


Children's Adherence to Antiretroviral Therapy and Associated Factors: Multicenter Cross-Sectional Study

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Background: Poor adherence to antiretroviral therapy (ART) causes drug resistance, treatment failure and death. Studies conducted among children below 15 years were limited in Ethiopia in general and in the study area. Therefore, this study aimed to assess the status of children's adherence to ART and associated factors in the study area.

Methods: We conducted a facility-based cross-sectional study from April 1 to May 10, 2020 by including 282 children <15 years. All children who received ART for at least one month and attend ART clinic during data collection period were consecutively recruited. Face-to-face interview was conducted using a standardized questionnaire. Both bivariate and multivariate logistic regression were performed. Adherence and exposure variables (i.e., sociodemographic and reason for missing) were measured by the caregivers/ children's report of a one-month recall of missed doses.

Results: Among 282 caregivers included with their children, 226 (80.2%) were females (mean age = 38.6 and SD = 12.35) and half (50%) of children were females. Two hundred forty six (87.2%) children were aged between 5–14 years (mean age = 8.5 and SD = 2.64), and 87.2% were adhered ($\geq 95\%$) to ART in the month prior to the interview. Children whose caregivers were residing in urban were 3.3 (95% CI: 1.17, 9.63) times more adherent to ART than their counterparties. Children whose caregivers were biological parents were 2.37 (95% CI: 1.59, 3.3) times more adherent than children with non-biological parents. Children with knowledgeable caregivers about ART were 4.5 (95% CI: 1.79, 9.8) times more adherent to ART.

Conclusion and Recommendation: Children's adherence to ART in our study area was sub optimal. Biological caregivers, residing in urban and being knowledgeable about ART facilitate adherence to ART. Adherence counseling targeting non-biological parents and for those who come from rural areas were recommended.

Keywords: adherence, antiretroviral therapy, children, Ethiopia, ART

Background

Globally there were an estimated 37.7 million (35.9 million adults and 1.8 million 0–14 years children) people living with HIV in 2020, over two thirds of whom (25.4 million) are in the WHO African Region.¹ At the end of 2019, in Ethiopia, 610,335 people were living with HIV (PLWHIV), in which 62,168 were children under the age of 15.²

In response to HIV/AIDS pandemic, multiple strategies including treatment of patients with Anti-Retro Viral Therapy (ART) have been implemented worldwide to curb the epidemics.³ According to Ethiopian ART guideline, ART should started as early as possible (even the same day with diagnosis of HIV if patient is ready) to all children living with HIV regardless of their WHO clinical stages and CD4 counts/percentage. The preferred first line for all children is AZT or ABC or TDF + 3TC + LPV/r and the preferred 2nd line AZT or ABC or TDF + 3TC + EFV/NVP.⁴

An important factor in achieving treatment success specially in children is maintaining optimal adherence to ART.^{3,5,6} Adherence to antiretroviral treatment is defined as taking 95% or more of the prescribed doses on time and in the correct way, either with or without food.^{3,7} Adherence can be measured using self-report, viral load monitoring, pill count and pharmacy refill records.⁴ Among these, viral load monitoring is the gold standard for monitoring adherence and

confirming treatment response.^{4,8,9} It introduced as routine activity since 2015/16 in Ethiopia and the national guideline recommended that, every stable PLWHIV receiving ART should be monitored using VL every 12 months.⁴ Even though UNAIDS set a target of 95-95-95,¹ currently in Ethiopia, viral load test is 73% and viral suppression is 78.9% among children below 15 years.⁸

According to a global HIV/AIDS report, the status of adherence to ART among children living with HIV varied from 65% to 90%,¹⁰ 75% in low and middle income countries¹¹ and 88.8% in Ethiopia.¹²

Poor adherence to ART will lead to an increased risk of drug resistance, treatment failure and clinical deterioration with increased premature death in children.^{9,10,12}

The causes of poor adherence to ART among pediatric patients are complex and interrelated factors. Total dependency of the child on caregiver, pill burden and dosing frequency, treatment side effects, poor health literacy, limited access to ART,¹³⁻¹⁵ socioeconomic status of the caregiver, substance use and access to service delivery, non-disclosure^{16,17} are among some factors. In addition, currently HIV services are disrupted and public response is slowed due to COVID-19 restriction and lockdown, resulting in increasing HIV infection, lifting up lost to follow up and becoming barriers to adherence.¹⁸

