 259 (62%) recalled being prescribed a combination therapy consisting of Tenofovir, Lamivudine, and Dolutegravir (D-T-L) corresponding with the Firstline ART combination drugs commonly used in Ghana. This explains why 412 (98.6%) of the clients followed a once-daily pill regimen, as prescribed, with 404 (97%) affirmed having taken their prescribed medications at home without disposing of them. Within the month before the study, 336 (80.4%) of respondents reported complete adherence to their medication regimen.

Individual factors influencing adherence

As outlined in Table 3, 350 (83.7%) of respondents preferred to keep their HIV status private. Additionally, 266 (63.7%) of the participants reported feeling shocked or depressed upon learning of their HIV diagnosis. Nevertheless, 328 (78.4%) acknowledged the necessity of self-discipline in maintaining adherence to their therapy with 252 (60.3%) not concerned about their partners knowing their status. Notably, 358 (85.6%) of respondents believed

Table 1 Socio-demographic characteristics of respondents ($N = 418$)

Variable	Frequency (N)	Percentage (%)
Age (years)		
18-29	100	23.9
30-49	236	56.5
At least 50	82	19.6
Gender		
Male	112	26.8
Female	306	73.2
Marital status		
Single	95	22.7
Married	259	62.0
Divorced/Widowed	54	12.9
Cohabiting	10	2.4
Ethnicity		
Dagomba	270	64.4
Mamprusi	34	8.1
Mossi	31	7.4
Others	83	20.1
Religion		
Christianity	119	28.5
Islam	299	71.5
Patient educational level		
No formal education	148	35.4
Low (Primary and JHS)	88	21.1
High (At least SHS)	182	43.5
Employment status		
Unemployed	183	43.8
Employed	207	49.5
Student	19	4.5
Retired	9	2.2
Income Per Month		
<200 Cedis	98	23.4
200-500 Cedis	183	43.8
501-1000 Cedis	78	18.7
>1000	59	14.1
HIV Status of Partner		
Positive	112	27.0
Negative	113	27.0
Unknown	193	46.0
Children		
Yes	328	78.5
No	90	21.5
Type of Settlement of Patient		
Urban	305	73.0
Rural	89	21.3
Sub-rural	24	5.7
Distance to ART clinic		
<150 Metres	204	48.8
≥150 Metres	214	51.2

Table 1 (continued)

Variable	Frequency (N)	Percentage (%)
Transport to access the ART clinic		
Vehicle	375	89.7
Walking	43	10.3
Time to reach the ART centre		
<30 Minutes	135	32.3
30-60 Minutes	186	44.5
>60 Minutes	97	23.2
Did the participant smoke or take alcohol?		
Yes	39	9.3
No	379	90.7

they had HIV, reflecting a high level of acceptance of their diagnosis.

Socio-cultural factors influencing adherence to ART

The results show that negative community norms towards PLHIV have affected ART adherence in 241 (57.6%) of respondents. Additionally, 269 (64.3%) of respondents feared stigma and discrimination by family or society if recognized at the ART centre. Despite this, a significant majority 383 (91.6%) understood that non-adherence could lead to AIDS or death, with 362 (86.6%) acknowledging that adhering to a treatment regimen has the potential to decrease viral load. and 401 (96.0%)

reported improved well-being when taking their ART. The societal influence on adherence is evident, as 272 (65.1%) of respondents indicated that disclosing their HIV status affected their adherence. Hearing from other PLHIV influenced 265 (63.4%) of respondents, and, notably, a majority 387 (92.6%) of respondents did not prefer alternative medicines or visits to prayer camps, and 382 (91.4%) did not agree that HIV is a spiritual disease requiring spiritual healing (Table 4).

