Addis Ababa University

School of Public Health

Assessment of magnitude and factors affecting nutritional status of HIV infected under-five children at five public hospitals in Addis Ababa and its programmatic implication

A Thesis Submitted to

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BY

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DECLARATION

I, the undersigned, declared that this thesis is my original work, has not been presented for a Degree in this or any other university, and that all sources of materials used for the thesis have been fully acknowledged.

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Abstract

Background: Even though malnutrition can affect any child who is at risk, HIV infected children are at a greater risk to have malnutrition due to the synergistic relationship between infection and malnutrition.

Objective: to assess factors affecting nutritional status of HIV infected under-five children at five public hospitals in Addis Ababa.

Methods: the research was conducted at five public hospitals in Addis Ababa using a cross-sectional research design and data was collected from June 3 to September 20, 2013. Using simple random sampling method 243 under five HIV infected children were included in the study. A structured questionnaire was used for data collection and data was analyzed by running simple frequencies, odds ratio and binary logistic regression.

Result: The prevalence of underweight, stunting and Global Acute Malnutrition among the children were 15.4%, 62.1% and 2.5% respectively. Under multivariate analysis CD4 percentage equal to or above 25% was protective of stunting while always not having enough food in the family of the child was significant in the model for predicting stunting. Maternal age from 36-49 years old was found to be protective of being underweight while being a girl was protective of wasting.

***Conclusion and recommendation*:** the magnitude of chronic malnutrition in the HIV infected under five children having follow up in the five public hospitals was very high which can affect survival. It needs intervention by addressing the food insecurity and CD4 percentage value of the child which were related to it.

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ACRONYMS

AIDS- Acquired Immune Deficiency Syndrome

AOR-Adjusted Odds Ratio

ART- Anti Retroviral Therapy

ARV- Anti Retro Viral

CD4- Cluster of Differentiation

DNA- Deoxyribo Nucleic Acid

EDHS- Ethiopian Demographic Health Survey

GAM- Global Acute Malnutrition

HAART- Highly Active Anti Retroviral Therapy

HAZ- Height-for-Age Z-score

HIV- Human Immune Deficiency Virus

IQR-Inter-quartile Range

OR-Odds Ratio

MUAC- Mid Upper Arm Circumference

PCR- Polymerase Chain Reaction

SAM- Severe Acute Malnutrition

UNAIDS- Joint United Nations Program on HIV/AIDS

WHO- World Health Organization

WAZ- Weight-for Age Z-score

1. Introduction

1.1. Background

As it is depicted on figure 4 causes of malnutrition is classified in three major groups; immediate causes, underlying causes and basic causes. Factors like inadequate dietary intake and infections are considered as immediate causes of malnutrition. Underlying causes of malnutrition includes inadequate access to food and inadequate health care services. Political and economic factors are basic causes of malnutrition [1]. Human Immune Deficiency Virus (HIV) infected individuals are at a greater risk of having malnutrition and decreased energy intake is the main reason among others. Disorders of food intake due to disturbance of the gastrointestinal tract and having opportunistic infections are also reasons for developing weight loss and malnutrition for HIV infected people. Hence even if there is a need for nutritional treatment of HIV infected individuals, this means that there is more strain to the already marginal health care resource[1, 2]

Even though the Daily Energy Expenditure is normal in asymptomatic HIV infected people, their Resting Energy Expenditure is higher than the healthy control subjects. Resting energy expenditure is also elevated in asymptomatic HIV infected patients who are on Anti Retroviral Treatment (ART) and HIV infected patients who have secondary infections. Therefore these people have to be given extra calorie to prevent weight loss [3]. Both nutritional counseling and nutritional supplements are helpful in improving health outcomes in HIV infected people [4]. Micronutrients like vitamin A, vitamin D and zinc also have a substantial role in decreasing mortality and morbidity from infectious diseases. Supplementation of micronutrients to replenish deficiency state is helpful to improve the health of HIV infected people [4, 5].

The importance of doing nutritional assessment of HIV infected children which includes clinical, biochemical, anthropometric and dietary parameters to look for either form of malnutrition is paramount and emphasis has to be given to it [6]. The World Health Organization (WHO) recommends nutritional assessment of HIV infected children by doing initial complete nutritional assessment and then after by measuring weight and height at each scheduled visit but more often if weight gain is not adequate [7]. Similar recommendation exists on the Ethiopian national pediatric HIV/AIDS (Acquired Immune Deficiency Syndrome) care and treatment guide line.

With the presence of close relationship between HIV infection and malnutrition it is important to link nutritional intervention activities with antiretroviral treatment in programmatic areas that address HIV infected people [8]. Because HIV infected under-five age children are at higher risk of developing malnutrition, we need to investigate the magnitude and risk factors that contribute to malnutrition in these group of children. Since there were a reasonable number of HIV infected under-five age children who have follow up in public hospitals in Addis Ababa, conducting a research in these hospitals helped us to look for the factors affecting their nutritional status.

