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Original Article

Adherence to Antiretroviral Therapy and Factors Associated among Adult HIV Positives in Public Hospitals of Hawassa City, Sidama, Ethiopia, 2024

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Abstract

Background: HIV/AIDS remains as a major global health problem despite the introduction of antiretroviral (ART) therapy to control it. In Ethiopia, access to ART has improved, but understanding of the level of adherence and the factors influencing it is still poor. The limited study reports showed that most studies were based on document analysis and that less attention was paid to investigating adherence factors in HIV-positive patients. This study aimed to close this gap by assessing adherence rates and identifying key predictors among HIV-positive adults in public hospitals in Hawassa city, Sidama region, Ethiopia.

Objective: To assess the level of antiretroviral adherence and related factors among adult HIV-positive patients in public hospitals in the city of Hawassa, Sidama region, Ethiopia, 2024.

Method: A cross-sectional study was performed on 333 randomly selected adults in ART clinics in public hospitals from 10 to 30 December, 2024. The participants were selected by stratified sampling from six health public hospitals. Data were collected through structured questionnaires by six data collectors under a close supervision of two supervisors. Adherence was retrospectively assessed by self-reported doses and pill counts, with <5 missed doses considered to be good or good adherence. The data were coded, cleaned and analyzed using SPSS version 26. Descriptive statistics, bivariate and multivariate logistic regression models were used to identify factors influencing adherence as reported in adjusted odds ratios (AOR) with 95% CI and p<0.05.

Results: The adherence rate in adult HIV-positive patients was 261 (79.6%), 95% CI (75.0-83.7). This level was below the WHO standard (>95%). Some of the main factors identified for the low adherence observed were no formal education (AOR=3.225, 95%, CI (1.237, 8.409)) and frequent travel within the last month (AOR=2.806, 95%; CI (1.354, 5.817)).

Conclusions: Analyses showed that the adherence rate to ART was below WHO standard in the study population. This low adherence was associated with factors such as lack of formal education and long-distance travel from home, fear of stigma and discrimination, inconvenience related to the size and frequency of ART doses and adverse reactions, among other important factors reported by study participants. This highlights the importance of regular counseling of HIV/AIDS patients, both prior to and during follow-up visits, to adhere to their treatment regimen, thus avoiding missed doses, medical complications, co-morbidities and drug resistance in the study population.

Keywords: Adherence to ART, Associated factors, Public hospitals, Hawassa city, Sidama, Ethiopia

Introduction

Human immunodeficiency virus (HIV) causes acquired immune deficiency syndrome (AIDS). HIV/AIDS is a major killer disease, killing millions worldwide (1). It is a communicable disease which affects many people irrespective of age, gender, ethnic origin or country of residence. For example, in 2023, the World Health Organization reported that 39.9 million people worldwide live with HIV, around 65% of whom live in Africa (2). In addition, the reports showed that in the same year (2023), some 630 000 people died as a result of complications associated with HIV infection (3). HIV/AIDS is also known to cause significant economic costs, directly or indirectly, at national and individual levels (4-7). The HIV/AIDS health challenge is particularly serious in developing and low income countries, including Ethiopia (8-10).

Although HIV/AIDS is not a curable disease, there are different medicines that can help people infected with the disease alive for a long time (3,10). Antiretroviral therapy (ART) is the widely accepted treatment approach. The introduction of ART has led to improved health outcomes for many people living with HIV, although there are limitations in terms of availability and affordability of ART services (11,12). Therefore, adherence to ART is essential to improve clinical outcomes in HIV-positive patients. ART adherence is known to have a significant effect on reducing viral replication, preventing virus resistance in

those infected and on the overall progression of disease (13). However, adherence to ART is not at the expected level in many HIV-positive patients, as many patients are either discontinuing or not taking their medication consistently (14,15).

The World Health Organization (WHO) has developed guidelines stating that high adherence (> 95%) is critical to ART effectiveness (16-18). In order to improve adherence to ART and to support the quality of life of people living with HIV, various stakeholders are working to improve access to HIV screening, advice and ART services (19). Adverse drug reactions and problems with dose regimens are reported as some of the factors that have caused many patients to discontinue ART therapy (20,21). This could lead to drug resistance, increased mortality, decreased CD4 counts, decreased undetectable viral load, decreased treatment success and longer hospital stays (22).

The Government of Ethiopia has provided ART medicines to HIV-positive persons to reduce disease and mortality and to improve the quality of life of people living with HIV. The reports showed that Ethiopia had implemented its ART programme in 2003 and that in 2005 the treatment became free of charge (23). Increased availability of ART services has been shown to reduce the disease and mortality rates of HIV-positive people. For example, in 2022, some 367 000 people received ART, representing a 62% coverage rate (23,24). This progress in access to ART

services has contributed to the reduction of AIDS-related deaths. In addition, reports show that overall ART coverage in the country has improved from 73% in 2011 (25) to 74% in 2019, according to UNAIDS estimates (26).