Determinants of adherence to ART among PLHIV

Following adjustment for potential confounding variables through multivariable logistic regression analysis, certain factors retained significant associations with adherence to ART. These included individual factors such as educational attainment and frequency of forgetting medication schedules, as well as sociocultural factors like inclination towards alternative medicines such as traditional/herbal remedies or visits to prayer camps, and participation in peer support groups. Patients who had completed at least primary education were found to be 6.8 times more likely to adhere to ART compared to those with no formal education (Adjusted Odds Ratio [AOR] = 6.80, 95% Confidence Interval [CI]: 1.57–29.42, $p=0.010$). Similarly, patients who did not report forgetting to take medications were 10 times more likely to adhere to ART compared to those who did (AOR = 10.73, 95% CI: 4.24–27.15, $p<0.001$), indicating a higher

Table 2 Frequency of adherence to ART among people living with HIV (N = 418)

Items	Options	Frequency (%)
How long have you been on ART?	Below 1 year	68 (16.3%)
	1-5 years	178 (42.6%)
	Above 5 years	172 (41.1%)
Which of the following drugs are you taking?	D-T-L ^a	259 (62.0%)
	E-T-L ^a	2 (0.4%)
	E-D-L ^a	21 (5.0%)
	N-T-L ^a	6 (1.4%)
	ALL	3 (0.7%)
	Can't remember	123 (29.4%)
How many pills do you take daily?	1	412 (98.6%)
	2	5 (1.2%)
	3	1 (0.2%)
Did you miss taking any of your medication in the past 30 days?	Yes	82 (19.6%)
	No	336 (80.4%)
How many doses of your medications did you miss in the past 30 days?	<3 Doses	52 (12.4%)
	3-12 Doses	15 (3.6%)
	>12 Doses	15 (3.6%)
	Did not miss	336 (80.4%)
Do you pick up prescriptions for ART but not take them?	Yes	14 (3.3%)
	No	404 (96.7%)

NB^a: D Dolutegravir, E Enfuvirtide, T Tenofovir, L Lamivudine, N Nevirapine

Table 3 Individual factors influencing adherence to ART

Variable	Frequency (N)	Percentage (%)
I fear my spouse will know		
Agree	166	39.7
Disagree	252	60.3
I don't want others to know		
Agree	350	83.7
Disagree	68	16.3
I feel shocked/depressed knowing I have HIV		
Agree	266	63.7
Disagree	152	36.3
I forget to go for my medications		
Agree	46	11
Disagree	372	89
I get busy with work/social activities		
Agree	49	11.7
Disagree	369	88.3
I get anxious when I see people at the centre		
Agree	176	42.1
Disagree	242	57.9
I have to forego my daily income-generating activities		
Agree	115	27.5
Disagree	303	72.5
I go through a lot of stress daily		
Agree	110	26.3
Disagree	308	73.7
I am struggling with poor health status (including co-occurring infections)		
Agree	32	7.7
Disagree	386	92.4
I am influenced by my beliefs (e.g. culture and religion)		
Agree	105	25.1
Disagree	313	74.9
My employer does not allow me to leave early for the clinic		
Agree	23	5.5
Disagree	395	94.5
I don't believe I have HIV and AIDS		
Agree	60	14.4
Disagree	358	85.6
I lost my job		
Agree	57	13.6
Disagree	361	86.4
I have been away from home (e.g. travelled)		
Agree	52	12.4
Disagree	366	87.6
It requires self-discipline to adhere to ART		
Agree	328	78.4
Disagree	90	21.6
Job insecurity arising from regular leave of absence to receive ART		
Agree	58	13.9
Disagree	360	86.1
I use memory aids (e.g Watch/mobile alarm, Written schedule)		
Agree	277	66.3
Disagree	141	33.7

