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Original Article

Incidence and Predictors of Mortality Among Children on ART in Health Facilities Of Hawassa City, Southern Ethiopia: Retrospective follow up study

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Abstract

Background: Highly active anti-retroviral therapy (HAART) has reduced mortality and morbidity of children with HIV. Identification of factors that affect the survival of children on Anti-Retroviral Therapy (ART) is important to maximize benefits by addressing any modifiable cofactors. The aim of the study was to assess the incidence and predictors of mortality among children on ART in health facilities of Hawassa city administration, Southern Ethiopia.

Method: Institutional-based retrospective cohort study was carried out on consecutively selected 416 medical records of children ≤ 14 years who started ART from January 1, 2010 to December 31, 2018. The data was collected from selected health facilities in Hawassa City Administration, which have pediatrics ART service by trained health professionals. The data were analyzed by SPSS Version 21. Kaplan Meir (KM) curve, Log rank test and Cox-Proportional hazards model were carried out to determine the predictors.

Results: Out of the 416 cohort of children on ART, 336(80.8%) were alive, 27 (6.5%) were dead, 15 (3.5%) were lost to follow up, 27 (6.5%) transfer out and 11(2.6%) drop out. The overall incidence density rate was 17.25 per 1000 child year. Survival times at the end of 6, 12, 60 and 96 months were 98.3%, 95.5%, 92.3% and 90.5.%, respectively, and overall mean survival time was 90.8 months (CI:88.59 to 93.0). Multivariate analysis showed that low hemoglobin level (AHR =6, 95% CI:1.83 to14.54), tuberculosis co-infection (AHR=6.18, 95% CI:2.58 to 14.83) , baseline CD4 count below threshold (AHR=2.1,95%CI:1.15 to 3.77), Isonized prophylaxis (AHR=0.27, 95% CI:0.22 to 0.68), Cotrimoxazole prophylactic therapy (AHR=0.28, 95% CI:0.15 to 0.46) and poor adherence to antiretroviral therapy (AHR=2.87, 95% CI:1.1 to 7.49) were independent predictors of mortality of children on ART.

Conclusion: The study showed that higher mortality among children with TB co-infection, presence of anemia, and having lower CD4 cell count and poor adherence. Close follow up of children on HAART, with early detection of biomarkers deviation, diagnosis of opportunistic infections and early treatment initiation as well as strengthening adherence support should be underlined.

Keywords: Children, HIV, ART, Mortality, Ethiopia

Introduction

HIV continues to be a major global public health challenge especially in middle and low income countries. According to 2017 estimate globally, 36.9 million people were living with HIV among these 1.8(4.9%) million were children ≤14 years. About 500 children ≤ 14 years were infected with HIV every day(1).The vast majority of people living with HIV are located in low- and middle- income countries, with an estimated 66% living in sub-Saharan. Globally in 2017; 940,000 people died of AIDS-related illnesses among these110, 000 (11.7%) were children ≤14 years, which showed deaths were higher than the estimated infected. This number has reduced by more than 51% (1.9 million) since the peak in 2004 and 1.4 million in 2010(1, 2).

The HIV epidemic continues to have a disproportionate impact on children. Only Just slightly more than half of children under 15 living with HIV receive treatment. In the absence of treatment, children born with HIV experience significantly faster progression to AIDS-defining illness and death compared to adults; more than half of children born with HIV will die within two years without treatment HIV infection follows a more aggressive course among infants and children than among adults, with 30% dying by 1 year and 50% by 2 years of age without access to life-saving drugs, including antiretroviral therapy and preventive interventions(2-4).

Sub-Saharan Africa carries the highest burden of pediatrics HIV which represents 90% of all children living with HIV worldwide. In Ethiopia, it is estimated 62,000 children living with HIV, about 15 children infected HIV every day and approximately 3600 AIDS related deaths each year in 2017 which have reduced by around 40 % from the 2010 death(2, 3, 5).

Many studies show that highly active anti-retroviral therapy (HAART) has improved the survival of HIV infected patients. A cohort study in 17 middle- and high-income countries showed that the trend of mortality rate was highest in earlier calendar years, peaking at 1,773 per 100,000 person-years in 2003 and decreasing to 360 in 2006, after which it was relatively stable at between 122 and 435 cases per 100,000 person years(6). However Mortality was higher in low-income settings than in high-income settings .According to a systematic review study, after HAART between resource-limited and developed settings reported that, mean percentage of deaths per cohort and mean deaths per 100 child-years after HAART were higher in Resource Limited Countries than Developed Countries (7).