There are several studies conducted in different regions of Ethiopia assessing adherence to ART by HIV-positive persons and identifying factors influencing adherence in the context of combating HIV and AIDS (19,27-30). Some of the factors identified are socio-economic circumstances, access to healthcare or access to ART services in limited facilities, stigma and discrimination, lack of motivation, lack of support from case managers and supporters, mental health problems and reliance on traditional practitioners. All of these may lead to poor HIV outcomes or contribute to the reported low adherence rates (11,28). For example, the report by Demissie *et al.* on ART adherence levels among HIV-positive women in Southern Ethiopia (27) and a review by Aytenew *et al.* (28) showed that HIV/AIDS patients have adherence levels below the recommended standard level of adherence (>95%) (16,17). Investigations at the Nekemte referral hospital in West Ethiopia (29) and Hara City in Northeast Ethiopia (30) also showed adherence rates of 73.1% and 71.8%, respectively. The levels in these reports also showed that adherence to ART were below 95% (16-18) of the recommended adherence level. As elsewhere in the world, the side effects of medicines, together with the factors

listed above, may contribute to insufficient adherence of HIV-positive persons to ART in various regions of Ethiopia (31-34).

In many regions of Ethiopia, including the study area (Hawassa City), the level of compliance is not well researched. The aim of this study was, therefore, to assess the rate of adherence to ART and its associated factors in adult HIV-positive HIV patients treated with ART in public hospitals in Hawassa, Sidama Regional State, Southern Ethiopia, in 2024. The results of this study are expected to help in the development and implementation of better treatment strategies by relevant stakeholders and improve the health outcomes of people living with HIV.

Methods and Materials

Study area and period

The study was carried out in the ART clinics of public hospitals in Hawassa, the Sidama region, Southern Ethiopia. Hawassa has eight (08) sub-cities and is located 272 km south of the Ethiopian capital, Addis Ababa, with an average altitude of 1,708 m. According to the 2018 report by the Hawassa City Administration, the city has a population of 374,034 inhabitants (of whom 190,757 are men and 183,277 are women). There are public hospitals. These include the comprehensive specialized hospital of Hawassa University, four public hospitals, seven health centers, five private hospitals and one affiliated NGO hospital.

The public hospitals selected for the study were the Hawassa University

Comprehensive Specialized Teaching Referral Hospital, Adare General Hospital, Bushula Primary Hospital, Motite Furra Primary Hospital and Tula Primary Hospital. These public health institutions have been deliberately chosen because they offer a range of healthcare services (including ART) to the public at reasonable prices. Customers of these public institutions come from Hawassa City and its surrounding districts and neighboring regions. This study was carried out between November 10 and December 30, 2024.

Study design

An Institution-based cross-sectional study design was conducted.

Study population

Source population

The source population consists of all HIV-positive adults who have been on ART for at least six months and are receiving treatment in the selected public hospitals, Hawassa City.

Study participants

In this study, randomly selected adult patients on HIV-positive adults who have been on ART for at least six months at public hospitals in Hawassa City, and available during the study period.

Inclusion and exclusion criteria

Inclusion criteria

The study included all the HIV-infected adults aged 18 or older who are receiving ART in the selected public hospitals and

consent to participate at the time of data collection.

Exclusion criteria

All Adults who were unable to respond and sign consent due to the severity of their illness were excluded from the study.

Sample size and sampling techniques

Sample size determinations

The sample size was determined based on single population proportion formula. Based on the assumption a 95% confidence level, 5% margin of error, the proportion of adherence to ART being 73.1% which was from the study in southwest Ethiopia (34) and 10% non-respondent rate.

$$n = (Z_{1-\alpha/2})^2 \frac{P[1-P]}{d^2}$$

Where:

n: sample size

Z: Standard normal variable at for 95% confidence level (1.96)

P: Expected prevalence self-reported good adherence = 73.1%

d: Precision (marginal of error) = 0.05

In addition, 10% of non-response rate

$$n = \frac{(1.96)^2 \times 0.731(1 - 0.731)}{0.05^2} = 302.2$$

By adding (n=302.2) +(10% non-respondent rate) = (302.2 + 30.22) = 332.42 $\approx$ 333

Sampling technique and procedure: A systematic random sampling technique was employed to choose the 333 participants for the study. During the month-long study period, it was projected that 3302 patients would attend the selected health facilities (Adare General Hospital, Hawassa University Comprehensive Specialized Teaching Referral

Hospital, Bushulo Primary Hospital, Motite Furra Primary Hospital, and Tula Primary Hospital). Individual participants were chosen from each health facility using systematic

random sampling, with k calculated to be 10. Consequently, participants were recruited for the study every 10th individual based on their arrival at the ART unit.