Table 4 Socio-cultural factors influencing adherence to ART

Variable	Frequency (N)	Percentage (%)
I fear that I will go through stigma and discrimination from family/society if recognized at the ART centre		
Agree	269	64.3
Disagree	149	35.7
I am influenced by the negative norms in my community towards people living with HIV		
Agree	241	57.6
Disagree	177	42.4
I am not satisfied with the treatment because I see no benefit		
Agree	29	7.0
Disagree	389	93.0
I believe that Antiretroviral therapy (ART) is still effective without regular use		
Agree	77	18.4
Disagree	341	81.6
I prefer the use of alternative medicines like traditional/herbal medicines or visit prayer camps		
Agree	31	7.4
Disagree	387	92.6
I know a friend or family who died of HIV		
Agree	127	30.4
Disagree	291	69.6
I know a friend or family who died of HIV due to non-adherence		
Agree	158	37.8
Disagree	260	62.2
My refusal to adhere leads to getting AIDS faster		
Agree	383	91.6
Disagree	35	8.4
When I take my medications, I feel better		
Agree	401	96.0
Disagree	17	4.0
Irregular intake of my medications can lead to death		
Agree	383	91.6
Disagree	35	8.4
Following a treatment plan can reduce viral load		
Agree	362	86.6
Disagree	56	13.4
Following a treatment plan can make me healthy		
Agree	410	98.1
Disagree	8	1.9
I get support from friends and family		
Agree	226	54.1
Disagree	192	45.9
Disclosing my status has influenced my adherence to ART		
Agree	272	65.1
Disagree	146	34.9
I belong to a peer support group		
Agree	142	34.0
Disagree	276	66.0
Hearing from another person living with HIV influenced me		
Agree	265	63.4
Disagree	153	36.6

Table 4 (continued)

Variable	Frequency (N)	Percentage (%)
It is a spiritual disease that needs spiritual healing		
Agree	36	8.6
Disagree	382	91.4
The people in my religion have influenced my adherence		
Agree	74	17.7
Disagree	344	82.3
I have lost friends by telling them I have HIV		
Agree	117	27.9
Disagree	301	72.1
Not abiding by ART leads to drug resistance		
Agree	319	76.3
Disagree	99	23.7

likelihood of adherence among those who did not forget their medication schedules. Moreover, clients without a preference for alternative medicines such as traditional/herbal remedies exhibited 8 times greater adherence compared to those with such preferences (AOR=8.04, 95% CI: 2.90–22.29, $p < 0.001$). Additionally, patients who participated in peer support groups were 3.7 times more likely to adhere to ART compared to those who did not partake in such groups (AOR=3.73, 95% CI: 1.02–13.56, $p < 0.05$) (Table 5). The combination of these four variables explained 35.2% of the variance in ART adherence (Nagelkerke R Square=0.352).

Discussion

Compliance with medical therapy remains essential for improving health outcomes in long-term illnesses like HIV and AIDS. This cross-sectional study demonstrates a sub-optimal compliance rate of 93%, the estimated level of adherence drops below the recommended threshold of 95%, which is essential for attaining viral suppression and stopping the worldwide spread of the AIDS pandemic by 2025 [13]. The sub-optimal ART compliance rate observed in this study highlights the necessity for enhanced focus on designing and implementing integrated interventions, it is consistent with a Nigerian study that reported a similar rate of 92.6% [28]. Comparable rates have been observed in multiple African and Asian nations, with reported adherence rates ranging from 92.7% to 95.2% [29]. Conversely, studies conducted within Ghana and abroad have depicted lower adherence rates. For instance, studies carried out in Upper West and Upper East regional hospitals in Ghana found adherence rates to ART to be 62.2% and 62.6% respectively [14]. Likewise, a study carried out in the Ga West suburb outlined an adherence rate of 44.6% [27]. Beyond Ghana's borders, adherence levels were reported at

63.7% in Tanzania [30], 85.6% in Eastern Ethiopia [31], and approximately 74% in the United States [32]. The disparities in these adherence rates may stem from variations in assessment methodologies and population demographics.