The government of Ethiopia took several steps in preventing further spread of the disease, and in increasing accessibility to HIV care, treatment and support for persons living with HIV.Sample size was calculated based on double population proportion formula by using Epi-Info version 7. Anemia, CD4 below threshold, CPT and WHO staging were considered as predictor variables. The most significant predictor of Mortality, CD4 below threshold, was used which was taken from a study conducted at Arba Minch hospital. Additionally the following assumption were considered, 95% CI, power 80%, ratio of unexposed to exposed 1:1 and P1: percent of exposed with outcome (CD4below threshold) = 20.98 %, P2: percent among the non-exposed with outcome (CD4 above threshold) = 11.25% and Ethiopia has been engaged in the scale-up of ART access to the level of health center starting since 2006.In 20017 reports, ART service is being available in more than 1361 health facilities of which around 909 are health centers. In 2017estimation ART need was 551,630 for adults and 62,194 for children under 15 years of age, however around 414,854 adults and 21,146 children under the age of 15 was taking ARV. Based on the new spectrum estimate for 2017, ART coverage for adults (age >15) has reached 75% but the coverage remains low (34%) for children (age <15) living with HIV(2, 5, 8).

The 2014 national guidelines HAART is recommended for all children <15 years with HIV infection regardless of CD4 count and WHO clinical stage(9). According to systematic review and meta-analysis control trial report initiation of Antiretroviral therapy (ART) in asymptomatic infants led to 74% reduction of mortality or disease progression among children with HIV(4, 10).

Studies had shown that WHO clinical staging, viral load, CD4 cell count, age, nutritional status, opportunistic infection, adherence and baseline hemoglobin level were significant predictors for mortality of children on ART(11-15). However, the findings of the studies were not consistent. Therefore, the purpose of this study is to determine incidence and identify predictors that affect the mortality of HIV positive children after initiation of ART in Hawassa city administration health facilities.

Methods

Study design and Settings

Institution based retrospective follow-up study was conducted in Hawassa health facilities which have pediatric ART service. Hawassa city is found 270kms south of Addis Ababa, the capital of Ethiopia. The city is divided in to 8 sub cities and 32kebeles. Its population is estimated to be 376,539 among them 180,231 estimated less than 15 years. The city has one public referral hospital, one public general hospital, one public district hospital 10 governmental health centers, 4 private hospitals and about 51 private clinics .The ART was being provided for children living with HIV regardless of CD4 count and World Health Organization clinical stage classification. All facilities use national standardized monitoring and evaluation tools, and the data collection and management processes are well controlled and supported by electronic data back-up and processing. There were about a total of 5,874 people on ART among these children of ≤14yeas were more than 481(16).

Source and study population

The Source population was records of all HIV infected children ≤ 14 years who have started ART in health facilities of Hawassa city administration. All children with HIV in the five health facilities that were enrolled in to the chronic and HIV care follow up from January 1, 2010 to December 31, 2018, were included in the study. Those patients with missing chart or incomplete base line and follow up data were excluded.

Sample size determination

Sample size was calculated based on double population proportion formula by using Epi-Info version7.Anemia, CD4 below threshold, CPT and WHO staging were considered as predictor variables. The most significant predictor of Mortality, CD4 below threshold, was used which was taken from a study conducted at Arba Minch hospital. Additionally the following assumption were considered, 95% CI, power 80%, ratio of un-exposed to exposed 1:1 and P1: percent of exposed with outcome (CD4below threshold) = 20.98 %, P2: percent among the non- exposed with outcome (CD4 above threshold) = 11.25% and HR=2.08. The total sample size was 336. Finally, after adding 10% for contingency modifier, the final sample size of our study was calculated as 370.

Sampling technique and procedure

The study was conducted in selected 2 hospitals and 3 health centers among Hawassa health facilities which have

pediatric ART service .The selected health facilities are Hawassa University Compressive Specialized Hospital (HCSH), Adare General Hospital, Tula health center, Millennium health center and Bushulo health centers. A total of 436 children who started ART during the study period were identified from selected ART clinics. Charts were organized according to the card number, in a chronological order, with each chart representing one child. Where, 416 cards of children were selected consecutively started ART 1stJanuary 2010 to 30th December 2018 and fulfill the inclusion criteria were included in study.