1.2. Statement of the Problem

Globally malnutrition is the major underlying cause of death in children under five years of age [9]. Each year it claims the lives of over one million children and severe acute malnutrition is one of the common presentations of HIV infected African infants and children [10].

In Ethiopia it is also a major public health problem. According to the 2011 Ethiopian Demographic Health Survey (EDHS), ten percent of the nation's children were wasted where three percent were severely wasted and twenty nine percent were under weight. Forty four percent of the country's under five age children were stunted and twenty one percent of the children were severely stunted [11].

Even though malnutrition potentially can affect any child who is at risk, there is a strong relationship between malnutrition and HIV due to the effect of HIV on the immune system [12]. Malnutrition in HIV infected children is also augmented by the social and economic disruption effect that HIV can create on the family of HIV infected children. Being underweight was found to be predictor of mortality in HIV infected children in Tanzania [13]. Severe malnutrition was also an independent predictor of mortality among HIV infected adult patients according to a research conducted in Singapore and Tanzania in addition to factors like stage of HIV disease, type of ART initiated and anemia. In the case of the study done in Singapore, 16% of the patients were severely malnourished at the time of ART initiation [14, 15]. On the other hand a research conducted in Malawi in the Nutrition Rehabilitation Units across the country found out a high prevalence of HIV infection in severely malnourished children. In this study the prevalence of HIV infection amongst severely malnourished children was 26% [16].

The burden of malnutrition on HIV infected children described by one hospital based study in Ethiopia illustrated that before initiation of Highly Active Anti Retroviral Therapy (HAART), 55.6% of the children were stunted, 27.3% were wasted and 61.1% of them were under weight. In this study severe wasting was found to be an independent predictor of death for the HIV infected children [17].

However, despite the seriousness of the problem the number of studies conducted to explain factors affecting the nutritional status of HIV infected under five years of age children is still relatively inadequate particularly programmatic implications are not paid due attention. This is the main reason for under taking this research hoping that it will shed some light on the issue and

provide important information both to the clinicians and to the programmers to manage malnutrition among the under five HIV infected children.

1.3. Rationale of the Study

Most of the time children who are under follow up and treatment for HIV infection are evaluated (assessed) for their nutritional status during their follow up visit. This practice is also recommended by the Ethiopian nutrition strategy and the nutrition program of the country which recommend priority to be given in terms of nutritional assessment and nutritional intervention for under five age children and HIV infected people [18, 19]. There is also a national guide line which recommends assessment of the nutritional status of children on ART at every visit and support their parents to ensure children on ART consume adequate energy [20]. Even though we are witnessing that in the day to day clinical practice of the study hospitals nutritional assessment is being done for the HIV infected under five children having follow up there, it is seldom that assessment results of their nutritional status is evaluated for its nutritional and HIV care and treatment program implication. Hence the existing clinical practice in the study hospitals might help us to see the nutritional status of the individual child but not the magnitude of malnutrition among the under five children having follow up there. This study tried to fill this gap where by doing nutritional assessment for the sampled HIV infected under five children having follow up in the study hospitals, it was possible to see the prevalence of malnutrition among the children and factors related to it. In addition to this, the assessment of nutritional status of the children in the study hospitals helped to see programmatic implication at a clinical set up level as intervention towards the existing malnutrition among the children require research evidence as an input for implementation.

2. Literature Review

2.1. Burden of malnutrition and HIV

The term malnutrition refers to both under-nutrition and over nutrition. Under nutrition is defined as 'failure of the body to obtain the appropriate amounts of protein, energy, vitamins and other nutrients it needs to maintain healthy tissues and organ function' [21]. Because HIV infected children are at a greater risk to be affected by malnutrition, we need to understand factors that determine the nutritional status of HIV infected children in order to address their problems related to malnutrition.

Child under nutrition is still one of the major public health problems across the world even if its burden is declining as compared to its magnitude in the 1990s. Its prevalence may vary from country to country but predominantly is the problem of the developing countries especially in the sub-Saharan Africa [22]. In some African and Asian countries, fifteen percent of their children are wasted. Stunting is also common in sub-Saharan Africa where in some countries more than half of the children under five years old are stunted. In the developing world wasting also affected an estimated 13 percent of under five years old children among which 5 percent of them are severely wasted. In addition, globally under nutrition contributes to more than one third of child deaths [23].

Likewise, even though morbidity and mortality due to HIV/AIDS is declining, the disease continues to be a challenge to the globe. Still morbidity and mortality due to the disease in developing countries remains unacceptably high. In sub-Saharan Africa while the number of newly HIV infected children is declining as compared to the magnitude in the previous United Nations' AIDS (UNAIDS) reports, the region accounted for more than 90% of the children newly infected in 2011 only. In this region, despite a significant reduction in AIDS related mortality, it still accounted for 70% of all the people dying from AIDS in 2011. This is an indicator that despite the success that is being seen still a lot has to be done in the region [24]. A prevalence of 63% underweight, 58% stunting and 16% wasting was reported from India in under five HIV infected children [25].