Educational achievement emerged as a key determinant of adherence to ART, revealing that individuals who have completed at least primary education exhibit higher rates of adherence. This observation aligns with prior research indicating that educational attainment plays a crucial role in promoting adherence among PLHIV. Higher educational levels facilitate better comprehension of health-related information, including guidance on adhering to ART [20, 24, 33, 34]. Conversely, investigations by Safira et al. (2018) and Ejigu et al. (2020) yielded consistent findings, indicating a lack of compelling evidence supporting a significant link between education level and ART adherence. In this study, patients who had completed at least primary education demonstrated a 6.8-fold increase in ART compliance as opposed to individuals with no formal education, consistent with another study highlighting that PLHIV with adequate understanding of ART medications had a 2.8-fold increase in ART adherence, in contrast with those with limited understanding [35]. Likewise, within the scope of this investigation, patients who did not disclose instances of medication forgetfulness demonstrated a tenfold higher likelihood of adhering to ART compared to those who did., indicating an increased probability of adherence among those who adhered to their medication schedules consistently. Additionally, utilizing memory aids, for instance, watch/mobile alarms and written schedules, was identified as a key factor contributing to good adherence, with 89% of respondents indicating they did not forget their medications. This discovery aligns with findings from other studies, suggesting a predominant trend (66.7%) of patients

Table 5 Determinants of adherence to ART among PLHIV

Variables	Categories	N	Adherence		Test statistic (Bivariate)	COR (95%CI) (Multivariate)	AOR (95%CI) (Multivariate)
			Non-adherent (<95%)	Adherent (≥95%)			
Individual factors			N(%)			N(%)	
Education	No formal education	148	20 (13.5)	128 (86.5)	Fisher's Exact Test = 12.5, $p = 0.002$	Ref*	Ref*
	Low (Primary and JHS)	88	3 (3.4)	85 (96.6)		4.43(1.28-15.36)*	6.80(1.57-29.42)*
	High (At least SHS)	182	7 (3.8)	175 (96.6)		3.91(1.60-9.52)*	3.39(1.26-9.16)*
Monthly Income (Cedis)	<200	98	13(13.3)	85(86.7)	Fisher's Exact Test = 15.6, $p = 0.001$		
	200-500	183	5(2.7)	178(97.3)			
	501-1000	78	10(12.8)	68(87.2)			
Smoke or take alcohol?	Yes	39	6(15.4)	33(84.6)	$\chi^2 = 4.3, p = 0.04$		
	No	379	24(6.3)	355(93.7)			
Forgetfulness	Disagreed	372	16 (4.3)	356 (95.7)	$p < 0.001$	9.73 (4.36, 21.74)***	10.73 (4.24, 27.15)***
	Agreed	46	14 (30.4)	32 (69.6)		Ref*	Ref*
Engagement in social activities	Disagreed	369	23 (6.2)	346 (93.8)	$\chi^2 = 4.2, p = 0.04$		
	Agreed	49	7 (14.3)	42 (85.7)			
Struggles with poor health status	Disagreed	386	22 (5.7)	364 (94.3)	$\chi^2 = 16.5, p < 0.001$		
	Agreed	32	8 (2.5)	24 (75.0)			
Believe in being afflicted with HIV	Disagreed	358	21 (5.9)	337 (94.1)	$\chi^2 = 6.4, p = 0.01$		
	Agreed	60	9 (15.0)	51 (85.0)			
Travel	Disagreed	366	21 (5.7)	345 (94.3)	$\chi^2 = 9.1, p = 0.002$		
	Agreed	52	9 (17.3)	43 (82.7)			
Socio-cultural factors							
Preference for alternative treatment modalities	Disagreed	387	19 (4.9)	368 (95.1)	$\chi^2 = 40.3, p < 0.001$	10.65 (4.47, 25.38)***	8.04 (2.90, 22.29)***
	Agreed	31	11 (35.5)	20 (64.5)		Ref*	Ref*
Treatment Dissatisfaction	Disagreed	389	23 (5.9)	366 (94.1)	$\chi^2 = 13.5, p < 0.001$		
	Agreed	29	7 (24.1)	22 (75.9)			
Adherence promotes health	Disagreed	35	6 (17.1)	29 (82.9)	$\chi^2 = 5.7, p = 0.02$		
	Agreed	383	24 (6.3)	359 (93.7)			
Adherence to treatment plans	Disagreed	8	2 (25.0)	6 (75.0)	Fisher's Exact Test = 3.9, $p = 0.05$		
	Agreed	410	28 (6.8)	382 (93.2)			
The disease requires spiritual healing	Disagreed	382	23 (6.0)	359 (94.0)	$\chi^2 = 8.9, p = 0.003$		
	Agreed	36	7 (19.4)	29 (80.6)			
Involvement in peer support groups	Disagreed	276	27 (9.8)	249 (90.2)	$p = 0.004$	5.02(1.50, 16.86)*	3.73(1.02,13.56)*
	Agreed	142	3 (2.1)	139 (97.9)		Ref*	Ref*

