Chapter

Nutritional Status and Its Effect on Treatment Outcome among HIV-Infected Children Receiving First-Line Antiretroviral Therapy in Arba Minch General Hospital and Arba Minch Health Center, Gamo Zone, Southern Ethiopia: Retrospective Cohort Study

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Abstract

Antiretroviral therapy is a drug treatment that plays a great role in reduction of mortality among children infected with human immunodeficiency virus (HIV). Studies in Africa have shown that there is short survival time among children receiving antiretroviral therapy. The aims of this study were to estimate the survival time and identify associated factors among HIV-infected children after initiation of antiretroviral therapy. Institution-based retrospective cohort study was conducted among 421 children. Cox proportional hazards regression model was used to determine independent predictors. Findings of this study reveal that 261 (62%) children were alive, 43 (10.2%) were lost to follow-up, 52 (12.4%) were transferred out to other facilities, and 65 (15.4%) were reported to have died, and overall prevalence of malnutrition among respondents was 23.7% (95% CI, 19.13–28.27%). Multivariable analysis showed that nutritional status (adjusted hazard ratio (AHR) = 4.1, 95% CI = 2.41–6.9), absolute CD4 count below threshold (AHR = 2.3, 95% CI = 1.32–3.88), fair and poor adherence to antiretroviral therapy (AHR = 0.4, 95% CI = 1.66–6.9), (AHR = 3.3, 95% CI = 1.73–6.23), isoniazid prophylaxis (AHR = 0.4, 95%, CI = 0.21–0.65), and co-trimoxazole prophylaxis (AHR = 0.3, 95% CI = 0.14–0.44) were independent predictors of the survival time. Therefore, children living with HIV should be encouraged to adhere to the antiretroviral therapy and take co-trimoxazole and isoniazid preventive therapies.

Keywords: antiretroviral therapy, co-trimoxazole preventive therapy, isoniazid preventive therapy, children, Ethiopia

1. Introduction

Acquired immune deficiency syndrome (AIDS) is a disease caused by a retrovirus known as human immunodeficiency virus (HIV) [1]. HIV/AIDS remains one of the world's most significant public health challenges, particularly in low- and middle-income countries [2]. Children constitute a segment of the population affected by the virus. HIV contributes to illness and death of children and is the commonest cause for pediatric hospital admission [3].

Of the total 1.8 million children living with HIV, an estimated 110,000 die of AIDS-related illnesses each year which means 290 children die of AIDS-related illnesses every day. Nearly 90% of HIV-infected children live in sub-Saharan Africa (SSA) [4]. In Ethiopia it is estimated that 65,088 children are living with HIV. In 2016, over 3100 children died due to AIDS-related illness [5].

The introduction of antiretroviral therapy (ART) presented an enormous opportunity in terms of reducing morbidity and mortality due to AIDS, worldwide. Ethiopia has been engaged in the scale-up of ART access to its people since 2005 [6]. It has been shown that the improvement in access to ART improves the quality of life and survival of children [7, 8].

Studies show that early access to ART could prevent 25% of HIV-related deaths [7–9]. Therefore, to reduce child mortality attributed to HIV/AIDS, the provision of comprehensive treatment, care, and support for HIV-infected children is very important.

Ethiopia has adopted the World Health Organization's (WHO) recommendations for ART where "regardless of their CD4 cell count, all HIV-infected individuals should start treatment to reduce morbidity and mortality associated with HIV infection" [3]. The number of sites providing ART service in Ethiopia, including both public and private facilities, has increased from 3 to over 1000, and persons initiated on treatment has increased from 24,000 to 308,000 during the period 2006–2016 with more than 23,400 children under the age of 15 taking antiretroviral drugs [10].