The emergence of drug resistant HIV among children adds an enormous burden.¹⁹ It may lead to further spread of resistant virus through vertical and horizontal transmission once the child reaches adolescence and adulthood.^{19,20}

Therefore, designing strategies for maintaining the optimal status of adherence among children, is essential to ensure treatment success. However, the task requires careful assessment of the status of adherence and age specific factors.²¹ Studies on adherence to ART and associated factors among children below 15 years of age are limited in Ethiopia, in general and in the study area. Additionally, adherence is not static and can vary with time on treatment, making assessing adherence status crucial.¹⁷ Moreover, viral load was added as one variable in this study, which has not been researched in previous studies. Therefore, this study aimed to examine the status of adherence and associated factors among children under the age of 15 years in the study area.

Methods and Materials

Study Design, Area and Period

A facility-based cross sectional study was conducted from April 1 to May 10, 2020 in the Sebeta, Teji, Tullu Bollo and Waliso towns which are located 20 km, 50 km, 65 km and 114 km away from Addis Ababa, respectively (Figure 1). These towns were, in the southwestern direction along the main road from Addis Ababa to Jimma. In total, there are 8 public ART sites included in all 4 towns. Three of the public ART sites are within Sebeta town (Sebeta health center provides ART services for 41 under 15 children, while 21 and 09 are served in Alemgena and Tefki health center respectively). Two public ART sites are found in Tullu Bolo town. Tullu Bolo General Hospital serves 25 children living with HIV and Tullu Bolo health center provides services for 17 children living with HIV. Teji town also, has Teji health center who provides services for 18 children under 15. The rest are found in Waliso town (St. Lukes Referral Hospital serves 130 and Waliso health center serves 29 children under 15). In total, 290 children are on ART in those health facilities. These health facilities have case managers and adherence supporters, who promote adherence by giving advice for clients on ART.

Sample Size and Sampling Technique and Inclusion Criteria

Sample size was calculated using STAT CALC of Epi-info by taking disclosed child as associated factors identified by previous study that provide the ratio of unexposed to exposed 0.6, outcome in the exposed group 49%, and outcome in the unexposed group 29.5%.²² And also 95% CI and power 80% was used to calculate sample size and adding 10% nonresponse rate, the total sample size was 254.

However, currently children who are taking ART and being followed up at public ART site of those health facilities were totally 290. Therefore, rather than minimizing 36 extra children, we had included all those children to the study. Therefore, all children/caregivers who fulfill inclusion criteria (who treated with ART at least one month) and attending ART clinic at each facility were consecutively recruited to the study as they come to refill their medication on the appointment day.

