


Adherence to Antiretroviral Treatment and Associated Factors among Seropositive People Received Treatment in Jimma Town Public Health Facilities, Ethiopia

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Abstract

Background: Drug adherence is the most significant in the progression of diseases. Thus, this study aimed to assess adherence and associated factors among seropositive people received treatment. **Methods:** Facility-based cross-sectional study was conducted in Jimma town public health facility from March to April 2019 on 385 selected participants. Systematic sampling technique was used to select study participants. The data were entered using Epi-data version 4.1 and analyzed by SPSS version 20 software. Variables with p-value of less than 0.25 in binary logistic regression were entered into the multivariable logistic regression to control confounding. A significance level of less than 0.05 was used in the final model to judge statistical significance. **Results:** The magnitude of adherence to antiretroviral treatment was 69.4%. Food security (AOR = 1.75 (95% CI; 1.01-3.0), substance abuse (AOR = 0.55 (95% CI; 0.32-0.96), Didn't take other medications (AOR = 2.11 (95% CI; 1.15-3.87), Good relationship with providers (AOR = 3.35 (95% CI; 1.55-7.2), and irregular appointment (AOR = 0.19 (95% CI; 0.11-0.34) were significantly associated. **Conclusion:** The magnitude of adherence to Anti-retroviral therapy was low compare to WHO. Food security, substance abuse, use of other medication, relationship with the health care providers, and irregular appointment were the factors associated. Treatment. Therefore, it is recommended that patients and health care workers enhance Antiretroviral Treatment adherence.

Keywords

anti-retroviral therapy, AIDS, HIV, Africa

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Introduction

HIV/AIDS, with which 36.7 million people were living and 2.1 million newly infected at the end of 2016, has been one of the major health problems globally. From the beginning of the epidemic to 2016, 35 million people died from AIDS-related illnesses.¹ Although the burden of HIV continues to vary significantly across countries, Sub-Saharan Africa remains the most affected with almost 1 in every 25 adults (4.4%) living with it, accounting for nearly 70% of the global burden.²

According to the 2014 estimate the national HIV prevalence in Ethiopia was 1.14%, and the number of people living with HIV is 769, 600 with 15, 700 new HIV infections and 35, 600 AIDS-related deaths each year.³ Adherence is defined as a patient's ability to follow a treatment plan, take medications at prescribed times and frequencies, and follow restrictions

regarding food and other medications. To achieve optimal results from ART, high levels of patient adherence to ART is essential. High levels of adherence to ART (at least 95%) is needed to ensure optimal benefits.⁴

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The Human Immunodeficiency Virus (HIV) infection does not only upset the health of individuals but also impacts on households, communities, and the development of nations. When countries are affected by HIV, they also suffer from other infectious diseases, food insecurity, and other serious problems.⁵ Antiretroviral therapy has an impressive clinical effect in that it decreases the viral replication and viral load which in turn preserves the CD4 level, decreases the progress of AIDS, and reduces AIDS-related deaths.⁶

Concerns about adherence and subsequent development of drug resistance, poor infrastructure, logistic and human capacity, and cost-effectiveness were the major issues.⁷ The most frequently economic-related, therapy-related and behavioral related factors were identified as a factor related to non-adherence. In addition to this relationship and psychological related factors were identified as barriers to good adherence.^{8, 9}

Non-adherence has been measured as the most public reason for treatment failure, which resulted in a potential risk of drug resistance development through suboptimal viral suppression^{10, 11} Considering the Ethiopian government's commitment toward ending HIV by 2030, achieving the required level of suppressed viral load is more challenging compared to the increasing number of People Living with HIV that knew their status and an increasing number on treatment were 32%, 79%, and 65% respectively. Although, a low level of adherence that is below 95% has been reported in sub-Saharan Africa including Ethiopia suggesting the need to identify determinants of adherence to Antiretroviral therapy as paramount.¹²

Therefore, this study aimed to assess magnitude of adherence to antiretroviral treatment and associated factors among seropositive people received treatment in Jimma town public health facilities,

Methodology

Study Design and Setting

A facility-based cross-sectional study design was employed in Jimma town public health facilities from March to April 2019. Jimma town is one of Oromia Regional State which is located 352 km southwest from the capital city of Ethiopia, Addis Ababa. Jimma town has two public hospitals (JUMC and Shanen gibe general hospitals), three private hospitals (Oda hulle, Hawetu and Firomsis hospitals), four health centers (Mandara kochi H/c, Jimma H/c, Bacho bore H/c and Higher 2° H/c) and two non-governmental health facilities (FGAE and Meri stope). The study focused on the four public health facilities (two hospitals and two health centers) which are providing antiretroviral treatment services for people living with HIV/AIDS (PLWHA).