Ref*: Reference; *Significant at $p < 0.05$; **Significant at $p < 0.01$; ***Significant at $p < 0.001$; AOR(95% CI): Adjusted odds ratio at 95% Confidence Level; COR (95% CI): Crude/unadjusted odds ratio at 95% Confidence Level; $\chi^2 = \text{Chi-square}$

who reported frequent forgetfulness acknowledged missing their prescribed medications. The underlying causes of forgetfulness may stem from an improvement in health status or busy schedules [28, 36].

A patient's understanding of ART is pivotal in optimizing compliance with the recommended treatment protocol [33, 37]. PLHIV who utilize reminders (cue to action) to take medication are five times as inclined to adhere to ART in comparison to those who do not utilize reminders [20, 35]. This underscores the importance of interventions targeting memory aids or reminder systems to improve adherence. However, in another study with results consistent with the present study, it was also identified that within the non-adherent cohort, individuals employing reminders to adhere to their treatment regimen (8.3%) demonstrated lower adherence to ART in comparison to those who did not utilize any reminders (14.7%) [38].

A significant correlation was observed between various socio-cultural factors and the level of adherence demonstrated. The present investigation revealed that patients engaging in peer support groups demonstrated a 3.7-fold increase in adherence to ART compared to those abstaining from such groups. Additionally, 93.0% recognized the benefits of adhering to therapy confirming that health literacy exhibits a positive correlation with ART adherence. In essence, patients who possess a deeper understanding of the significance of adhering to medication and the risks associated with treatment default are less likely to stray from their prescribed regimen [39]. The result aligns with research conducted in South Africa that revealed that participants attending support groups had a 1.6-fold increased likelihood to follow through on taking ART and HIV prophylaxis in contrast with non-attendees [40]. Numerous investigations have established a noteworthy correlation between PLHIV participating in support groups or possessing a robust peer social support network and their adherence to ART [24, 25, 28, 34, 39, 41, 42].

While education constitutes a crucial element in HIV care and management, its efficacy as a standalone intervention may be limited. This is evident in the transient nature of its impact compared to the sustained and interactive benefits derived from engagement in peer support activities. The extent of participation in these peer support groups may have a tremendous effect on treatment compliance among PLHIV [43]. Additionally, there is a higher prevalence of alcohol consumption among PLHIV who are not participating in peer support groups, suggesting that peer-driven behavioural interventions may mitigate risky behaviours and enhance treatment outcomes [43]. The existence of peer support groups not only facilitates medication adherence but also fosters a supportive

environment for the exchange of experiences and mutual encouragement. Such social support contributes to bolstering patients' self-esteem, thereby facilitating adherence to ART. Conversely, the absence of such support may engender feelings of hopelessness, potentially leading to treatment non-compliance [44].

Additionally, the study found that clients lacking a preference for alternative medicines, such as traditional or herbal remedies, demonstrated adherence levels approximately eight times higher than those who did express such preferences. Furthermore, clients who did not perceive their ailment as necessitating spiritual healing exhibited greater adherence compared to those who believed in the need for spiritual intervention. This discovery aligns with the findings from research in Ghana [45], which encompassed a descriptive cross-sectional mixed-method investigation involving 229 HIV-infected women aged 18 to 49 years, along with 14 healthcare professionals across three ART centres in Kumasi. Boateng et al. (2013) observed a tendency among certain individuals living with HIV to favour traditional and alternative treatments over antiretroviral medication, often resulting in treatment default.

The findings of this study have important implications for clinical practice and policy development in HIV care. They emphasize the need for targeted interventions focused on education and psychosocial support, such as peer support programs and counselling services, for PLHIV. Additionally, culturally tailored approaches that consider traditional beliefs and utilize peer support networks could further enhance treatment outcomes.