Survival of HIV-positive children in Ethiopia and other similar settings has improved as a result of increased access to ART; however, it is still low in the first 6 months after initiation of ART [11]. Reports from Kenya, Zambia, and Malawi show that death among HIV-positive children following ART initiation remains high, ranging from 7.5 to 15% [12–14]. This contrasts the substantially higher survival probability among HIV-positive children initiated on ART in developed countries [15]. Findings from other studies elsewhere in Africa and other low-income countries show that ART programs have resulted in decreased mortality among children on ART [16–18]. Available evidences also depicted that the survival of the children is not only affected by the care delivered by ART programs but also more fundamentally influenced by low CD4 count, advanced disease according to WHO staging, low hemoglobin (Hgb) level, and opportunistic infections (OIs) like bacterial pneumonia and tuberculosis [19–21]. However, as far as our search of the available literature has revealed, little is known about the effect of factors like viral load, nutritional status, co-trimoxazole (CTZ) preventive therapy (CPT), and isoniazid (INH) preventive therapy (IPT) on survival status of children below 15 years of age. Therefore, this study intended to estimate the survival time and identify associated factors by including viral load, nutritional status, CPT, and IPT among HIV-infected children initiated on ART in public health facilities in Arba Minch town, Southern Ethiopia.

2. Main body

2.1 Patients and methods

Study area and period: We conducted the study in Arba Minch town from March 20, 2017 to April 10, 2017. Arba Minch town is located about 495 km southwest of the capital city Addis Ababa and about 275 km from Hawassa, the capital of the Southern Nations, Nationalities, and Peoples' Region (SNNPR). Arba Minch town has one general hospital and one public health center, which provide ART service. Arba Minch Hospital was among the first few public hospitals to start ART in Ethiopia in August 2003. Arba Minch Health Center started ART service at the end of 2007. According to the Gamo Gofa Zone Health Department (ZHD) report, the Arba Minch Hospital and Arba Minch Health Center provide HIV/AIDS interventions, including free diagnostic, treatment, and monitoring services. Since August 2003, ART has been provided to children living with HIV regardless of CD4 count and WHO clinical stage, with financial support from the Norwegian Lutheran Mission. Data from ZHD show that a total of 664 children with HIV/AIDS were enrolled on chronic HIV care at the hospital and the health center since January 2009, but only 608 started ART (460 children at Arba Minch General Hospital and 148 children at Arba Minch Health Center) [22].

Study design: A health facility-based retrospective cohort study.

Source populations: All children living with HIV who were enrolled on first-line ART at the center.

Study populations: All children living with HIV who were enrolled on first-line ART at the center and who fulfill the inclusion criteria.

Inclusion criteria: Those who were aged <18 years and enrolled on first-line ART and have follow-up at Arba Minch General Hospital and Health Center.

Sample size determination: The sample size was calculated by applying a two-population proportion formula using Epi-Info version 7. Co-trimoxazole preventive therapy, tuberculosis (TB) co-infection at baseline, and anemia were considered, and taking the most significant predictors of the three variables, anemia was used [17] with the following assumptions: 95% CI, power 80%, ratio of unexposed to exposed 1:1, parameter outcome in exposed hemoglobin (Hgb) < 10 gm/dl = 14.7%, outcome in unexposed Hgb ≥ 10 gm/dl = 5.8%, and hazard ratio (HR) = 2.5. This resulted in sample size of 412 children. As there were a total of 421 children in the study area who fulfilled the inclusion criteria, we included all 421 in this study.

Sampling procedure and sampling technique: A total of 608 children who started ART during the study period were identified in the two ART clinics. Charts were organized according to the hospital card number, in a chronological order, with each chart representing one child. As some of the charts in the hospital were not arranged in numerical order, the investigator assigned new numbers for all those registered between 2009 and 2016, starting from 1 to 608. Of these, the investigator drew 421 samples which fulfilled the inclusion criteria after reviewing the information transcribed to the pre-structured data abstraction form; 187 individuals did not fulfill the inclusion criteria; therefore, those charts were excluded from the study. Children ≤14 years of age and on ART registered for chronic care at public health institutions of Arba Minch town from 1 January 2009 to 30 December 2016 were included in the study. Those whose cards were incomplete with information on baseline CD4 count, WHICH staging and date of ART start and current status were excluded from the study.

2.2 Variables in the study

Dependent variable: The response (outcome) variable in this study was "survival time" of HIV-infected children after starting ART.

Independent variables: The predictor variables included five continuous covariates (age, hemoglobin level, weight, height, and CD4 count) and nine categorical variables (gender, co-trimoxazole prophylaxis, TB co-infection status, isoniazid prophylaxis, functional status, clinical stage of the disease according to WHO scaling, type of ART drug, adherence to ART, and year of ART initiation).