Data collection procedures & tools

The data extraction tool was developed from the format of WHO standardized ART entry and follow up form currently used by the ART clinics. Additionally different peer reviewed published literatures were considered (12, 14, 15). The data extraction tool was prepared in English language. The tool contains four parts which include socio demographic factors, nutritional factor, clinical and laboratory factors and treatment factors. Most recent laboratory results before ART initiation were used as baseline values. If there is no pre-treatment laboratory test, results obtained within one month of ART initiation were considered as baseline values. Death was confirmed by reviewing medical registration in the hospital, or registration by ART adherence supporter through calling using the registered phone number. Children were considered lost to follow up if they did not collect treatment for 3 consecutive months. Attempts were made to contact all children who were lost to follow up to determine their status. All lost to follow ups and transfers out were censored on the date of their last visit. Otherwise follow-up time was censored at the end of the study period.

Data was collected by five diploma nurses who were trained on Comprehensive HIV care and currently working in the ART clinic. Two trained BSc nurses were used for supervision and data was encoded by two data clerks.

The data was collected by reviewing the patients' medical cards (follow up and ART intake forms) and ART electronic database. Both the data collectors and supervisors were trained for one day to familiarize the data extraction tool and ethical aspects during data collection procedure.

Data processing and Analysis

Data was checked for completeness and consistencies. Subsequently, the data was coded and entered in to Epi data version 3.5 and then exported to SPSS version 21 for analysis. The WHO Anthro Plus Version 1.04 and ENA for Smart Software were used

to generate the Z score (WAZ, HAZ) to define nutritional status. Summary statistics was carried out to describe demographic, baseline and follow up data.The Kaplan-Meier survival curve was used to estimate survival time after initiation of ART, and log rank tests were used to compare the survival curves. Bivariate and multivariate Cox proportional hazards regression models were used to identify the predictors of mortality. Those variables with p-value ⩽0.2 in the bivariate analysis were included in the multivariate Cox proportional hazards model. The independent predictors of mortality were identified using adjusted hazard ratios (AHRs) at 95% confidence interval (CI) and p-value < 0.05.The necessary assumption of cox proportional hazard model was checked using Schoenfield residual test.

Operational Definition

Stunting: is height/age< -2 standard deviation according to WHO 2006 curve. **Underweight:** Weight / age <-2standard deviation according to WHO 2006 curve for children less than 5year and body mass index (BMI) was calculated for 5 years old or above children and BMI less than 16 kg/m2 (17).

Baseline CD4 level -Children under age 1 and had CD4 cell count <1500 cells/ mm 3; children aged 1 to below 3 years old and had CD4 cell count <750 cells/mm3; children aged 3 to below 5 and had CD4 cell count <350 cells/mm3; and children aged 5 to below 15 and had CD4 cell count <200 cells / mm3 categorized as CD4 below threshold (4).

Adherence to HAART was measured by the last adherence level recorded on the follow-up form and classified as good >95%, fair 85-94%, poor <85% based on percentage of drug dosage calculated from the total monthly doses of HAART drugs(18).

Results

Socio demographic charactrstics of study participant

Among the 436 HIV positive children's records reviewed, 416 records were included in the final analysis and 20 (4.5%) records were excluded due to missed information. Three hundred sixty two (87.0%) study participants were from Hawassa University Specialized Referral Hospital (HUSRH) and Adare General Hospital the rest from the three health center. Majority of age group were lined between 5-14 years 280 (67.3%). The median age of the cohort at the time of ART initiation was 8 years with IQR 4-11year.