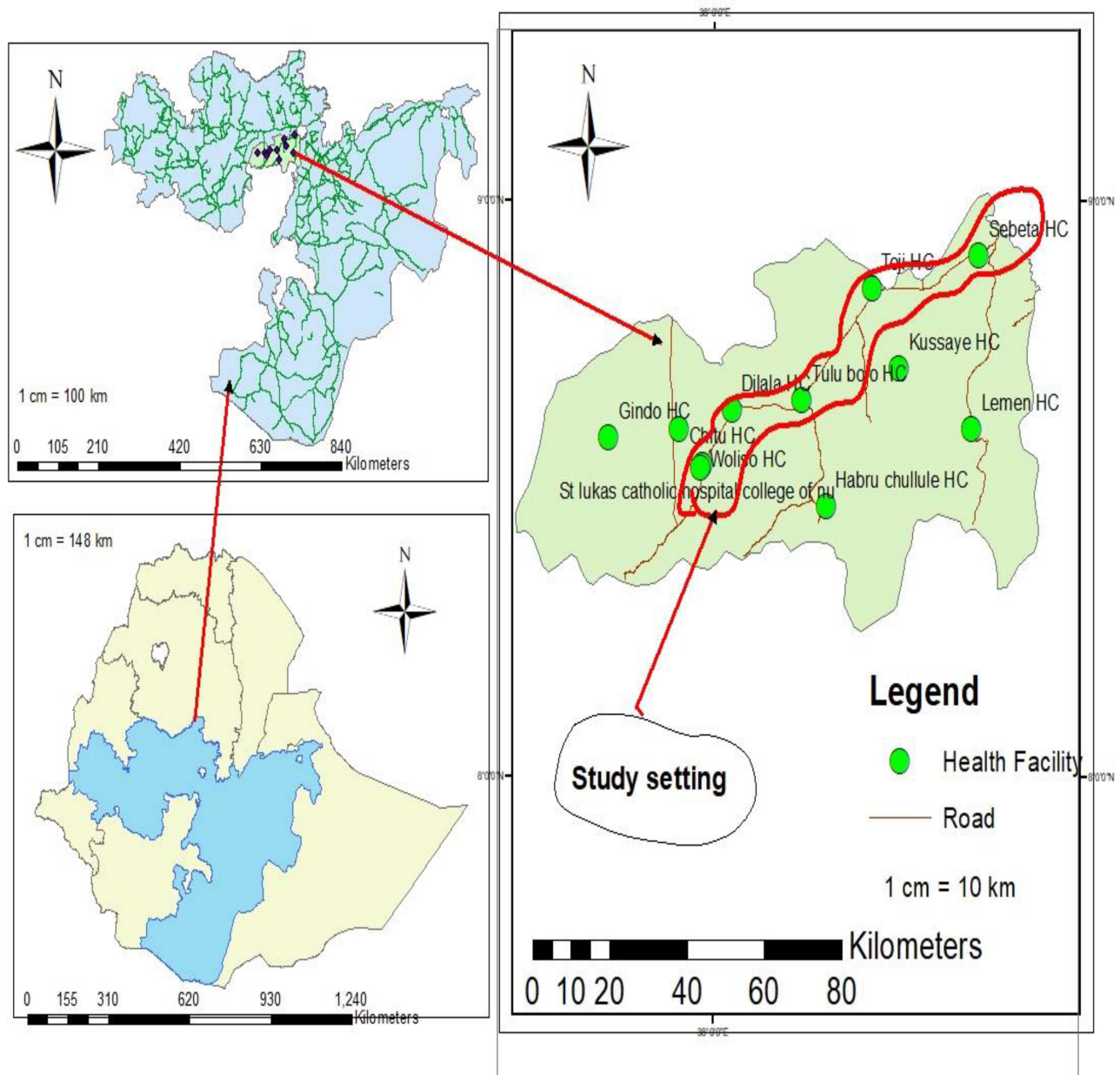


Figure 1 Map of study area and study setting of the study conducted at central Ethiopia, 2020.

Data Collection Tool and Method

Data were collected by 8 clinical nurses using structured questionnaires and face-to-face interviews, were held with mothers/caregivers. The data collection process was supervised by one health officer and one BSc nurse. Adherence and exposure variables were measured by the caregivers' or children's report of a one-month recall of missed doses prior to the date of the interview. Medical records were reviewed to collect clinical data such as WHO clinical stages, regimen type, viral loads (conducted in the last 12 months) and the CD4 counts (done in the last 6 months) of children.

Data Quality Assurance

Pretested and structured questionnaires was used for data collection. The questionnaires were adapted from previously conducted related studies^{22–24} and some changes were made after reviewing the relevant literature. It was initially prepared in English and translated to Afan Oromo and Amharic, commonly used local languages, using online Google translation. We gave two days

training for data collectors and supervisors and a pre-test was done on five percent of the total sample size before the actual data collection in Awash health center. Based on the result of pre-testing, necessary revision like timing, skipping pattern and coherence was conducted.

Data Analysis

The questionnaires were coded and entered into the EPI Data software and exported to SPSS Windows version 23 for further analysis. Data were summarized and presented using descriptive and analytic statistics. Bivariate and multiple logistic regressions were computed to identify the presence and strength of associations. Variables with a p value <0.25, in binary logistic regression, were subjected to multiple logistic regression for analysis. However, before multiple logistic regression, collinearity diagnostic test was done and no multicollinearity (maximum Variance Inflation Factor [VIF] = 3.883). On the other hand, Breslow-Day test showed, there is significant synergetic interaction between two variables (i. e., child relationship with caregiver vs. caregiver ART history). As a result, the stratum specific odds ratio was considered to measure the strength of the association. At the end, multiple logistic regression (odds ratios with 95% CIs were computed) and variables with p-values less than 0.05 were considered significantly associated with the dependent variable. Finally, the model was fitted using the backward elimination method, and the Hosmer-Lemeshow goodness of fit test indicated a p-value of 0.47). Furthermore, cluster effect was also analyzed using hierarchical cluster analysis classifying into eight cluster. Thus, dendrogram plot result using ward's method showed that there were higher similarity among each cluster.