Study Population

The study population was all systematically selected adult PLHIV who are on Antiretroviral therapy with the age of 18 years and above and duration on Antiretroviral therapy six

months and above were included in the study. Those participants are seriously ill or unable to communicate during the study period were excluded from the study.

Sample Size and Sampling Procedure

The sample size was determined using single population proportion formula ($n = (Z \alpha/2)^2 P (1-P)/d^2$) by considering the assumption of the prevalence of adherence to ART among adult PLWHA with unable to get quality of food in the study conducted in hospitals found in Tigray Regional State Northern Ethiopia was 46%,¹³ 95% confidence level, and 0.05 margin of error, 10% non-response rate. Calculated by the mentioned assumptions, the sample size was adjusted by correction formula due to the source population which was the total admitted patients (4232) in the study facilities were less than ten thousand, so the final sample size was 385.

The study participants were selected four Antiretroviral Therapy providing Jimma town public health facilities like Jimma medical center hospital, Shenen Gibe district Hospital, Jimma health center, and Higher two Health Center using a systematic sampling technique. The samples were drawn proportionally from each facility based on the number of seropositive peoples who received treatment.

Data Collection Tools and Method

Questionnaires were developed after reviewing different kinds of literature. A structured interviewer-administered questionnaire was used to collect data. Some changes were made to the questionnaire after the pretest result. The tools were clear and suitable for the participants, with modifications made to improve the clarity, sequence, consistency, and structure of the questionnaire. The content validity of the tool was checked by two experts and the reliability of the tools was checked by Cronbach's alpha after the pre-tested result.

Data were collected by five BSc nurses and supervised by two MSc nurses after two days of training. The questionnaire was translated into local languages and then retranslated back to English to maintain consistency by language experts of both languages. The data collectors completed the questionnaire for each respondent and it took about 20 min to complete the questionnaire. Participants were interviewed in a separate quiet room to maintain confidentiality. Finally, the completed questionnaires were checked by supervisors.

Data Analysis

Data were cleaned and entered into Epi Data version 4.1 and exported to SPSS version 20 for descriptive and inferential analysis. Bivariate logistic regression analysis was done and variables with a p-value of <0.25 were included in multivariable logistic regression analysis. Variables with a p-value of <0.05 in the final regression were considered as statistically significant associated with the outcome variables.