2.2. Malnutrition and infections

Both macronutrient deficiency (protein-energy under-nutrition) and micronutrient deficiency (vitamins and minerals) have wide spread impact on the body. In both conditions the effect of malnutrition to the body ranges from causing weakening of the immune system to creating different kinds of pathologic changes to specific organs of the body [12].

Malnutrition and infection have a synergistic relationship. Infection precipitates malnutrition and malnutrition also favors morbidity and mortality from infection. This relationship is especially well illustrated in the disadvantaged population. Infection causes decreased nutrient intake and increased nutrient losses through decreased intestinal absorption, direct loss in the gut through increased secretion, internal diversion for metabolic responses to infection and increased basal metabolic rate. This mechanism works for all infections including HIV/AIDS with variation in the degree of severity [26-28].

2.3. Risk factors of malnutrition

Malnutrition in children is related to different types of socioeconomic factors across the developing world. In Ghana child malnutrition was associated with poverty, maternal education and health care utilization [29] while in Cameroon child malnutrition increased in conditions of reduced house hold economic status and limited access to health care during the times of economic crisis and adjustment programs in the 1990s [30]. Women's education, age of the child and house hold economic status were factors incriminated for child under nutrition in a study conducted in the southern Ethiopian region [31]. Similar socioeconomic factors found to operate as risk factors of child malnutrition in South Africa in addition to HIV infection [32]. In Dhaka city (Bangladesh) stunting in preschool children was independently affected by height of the mother, maternal knowledge on nutrition, birth weight of the child, frequency of feeding and education of fathers [33]. Living in rural area, having poor health, the use of unprotected water supplies, lack of milk consumption, and lack of personal hygiene were some of the factors associated with marasmus and being under weight among children less than 30 months of age in central Ugandan community [34].

2.4. Malnutrition and HIV

Both malnutrition (wasting and stunting) and HIV infection are independently associated with increased risk of mortality in children. Among the HIV infected children, wasting due to malnutrition increases their risk of death as compared to those who are not wasted [35].

HIV infected children are at increased risk of malnutrition. In one study, HIV infected children were found to be more wasted, more under weight and tended to be more stunted than HIV negative severely malnourished children. In this study, edematous malnutrition was less prevalent in the HIV infected children as compared to in the HIV negative children. The CD4 count of these HIV infected children was also didn't rise only with nutritional rehabilitation; rather there was a decline in CD4 count after treatment of the severe malnutrition [36]. Hunger, feeding frequency, low birth weight, diarrhea and CD4 percentage were factors associated with malnutrition in HIV infected children [37, 38].

A hospital based study conducted in Ethiopia on HIV infected children found out that the magnitude of severe malnutrition in these children before the initiation of HAART to be high. In this research severe wasting was found to be a significant independent predictor of death for the HIV infected children in addition to low hemoglobin value and absolute CD4 count below the threshold for severe immunodeficiency [17].

It is not only under nutrition that HIV infected children could face. According to the findings by Sharma et al, after initiation of HAART in HIV infected children excessive calorie intake due to the improvement of their appetite could bring another problem. These children were at increased nutritional risk due to the excess caloric intake which is the opposite of the problem that we faced before the HAART era [39]. In HIV infected children, the reduction in body weight is not only attributed to reduction in fat free mass of the body; rather there is also a reduction in body fat in them. But fat free mass of the body in HIV infected children is significantly less than fat free mass in control children of similar age [40].

One study has tried to see the risk factors of malnutrition among children age under five with HIV positive mothers across countries of the sub-Saharan Africa using the data from the demographic Health Survey in the countries. In this study the risks of stunting and underweight were highest among children aged less than one, male children, multiple births, and those who

were small at birth. Risk factors for wasting were also similar except for the child's age where the risk of wasting was the lowest among older children aged four and highest among births of order five and above. Maternal factors like being a teenage mother, absence of maternal education, and poorer or single parent household were associated with higher risk of child stunting. On the contrary to what is expected, in this study the risk of under-nutrition in children of HIV positive mothers is found to be lower in communities or countries with higher HIV prevalence compared to countries with lower HIV prevalence [41].

Other factors which are responsible for malnutrition in HIV infected children include reduced appetite due to oral lesion and illness, side effects of medicines and depression. Diarrhea is very common in HIV infected patients especially in the developing countries [12]. Poor weaning practices, parental death and higher birth order are also risk factors of malnutrition [42].

Dietary diversity in HIV infected children was significantly less than those of HIV-uninfected children according to a research done in South Africa. This might be is a reflection of the socioeconomic status of HIV infected children's family and could contribute to the development of a specific nutrient deficiency [43].

In a research conducted in Cote d'Ivoire, improvement in the anthropometric indicators was seen after initiation of cotrimoxazole prophylaxis in adults who were infected with HIV [44]. In another study conducted on children, administering Highly Active Antiretroviral therapy (HAART) was associated with significant increase in weight and height Z-scores five years after initiation of the drugs in the HIV infected children [45].