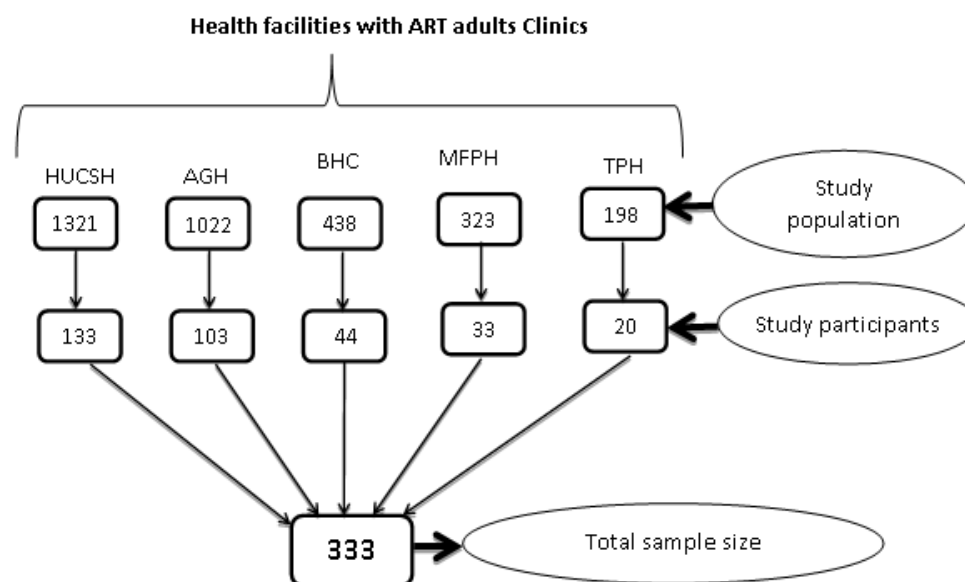


Figure 1: Proportional allocation of samples size from a study population

AGH= Adare General Hospital, HUCRH= Hawassa University Comprehensive Specialized Teaching Referral Hospital. Bushulo Primary Hospital, MFH= Motite furra Primary Hospital, TPH= Tula Primary Hospital

Study Variables

Dependents variable

Adherence status to ART

Independents variables

Age, sex, marital status, occupation, monthly income, family size, place of residence, education attained, access to medication, medication adverse reaction of drugs, time taken to reach facility, forgetfulness, side effects, stigma and discrimination, friends, health care workers, media and peer support, felt asleep, being away from home, being busy, opportunistic infection precludes from ART, receiving information about ART, CD4 count, open communication with health care provider, counseling, service affordability, time duration on ART, in taking food, smoking,

chewing *khat*, transportation cost, proper visit and alcohol use.

Operational definition

- **Adherence level:** using regimens dose as combination once daily. The level of adherence that is determined by missing doses <5 per 30 doses considered as fair to good adherence whereas, missing >5 doses per 30 doses considered as poor adherence
- **Substance use:** refers to the use of substances like smoking cigarette, drinking alcohol and chewing *khat* regularly that means:
 - **Smoking cigarette** at least two cigarettes or more per week in the last month
 - **Drinking alcohol** at least two bottles or more per week in the last month.

- **Chewing *khat*** at least two or more per week in the last month
- **Health belief model:** refers to beliefs (perception) of respondents towards ART adherence and it incorporates five components like (36,37)
- **Adherence:** It refers to the ability of the patients to follow the treatment procedure, rules and restrictions in terms of life styles, food and other medications (38)
- **Self-efficacy:** Ability of the study participant towards ART drugs and its adherence was classified as yes if the respondents answer all questions positively.
- **Health Belief model variables:** discriminated against for being ART user, able to resolve your situation and the problems, and using herbal/ traditional medication for HIV/AIDS, risk of death, developing opportunistic infection, reduce mortality, did ART improve quality of life, do ART reduce mortality, do ART reduce HIV transmission, reminding ART medication, missing tablets, medication big in size and not pleasant, it is boring to take medication, pressure from others

Data collection methods and procedures

The personal interview was carried out using a structured questionnaire (**Supplementary material S1**). Data collection was performed by six BSc nurses working in ART facilities and two MPHs holder supervisors. Training sessions were given to data collectors and supervisors for two days

beforehand on how to extract data from patient medical records and conduct face-to-face interviews to obtain the necessary information and how to fill in a structured questionnaire. Interviewers collected data on the basis of the instructions given. The data collection process and the consistency and completeness of the data were monitored daily by the assigned supervisors who were responsible for informing the principal investigator. The adherence to ART has been determined using the WHO definition in the Supplementary Graph (16,17).

Data analysis procedures

Data entry and analysis was performed with the help of SPSS version 26 software. The data were summarized and presented in descriptive measures such as tables, figures, central trend measures and frequency distribution. The factors determining the dependent variable for adherence levels were retrospectively evaluated on the basis of self-reported data. Missing doses of less than 5 in 30 doses were considered to be fair to good adherence, while missing 5 or more doses was considered poor adherence according to the criteria reported in the literature (16,17). Bivariate and multivariate binary logistic regression models have been implemented. The fitness of the models was checked by the Hosmer and Lemeshow goodness of fit test (39) where a p value >0.05 was considered acceptable. According to Hosmer and Lemeshow's theory, the threshold for inclusion in a multivariate logistic regression analysis is p-value < 0.25 ; for 11 or more

variables, the threshold is < 0.2 . Multivariate logistic regression was used to adjust the values of the outcome variables for the effect of confounding variables for the assessment of the prevalence of ART adherence. The results were considered statistically significant with a $p < 0.05$.