Operational Definition

Adherent to ART – when the child has missed ≤ 1 dose or takes $\geq 95\%$ of ART in the month prior to the interview.

Non adherent to ART – missing at least two doses or takes <95% of ART in the month prior to interview.

Care givers – Parent/guardian or person in charge of routinely administering antiretroviral drugs to children on ART.

Baseline CD4 count – CD4 count done when a child started ART.⁷

Current CD count – CD4 count done within 6 months of data collection.⁷

Knowledge about ART – Those respondents who scored greater than or equal to the mean for the knowledge questions were considered knowledgeable; otherwise, they were not.

Care giver/child substance use – if caregiver/child use either of alcohol, khat, cigarettes or other substance in the month prior to data collection.

Ethical Considerations

Ethical clearance letters were obtained from the Ethical Review Committee, Jimma University, Institute of Health and from Ethical and research committee of Oromia national regional health bureau. The interviews were conducted after informed verbal consent/assent and assurance of confidentiality. This is because the participants in this study were mothers/caregivers in which many of them were carriers of HIV and do not want to give written consent due to suspect that it will take away their privacy as it identified during pretest and, since there is also no any harm procedure. This non-written consent was documented and witnessed according article 26 of Helsinki declaration.

Results

Sociodemographic Characteristics of the Study Participants

Of the 290 study participants, 282 children, along with their caregivers, were included in the analysis, yielding a response rate of 97.2%. Four caregivers were excluded because they did not appear in the health facility during the data collection period. Three questionnaires were discarded as they were not complete (caregivers did not know the dosing history for the past month) and one caregiver was not willing to respond to the questionnaire (did not provide consent). Among the respondents, 226 (80.2%) of the caregivers were females, and the mean age of the respondents was 38.6 years (SD = 12.35). Out of the total respondents, 176 (62.5%) were married. One hundred fifty-eight (56%) of the caregivers attended primary education. Two hundred and nine (74.1%) of the caregivers were urban dwellers.

Among the children included in the study, half (50%) were female, 246 (87.2%) were 5–14 years old with the mean age of 8.5 years (SD = 2.64). One hundred and eighty three (64.9%) children are currently attending 1–4 grades (Table 1).

Table 1 Sociodemographic Characteristics of Study Participants, Central Ethiopia, April 1–May 10, 2020 (n=282)

Variables		Frequency	Percentage
Caregivers Sex	Female	226	80.2
	Male	56	19.8
Caregivers age	<30years old	60	21.3
	≥30years old	222	78.7
Caregivers marital status	Married	176	62.5
	Widowed	53	18.8
	Single	31	11.0
	Divorced	22	7.7
Caregivers educational status	Not educated	67	23.7
	Primary	158	56.0
	≥ 9 Grade	57	20.2
Caregivers religion	Orthodox	216	76.6
	Protestant	40	14.2
	Muslim	26	9.2
Caregivers ethnicity	Oromo	231	81.9
	Amhara	38	13.4
	Gurage	13	4.7
Caregivers occupation	Self-Employed	147	52.1
	Farmer	76	27.0
	Merchant	45	15.9
	Gov't employee	11	3.8
	Unemployed	3	1.1
Caregivers residence area	Urban	209	74.1
	Rural	73	25.9
Caregivers monthly income	< 500 Ethiopian Birr	35	12.4
	≥ 500 Ethiopian Birr	247	87.6
Sex of child	Male	141	50.0
	Female	141	50.0
Age of child	0–4 years old	36	12.8
	5–14 years old	246	87.2

(Continued)

Table 1 (Continued).

Variables		Frequency	Percentage
Educational status of child	Not eligible	33	11.7
	Not started	45	15.9
	Kindergarten (KG)	6	2.0
	1–4 grades	183	64.9
	5–8 grades	15	5.4

Clinical Characteristics of Study Participants

Among the children who participated in this study, 102 (36.2%) started ART at WHO clinical stage I and 273 (96.8%) were currently on WHO stage I. At initiation of ART, 142 (50.4%) children had a CD4 count of >500 cells/mm³. During data collection, viral load was done for 206 (73%) children and out of these, high viral load (≥ 1000 copies/mL) was detected in 55 (19.5%) children (Table 2).