Strengths and limitations of the study

A key strength of this study is the integration of self-reported data with clinical methods, alongside a strong emphasis on maintaining patient confidentiality throughout the data collection process and excluding patients undergoing early therapy. The primary beneficiaries are PLHIV and healthcare providers at ART centers, who directly benefit from insights the factors identified within the study to improve treatment adherence and patient outcomes. Secondary beneficiaries include policymakers, health administrators, and peer support groups, who can utilize the study findings to inform policies, resource allocation, and support strategies. Tertiary beneficiaries encompass the general public, the academic and research community, and international donors and NGOs, who benefit from the broader, long-term impacts of improved public health outcomes and knowledge dissemination expected from the implementation of the study recommendations. However, there are inherent limitations that merit consideration. Firstly, the comprehensive questionnaire employed might impose cognitive strain on participants, potentially

influencing their responses through heuristic reasoning. Secondly, the cross-sectional nature of the study, which collects data at a single time point, presents challenges in determining causal relationships, highlighting the necessity for longitudinal investigations to establish temporal associations. Thirdly, reliance on self-reported data introduces the risk of recall bias, which could potentially lead to inaccurate data such as overstating or understating adherence as well as obscure associations between variables. To mitigate this risk, the study incorporated healthcare provider involvement, reviewed patient clinical records and utilized a short recall period of 30 days prior to the study. Additionally, the sensitive subject matter of the study may have induced social desirability bias among participants impacting the accuracy of the study findings through compromised consistency of responses which eventually affects the reliability of participants responses. To mitigate this risk, the study ensured anonymity and confidentiality during data collection. Future studies could incorporate objective measures of adherence, such as mixed-methods study design, pharmacy refill records, taking blood for viral load assessment or electronic monitoring devices, to provide more accurate assessments of adherence behaviour. Additionally, the Hawthorne effect might have influenced participant behaviour, as their awareness of being part of a study could have altered their responses or actions. Nevertheless, ensuring confidentiality may have mitigated these limitations to some extent.

Conclusion

The study identified a sub-optimal adherence rate of 93% among PLHIV with key determinants of ART adherence. Among individual factors, educational attainment and forgetfulness played a significant role in influencing adherence levels. In terms of sociocultural factors, inclinations toward alternative therapies, such as traditional or herbal remedies, and active engagement in peer support networks were found to impact adherence. The Ghana AIDS Commission and its partners should implement targeted educational programs, interventions such as reminder systems (e.g., mobile phone alerts, pill organizers) should be developed and promoted, develop culturally sensitive outreach programs that respect traditional beliefs while promoting the benefits of ART and strengthen peer support networks.

Abbreviations

ART	Antiretroviral Therapy
PLHIV	Persons living with HIV
TTH	Tamale Teaching Hospital
TWH	Tamale West Hospital
TCH	Tamale Central Hospital

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Authors' contributions

AFG identified the research problem, conducted the study, and wrote the manuscript. GAA rigorously supervised proposal development, data collection, and data analysis and reviewed the manuscript for submission. AA critically reviewed the results and approved the manuscript for submission. BYG also reviewed the manuscript and offered feedback.

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Data availability

The corresponding author can provide the data sets that were used or otherwise evaluated in the current work upon reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval: The approval for this study came from the Institutional Review Boards of TTH, TWH, and TCH, as well as the Northern Regional Health Directorate in Tamale. Clearance of ethics was granted by the Ethics Review Committee of TTH and the Ghana Health Service, with approval numbers TTHERC/20/11/23/01 and GHS-ERC:053/09/23, respectively. Following the attainment of ethical clearance, notification was extended to the hospital's administration and the individuals responsible for overseeing the ART clinic about the research study. Their cooperation was sought to facilitate the identification and engagement of prospective study participants. Subsequently, a mutually agreed-upon meeting date was scheduled with these potential participants. During this meeting, a comprehensive disclosure process was conducted. No financial costs or expenses were incurred by participants during their involvement in this research.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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