Ethical consideration

Ethical Approval Letter (Protocol No. IRERC 040-25) was obtained from the Institutional Research Ethics Review Committee (IRERC) of the Pharmaceutical College, together with letters of support sent to selected public hospitals by the Sidama Public Health Institute in Hawassa, Ethiopia.

In order to obtain permission to start data collection, the administrative staffs of the selected hospitals were informed about the objectives of the study. Participants were informed about the purpose of the study and the importance of their participation. In addition, participants were informed that they could withdraw from the study at any time, or whenever they had any concerns prior to or during the data collection. The confidentiality of the participants was ensured by excluding personal identifiers such as their names from the forms for the collection of data. Informal oral and written consent was obtained from all participants after they had been provided with sufficient information on the purpose of the study, before the start of the study.

Results

Socio-demographic characteristics of participants

A total of 328 patients enrolled in the study, with a 98.5 percent response rate. The study included 213 male (64.9%) and 115 female (35.1%) subjects, the majority of whom were married (49.4%). Of these, 238 (72.56%) lived in urban areas, whereas 174 (53.05%) lived in Hawassa city. With regard to education, 36 (11.0%) did not have formal education, 138 (42.1%) had completed primary education and 96 (29.3%) had completed secondary education, and only a small number (10.4%) had completed higher education. Family size was low, as shown by the observation data, which showed that 242 (73.8%) of the participants had less than 4 family members, and the mean family size was $3.5 (\pm 2.0)$ family members.

With regard to income, the majority of the 213 (64.9%) had a monthly income of less than 8,273 Ethiopian Birr. Age: 153 (46.6%) were aged 30-39 years, 95 (29.0%) were aged 40 years or over, and 80 (24.4%) were aged 19-29 years, with a mean age of 34.4 ± 7.25 years. The employment status of the participants showed that 135 participants were employed (41.2%), while 49 were unemployed (14.9%). The majority of the participants, 158 (48.2%), were married, while 74 (22.6%) were single (Table 1).

Table 1. The socio-demographic characteristics of adult HIV positive individuals in public hospitals of Hawassa City, Sidama, Ethiopia, 2025.

Variables	Response	N	(%)
Age	19 -29 years	80	(24.4)
	30-39 years	153	(46.6)
	≥ 40 years	95	(29.0)
Sex of respondent	Male	213	(64.9)
	Female	115	(35.1)
Marital status	Unmarried	44	(13.4)
	Married	162	(49.4)
	Divorced	50	(15.2)
	Separated	16	(4.9)
	Widowed	56	(17.1)
Education status	No formal education	36	(11.0)
	Read & write	24	(7.3)
	Elementary	138	(42.1)
	High school	96	(29.3)
	College and above	34	(10.4)
Family size	< 4	242	(73.8)
	≥ 4	86	(26.2)
Place of residence	Urban	238	(72.6)
	Other urban area	64	(19.5)
	Rural area	26	(7.9)
Employment status	Employed	135	(41.2)
	Unemployed	49	(14.9)
	Merchants	44	(13.4)
	Farmer	12	(3.7)
	Pensioner	7	(2.1)
	Student	9	(2.7)
	Not working actively	37	(11.3)
	Others	35	(10.7)
	Live alone	74	(22.6)
Whom do you live with	My wife/ husband	158	(48.2)
	My children	68	(20.7)
	My Family	19	(5.8)
	Unstable	0	(.0)
	My friends	9	(2.7)
Monthly income (birr)	< 8,273 ETB	213	(64.9)
	≥ 8,273 ETB	115	(35.1)

**Income of \$2.15/day, World Bank 2024 report (128.28 ETB in Feb 2025).*

Clinical service-related factors

Of the 328 participants, 300 (91.5%) did not report any side effects from ART, while 28 (8.5%) reported side effects. In terms of baseline CD4 count, 220 (67.1%) participants had a count < 350 cells per mm³ and 108 (32.9%) participants had a count > 350 cells per mm³. Regarding the last CD4

count, 270 (82.3%) of the participants had a > 350 cells per mm³ and 58 (17.7%) of the participants had a < 350 cells per mm³. In addition, 191 (58.2%) of the participants had been in ART for less than 5 years, while 137 (41.8%) had been in ART for more than 5 years (Table 2).

Table 2: Clinical service-related factors of adult HIV positive individuals in public hospitals of Hawassa city, Sidama, Ethiopia, 2025.