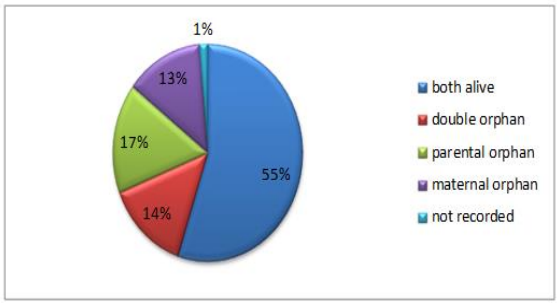

Figure 1. Orphan hood status among children on ART at health facilities of Hawassa City Administration (from January, 2010 to December, 2018)

Of the total patients included in the study, more than half, 280 (57.2 %) were males and 372 (89.4%) were live in urban area. Majority of children (375, 87.62%) live with their parents. Fifty eight (13%) children were double orphan and 314 (76.4%) of children's care givers were HIV positive (Table 1 and Figure 1).

Table 1: Baseline socio-demographic characteristics of children on ART at health facilities of Hawassa City Administration, from January 2010 to December 2018

Variables	Number	Percent (%)
Age category		
Under 1years	11	2.6
1-5years	125	30.1
5-14years	280	67.3
Sex of the child		
Male	238	57.2
Female	178	42.8
Residence		
Urban	372	89.4
Rural	44	10.6
Care giver of the child		
Parents	345	83.3
Sibling	18	4.4
Grand parent	19	4.6
Guardians	16	3.9
Orphanage center	16	3.9
Marital status of care giver		
Married	268	67.3
Single	13	3.3
Divorce	9	2.3
Widowed	108	27.1
Care giver status		
Positive	317	76.4
Negative	22	5.3
Not determine	76	18.3

Clinical & laboratory characteristics

Among the total study participants, 230 (55%) of the children initiated ART on WHO clinical stage I and II. Most of the children (291, 70%) had CD4 counts above the threshold. At initiation half of the children, 216 (51.9%) were ambulatory. Three hundred forty seven (83.4%) of the children had achieved appropriate

developmental milestones prior to ART initiation. Sixty two (14.9%) of the children had hemoglobin (Hgb) less than 10mg/dl at initiation of ART. The nutritional status of the study participant at baseline showed that 291 (70%) were under weight, and 176 (42.3%) were stunted. About 84 (20.2%) of the children had tuberculosis (TB) co-infection during initiation of ART. More than half, 229 (55%), of the children enrolled in the study had opportunistic infection (OI) at initiation of ART. The most common OI were recurrent bacterial pneumonia (38%) and TB (33%), respectively (Figure 2 and Table 2).

Table 2. Clinical and laboratory characteristics among children on ART in health facility of Hawassa City Administration, from January 2010 to December 2018

Variables	Number	Percent (%)
Developmental status		
Appropriate	**347**	**83.4**
Delayed	**64**	**15.4**
Regressed	**5**	**1.2**
Functional status		
Working	164	39.4
Ambulatory	216	51.9
Bed ridden	17	4.1
WHO clinical stag		
Stage I	124	29.8
Stage II	106	25.5
Stage III	160	38.5
Stage IV	26	6.3
CD4 count		
Below trash hold	125	30
Above trash hold	291	70
Hemoglobin level		
<10mg/dl	62	14.9
≥10mg/dl l	354	85.1
Opportunistic infection		
Yes	229	55.1
No	187	44.9
Tb co infection		
Yes	84	20.2
N0	332	79.8
Under weight		
Yes	291	70.0
No	125	30.0
Stunting		
Yes	176	42.3
No	240	57.7
Tb screened		
Yes	402	96.6
No	14	3.4
Viral load		
<1000	331	79.6
≥1000	67	16.1
Not done	18	4.3