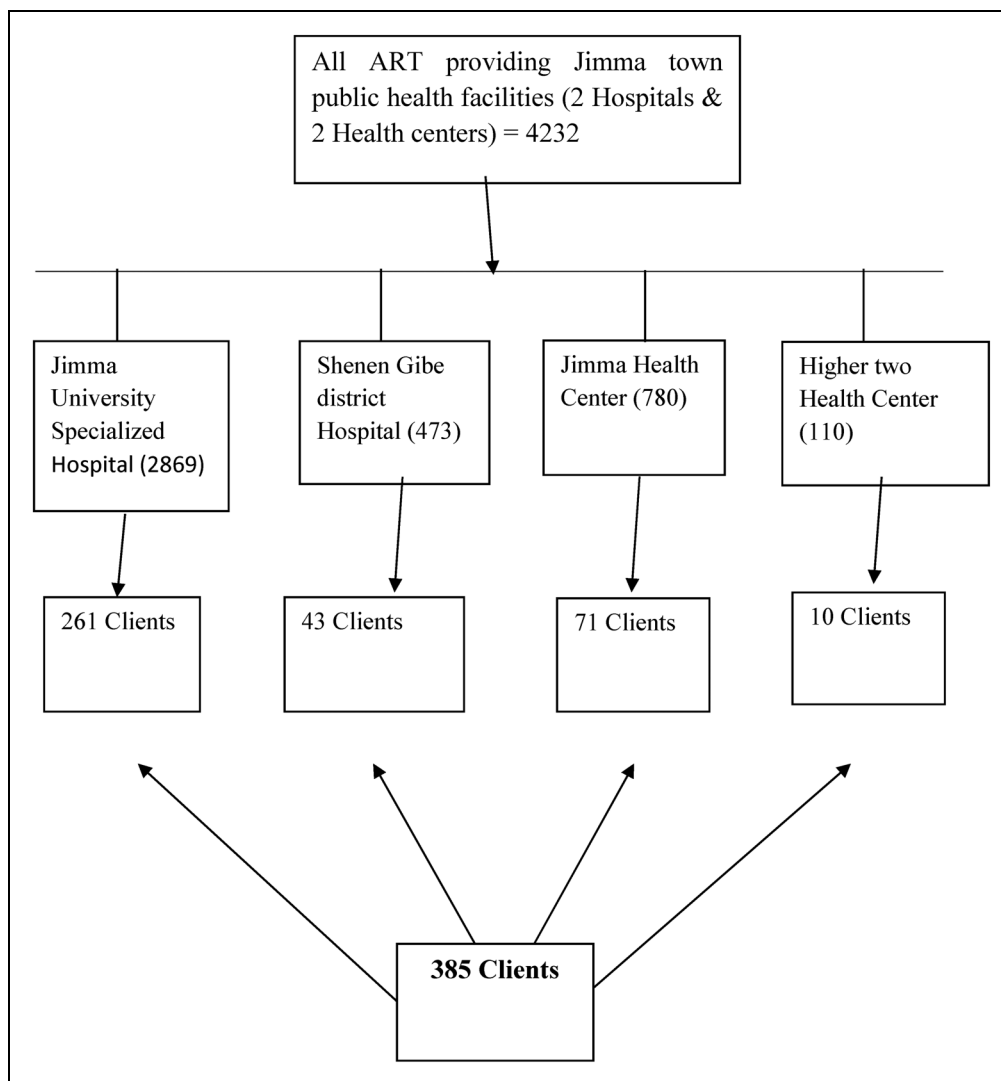


Figure 1. Schematic presentation of the sampling proportion of the adherence to antiretroviral treatment among seropositive peoples on the treatment in Jimma town public health facilities, 2019.

Data Quality Management

To ensure the quality of data, a questionnaire was translated to the local language, training was given for data collectors and supervisor, a pre-test was done on 19 (5%) of the total sample size in Yabu health center and a necessary adjustment was made before used for actual data collection.

Variables of the Study

Dependent variable: Adherence to ART

Independent Variables. Socio-demographic variables, food security status, treatment related factors, client and social related factors, health facility and health care provider related factors.

Operational Definition

Adherence to ART. Adherence to ART: is defined as taking one’s medicine as prescribed and agreed between the patient and

provider which is 95% or more adherence to ART. This means taking doses no more than two hours before or two hours after the time of a doctor’s advice to take doses (95% or more adherence = missing ≤ 2 doses of 30 doses or ≤ 3 doses of 60 doses).¹⁴

Ethics Approval and Consent to Participate

Ethical approval was obtained from Jimma University, Institute of Health, Institutional Review Board (IHRPGD/64/2019). A permission letter was obtained from the Jimma Zonal and district health office then offered to hospitals and health centers. Since the authors thought that there was no any potential risk associated on the provision of the data and it is a cross-sectional study, informed verbal consent was considered and obtained from each respondent before study. Participants were informed about their rights to decline if they didn’t want to continue. The questions were coded instead of using names, confidentiality was assured throughout the study. Involving the use of any animal or human data or tissue: “Not applicable” in this research section. Data

from any individual person in any form (including individual details, images or videos): “Not applicable” in this research.