2.3 Operational definition of terms

Censored: includes lost to follow-up, transfer out, and live beyond the study time.

Adherence to ART: assessed by counting the number of tablets the children miss within the first 3 months after starting ART.

Survival: absence of experience of death.

Survival time: the length of time in months a child was followed up from the time the child started ART until death, was lost to follow-up, or was still on follow-up.

3. Data collection procedure and data quality control

A structured interviewer-administered questionnaire was used to collect the data [23–25]. The questionnaire was primarily developed in English and then translated into Amharic language for simplicity of data collection. Then Amharic version was also back-translated to English language for its consistency by two different language experts. The data collection tool has four sections. Pretesting of the data collection tool was done on 17 individuals who were selected from Berber Health Center that were not included in the actual study. Based on the pretest, a data collection tool was corrected to ensure logical sequence, clarity, and skipping patterns. Data was collected by eight trained health professionals and supervised by two bachelor degree health professionals. All data collectors and supervisors were trained for 2 days and performed practical exercises to be familiar with the questionnaire. Exit interview was done. The participants' weight was measured in kilograms with 0.2 kg increments using standard beam balance, and the scale was checked at zero during measurement. The study participant was removing their heavy outer clothes and shoes. The participant height was measured using the standard measuring scale to the nearest 0.5 cm. The participants were asked to take off their shoes, stand erect, and look straight in vertical plain. The data collectors were regularly supervised for proper data collection as well as checked for completeness and consistency throughout data collection period.

Data processing and analysis: The completeness and consistency of the data was checked, coded, and double entered into Epi-info version 7 and exported to Statistical Package for Social Sciences (SPSS) version 20 for analysis. Exploratory data analysis was carried out to check the levels of missing values and presence of influential outliers. Descriptive statistics such as mean (standard deviation), frequencies, and proportions were used to describe the characteristics of the cohort. Kaplan-Meier survival curve together with log-rank test was used to assess survival experience of an individual at specific times and to compare survival between different independent variables.

The analysis was conducted in several steps. First, univariate Cox proportional hazard regression model was performed for each independent variable

and outcome of interest to identify potentially significant variables for consideration in the multivariable Cox proportional hazards regression model. Based on the univariate analysis, variables were selected for the multivariable analysis. Variables whose univariate significance test results were below p-value <0.25 were included in the multivariable regression model. In addition, context and findings of previous studies were considered in the identification of candidate variables for multivariable analysis.

Multivariable analysis was started with a model containing all of the selected variables. The model was built through a stepwise regression procedure, which added variables successively (the most significant at each step) until no variable added significant information and compared by likelihood ratio test and Harrell's concordance statistic test. Interactions and confounders were tested and the cutoff point of beta change greater than 20% was used. The results of the final model were expressed in terms of hazard ratio with 95% confidence intervals (CI) and interpreted accordingly. Kaplan-Meier survival curve together with log-rank test was used to check for the existence of any significant differences in survival between the various categories of variables considered in this study. Statistical significance was declared if the p-value was less than 0.05.

Ethical considerations: Ethical approval was obtained from the ethical review committee of Arba Minch University, College of Medicine and Health Sciences, with reference number CMHS/4268/09. Following the approval, an official letter of cooperation was written to concerned bodies by the Department of Public Health of Arba Minch University. Permission was granted from the Hospital and Health Center Administration as per the recommendation letter from the department. Personal identifiers were excluded during data extraction; rather codes were used. Considering the study was being conducted on secondary data, obtaining informed consents from the participants was not possible. However, the confidentiality of information was maintained by not recording their name from the chart, and the recorded data were not accessed by a third person except by the principal investigator.