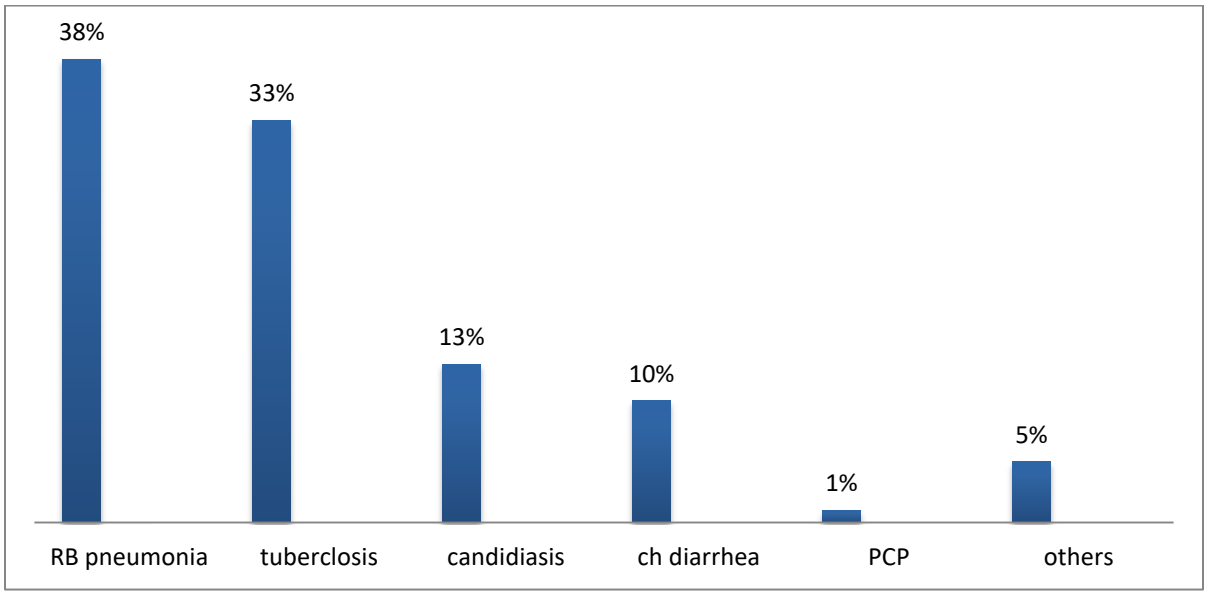

Figure 2: Proportion of opportunistic infection in children on ART in health facilities of Hawassa City Administration, from January 2010 to December 2018.

ART & other prophylaxis medications

Among the reviewed participants 412 (99%) were started ART on first line ART regimen. Among the study participant, 71 (17.1%) of the children had developed ART related side effect; mainly nausea 45 (33%) followed by skin rash 32 (24%).Among the cohort most of the participants, 383 (92%), were given cotrimoxazole at the time of initiation of ART. Two hundred ninety seven children (71.4%) were given INH prophylaxis. Twenty seven (6.5%) of them change their drug regimen during the follow-up period. Among the total study participant 343 (82.5%) had good adherence to ART treatment (Table 3).

Incidence of mortality after initiation of ART

A total of 416 children started ART have been followed for different periods; a minimum of 1 month and a maximum of 97 month with median follow up period of 40 month and intra quartile range (IQR) of 22 to 68months. Out of total observation 336 (80.8%) were alive, 27(6.5%) were died, 15 (3.6%) were lost to follow up, 27 (6.5%) were transferred out and 11(2.6%) drop out the treatment. The total cohort contributed 1564.8 child-years, resulting in the overall mortality rate of 17.25 deaths per 1000 child-years. The cumulative survival probabilities of children after 6, 12, 24, 60 and 96 months were 0.981, 0.955, 0.940, 0.923 and 0.905, respectively. The mean survival time was 90.8 month (CI= 88.59 to

93.0).Of the 27 deaths, 8 (22%) and 18 (66.7%) of were occurred within the 6 and 12 months after initiation of ART, respectively.

Table 3: Medication history among children on ART in health facilities of Hawassa City Administration, January 2010 to December 2018

Variables	Categories	Number	Percent (%)
ART regimen	4a=d4t-3t-NVP	76	18.3
	4b=d4t-3tc-EFV	24	5.8
	4c=AZT-3TC-NVP	144	34.6
	4d=AZT-3TC-EFV	69	19.7
	4g=ABC+3TC+LPV	65	15.6
	2^{nd} line regimen	4	1
	Others	19	4.6
CPT	Ye	383	92.1
	No	33	7.9
INHP	Yes	297	71.4
	No	119	28.6
Tb treatment	Yes	47	11.3
	No	369	88.7
Drug side effect	Yes	71	17.1
	No	344	82.7
Change of regimen ART	Yes	27	6.5
	No	389	93.5
Adherence of ART	Good	343	82.5
	Fair	16	3.8
	Poor	57	13.7

Survival function for different categorical variables

To test equality of survival curves of different categorical explanatory variables, Kaplan Meier survival curve together with log rank test was performed. The test statistics showed that there was a significant difference in survival function for different categorical variables. Children that initiated ART at advanced stage of the disease (WHO stage III & IV) progression showed significantly lower survival probability compared to those who start early in the disease progression (log rank, P<0.001). Children with normal hemoglobin level at initiation of ART have longer survival experience than those children with low hemoglobin level (log rank, P<0.001). Additionally, children with OI during initiation of ART had lower survival compared to OI free children (Figure 3).