Results

Socio-Demographic Characteristics

The study was conducted on 385 study participants and the response rate was 100%. The mean age of participants was

Table 1. Socio-demographic Characteristics of the Adherence to Antiretroviral Treatment Among Seropositive Peoples on the Treatment in Jimma Town Public Health Facilities, 2019. (N = 385)

Variables	Description	Frequency (No)	Percentage (%)
Sex	Male	116	30.1
	Female	269	69.9
Age in years	18–28	62	16.1
	29–38	170	44.2
	39–48	108	28.1
	≥48	45	11.7
Residence	Urban	377	97.9
	Rural	8	2.1
Religion	Orthodox	196	50.9
	Protestant	51	13.2
	Muslim	132	34.3
	Catholic	6	1.6
Ethnicity	Oromo	224	58.2
	Tigre	4	1.0
	Amhara	88	22.9
	Gurage	15	3.9
	Keffa	37	9.6
	Others*	30	4.5
Marital status	Single	32	8.3
	Married	198	51.4
	Divorced	96	24.9
	Widowed	59	15.3
Family size	1–2	140	36.4
	3–5	217	56.4
	≥5	28	7.3
Educational status	Can't write and read	66	17.1
	Can read & write	23	6.0
	Attended Primary school	170	44.2
	Attended Secondary school	96	24.9
	College graduate & above	30	7.8
Occupation	Farmer	4	1.0
	Gov. employed	67	17.4
	Private employed	78	20.3
	Merchant	104	27.0
	Daily labor	81	21.0
	Housewife	41	10.6
	Others**	10	2.6
Monthly income	< 500	11	2.9
	500–1000	108	28.1
	1001–1500	78	20.3
	≥1500	188	48.8

Keys: *(Wolaita, Sidama, Yem) **(Student, Driver).

37.61 (SD ± 8.71) years. Among the participants, 269 (69.9%) were females. The majority of the participants were Orthodox 318 (82.6%) followed by Muslim 132 (34.3%) in religion (Table 1).

Clinical and Behavioral status of Seropositive Peoples

This study showed 228 (59.2%) of respondents were having food insecurity. The majority of participants 238 (62.1%) did not use substances use. Among those 173(45.2%) were adhered to ART treatment. Out of the total participants, 68 (17.7%) were used other medication other than ART. Among those (6.8%) were used for the anti-hypertension medication. The majority of participants 344 (89.4%) have a good relationship with ART providers. More than half (56.1%) participants did not follow up their ART appointment regularly (Table 2).

Factors Associated with Adherence to ART Treatment

Food insecure individuals were 1.75 times more likely to be ART to have non-adherence than those who were food secure (AOR = 1.75 (95%CI; (1.01-3.0), P = 0.04. Individuals who reported substance abuse were 45% less likely to be adherent than those who did not report substance abuse (AOR = 0.55(95% CI ;(0.32-0.96), P = 0.035).

Individuals who took other medications due to comorbidity were 2.11 times more likely to have non-adherence than those who did not use other medications (AOR = 2.11 (95%CI; (1.15-3.87), P = 0.01. Individuals who had no good relationship with ART provider were 3.35 times more likely to have poor ART adherence than those individuals who had good relationship (AOR = 3.35(95% CI;(3.17-9.0), P = 0.002).

Table 2. Clinical and behavioral status of seropositive peoples on the treatment in Jimma public health facilities, 2019. (N = 385).

Variables	Categories	Adherence status	
		Adherent	Non-adherent
Food security status	Food secured	121 (31.4)	36 (9.4)
	Food in secured	146 (37.9)	82 (21.3)
Substance use	Yes	93 (24.3)	52 (13.6)
	No	173 (45.2)	65 (17.0)
Substance abuse	Non-abuse	205 (53.2)	73 (19.0)
	Abuse	62 (16.1)	45 (11.7)
Other's medication taken	Yes	36 (13.6)	32 (27.4)
	No	229 (86.4)	85 (72.6)
A good relationship with ART provider	Yes	252 (65.5)	92 (23.9)
	No	15 (3.9)	26 (6.8)
Regularly follow up	Yes	147 (38.2)	22 (5.7)
	No	120 (31.2)	96 (24.9)
Disclosure of HIV	Yes	221(82.8)	91(77.1)
	No	46 (17.2)	27 (22.9)
Pill burden	1-4	259 (97.0)	109 (92.4)
	≥5	8 (3.0)	9 (7.6)

Table 3. Factors associated with adherence among seropositive peoples on the treatment in Jimma public health facilities, 2019. (N = 385).