Table 2 Clinical Characteristics of Study Participants, in Central Ethiopia, April 1–May 10, 2020 (n=282)

Variables		No	%
Baseline CD4 count of the child	≤ 200	26	9.2
	201–499	54	19.2
	≥ 500	142	50.4
	Not done	60	21.2
Current CD4 count of the child	≤ 200 cells/mm ³	3	1.0
	201–499 cells/mm ³	13	4.6
	≥ 500 cells/mm ³	109	38.7
	Not done	157	55.7
WHO stage at Initiation of ART	WHO stage I	102	36.2
	WHO stage II	87	30.9
	WHO stage III	82	29.0
	WHO stage IV	11	3.9
Current WHO stage	WHO stage I	273	96.8
	WHO stage II	4	1.4
	WHO stage III	4	1.4
	WHO stage IV	1	0.4
Viral RNA Copies per mL within 12 months	< 1000	151	53.5
	≥ 1000	55	19.5
	Not done	76	26.9

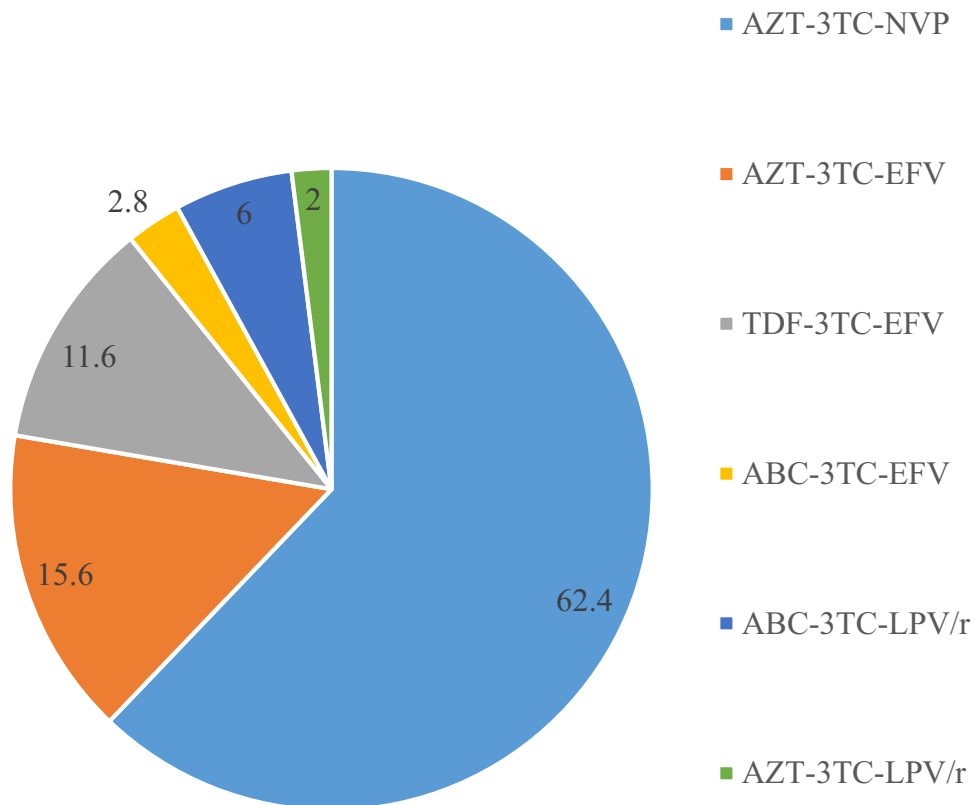
Table 3 ART and Other Drug History of Study Participants in Central Ethiopia, April 1–May 10, 2020 (n = 282)

Variables		No	%
Duration of child on ART	<1yrs	35	12.3
	≥1yrs	247	87.6
Line of treatment	1st line	270	95.8
	2nd line	12	4.2
Number of pills child is taking/day	1 pills	38	13.4
	2 pills	195	69.2
	≥ 3pills	49	17.3
Is child taking Cotrimoxazole preventive therapy (CPT)	Yes	82	29.0
	No	200	70.9

ART and Other Drug History of the Children

Among the children included in the study, 270 (95.8%) were on 1st line ART medication and 195 (69.2%) of the children were taking 2 pills/day while 38 (13.4%) of the children were taking 3 doses. (Table 3).