In a randomized trial of multivitamins supplements in HIV infected women, it was found out that multivitamins delay the progression of HIV disease [46].

2.5. Food security and HIV

Even in developed countries there is a possibility that the occurrence of food insecurity in HIV positive individuals is greater than the general population [47]. HIV/AIDS predisposes a house hold to food insecurity through depleting savings and assets[48]. As a result access to food is the main problem of HIV affected people[49]. Food insecurity, HIV/AIDS and under nutrition have additive effects. Therefore it is important to integrate HIV care services and nutritional interventions. Targeted food and nutritional assistance is claimed to improve nutritional status of

HIV infected individuals. It also improve adherence to therapy, increases home production of food and wage earning by improving labor productivity which contribute to house hold food security. Ready-to-use-therapeutic foods are good example of food support that is becoming increasingly in use in HIV treatment programs[8]. In general similar to Anti Retro Viral (ARV) drugs, food security and nutrition are basics to HIV treatment and improve patients' survival[50].

It is unclear what factors are affecting the nutritional status of HIV infected under-five age children in the presence of antiretroviral therapy in the setting where HIV has a substantial role to child mortality and morbidity. This study tried to look at factors which contribute to child malnutrition in the context of HIV infection in our setting so that it could help identify preventable factors to improve child survival.

3. Objective

3.1. General Objective

To assess the magnitude and factors that affect the nutritional status of HIV infected under-five age children who have follow up and treatment at five public hospitals in Addis Ababa.

3.2. Specific Objectives

1. To assess the nutritional status of HIV infected under-five age children who have follow up in five public hospitals of Addis Ababa.
2. To identify the risk factors of malnutrition among HIV infected under-five age children who have follow up in the five public hospitals.
3. To determine the effect of ART on nutritional status among the under five age HIV infected children.
4. To compare the magnitude of malnutrition among HIV infected under-five age children in the five hospitals.

5. Methods and Subjects

5.1. Study Design

This study was done using an institutional based cross sectional study design .

5.2. Study Period

The study was conducted from January 2013 to January 2014 using a cross-sectional study design among eligible HIV infected under-five age children who were seen during the follow up in the five public hospitals of Addis Ababa.

5.3. Study Area

This study was conducted at Tikur Anbessa Specialized Hospital, Yekatit Twelve Hospital, St Paul Hospital, Zewditu Memorial Hospital and ALERT Hospital in Addis Ababa, Ethiopia. These five public hospitals were selected for the study because there were a reasonable number of under-five age HIV infected children who were having follow up there. Tikur Anbessa Specialized Hospital, St Paul Hospital and ALERT hospitals are referral and teaching hospitals of the country and according to the current health tier system of the country each hospital is expected to serve 3.5 to 5 million people.

Yekatit Twelve Hospital and Zewditu Memorial Hospital are General Hospitals in Addis Ababa where each hospital is expected to serve 1-1.5 million people.

The hospitals have a follow up clinic and in patient service for HIV infected children where a team of pediatricians or doctors and nurses are involved in caring for the patients.

The number of HIV infected under-five age children who were having follow up in each hospital at the time of the data collection was as follows; 92 in Tikur Anbessa Specialized Hospital, 70 in Yekatite Twelve Hospital, 67 in Zewditu Memorial Hospital, 26 in St Paul Hospital and 152 in ALERT hospital .At the time of the data collection, diagnosis of HIV infection on a child was being made using the national HIV diagnosis algorism. HIV infection was being diagnosed using rapid HIV antibody test for those age 18 months and above. In children age less than 18 months, PCR (Polymerase Chain Reaction) for HIV DNA (Deoxyribo Nucleic Acid) test was being used

to diagnose HIV infection. Similarly ART initiation for an HIV infected child in the hospitals was based on the national guide line. According to the Ethiopian national guideline for HIV care and treatment which was in use at that time, ART initiation depends on clinical and immunologic criteria. Clinical criteria to start ART include World Health Organization (WHO) pediatrics HIV/AIDS disease stage 3 and 4 irrespective of CD4 count. ART was being initiated for all infants less than 12 month of age with confirmed HIV infection. For those HIV infected children with WHO stage 1 and 2, ART was initiated when their CD4 value was at or below the thresh-hold for their age [51].

5.4. Population

Source population

All HIV infected under-five age children who were under follow up and treatment at Tikur Anbessa Specialized Hospital, Yekatit Twelve Hospital, Saint Paul Hospital, Zewditu Memorial Hospital and ALERT Hospital were the source population of this study.

Study population

Sampled HIV infected under-five age children who were under follow up and treatment at Tikur Anbessa Specialized Hospital, Yekatite Twelve Hospital, St Paul Hospital, ALERT Hospital and Zewditu Memorial Hospital were the study population.

Inclusion and exclusion criteria

Inclusion criteria- HIV infected under-five age children who were having follow up and treatment in the five public hospitals in Addis Ababa at the time of the data collection.