Variables	Category	Status of adherence		COR (95%CI)	AOR (95%CI)	p-value
		Adhered	Not Adhered			
Age in year	18–28	46 (17.2)	16 (13.6)	0.52 (0.22-0.12)	0.67 (0.22-2.0)	0.4
	29–38	116 (43.4)	54 (45.8)	0.69 (0.35-1.37)	0.24 (0.51-3.0)	0.6
	39–48	78 (29.2)	30 (25.4)	0.57 (0.57-0.27)	0.99 (0.4-2.4)	0.9
	≥48	27 (10.1)	18 (15.3)			
Sex	Male	67 (25.1)	49 (41.5)	2.12 (1.34-3.35)	1.49 (0.83-2.68)	0.17
	Female	200 (74.9)	69 (58.5)			
Monthly income	< 500	6 (2.3)	5 (4.3)	3.13 (0.19-51.1)	0.37 (0.019-7.25)	0.51
	500–1000	65 (24.4)	43 (36.8)	2.61 (0.76-8.96)	1.24 (0.24-6.36)	0.78
	1001-1500	54 (20.3)	24 (20.5)	3.13 (0.19-51.1)	0.37 (0.019-7.25)	0.47
	≥1500	143 (53.0)	45 (38.5)			
Family size	1-2	91 (34.1)	49 (41.5)			
	3-5	157 (58.8)	60 (50.8)	0.71 (0.44-1.12)	0.85 (0.47-1.55)	0.6
	≥5	19 (7.1)	9 (7.6)	0.88 (0.37-2.09)	0.83 (0.26-2.5)	0.7
Place of residence	Urban	263 (98.5)	114 (96.6)			
	Rural	4 (1.5)	4 (3.4)	2.3 (0.56-9.38)	5.85 (0.99-34.5)	0.08
Food security status	Secured	121 (45.3)	36 (30.5)	1.88 (1.19-2.99)	1.75 (1.10-3.00)*	0.04
	In secured	146 (54.7)	82 (69.5)			
Pill burden	1-4	259 (97.0)	109 (92.4)			
	≥5	8 (3.0)	9 (7.6)	2.67 (1.0-7.11)	1.19 (0.32-4.42)	0.78
Other's medication than ART	Yes	36 (13.6)	32 (27.4)			
	No	229 (86.4)	85 (72.6)	2.39 (1.39-4.0)	2.11 (1.15-3.87)*	0.01
Substance use	Yes	93 (35.0)	52 (44.4)	1.48 (0.95-2.31)	0.57 (0.24-1.37)	0.21
	No	173 (65.0)	65 (55.6)			
Substance abuse	Abused	205 (76.8)	73 (61.9)	0.49 (0.3-0.78)	0.55 (0.32-0.96)*	0.035
	Non-abused	62 (23.2)	45 (38.1)			
Disclosure of HIV	Yes	221 (82.8)	91 (77.1)			
	No	46 (17.2)	27 (22.9)	1.42 (0.83-2.43)	1.47 (0.78-2.79)	0.22
Relationship with ART providers	Yes	252 (94.4)	92 (78.0)	4.74 (2.4-9.3)	3.35 (1.55-7.20)*	0.002
	No	15 (5.6)	26 (22.0)			
Regularly follow up	Yes	147 (55.1)	22 (18.6)			
	No	120 (44.9)	96 (81.4)	5.34 (3.17-9.0)	0.19 (0.11-0.34)*	0.001

Individuals who did not follow up appointment regularly were 81% less likely to be ART adherence than those individuals who followed their appointment regularly (AOR = 0.19 (95%CI; (0.11-0.34), $P < 0.001$ (Table 3).

Discussion

This study revealed that the magnitude of adherence to antiretroviral treatment was 69.4%. This result is inconsistent with findings of studies done in Nekemte 77.9%,¹⁵ in Dessie 90%¹⁶ in Arba Minch government hospital 77.10%,¹⁷ in Gondar Referral Hospital 88.2%,¹⁸ in Goba Hospital 90.8% adherence.¹⁹ The possible explanation for the difference might be due to the socio-demographic, commitment of health care providers, accessibility of ART medication, and intervention-related factors.