In addition, according to current, 176 (62.4%) are on AZT-3TC-NVP and 47 (15.6%) are on AZT-3TC-EFV regimen. Only 6 (2%) of the children who are currently on ART have been taking AZT – based LPV/r (boosted drug with Protease inhibitor) (Figure 2).

**Figure 2** Type of ART regimen children currently taking in percent at, central Ethiopia, April 1–May 10, 2020.

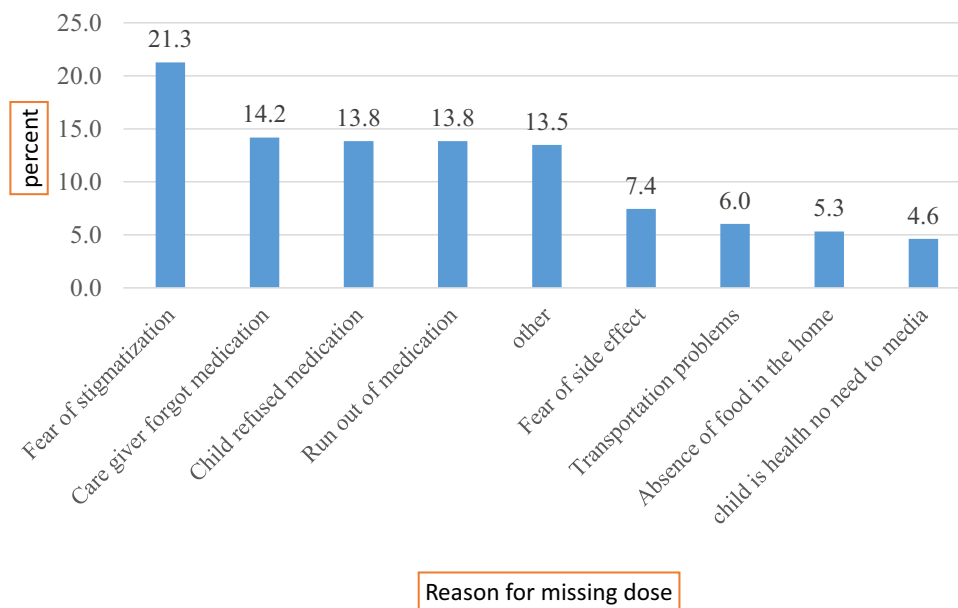


Figure 3 Reason for non-adherence to ART drugs among children at study area, central Ethiopia, April 1–May 10, 2020.

Adherence Status of the Children to ART

Based on the caregivers’ report, a total of 246 (87.2%, [95% CI: 83.3–91.1%]) children had an adherence status of $\geq 95\%$ in the month prior to interview. The status of adherence to ART among children in the past three and seven days before the interview date was 98.9% and 95.8%, respectively.

Reasons for Non-Adherence

According to the current study, 36 (12.8%) of the children missed at least 2 doses out of their prescribed doses of which, 30 (10.6%) were among in age group of 5–14 years. The commonly mentioned reasons were: fear of stigma (21.3%), caregiver’s forgetfulness (14.2%), child’s refusal to take the drugs (13.8%) and run out of medication (13.8%) (Figure 3).

Distance from Health Facility and Mode of Transportation

Out of the total caregivers/children who participated in the study, majority, 219 (77.7%) came from less than 10 km and 113 (40.1%) of the participants came to the health facility on foot (Table 4).

Table 4 Distance from Health Facility and Mode of Transportation of Study Participant to Refill Medication, Central Ethiopia, May 10, 2020 (n = 282)

Variables		No	%
Distance	<10 km	219	77.7
	≥ 10 km	63	22.3
Mode of presentation	On foot	113	40.1
	By public bus	104	36.9
	By cart	22	7.8
	By Bajaj	43	15.3

Factors Associated with Adherence to ART

In multiple logistic regression, the residence area of caregivers, blood relationship between children and caregivers and knowledge of caregivers about ART treatment, were significantly and independently associated with adherence. Children whose caregivers resided in urban areas were 3.3 times more likely adherent to ART than their counterparts (AOR = 3.3 [95% CI: 1.17, 9.63]). Children whose caregivers were biological parents were 2.37 times more likely to be adherent than those whose caregivers were non-biological parents (AOR = 2.37 [95% CI: 1.59, 3.2]). The present study also showed that if the caregiver was knowledgeable about ART treatment, the child was 4.5 times more likely to be adhere to ART (AOR = 4.5 [95% CI: 1.79, 9.8]) (Table 5).