Exclusion criteria- sampled HIV infected under-five age children whose parents or care takers refused to give consent were excluded from the study.

5.5. Sample Size

At the time of the data collection there were a total of 407 HIV infected under-five age children who were under follow up and treatment in the five public hospitals in Addis Ababa. Since the population proportion of HIV infected under-five age children in the hospitals who were malnourished at that time were unknown, we used a prevalence of 50% (0.5) to get the maximum

value of the sample size for the study. Here, since the number of HIV infected under-five age children who were under follow up and treatment in the above mentioned five public hospitals in Addis Ababa was less than 10,000 in number, a finite population correction formula was used to calculate the sample size. A 95% confidence interval and 0.04 margin of error were also used to calculate the sample size.

Taking the above assumptions in to consideration, the following formula was used to calculate the sample size;

$$n = \frac{Nz^2pq}{d^2(N-1)+z^2pq} = 243$$

Where= Z=1.96 a standard score at α=0.05

p =0.5 assumed prevalence of malnutrition

d=0.04 the margin of error

N=407 total number of under-five age HIV infected children who were under follow up and treatment in the five public hospitals in Addis Ababa.

q=1-p

Assuming a 5% non response/refusal among the respondents, we had a sample size of;

243x0.05 + 243=255

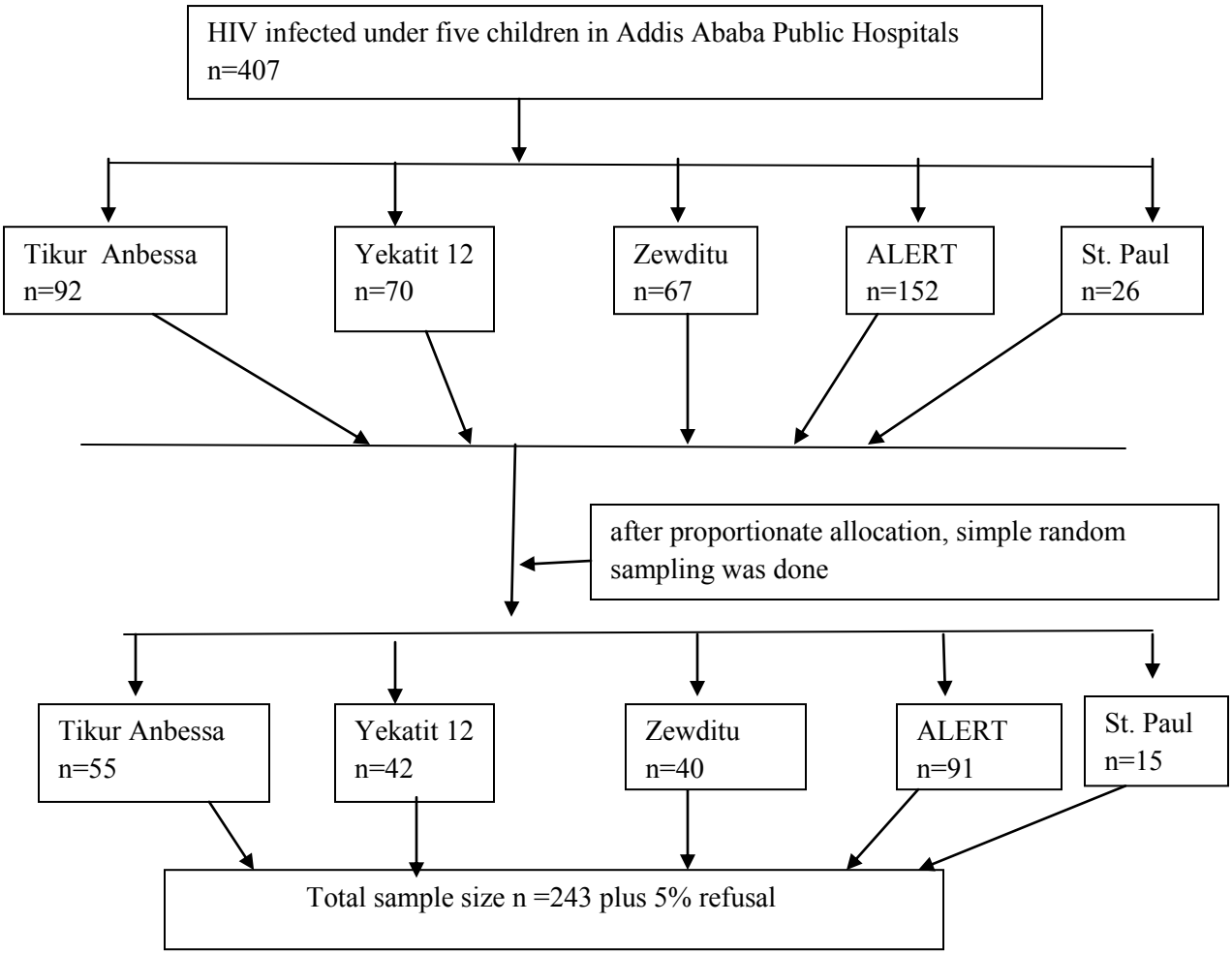
5.6. Sampling Procedure

To get the calculated number of HIV infected under-five age children who were included in the study from each of the five public hospitals in Addis Ababa, proportionate allocation sampling method was employed. Accordingly, the number of HIV infected under-five age children who were included in the study were; 55 from Tikur Anbessa, 42 from Yekatite Twelve, 40 from Zewditu Memorial, 91 from ALERT and 15 from Saint Paul Hospitals. This made up the 243 under-five HIV infected children who were included in the study. A 5% non response/refusal to participate in the study was assumed and over all 255 children were recruited for the study.

In each hospital there was a computer registered list of the HIV infected children's name and age who were getting the follow up care there. From this registration list in each hospital, the name

of those children who were under-five age was carefully selected and was listed on a separate paper by giving a serial number for each child. This numbered list of under-five age HIV infected children in each hospital was used as a sampling frame and a simple random sampling method was used to recruit the HIV infected under-five children who were included in the study. For this purpose, for each hospital a separate computer generated random number was used. Once the HIV infected under five age child who was to be included in the study was decided based on the above technique, he/she and his/her parent or care taker were contacted for the data collection when they appear in the hospital for the regular follow up.

Schematic Presentation of Sampling Procedure



variables

dependent variable: child nutritional status (stunting, wasting and under weight)

Independent variable: Age and sex of the child, preceding birth interval, maternal age, maternal educational attainment, income, orphanhood, ART treatment status, cotrimoxazole prophylactic treatment status, history of hospital admission, adherence status to HAART, family size, recurrent oral lesion, drug side effect, persistent diarrhea, presence of other co morbidity and age at HIV diagnosis.

5.7. Data Collection Procedures