Variables	Response	N	(%)
Adverse reaction	Yes	28	(8.5)
	No	300	(91.5)
How long you have been on HAART	< 5 Years	191	(58.2)
	≥ 5 Years	137	(41.8)
CD4 count initial	≤ 350 cells/mm ³	220	(67.1)
	> 350 cells/mm ³	108	(32.9)
CD4 count recent	≤ 350 cells/mm ³	58	(17.7)
	> 350 cells/mm ³	270	(82.3)

Description of health belief model constructs

The survey found that 229 (69.8%) of those surveyed thought that missing one or two doses per week could increase the risk of HIV-related deaths. A significant number, 284 (86.6%), thought skipping one or two tablets per week would increase the risk of opportunistic infections, while 275 (83.8%) thought skipping tablets would make the disease worse. In addition, 269 (82.0%) of the participants reported that not taking ART medicines could increase the risk of passing on the virus to others. Regarding the perceived benefits, 301 (91.8%) of the participants considered that taking ART regularly helped them to live a normal life and 289 (88.1%) considered that ART reduced the incidence of HIV related morbidity. In addition, 271 (82.6%) of the participants submitted opinions that ART reduced HIV mortality and increased life expectancy, and 292 (89.0%) of them considered ART to have reduced the severity of symptoms and improved quality of life. Regarding HIV transmission, 243 (74.1%) respondents

considered ART to reduce the risk of transmission and 316 (96.3%) considered ART to maintain or improve CD4 counts (**Supplementary Material S2**).

Regarding perceived barriers to adherence, 228 (69.5%) of the participants found ART to be uncomfortable because of its size and 274 (83.5%) considered ART to be boring and tedious. In addition, 61 (18.6%) reported being embarrassed or intimidated about using ART in front of others and 137 (41.8%) reported that opportunistic infections had made it more difficult to take medicines. Regarding other problems, 130 (39.6%) reported insufficient or inappropriate nutrition as a reason for skipping doses, 53 (16.2%) reported forgetfulness and 97 (29.6%) reported that managing multiple medications at the same time was the main reason for not being able to manage their adherence. Finally, 246 (96.5%) of the participants received advice from healthcare professionals on the importance of regular use of their medicines and 220 (86.3) had a reminder person at home. Regarding self-efficacy, 156 (61.2%) of the respondents were confident that they

could take their medicine every day without fail (**Supplemental Material S2**)

Health care system related variables

As regard to health care system-related factors, the majority of study participants were satisfied with their clinical services, with 312 (95.1%) responding in the affirmative. In addition, 315 (96.0%) reported that they had an open relationship with their healthcare provider. The majority of participants, 296 (90.2%), also attended all meetings and 305 (90.0) felt that they were given appropriate advice. As regards recent aid, 250 (76.2%) of the participants received advice within the last

three months, and 314 (95.7%) had access to a reliable pharmacy whenever they needed it.

The data from the study also showed that 320 (97.6%) of the participants were satisfied with the outcome of their treatment and 323 (98.5%) were satisfied with the confidentiality of the healthcare provider. As regards logistics factors, 200 (61.0%) respondents indicated that transport costs should be affordable for access to ART services, while 138 (42.1%) respondents reported that they had to walk more than 30 minutes to access ART services (Table 3).

Table 3: Health care system related factors of that affect adherences to ART by adult HIV positive individuals in public hospitals of Hawassa City, Sidama, Ethiopia, 2025.

Variables	Yes		No		Not sure	
	N	(%)	N.	(%)	N	(%)
Satisfied with their clinical service	312	(95.1)	15	(4.6)	1	(0.3)
Open communication with HCP treating you	315	(96.0)	12	(3.7)	1	(0.3)
Proper visit for all your appointments	296	(90.2)	27	(8.2)	5	(1.5)
Adequate counseling	305	(93.0)	22	(6.7)	1	(0.3)
Last three month get counseling	250	(76.2)	75	(22.9)	3	(0.9)
Access to reliable pharmacy any time you want	314	(95.7)	14	(4.3)	0	(0.0)
Satisfied by the changes/ improvements from treatment	320	(97.6)	6	(1.8)	2	(0.6)
Satisfied by their appointments and confidentiality	323	(98.5)	3	(.9)	2	(0.6)
Walk more than 30 minutes to get ART service	138	(42.1)	188	(57.3)	2	(0.6)
Transportation cost affordable for you to get ART service	200	(61.0)	128	(39.0)	0	(0.0)

HCP: Health care provider

Behavioral factors: Substance use

When ART-related behavioral factors are considered, the majority of study participants,

322 (98.2%), 280 (85.4%) and 290 (88.4%) had no prior history of smoking cigarettes, drinking alcohol or chewing tobacco, respectively (Table 4).

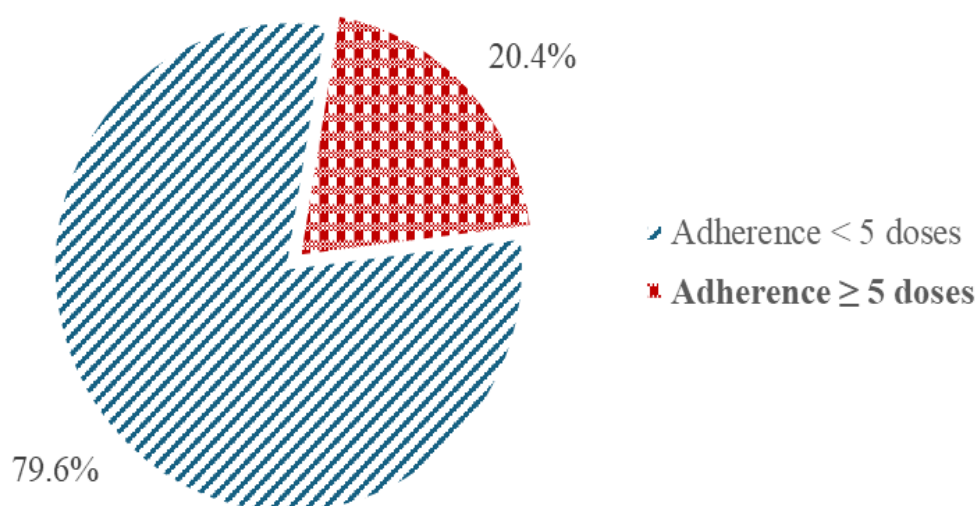
Table 4: Prevalence of substance use among adult HIV-positive individuals in public hospitals in Hawassa city, 2025.