Table 5 Crude and Adjusted Odds Ratios and 95% Confidence Intervals (CIs) of Explanatory Variables of Adherence to HAART in the Study Area, Central Ethiopia, April 1–May 10, 2020 (n = 282)

Variables		Adherence Status		Bivariate Logistic Regression		Multiple Logistic Regression
		Adherent: No (%)	Non-Adherent: No (%)	COR (95% CI)	P-value	AOR (95% CI)
Sex of care givers	Male	46 (82.1)	10 (17.9)	0.6 (0.27–1.32)	0.206	1.56 (0.51–4.73)
	Female	200 (88.5)	26 (11.5)	1		1
Educational status of care givers	Not educated	48 (71.6)	19 (28.4)	1		1
	Primary	144 (91.1)	14 (8.9)	0.25 (0.114–0.53)	0.000	0.3 (0.45–1.97)
	≥9 Grade	54 (94.7)	3 (5.3)	0.14 (0.04–0.504)	0.003	0.78 (0.14–4.35)
Residence of care giver	Urban	187 (89.5)	22 (10.5)	2.02 (0.97–4.19)	0.060	3.2 (1.17–9.63)**
	Rural	59 (80.8)	14 (19.2)	1		1
Monthly income of caregiver	<500 ETB	22 (62.9)	13 (37.1)	0.17 (0.077–0.39)	0.000	0.45 (0.15–1.34)
	≥500 ETB	224 (90.7)	23 (9.3)	1		1
Educational status of child	Not eligible	26 (78.8)	7 (21.2)	1		1
	Not started	41 (91.1)	4 (8.9)	0.36 (0.097–1.36)	0.133	0.35 (0.005–24.0)
	KG-4 grades	165 (87.3)	24 (12.7)	0.54 (0.211–1.38)	0.198	0.12 (0.02–7.24)
	5–8 grades	14 (93.3)	1 (6.7)	0.27 (0.03–2.38)	0.276	
Biological parent	Yes	213 (95.1)	11 (4.9)	14.67 (6.6–32.59)	0.000	2.37 (1.59–3.2)**
	No	33 (56.9)	25 (43.1)	1		1
Is care givers taking ART	Yes	203 (94.9)	11 (5.1)	10.73 (4.9–23.45)	0.000	0.61 (0.07–5.51)
	No	43 (63.2)	25 (36.8)	1		1
Knowledgeable	Yes	206 (94.1)	13 (5.9)	9.11 (4.26–19.48)	0.000	4.9 (1.7–9.8)**
	No	40 (63.5)	23 (36.5)	1		1
Viral RNA Copies per mL within 12 months	<1000	136 (90.1)	15 (9.9)	1		1
	≥1000	42 (76.4)	13 (23.6)	2.8 (1.24–6.37)	0.014	0.51 (0.14–1.88)
	Not done	68 (89.5)	8 (10.5)	1.07 (0.43–2.64)	0.889	

Note: **Significant variables.