4. Results

Baseline characteristics of the study participant: A total of 421 study participants (children under 15 years old) were included in the study. The sample is comprised of 241 (57.2%) males and 180 (42.8%) females. The ages of the cohort at ART initiation ranged from 3 to 168 months with a median age of 72 (IQR = 33–108) months. Based on WHO clinical staging, 196 (47%) children initiated ART at an advanced stage of the disease, i.e., WHO clinical stage III or IV. During the ART initiation, 139 (33%) children were affected by one or more opportunistic illness, of which 41 children were found to have died at the end of the study. Sixty (14.3%) had history of TB at the start of ART, and 36 died during the follow-up time. At the initiation of ART, mean (SD) value for weight of children was 18.6 (±9.65) kg, and mean (SD) value for height of the cohort was 110.8 (±32.19) cm. The baseline median value for Hgb was 10.9 (IQR = 8.8–12.3) g/dl, and 181 (43.1%) of the children had absolute CD4 count below threshold for immune deficiency at initiation of ART.

Among the reviewed participants, 410 (97.4%) were on first-line ART regimen, while the rest were started on second line. Concerning the type of ART regimens, around 61% of children were taking D4T-based drug regimens when they started the treatment (**Table 1**).

Variables	Categories	Frequency	Percent
Sex	Male	241	57.2
	Female	180	42.8
Age category	<1 year	30	7.1
	1–4 years	169	40.1
	5–14 years	222	52.7
Primary caregiver	Parents	268	63.7
	Relatives	119	28.3
	Guardian/orphan	34	8.0
Parental status	Both parents are alive	260	61.8
	Maternal orphan	45	10.9
	Paternal orphan	31	7.4
	Double orphan	84	19.9
WHO clinical staging at entry	Stage I	91	21.6
	Stage II	135	32.1
	Stage III	147	34.9
	Stage IV	48	11.4
TB at baseline	Yes	60	14.3
	No	361	85.7
Hemoglobin level at baseline	<10 gm/dl	78	18.5
	≥10 gm/dl	343	81.5
Absolute CD4 at baseline	CD4 above threshold	239	56.9
	CD4 below threshold	181	43.1
ART adherence status	Good	335	79.6
	Fair	33	7.8
	Poor	53	12.6
CTZ prophylaxis	Yes	314	74.6
	No	107	25.4
INH prophylaxis	Yes	302	71.7
	No	119	28.3

Table 1.
Demographic and clinical characteristics and chemoprophylaxis status among children on antiretroviral treatment at Arba Minch Hospital and Health Center, Southern Ethiopia, 2017.

5. Mean survival time after initiation of ART

After initiation of ART, children were followed up for a minimum of 1 and maximum of 95 months with median follow-up period of 50 (IQR = 24–80) months. At the end of follow-up, 261 (62%) of the children were alive, 43 (10.2%) were lost to follow-up, 52 (12.4%) were transferred out to other facilities, and 65 (15.4%) were reported dead. The overall mean estimated survival time after ART initiation of children in the study was 82.3 (95% CI = 79.48–85.14) months.

There is a significantly different survival time between different factors considered in this study. Females have relatively lower survival time of 79.3 months than males with 84.6 months. Children 1–4 years of age had higher survival time of 86.8 months than those less than 1 and 5–14 years of age who had a mean survival time of 69.3 and 80.8 months, respectively.

6. Comparison of survival curves

The overall Kaplan-Meier survivor function estimate showed that most of the deaths occurred in the earlier months of ART initiation, which declined in the later months of follow-up. Most of the graphs did not show differences between different categories. However, relatively larger gaps are observed in covariates such as WHO clinical stage, TB co-infection, low Hgb level (<10gm/dl), and CTZ and INH prophylaxes (**Figures 1** and **2**).

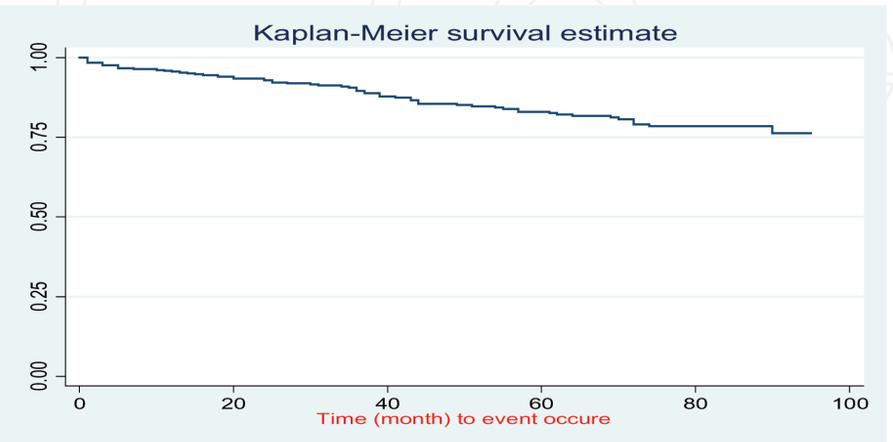

Figure 1.
The plot of the overall estimate of Kaplan-Meier survivor function among children on ART at public health facilities of Arba Minch town, Southern Ethiopia, 2017.