Variables	Responses	N	(%)
Smoke cigarette regularly in last one month	Yes	6	(1.8)
	No	322	(98.2)
Drink alcohol regularly in last one month	No	280	(85.4)
	Yes	48	(14.6)
Chew khat regularly in last one month	Yes	38	(11.6)
	No	290	(88.4)

Level of adherence of participants to ART medication

Of the 328 study participants, 55 missed at least one tablet, with a mean (SD) of 5.07 (4.86%) missing tablets. Based on WHO guidelines (16,17), 261 (79.6%) were

classified as participants with good adherence to ART, missing less than 5 tablets per month, with a 95%-CI (75-83.7), while 67 (20.4%) were missing 5 or more tablets, indicating poor adherence or a < 95% adherence (Figure 1).

**Figure 1:** The overall level of adherence among adult HIV positive individuals in public hospitals of Hawassa City, Sidama, Ethiopia, 2025.

The main reasons reported by participants for skipping or missing ART doses were, according to the respondents, that they were busy with other things or simply forgot, with 130 (51.0%) of the respondents reporting this as their cause. Other important factors included sleep (50, 19.6%), distance from home (46, 18.0%), depression or anxiety (53, 16.2%) and change in daily activities (37, 14.5%). Other contributing factors were the

size and inconvenience of ART treatments (222, 67.7%), the boredom of using lifelong treatments (228, 69.5%), and the shame or fear of using ART treatments in front of others in the household (274, 83.5%). In addition, 137 (41.8%) reported feeling hopeless about the efficacy of the medicine, while 106 (32.3%) reported stigma and discrimination as barriers to ART adherence (**Supplementary Material S3**)

Factors associated with poor adherence

In the bivariate logistic analysis, variables with a poor correlation and candidates for multivariate analysis were: age, gender, educational status, too busy or simply forgot, distance from home, alcohol consumption, perceived sensitivity and severity, perceived benefit and perceived barrier, with a p-value < 0.25 in the cultivation analysis and a statistically significant recruited p-value < 0.05

After controlling for multiple variables, the findings of this study showed that no formal education was significantly associated with poor adherence (AOR = 3.225, 95%; CI: 1.237, 8.409) compared to those with a high level of education. The study also showed that

distance from home within the last month was associated with poor adherence (AOR = 2.806, 95%; CI: 1.354 to 5.817). In addition, subjects who scored below the mean on perceived disease sensitivity and severity had a greater risk of poor adherence (AOR = 3.773, 95%; CI: 1.609, 8.847) than those who scored above the mean. In addition, those who scored below the mean on perceived benefits were more likely to have poor adherence (AOR = 2.777, 95%; CI: 1.258, 6.133) compared with those who scored above the mean. Finally, those who scored above the mean on perceived barriers to compliance had a significantly higher risk of poor compliance (AOR = 5.509, 95%; CI: 2.590, 11.720) compared to those who scored below the mean (Table 5).

Table 5: The factors associated with poor adherence among adult HIV positive individuals in public hospitals of Hawassa City, Sidama, Ethiopia, 2025.

	Adherence				COR, (95%CI)	AOR, (95%CI)	P-value
	< 5 doses		≥ 5 doses				
	No.	(%)	No.	(%)			
Age							
19 -29 years	70	(88.6)	9	(11.4)	1	1	
30-39 years	120	(77.4)	35	(22.6)	2.269 (1.030, 4.996)	1.040 (0.408, 2.649)	0.935
≥ 40 years	71	(75.5)	23	(24.5)	2.520 (1.090, 5.827)	1.057 (0.371, 3.008)	0.918
Sex of respondent							
Male	174	(81.7)	39	(18.3)	1	1	
Female	87	(75.7)	28	(24.3)	1.436 (0.829, 2.487)	1.989 (0.926, 4.275)	0.078
Education							
No formal education	36	(60.0)	24	(40.0)	4.750 (2.277, 9.908)	3.225 (1.237, 8.409)	0.017*
Elementary	111	(80.4)	27	(19.6)	1.733 (0.886, 3.391)	1.767 (0.792, 3.941)	0.164
High school & above	114	(87.7)	16	(12.3)	1	1	
Being too busy with other things or simply forgot.							
No	135	(91.8)	12	(8.2)	1	1	
Yes	126	(69.6)	55	(30.4)	4.911 (2.513, 9.597)	1.717 (0.762, 3.870)	0.192
Far away from home							
No	223	(86.4)	35	(13.6)	1	1	
Yes	38	(54.3)	32	(45.7)	5.365 (2.974, 9.679)	2.806 (1.354, 5.817)	0.006*
Drink alcohol regularly in last one month							