A structured questionnaire was developed and used to collect data. Previous study has shown that socio-demographic, anthropometric and clinical data are good predictors of nutritional status of HIV infected children [52]. Socio-demographic, anthropometric and clinical data were collected after written and verbal consent was obtained from parents or guardians of the children by interviewing. The respondent were the care takers or the parents of the children who were attending the children during the follow up visit in the hospitals.

Pretesting of the questionnaire was done in another hospital. After pre-test, some modification of the questioner was made for unclear and difficult question. The part of questionnaire that included the socio demographic characteristics of the child (family) was translated and back translated from English language to Amharic (the local language). The original English language was retained for the part of the questionnaire that included anthropometric and clinical data of the child since this data was collected by doing anthropometric measurement of the child and by taking recorded data from the patient follow up chart.

To keep the quality of the data collected, for each hospital two nurses who were graduated with Bachelor of Nursing Degree and who had at least three years of work experience on care and treatment of HIV infected children were trained as a data collectors for one day. The training was about how to conduct interviewing, questionnaire content and on how to do anthropometric measurements. The training involved demonstration and lecturing. There was one supervisor who was qualified in Bachelor Degree of Public Health and who was already trained on care and treatment of HIV infected children. In addition, data collection guideline was prepared and was used during the data collection procedure.

Relevant information about socio-demographic characteristics were collected using structured questionnaire by interviewing the parent or guardian of the child who was attending the child during the follow up. Socio-demographic information collected included age and sex of the child, preceding birth interval, family size, educational level and status of the mother, orphanhood, marital status of the mother, frequency of feeding in the past twenty four hour period, age of the mother, monthly income of the family, and occupation of the mother.

In each hospital, anthropometric measurements were performed by the trained nurses when the child came to the hospital for his/her regular follow up. This included weight and height of the child. The weight of the children was measured using weighing scale (seca gmbh & co. Germany) which was calibrated twice daily. It was recorded to the nearest 0.1kg. Height of the child was also measured by these two trained nurses. For those less than two years of age, length measurement was conducted using a length measuring board in a recumbent position on a hard and flat surface. For those who were two years old and above, height was measured on a standing position. Height (length) of the child was recorded to the nearest 0.1cm. Additionally, age, weight and height of the child that was taken at the time the child started follow up in the hospital and age, weight and height of the child that was recorded by the time ART was initiated for the child (if child was on ART) was collected from the patient follow-up chart. Presence or absence of bilateral pitting pedal edema currently on the child was also assessed.

Clinical data of the child which were collected include the following; recurrent oral lesion, age at HIV diagnosis, WHO HIV/AIDS disease stage, adherence status to HAART, ARV drug side effect, CD4 percentage, cotrimoxazol prophylactic therapy, previous history of hospital admission, persistent diarrhea, presence of other co-morbid illness and ARV therapy status were gathered from the patient follow up chart which was found in the clinic. These patient clinical data were normally regularly updated at each patient visit and recorded on the patient follow up chart.