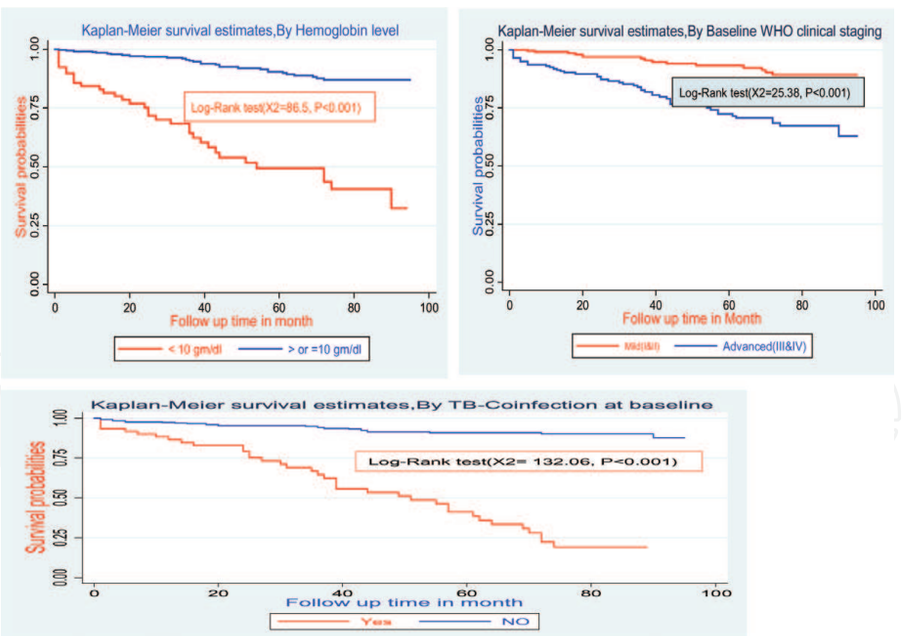

Figure 2.
Survival curves for children on ART by WHO clinical stage, hemoglobin level, and TB co-infection after start on ART at public health facilities in Arba Minch town, 2017.

7. Results of the Cox proportional hazards regression model

One important predictor of low survival time in univariable Cox regression analysis was advanced WHO staging. The risk of low survival chance in individuals with advanced disease according to WHO staging at baseline was nearly 4 times

Covariate/factor	Categories	CHR	P-values
Sex	Male		
	Female	1.617	0.053*
Age group	<1 year		
	1–4 years	1.259	0.336
	5–14 years	0.655	0.069*
Nutritional status	Normal		
	Underweight	1.903	0.010*
Anemia	No		
	Yes	2.702	0.001*
Absolute CD4 count	Above threshold		
	Below threshold	1.293	0.041*
INH prophylaxis	No		
	Yes	0.408	0.001*
CTZ prophylaxis	No		
	Yes	0.348	0.001*
ART adherence on follow-up	Good		
	Fair	6.256	0.001*
	Poor	5.937	0.001*
WHO clinical staging at entry	Stage I and II		
	Stage III	2.360	0.009*
	Stage IV	10.412	0.001*
Functional status	Working		
	Ambulatory	1.302	0.350
	Bedridden	1.375	0.392
ART regimens at entry	D4t-based regimen	0.294	0.420
	AZT-based regimen	0.513	0.290
	TDF-based regimen	0.562	0.404
	Second-line ART		
Evidence of TB during follow-up	Yes	1.383	0.050*
	No		

*Note: CTZ, Cotrimoxazole; ART, antiretroviral therapy; INH, isoniazid; TB, tuberculosis; OI, opportunistic Infections, *p < 0.25 which are candidate for Multivariate Cox regression model.*