No	228 (81.4)	52 (18.6)	1	1		
Yes	33 (68.8)	15 (31.3)	1.993 (1.009, 3.936)	2.293 (0.963, 5.465)	0.061	
Perceived Susceptibility and perceived severity						
Above mean	158 (74.9)	53 (25.1)	2.468 (1.302, 4.676)	3.773 (1.609, 8.847)	0.002*	
Below mean	103 (88.0)	14 (12.0)	1	1		
Perceived Benefits						
Above mean	123 (86.6)	19 (13.4)	1	1		
Below mean	138 (74.2)	48 (25.8)	2.252 (1.328, 4.039)	2.777 (1.258, 6.133)	0.012*	
Perceived Barriers						
Above mean	84 (60.4)	55 (39.6)	9.658 (4.911, 18.993)	5.509 (2.590, 11.720)	<0.001*	
Below mean	177 (93.7)	12 (6.3)	1	1		

NB; * *P*-value < 0.05 was statistically significant on multivariable, 1 = Reference

Discussions

The aim of the study was to assess the level of adherence to antiretroviral therapy and the factors influencing it in adult HIV-infected patients in public hospitals in Hawassa City, Sidama, South Africa. Self-reported questionnaires were used to collect information from the participants. The results showed that the adherence rate in adult HIV-positive patients in public hospitals in the study area was good, as demonstrated by the response rates of 261 patients (79.6%), 95%; CI: 75.0-83.7). The ART level indicated that most people in the study area were well adherent to ART.

This claim was supported by responses from participants who reported no adverse effects from taking ART (91.5%, Table 2) and by their awareness of the risks of not taking ART (missing ART medicines) and the benefits of taking ART (**Supplementary Material S2**). This conclusion is consistent with the reports by Rohera (2021) and Aseel *et al.* (2010) showed that HIV positive people in urban settings and with a good educational

background have a high adherence rate to ART (41,42).

In addition, acceptable behaviors of most participants such as non-smoking (98.2%), no alcohol consumption (85.4%) and no chewing of Khat (88.4%) (Table 2) could be a possible contributing factor to the observed good adherence. This finding is consistent with literature reports showed that HIV-positive people who did not take alcohol, smoke or chew Khat have good adherence to ART (43,44).

The risk of missing ART tablets, as responded by the participants, may increase the risk of opportunistic infection, death, severity of disease and the risk of transmission of virus or disease to others. The benefits reported by participants were that adherence to ART may help to live a normal life, reduce mortality and morbidity associated with HIV infection, and improve CD4 counts (Table 4). These findings were consistent with literature reports that state that understanding the risks of non-compliance and the benefits of adherence to ART can help HIV patients live a normal or long life (30,40)

As mentioned above, the overall ART adherence rate in this study was 79.6% (Figure 1). Data from the Health Belief Model (HBM) showed that factors such as the boring nature of taking ART medicines for life, the inconvenience and large sizes of ART medicines, opportunistic infections and problems with food intake were important factors preventing patients from taking ART medicines according to the schedules prescribed by their physicians. Fear of stigma and discrimination when taking ART drugs in front of others, the use of multiple drugs and the occurrence of adverse reactions in some people may be responsible for (30, 40%), (Table 4 and 5). Bivariate analysis also revealed that the factors responsible for the relatively lower adherence to ART (compared to WHO recommended levels) were lack of formal education (60; 18.3%), distance from home (70; 21.34%) and perception of vulnerability perceptions of susceptibility and severity as well as perceived barriers (Table 5).

Although lower than the WHO recommended rate (> 95%), the adherence rate (79.6%) of the present study was comparable to previous study findings that reported adherence levels of 82.6% in the North Shewa Zone of Amhara Regional State, Ethiopia (44), 81% at Nekemte Specialized Hospital, Oromia, Ethiopia (29), 83.3% in South Western Ethiopia (45), 82.8% in the National Defense Hospital, Bishoftu, Oromia, Ethiopia (46), 71.8% in Hara town, North Eastern Ethiopia (31), and 81.2% in Addis

Ababa, Ethiopia (47). This comparability of adherence rates can be attributed to the similarity of the health care settings in Ethiopia. However, the adherence level observed in this study was somewhat lower than that reported in comparable studies from Harari National Regional State in Eastern Ethiopia (48), Wolaita Soddo Hospital in Southern Ethiopia (49), Goba in South Eastern Ethiopia (50), Gondar in North Western Ethiopia (51), and Dire Dawa and Harar in Eastern Ethiopia (12) (48) and Ambo in the Oromia region of Central Ethiopia (52) where adherence levels ranged from 87% to 90.8%. The adherence level recorded in the current study was found to be higher than the reported adherence rates for individuals living with HIV in sub-Saharan Africa (72.9%) (53) and in other developing countries such as Cuba (70.6%) (54), Lao DR with an ART adherence of 60% (55), Ghana with 62.2% (40), South Africa with 69% (56), and Northern Tanzania with 71% (57). Differences in ART adherence levels can be attributed to socio-economic status, personal perceptions, study design, study design, methods of analysis and sample size. The findings in this study were primarily based on self-reported data; however, for patients who presented pills, the estimates of adherence were calculated by counting the pills, rather than relying on self-reported data alone, which may have affected the overall adherence rate.