This study revealed that participants who were Food insecure individuals were 1.75 times more likely to be ART to have non-adherence than those who were food-secure (AOR = 1.75 (95%CI; 1.01-3.00). This result is in line with studies conducted in Uganda where food insecurity was associated with ART non-adherence (AOR = 1.95; (95% CI; 1.65- 2.29).²⁰

This study revealed that participants who used substance abuse were 45% less likely to be ART adherent than those who did not report substance abuse (AOR = 0.55(95% CI; 0.32-0.96). This result is inconsistent with a study done in Areka town, southern Ethiopia reported an association of substance abuse and adherence (AOR = 2.360, (95%CI; 4.347-17.915).²¹ The possible explanation for the difference might be due to the study area, availability types of substance abuse, cultural and socio-economic factors.

This study revealed that participants who took other medications due to co-morbidity were 2.11 times more likely to have poor medication adherence than those who did not use other medications (AOR = 2.11; (95%CI; 1.15-3.87). This result is in line with studies conducted in South Africa on observed co-treatment of HIV and other infections as one of the factors associated with adherence to ART.²²

This study revealed that patients who had no good relationship with ART providers were 3.35 times more likely to have poor medication adherence than those individuals who had a good relationship with ART providers (AOR = 3.35; (95% CI; 3.17-9.00). This result is in line with the study conducted in SSA showed that having a good relationship with a health

provider was identified as one of the most frequently identified facilitators based on patient-reported barriers and facilitators to antiretroviral treatment (ART) adherence.⁸

This study revealed that participants who did not follow their ART appointment regularly were 81% less likely to be ART adherence than those individuals who followed their appointment regularly (AOR = 0.19, (95%CI; 0.11-0.34). This result is inconsistent with the study done in SSA countries for missing scheduled clinic visits (OR = 2.77; (95%CI; 1.73-4.43).²³ The possible explanation for the difference might be due to the study area, being busy with other activities, forgetfulness, cultural and socio-economic factors.

Conclusion

The rate of adherence to antiretroviral therapy was low (69.4%) as compared to the World Health Organization standard $\geq 95\%$. Food insecurity status, substance abuse, comorbidities, patient's relationship with an ART service provider, and regular follow-up of appointment were associated factors of adherence to antiretroviral treatment among seropositive peoples who received treatment. Therefore, it is recommended that patients, health workers, adherence supporters, and case managers improve Antiretroviral Treatment adherence.

Strength and Limitation of the Study

The large sample size and study focused on all Jimma town public health facilities which are providing antiretroviral treatment services for people living with HIV/AIDS (PLWHA) were indicated as strength. Since the study was conducted at a single town public health facility, the results cannot be generalized to seropositive people received treatment in Ethiopia. Causality cannot be confirmed since the study design is cross-sectional.

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Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
EDHS	Ethiopia Demographic Health Survey
ART	Antiretroviral Therapy
HAART	Highly Active Antiretroviral Treatment
HIV	Human Immune Deficiency Virus
SPSS	Statistical Package for Social Science
WHO	World Health Organization

Author's Contribution

ZD, AG, and AK participated in proposal writing, designed the study, coordinated and supervised data collection, data analysis, and

supervised data entry. AK and LA wrote the draft manuscript. All authors read and approved the final manuscript.

Availability of Data and Materials

All data apply to this study are available from the corresponding authors.

Consent for Publication

Not applicable

Competing Interests

This manuscript maintains no competing financial interest declaration from any person or organization, or non-financial competing interests such as political, personal, religious, ideological, academic, intellectual, commercial or any others.