5.8. Operational Definitions

HIV Infection- For those less than 18 months of age, a single HIV virologic test of DNA PCR positive test result was taken as HIV infection while for those age 18 months and above HIV serologic (rapid HIV antibody) test positive result was taken as HIV infection.

Under-five child- a child whose age was less than five years old.

A child was considered **orphan** if he/she has lost both of his/her parents.

A child's **frequency of feeding** was assessed based on the number of times the child fed over the previous 24 hour period.

The information about the child's status of WHO clinical HIV/AIDS disease stage, CD4 percentage, ARV therapy, and cotrimoxazol prophylactic therapy was the recent status at the time of data collection since such information was routinely updated on every clinic visit.

Persistent diarrhea- diarrhea that lasted for more than two weeks in the preceding 6 months.

ARV toxicity-moderate or severe or life threatening toxicity that dictated substitution or discontinuation of the ARV drugs in the past 6months and it was collected from patient follow up chart [51].

Adherence to ARV drugs- the recent adherence status of the child to the ART which is recorded as poor, fair and good based on left over pill count. Adherence is poor when the child takes less than 85% of the dose, fair when he/she takes 85-94% of the dose and good when he/she takes 95% and above of the dose [51].

Other co-morbid illness- chronic illness with settled diagnosis of the disease other than HIV infection. This included tuberculosis, renal, malignancies and other chronic illnesses.

5.9. Data Analysis

The data was entered in to a computer using EPI Info version 3.5.1 and then cleaned and checked for its completeness. It was entered to a computer twice to check for consistency. Then it was exported to and analyzed using SPSS version 20.0 for windows and ENA for SMART 2011 software (WHO child growth standards 2006). The following anthropometric indicators were used to assess the magnitude of malnutrition in the HIV infected children; Weight-for-age Z-score (WAZ), weight-for-height Z-score (WHZ), and height-for-age Z-score (HAZ) were calculated using ENA for SMART 2011 software. The 2006 WHO reference standard was used to define malnutrition. Malnutrition was diagnosed when the anthropometric Z-score of the child falls -2SD below the median of the reference population. Children whose anthropometric value falls -3SD below the reference population median were considered to have severe malnutrition.

Using the explanatory and response variables, univariate, bivariate and multivariate analyses of the data were done. Univariate analysis was used to calculate simple frequencies and proportions. A bivariate analysis was done to see the relationship between the independent variables and each type of child nutritional indicator i.e. wasting, stunting and underweight using odds ratio with its 95% CI. In the multivariate analysis, logistic regression was used. The logistic model considered the relationship between malnutrition and a set of independent variables. Variables included in multivariate analysis were those variables which have significant statistical association in the bivariate analysis (p-value less than 0.05). Here the response variable constituted binary outcomes taking a value of 1 if a child was malnourished and a value of 0 if child was not malnourished. A p-value less than 0.05 was regarded as statistical significant.

5.10. Data Quality Management

To ensure the quality of the data, trained nurses were used as a data collector. The questionnaire was pretested in other hospital which was not included in the study. The principal investigator and the supervisor monitored the data collection process by checking completeness of the required type of data and corrected faults on the spot. The investigator coded and entered questionnaires in to EPI info statistical package twice. After data entry was completed, data

cleaning was performed by running frequencies of each variable to check for accuracy, outliers and consistency.

5.11. Ethical Considerations

After presenting the research proposal for approval, ethical approval was obtained from the following institutional bodies; Research Ethics Committee of Addis Ababa University (School of Public Health), the AHRI/ALERT Ethics Review Committee (AAERC), Addis Ababa Regional Health Bureau Research Ethics Committee, St Paul Hospital Millennium Medical College Institutional Review Board and from the Research Ethics Committee of the Department of Pediatrics and Child Health of Addis Ababa University. Explanation was made to the parent or care taker of the child about the purpose of the research. Verbal and written consent from the respondents was obtained before conducting the interview. They were informed that confidentiality will be maintained strictly.

6. Results

6.1. Socio-demographic characteristics

During the data collection, there were two care takers from Tikur Anbessa Hospital, one from Yekatit Twelve Hospital and one from Zewditu Memorial Hospital who refused to participate in the study giving a response rate of 98.4%. In each hospital, the recruited cases and/ or care takers for the study were contacted for the data collection until the required sample size was obtained (243 under five children). Then data collection was terminated without contacting the remaining recruited 8 cases due to time constraints. Hence a total of 243 HIV infected under-five children were included in the study. Out of these, 129 (53.1%) of them were males. The mean and the median age of the children were 44.4(±15.3SD) and 49(IQR=27) months respectively while the minimum and maximum were 9 and 59 months respectively.

The mothers of 203 (83.5%) children were alive at the time of the survey while the rest 40 (16.5%) children had lost their mothers. The age of the mothers who were alive at the time of the survey ranged from 19 to 49 years. The majority of the mothers who were alive were either house wives (44.0%) or daily laborer (18.5%) by occupation. Of the alive mothers, 140(57.6%) of them had attended a formal education which ranged from elementary school level to university level while only 9(6.4%) of them had attended school above grade 12. One hundred twenty two (50.2%) of the alive mothers of the children were married while the remaining alive mothers were either single (16.5%), divorced (11.5%), separated (7%) or widowed (9.5%). Twenty two(9.1%) of the surveyed children were orphan (lost both of their parents).