The findings also showed that those with no formal education were significantly more

likely to be in poor attainment than those who completed secondary education or above. This observation is consistent with the research carried out in public hospitals in the town of Jigjiga in Eastern Ethiopia (58) and the studies in Bonga, Kofu in south-west Ethiopia (34) and Bahir Dar in northwest Ethiopia (59) which indicate that HIV-positive persons without formal education may have a reduced understanding of the importance of ART, which may lead to poor adherence. This supports the results of similar studies which have shown that patients with higher educational attainment are more likely to use ART than patients with lower educational attainment (45,58). In addition, the study showed that travelling long distances from home can lead to poor adherence compared with those who do not travel far. This finding was in line with reports from northern Ethiopia (60), Bonga, Kofu in south-west Ethiopia (34) and eastern Gojam in northwest Ethiopia (19). This may be because patients may forget to take their medicine or may not be able to take it with them when travelling long distances. This in turn resulted in an increase in missed doses.

The data obtained on Health Belief Model (HBM) variables such as perceived sensitivity and severity, perceived benefit and perceived barriers (Table 5) were also consistent with the data obtained on other variables to be attributed to the relatively good adherence (79.6%), although it is below the recommended rate (>95%). Literature reports

show that if perceived susceptibility and perceived severity of disease is high, adherence to medicinal products (prevention measures) is high (61,62). The opposite is true when patients have a lower perceived sensitivity and a lower perceived severity of a given disease. In the study, patients who scored below the mean on perceived disease sensitivity and severity had a greater risk of poor adherence (AOR = 3.773, 95% CI: 1.609, 8.847) compared with those who scored above the mean (Table 6). Similar patterns were obtained for the other HBM variables (perceived benefits and perceived barriers) supporting the observed adherence rates in the current study.

The findings of this study also showed that the occurrence of adverse reactions to ART medication caused some participants to miss or skip doses (**Supplementary Material 2**). These results are consistent with reports from the Kembata and Hadiya areas of central Ethiopia, where patients have sometimes or frequently missed or completely discontinued ART due to adverse events (63). Research in other countries, including the Netherlands, has shown that many people experience similar adverse reactions. Patients' perception of potential complications of their medication may also contribute to non-compliance. In addition, factors such as the amount, size and unpleasant taste of prescribed ART medications may have a negative impact on adherence. However, it is important to note that this study has limitations as the

assessment of compliance was based on self-reported data. Previous studies have shown that self-reported adherence levels often overestimate (64). As the current study focused on all HIV-positive adults (over 18 years of age) who were ART for at least one month and selected ART facilities in the municipality of Hawassa, the findings may not be applicable to all HIV-positive individuals living with HIV/AIDS in the same area who are receiving ART at all ART facilities of Hawassa city administration. The study highlights that ART adherence in this area is below WHO recommended standards and that various factors influence optimal adherence. To address the problems affecting adherence to ART, interventions such as reminder alarms for travel, alcohol-control strategies and health education to raise awareness of the perceived risks, the seriousness of the problems and the barriers to adherence are needed. Practically, health care providers should develop collaborative relationships with patients and involve them in the decision-making of treatment to improve adherence. This approach requires effective counseling and transparent communication with HIV-infected patients to ensure adherence to ART. Further studies are recommended to investigate the relationship between adherence to ART and quality of life in HIV-infected individuals in the study area.

Strengths and Limitations of the Study

The study used both primary and secondary data sources, where data collectors provided advice on adherence to ART to each participant during the study. It also integrated a HBM into ART adherence levels, taking into account socio-demographic and health facilities-related factors. However, as this is a cross-sectional study, it may not accurately reflect the year-on-year adherence trends due to seasonal variations. In addition, there is a risk of bias in reporting missed doses, behavioral factors and socio-economic status influencing the reporting of missed doses and social desirability. The selection of a small sample of selected public hospitals may be considered as one of the constraints. Finally, self-reporting may have led to inaccurate estimates of ART adherence rates.

Conclusion and Recommendations

Conclusion

This survey showed that the adult HIV-positive population in the public hospitals of the city of Hawassa is satisfactorily adherent to ART, although still below the WHO recommended standard of at least 95% adherence. The relatively low adherence rate in this region is strongly linked to factors such as lack of formal education, long travel distances from home, reduced awareness of the severity of the disease and increased perceived barriers to adherence.

These findings highlight the need to address these factors in order to increase adherence to ART and ultimately improve the health outcomes of people living with HIV.

Recommendations

The Regional Health Office and other stakeholders working on ART programs should support adherence counseling and awareness raising campaigns on side effects, adverse reactions and barriers to ART adherence, to better understand the factors contributing to poor ART adherence and inform policy improvements in the field.

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