Declaration of Conflicting Interests

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Reference

1. Fact sheet on global HIV statistics in: UNAIDS, editor. 2017.
2. WHO. Global Health Observatory (GHO) data. 2018.
3. WHO. Ethiopia | HIV/AIDS. WHO regional office for Africa, 2015.
4. Achappa B, Madi D, Bhaskaran U, Ramapuram JT, Rao S, Mahalingam S. Adherence to antiretroviral therapy among people living with HIV. *N Am J Med Sci.* 2013;5(3):220–223.
5. Foundation THJKF. The Global HIV/AIDS Epidemic. 2017.
6. UNAIDS. GLOBAL AIDS UPDATE. 2016.
7. Tiyou A, Belachew T, Alemseged F, et al. Predictors of adherence to antiretroviral therapy among people living with HIV/AIDS in resource-limited setting of southwest Ethiopia. *AIDS Res Ther.* 2010;7(1):39. doi:10.1186/1742-6405-7-39
8. Croome N, Ahluwalia M, Hughes LD, Abas M. Patient-reported barriers and facilitators to antiretroviral adherence in sub-Saharan Africa. *AIDS.* 2017;31(7):995–1007.
9. Dyno S, Toma A. Adherence to antiretroviral therapy in HIV-positive patients in Ethiopia: review. *J Trop Dis.* 2014;2(4):142. doi:10.4172/2329-891X.1000142
10. Paterson DL, Swindells S, Mohr J, et al. Adherence to protease inhibitor therapy and outcomes in patients with HIV infection. *Ann. Intern. Med.* 2000;133(1):21–30. doi:10.7326/0003-4819-133-1-200007040-00004.
11. Mills EJ, Nachega JB, Buchan I, et al. Adherence to antiretroviral therapy in sub-saharan Africa and North America: a meta-analysis. *JAMA.* 2006;296(6):679–690.

12. Unge C, Sodergard B, Marrone G, et al. Long-Term adherence to antiretroviral treatment and program drop-out in a high-risk urban setting in sub-saharan Africa: a prospective cohort study. *PLoS ONE*. 2010;5(10):e13613. doi:10.1371/journal.pone.0013613
13. Berhe N, Tegabu D and Alemayehu M. Effect of nutritional factors on adherence to antiretroviral therapy among HIV-infected adults: a case-control study in northern Ethiopia. *BMC Infect Dis*. 2013;13(1):233.
14. Uthman OA. Prevalence and pattern of HIV-related malnutrition among women in sub-saharan Africa: a meta-analysis of demographic health surveys. *BMC Public Health*. 2008;8:226.
15. Solomon HE, Wote AR, Mulugeta TA. Medication adherence and associated factors among patients on highly active antiretroviral therapy in Nekemte hospital. *Ethiopia. Gaziantep Med J*. 2014;20(3):199–208.
16. Birhanu D, Tesfahun C. Adherence to antiretroviral therapy and associated factors among patients living with HIV/AIDS in dessie referral hospital, Northern Ethiopia. *International Journal of Pharma Sciences and Research*. 2014;5(9):572–581.
17. Azmach NN. Adherence to antiretroviral therapy and associated factors among adult ARV users in Arba minch hospital, Southern Ethiopia. *Central African Journal of Public Health*. 2017;3(2):19–26.
18. Molla AA, Gelagay AA, Mekonnen HS, Teshome DF. Adherence to antiretroviral therapy and associated factors among HIV-positive adults attending care and treatment in University of Gondar Referral Hospital, Northwest Ethiopia. *BMC Infect Dis*. 2018;18(1):266.
19. Lecha B, Hasen K, Getachew T, Abdi M, Habtamu M. Adherence to antiretroviral therapy and associated factors among people living with HIV/AIDS at goba hospital, southeast Ethiopia: an institutional-based study. *Qual Prim Care*. 2015;23(6):336–341.
20. Weiser SD, Palar K, Frongillo EA, et al. Longitudinal assessment of associations between food insecurity, antiretroviral adherence and HIV treatment outcomes in rural Uganda. *Int J Viral AIDS*. 2014;28(1):115–120.
21. Koyra HC. Adherence to antiretroviral therapy among adult persons living with HIV/AIDS in southern Ethiopia. *Int J Viral AIDS*. 2018;5(1):38.
22. Mukui IN, Ng'ang'a L, Williamson J, et al. Rates and predictors of non-adherence to antiretroviral therapy among HIV-positive individuals in Kenya: results from the second Kenya AIDS indicator survey 2012. *PLOS ONE*. 2016;11(12):e0167465.
23. Heestermaans T, Browne JL, Aitken SC, et al. Determinants of adherence to antiretroviral therapy among HIV-positive adults in sub-Saharan Africa: a systematic review. *BMJ Global Health*. 2016;1(4):e000125.