Table 2.
Univariable Cox regression analysis of sociodemographic characteristics and clinical and immunological status among children who were started on ART at public health facilities of Arba Minch town, 2017.

higher than that of those at the mild stage of the disease (P < 0.001). The risk of surviving a shorter time in individuals who had severe acute malnutrition (SAM) at baseline was nearly 2.5 times higher when compared to those with no malnutrition (P < 0.006). Patients with baseline opportunistic infections (OIs) survive nearly three 3 times shorter than those without OIs (P < 0.001), and children with TB co-infection were nearly 11 times more likely to survive shorter when compared to those without TB co-infection (P < 0.001). The risk of surviving at short duration was significantly higher with low hemoglobin level (CHR = 7.3, 95% CI = 4.47–11.9,

Covariate	Categories	AHR	P-values
Nutritional status	Normal	1	
	Underweight	4.08	0.001
Absolute CD4 count	Above threshold	1	
	Below threshold	2.26	0.003
INH prophylaxis	No	1	
	Yes	0.37	0.001
CTZ prophylaxis	No	1	
	Yes	0.25	0.001
ART adherence on follow-up	Good	1	
	Fair	3.39	0.001
	Poor	3.28	0.001

Table 3.
Multivariable Cox regression analysis of sociodemographic characteristics and clinical and immunological status among children on ART at public health facilities of Arba Minch town, 2017.

P = 0.001) and CD4 count below the threshold (CHR = 1.7, 95% CI = 1.02–2.74, P = 0.041) when starting ART compared to their counterparts. CTZ and INH had preventive effect against surviving for short duration (CHR = 0.2, 95% CI = 0.10–0.27 P = 0.001) and (CHR = 0.1, 95% CI = 0.07–0.20 P = 0.001) when compared to their counterparts throughout the follow-up period, respectively (**Table 2**).

In multivariable Cox regression analysis, children with CD4 count below threshold for immunodeficiency at ART initiation were 2.3 times (AHR = 2.26, 95% CI = 1.32–3.88, P = 0.003) more likely to survive at shorter duration as compared to those with CD4 count above threshold. Children with low weight for age (underweight) at ART initiation were almost 4 times (AHR = 4.1, 95% CI = 2.41–6.9, P = 0.001) more likely to survive at shorter duration as compared to those with normal weight. Children that were presented for treatment with fair ART adherence and poor ART adherence were on follow-up 3.4 times (AHR = 3.4, 95% CI = 1.66–6.9, P = 0.001) and 3.3 times (AHR = 3.3, 95% CI = 1.73–6.23, P = 0.001) and more likely to survive at shorter duration, respectively, as compared to those with good adherence on follow-up. Estimated AHR for children on INH prophylaxis and CTZ prophylaxis were 0.4 (95% CI = 0.21–0.65, P = 0.001) and 0.3 (95% CI = 0.14–0.44, P = 0.001); short duration survival hazard among children who took INH prophylaxis was 63% and CTZ prophylaxis 75% (**Table 3**).

8. Discussion

In this study the overall mean survival time was 82.3 months (95% CI: 79.48–85.14). The cumulative probability of survival of children on ART was 82.9% after 5 years (95% CI: 78.2%–86.7%). The major factors that affect the survival time of children with HIV/AIDS and on ART are nutritional status, absolute CD4 count below threshold, and poor/fair adherence to ART. Isoniazid prophylaxis and cotrimoxazole prophylaxis were preventive factors.

Mean survival time in our cohort was 82.3 months (95% CI = 79.48–85.14). This was in line with the finding of a study conducted in Southwest Ethiopia [83 months (95% CI = 79–87)] [26]. However, our finding was higher when compared with study conducted in Northwest Ethiopia, which reported a survival time of 56.5 months [20]. This difference might be associated with the high proportion (74.3%) of children in this study taking CTZ prophylaxis as compared to the finding

of the study conducted in Northwest Ethiopia (52.3–70.4%), and the difference might also be associated with increased access to ART services.