Predictors of Mortality after Initiation of ART

To identify independent predictors of mortality, a multivariate Cox Proportional hazard adjusted model was fitted by forward stepwise procedures with the variables having P-values less than 0.20 in the bivariate analysis. In this study, CPT, Isoniazid (INH) prophylaxis, baseline CD4 count, tuberculosis co-infection, Hgb level and adherence for ART treatment were found to be independent predictors for mortality of children on ART.

Those children with CD4 below the threshold at initiation of ART were 3.2 (AHR=3.19, 95% CI: 1.45 to 6.92) times more likely to die at any time as compared to clients who had CD4 above threshold. From those children who took CPT, 72% (AHR 0.28, 95% CI: 0.11 to 0.74) had lower risk of death than those who did not took. There was 77% (AHR 0.23, CI: 0.09 to 0.48) reduction of death at any time for those who took INH than their counterpart. The risk of death was 6.39 (CI=2.81 to14.54) times higher for children who had low Hgb at baseline. Additionally, children who had TB co-infection at initiation were 6.18 (95% CI = 2.58 to 14.83,) times at higher risk of death compared to those children who were not found to have tuberculosis infection. Those children who had poor adherence for ART treatment had 2.87 (ARH=2.87, 95% CI1.10 to 7.48) times more at risk of death compared to children with good adherence (Table 4).