Discussion

According to this study, 87.2% of children had an adherence status of $\geq 95\%$ in the month prior to the interview. This is higher than the finding of global pooled estimation, which is 65%–75%.²⁵ This difference could be due to the context of the study area (i.e., specific study area among children living in almost similar sociodemographic characteristics vs. global context). In addition, the global pooled estimate used secondary data. However, our finding was comparable with an studies in East Africa 90%,²⁶ in Southeastern Nigeria, 91%,²⁷ Ethiopian national pooled prevalence of optimal HAART adherence 88.8%,¹² Eastern Ethiopia, 90.7%,²⁸ Tigray, Northern Ethiopia, 90.7%,²⁹ in Gondar University Hospital and Gondar Poly Clinic, 90.4%;³⁰ and in Addis Ababa, 86.9%.³¹ However, the finding of the current study was higher than the finding of study conducted in India, which revealed an overall adherence of 82.1%.³² This difference might be due to the study design (cross-sectional vs. cohort). It was also higher than that in a study in Uganda which reported an overall adherence status of 79.1%,³³ North Ethiopia, provided an adherence status of 78.6%,²² and central Ethiopia showed an adherence rate of 74%.²⁴ This difference could be due to the small sample size in central Ethiopia (120 vs. 282). Again, higher adherence rate was observed in our study when compared with finding of study conducted in the ART clinic of Tikur Anbessa Hospital, Addis Ababa (i.e., an adherence rate of children to ART was 34.8%).³⁴ This difference was due to adherence assessment methods (caregiver's report vs. unannounced home based pill count). This indicates that, self-report have less potential for the assessment of adherence when compared to pill count. In general, the current study finding of the adherence status of children to ART is below the recommendation of the WHO, which recommended that $\geq 90\%$ of people on ART should be adherent to ART to fully benefit from ART.³ Additionally, among non-adherent children, 10.6% were children in range of 5–14 years old. This is justified by research conducted in Ambo, eastern Ethiopia.¹² This is due to the fact that, most of the time older children played outside of the home and also due to schooling, they forget taking medication and this leads to miss a doses.

Regarding associated risk factors for non-adherence, the current study showed that children whose caregivers were biological parents were 2.37 times more adherent than those whose caregivers were non-biological parents (AOR = 2.37, 95 CI = [1.59–3.2]). This finding is similar to the cross-sectional study finding conducted in Hiwot Fana and Dil-Chora Referral Hospital in eastern Ethiopia, which revealed that children whose caregivers were biological parents were more adherent.

The other independently associated risk factor for adherence to ART among children identified by this study was caregivers' knowledge of ART. Accordingly, we found that children with knowledgeable caregivers were 4.5 times more adherent than those children whose caregivers were not knowledgeable (AOR 4.5 95% CI [1.7–9.8]). Our finding is similar to the study finding conducted in Hiwot Fana and Dil-Chora Hospital, which revealed that caregivers of children with good knowledge about the disease were 7.3 times (AOR = 7.3) adherent than their counterparts.²⁸ Again, our finding is also similar to the finding of a study conducted in India that came up with, children whose caregivers had good knowledge about ART treatment were 14.7 times more adherent.³² A similarly study conducted in north Ethiopia, justified our finding (AOR = 2.72).³³ Our finding is again in line with the study finding conducted at University of Gondar Hospital and Gondar Poly Clinic, which showed that children of knowledgeable caregivers had 4.7 times more adherent to ART than their counterparts (AOR = 4.7).³⁰ This implies that making caregivers knowledgeable about the importance of ART treatment through ongoing and extensive counseling is mandatory to make children more likely to benefit from good adherence to ART.

The current study also showed that children residing in urban areas were 3.2 times more adherent to ART than those residing in rural (AOR = 3.2 [95% CI 1.17–9.63]). This finding is supported by a study conducted in Tanzania that reported, suboptimal to ART was observed among children in the rural context of the Mwanza region.³⁵ However, our study is contradicts a comparative study conducted between rural and urban children, in South Africa that revealed, rural children were more adherent to ART (93.1% vs. 88%).³⁶ This difference might be due to the study design (cross-sectional vs. cohort). In general, this implies that urban dwellers have more access to information and education when compared with rural dwellers which benefit them to be more adherent to ART.

Our study is not free of limitations. There might be an overestimation of adherence status in our study because of self-report, recall and social desirability bias. Thus, to minimize this bias we used non ART providers as data collectors. Additionally, we did not assess adherence related to the correct timing of ART drug administration. Again, the cross-sectional nature of the study also hinders the causal relationship between adherence status and associated factors.

Conclusion and Recommendations

The adherence status of the children to ART in our study area was sub optimal. Children residing in urban areas, with biological caregivers and children of knowledgeable caregivers were more adherent to ART. Adherence counseling and health information dissemination should be strengthened targeting non-biological parents and for those who come from rural areas. Also other studies should be conducted using multiple and more objective adherence assessment tools (pill count, VL monitoring, etc.).

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Disclosure

The authors declare no competing interest for this work. The product used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of between authors and producers of the product because we do not intent to use these product as an avenue for litigation but for the advancement of knowledge.

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