The cumulative probability of survival of children on ART in our study was 82.9% after 5 years (95% CI: 78.2–86.7%). This was comparable with the report of a study conducted in Felege Hiwot Referral Hospital, Bahir Dar, Northern Ethiopia (83%) [27] and another one in Northwest Ethiopia (83%) [20]. However the cumulative survival probability from our study was much lower than that of the reports from Adama Referral Hospital and Medical College, Central Ethiopia (91.6%) [19], and Wolaita zone health facilities, Southern Ethiopia (92%) [20]. These variations between our study and those from central and Southern Ethiopia may have something to do with the variation in the quality of care provided at different institutions.

In this study we found that having CD4 cell count below the threshold level was significantly associated with an increased probability of having short duration of survival among the children. This concurs with the findings of different studies previously done in Ethiopia [20, 28]. The similarity might be related to the fact that children, in our series, with absolute CD4 counts below the threshold level are more prone to OIs like TB. Another possible explanation could be ART was initiated in an advanced HIV stage (stages III and IV) where immunity of the children was already compromised.

Another covariate that had a significant effect on survival time was adherence to ART. The HR for poor adherence was 2.1 times, and the HR for fair adherence was 2.2 times more likely to result in short duration of survival compared to children with good adherence. This finding was supported by studies conducted in Northwest Ethiopia [28] and Wolaita zone health facilities [20]. The poor adherence might be due to insufficient counseling and education of caregiver/patient.

The initiation of CTZ and INH at the start of ART in our cohort was associated with a longer duration of survival. This finding concurred with that of the studies conducted in Felege Hiwot Referral Hospital, Northern Ethiopia [20], and rural Mozambique [29]. The possible reason for higher risk of shorter survival time among children who did not receive CTZ at ART initiation could be due to occurrence of OIs such as *Pneumocystis pneumonia*, toxoplasmosis, bacterial pneumonia, sepsis, and diarrhea. Co-trimoxazole prophylaxis should be given at the initiation of ART to reduce OI and associated short duration survival among HIV-positive children on ART, thereby improving their survival.

The hazards of short survival time for children on INH prophylaxis was 0.38, which means that, in those children who take INH prophylaxis, the hazard of short duration of survival was reduced by 62%. This finding corroborates the finding of the study conducted in Mizan-Aman General Hospital, in Southern Ethiopia [26], and that of a double blinded, placebo-controlled trial on INH efficacy among HIV children infected in Cape Town, South Africa [30]. A possible reason could be INH prophylactic therapy (IPT) prevented the occurrence of TB.

There are some strengths and limitations of this study. The strengths of this study are the use of standard measurements which enabled to make the comparison of findings with other national and international literatures to be valid. In addition, considering long duration of follow-up period of children on ART and the inclusion of important predictors like CTZ, INH and nutritional status also add to the strength to this study. Since our study is retrospective based on available records, excluding those with incomplete information, survival time might be underestimated.

9. Conclusion

In general, this study showed that the probability of survival of children on ART was 73.9% after 96 months and the overall mean survival time was 82.3 months.

The main independent predictors of the survival time were nutritional status, absolute CD4 count below threshold, poor/fair adherence to ART, and absence of INH prophylaxis and CTZ prophylaxis. However, sex, age, advanced disease according to WHO clinical stage, and presence of TB at baseline were not predictors of survival time. Therefore, children living with HIV should be encouraged to take prophylaxis drugs like CTZ and INH. This could be achieved by collective efforts of all concerned bodies on high-risk groups such as children with OI especially TB after initiation of ART and a careful monitoring and follow-up of the children.

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Competing interest

The authors declare that there was no competing interest in connection to this research and its result.

Authors' contribution

NB conceived and designed the study, developed data collection instruments, and supervised data collection. NB and SH participated in the testing and finalization of the data collection instruments and coordinated study progress. NB and SH performed the statistical analysis; SH wrote all versions of the manuscript. All authors read and approved the final manuscript.

Acronyms and abbreviations

ART	antiretroviral therapy
AHR	adjusted hazard rate
AIDS	acquired immune deficiency syndrome
CPT	co-trimoxazole preventive therapy
FMOH	Federal Ministry of Health
HIV	human immune virus
NNRT	nonnucleated reverse transcripts
SAM	severe acute malnutrition
UNICEF	United Nations Children's Fund
WHO	World Health Organization

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