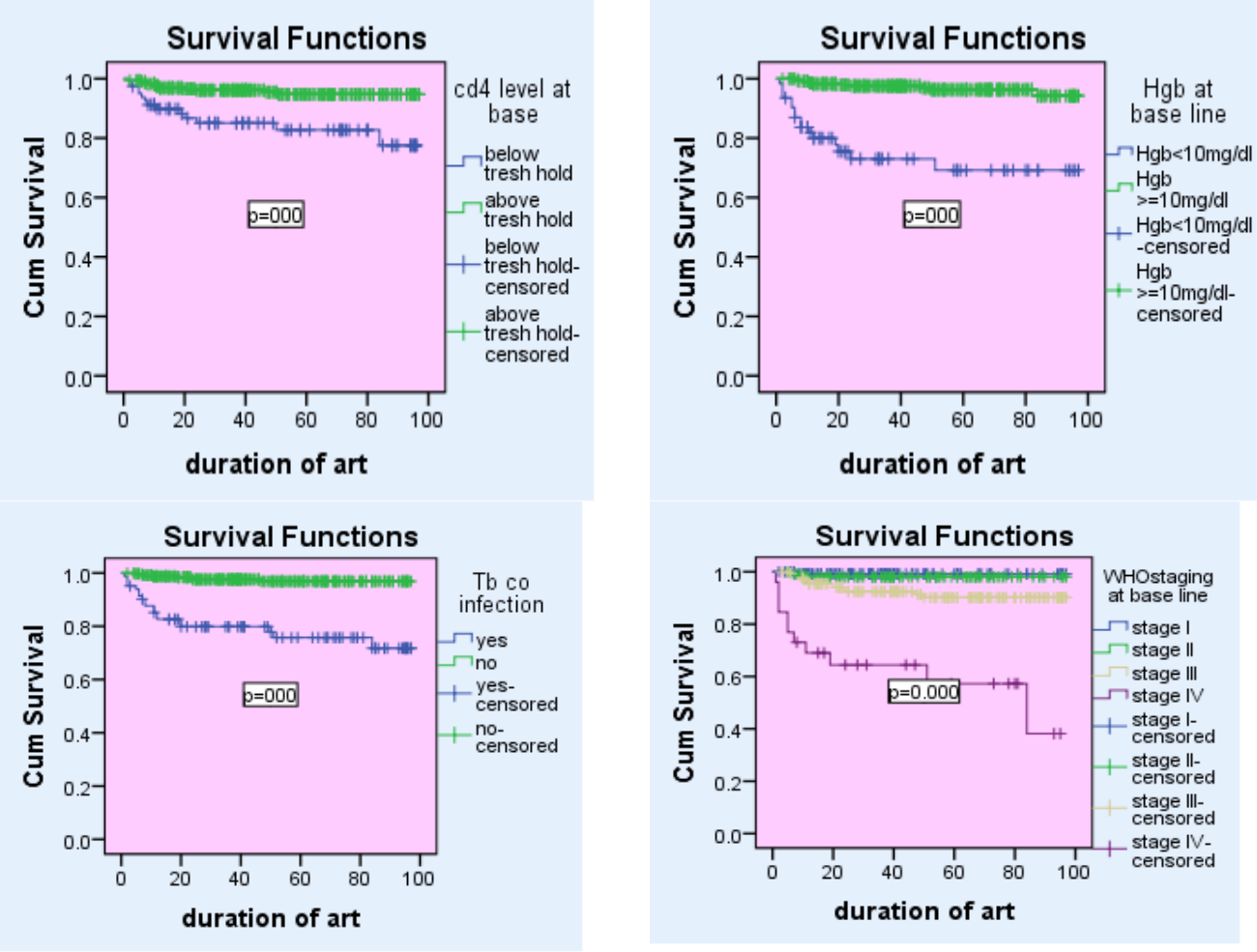

Figure 3: Kaplan-Meier Survival estimate based on CD4 count, TB co infection, Hgb level and WHO clinical staging on ART in health facilities of Hawassa City Administration, from January 2010 to December 2018

Table 4: The bivariate and multivariate Cox regression proportional Hazard regression analysis of predictors of mortality among children on ART in health facilities of Hawassa City Administration, from January 2010 to December 2018

Covariant	Dead	Censored	CHR	AHR	95 %CI	PValue
CPT						
Yes	18(4.7%)	395(87.7%)	0.14(0.06-0.31)	0.28	0.11-0.74	0.004
No	9(2.2%)	24(5.4%)	1			
Adherence level						
Good	16(3.8%)	327(78.6%)	1	1		
Fair	4(1.0%)	12(2.9%)	6.67(2.22-20.07)	2.79	0.84-9.26	0.093
Poor	7(1.7%)	50(12.0%)	2.48(1.02-6.05)	2.87	1.10-7.48	0.031
CD4 level						
< threshold	18(4.3)	107(25.7)	1.6(1.1-2.5)	3.19	1.15-6.92	0.003
> threshold	9 (2.2)	282(67.8)	1	1		
Hgb level						
Hgb<10mg/dl	16(3.8%)	46(11.1%)	10.21(4.73-22.03)	6.39	1.93-11.16	0.001
Hgb>10mg/d	11(2.6%)	343(82.5%)	1	1		
INH						
Yes	6(1.4%)	291(70%)	0.10(0.04-0.25)	0.23	0.09-0.48	0.002
No	21(5.1%)	98(23.6%)	1	1		
TB infection						
Yes	19(4.6%)	63(15%)	9.78(4.28-22.39)	6.18	2.56-14.83	0.001
No	8(1.9%)	326(78.4)	1	1		

Discussion

In this retrospective cohort study, the incidence and predictors of mortality were determined among HIV positive children on ART in health facility of Hawassa City Administration. Total of 416 were followed for 1564.8 person-years of observation. The overall mortality rate in this study was 17.25 deaths per 1000 child-years. This finding was consistent with findings in Mekelle Referral Hospital in Northern Ethiopia (16.85 per 1000 person year) and Addis Ababa hospitals (12.4per 1000 person year) (15,19). However, the mortality rate in this finding was found lower than study done in Arba Minch health facility (36 per1000 person year) Bahir Dar Referral Hospital Northwest Ethiopia (40 per 1000 child-years)and Eastern Ethiopia (46 deaths per 1000 child-years) (12,14,20). The mortality rate also lower than study conducted in Nigeria and Malawi (21). These variations may be explained by the difference in the

study period and setting. Additionally, it might be associated with high proportion of children in our study were taken CPT and INH prophylaxis than other studies which prevents the occurrence of OIs like TB and life-threatening bacterial infections (4).

Concerning the interval from ART initiation to death, 66.7% of the deaths occurred within the first 12 months. This finding is consistent with a study conducted at other places of Ethiopia, which showed that early mortality (death <18 months after ART initiation) was higher than late mortality (death ≥ 18 months after ART initiation) (12,19). This finding was also in line with other studies conducted in other countries Nigeria which showed that most of the deaths occurred in the first 6 months following ART initiation (22).

Accordingly, the risk of death in children who have low Hgb level (<10 gm/dl) at initiation of ART was 6.39 (AHR 6.39, 95% CI=2.81 to 14.54) times higher than those who have normal hemoglobin level. This finding is in line with findings of study conducted at other places in Ethiopia (13,14,23) and studies conducted in Kenya (24) and South Africa (25).

The finding of this study revealed that another strong predictor of mortality was tuberculosis co-infection. Those children who have tuberculosis co- infection at baseline were 6.18 (AHR=6.18, 95% CI=2.58 to 14.83, P=0.001) times more likely to die early than those without tuberculosis infections. This finding was support by the finding of study conducted in Malawi (21) and Arba-Minch (14) showed that TB co-infection had increased the risk of mortality among children on ART. Similarly, study which was conducted in Gonder Referral Hospital (26) showed that mortality rate was high among TB/HIV co infected children.

Children, who had CD4 counts below the threshold at baseline, showed a higher risk of death than their counterparts. Those children who had CD4 below the thresh hold at initiation of ART 3.2 (AHR=3.19, 95% CI: 1.48 to 6.92) times more likely to die at any time as compared to clients had CD4 above thresh hold. This finding is consistent with other previous studies conducted in Ethiopia (14,15,20)and South Africa (25) which all indicate that low CD4 count was an independent predictor of mortality.

Another predictor that had a significant effect on incidence of mortality was adherence to ART during follow-up period. Children who had poor adherence were 2.87 (AHR=2.87, 95% CI=1.1 to 7.49) times more likely to die early than those who had

good adherence for ART treatment .This finding was support by studies conducted in Arba Minch Hospital (14) and at Addis Ababa Hospitals (15).

Those children who took cotrimoxazole prophylaxis were hazard ratio of 0.28 (AHR=0.28 95% CI: 0.12 to 0.66). This means that children who took CPT prophylaxis had 72% reduced the hazard of death than those who did not took. This finding was supported by studies conducted in Arba Minch (14) hospital and Bahir Dar Hospital (12).

The hazards of death for children on INH prophylaxis was 0.23 (AHR=0.231, 95% CI:0.09 to 0.59), where children who took INH prophylaxis had 78% reduced hazard of early death than those who did not took during the follow-up time. This finding is agreed with the finding of the study conducted in Adama (27), Arba Minch (14) and South Africa (25).

Limitations

We have used record review of complete records, where some records were excluded from the study due to incompleteness, as well there were cases lost to follow-up. The reasons mentioned might contribute to underestimation of survival times.

Conclusion

The overall incidence density rate was 17.25 per 1000 person year. More than half of child death occurred in the first 12 months following ART initiation. The study also demonstrated higher mortality among children with tuberculosis co-infection, presence of anemia, and having lower CD4 cell count and poor ART adherence. CPT and INH prophylaxis were found to decrease the risk of deaths in children on ART. Therefore, attention is needed to ensure early diagnosis and enrollment into ART and its determinants need to be addressed by assessing patients for those risk factors, improving the quality of existing services and strengthening adherence support.

Ethical Considerations

Ethical approval to commence the study was obtained from Pharma College Institutional Research Ethical Review Committee (PC-IRERC). Following the approval by PC-IRERC, Official letter of co-operation was written to the selected health facilities by Pharma College. Letter of permission was also obtained from the management (CEO) of the hospitals. The consents for extracting data from records were obtained by The Heads of the HIV care clinics. Patient records were given unique identification

numbers in order to keep records confidentiality. Extracted data were used only for the purpose of this study and maintained within the hands of the PI.

Consent for publication

Not applicable

Availability of data and materials

Available from corresponding author on reasonable requests

Conflict of interests

The authors declare that no conflict of interest

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Authors' Contributions

HH conceptualized the paper, mentored the data collection process, analyzed the data and write the draft of the manuscript. HH, TG and HB supervised the study and commented on all successive drafts of this manuscript. BT and HM revised and edited the manuscript for publication. All authors read and approved the final manuscript

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