Out of the 243 children studied, it was possible to get information about monthly family income for the 232 (95.5%) of them. The median of family income was 800.00 birr per month. The family income ranged from 0.00 birr (4 children) to 5000.00 birr (1 child) per month (1 USD=18.89 birr at the time of the data collection). Information about family size of child's household was collected for 236 (97.1%) surveyed children and family size ranged from 2 to 9 in number. Feeding frequency of the HIV infected-under five children in the past 24 hours preceding the day of the data collection ranged from 1 to 10 times per day with the median being 4 times per day. As shown in table one, only 28(11.5%) of the care givers of the surveyed children reported that the family of the child was able to get food that was enough in kind and

amount for the family over the past 12 months preceding the date of the survey. More than half (53.1%) of the respondents said the family of the HIV infected child was not getting always enough food over the past 12 months before the survey. Eighty nine(36.6%) children were able to get supplemental food from institutions.

Table 1: Socio-demographic characteristics of HIV infected under five children who had follow up in five public hospitals in Addis Ababa, Sep.2013 (N=243).

Socio demographic characteristics		number	Percent*
Age of the child in months (N=243)			
	0-24	40	16.4
	25-35	29	12.0
	36-59	174	71.6
Sex of the child (N=243)			
	Male	129	53.1
	Female	114	46.9
Child with alive mother (N=243)			
	No	40	16.5
	Yes	203	83.5
Maternal educational level (N=140)			
	Grade 1-8	74	52.9
	Grade 9-12	57	40.7
	Above grade 12	9	6.4

Table 1 continued…

Socio demographic characteristics		number	percent
Child's family income per month in birr (N=232)	<850	125	53.9
	851-1500	59	25.4
	>1500	48	20.7
Feeding frequency of the child in the past 24 hours (N=243)	1-3	99	40.7
	4-6	99	40.7
	>6	45	18.5
Description of food eaten in the child's home in the past 12 months (N=243)	Enough food in kind and amount	28	11.5
	Enough food but not the kind the family wants	56	23.0
	Sometimes no enough food for the family	29	11.9
	Always no enough food for the family	130	53.5

*percentages values may not add up to 100% because of rounding off figures.

6.2. Clinical characteristics

Out of the total 243 children studied, 202 (83.1%) were on ART at the time of the survey. The median age of ART initiation for these children was 18(IQR=21.3) months. The median age to be diagnosed for HIV infection and the median age of starting follow up in the hospitals were the same (16 months).

At the time of the survey, two children (0.8%) had bilateral pitting edema of the legs. With in the preceding six months from the date of the survey, 41(16.9%) children had diarrhea which lasted for more than two weeks, 52 (21.4%) children had history of hospital admission due to illness and 23(9.5%) children had episode of oral lesion.

About half of the children (51%) had either WHO HIV/AIDS stage 1 or 2 defining illness and the remaining were having either stage 3 or 4 illness at one time during the follow up. Two hundred thirty two (95.5%) children were taking cotrimoxazol prophylactic therapy at the time of the survey. CD4 percentage value that was determined within six months preceding the date of the data collection was obtained for 239 (98.4%) children. The value ranged from 4% to 54% while the median value was 24% (IQR=12%).

As it is depicted on table two among the 202 children who were taking ART at the time of the survey, 193(95.5%) children were reported to have good ART adherence while the remaining had fair/poor (4.5%) adherence status to ART. Of those children who were taking ART, only 12 (5.9%) had documented ART side effect within 6 months before the survey. Eleven (4.5%) children had co-morbid illness in addition to the HIV infection at the time of the survey and out of them 10 children had tuberculosis.

Table 2: clinical characteristics of HIV infected under five children who had follow up in the five public hospitals in Addis Ababa, Sep. 2013 (N=243).

Clinical characteristics		number	Percent**
History of hospital admission in the past 6months (N=243)			
	No	191	78.6
	Yes	52	21.4
WHO clinical stage of HIV/AIDS (N=243)			
	I	30	12.3
	II	94	38.7
	III	98	40.3
	IV	21	8.6
Is child taking cotrimoxazol (N=243)			
	No	11	4.5
	Yes	232	95.5
CD4 percentage Value (N=239)*			
	<25	150	62.8
	≥25	89	37.2
On ART (N=243)	No	41	16.9
	Yes	202	83.1
ART adherence status (N=202)			
	Poor/fair	9	4.5
	Good	193	95.5

*CD4 percentage value for four children was missing.

**percentage values may not add up to 100% because of rounding off figures.

6.3. Child nutritional status

Using the 2006 WHO growth standard curve, underweight, stunting and wasting statuses were determined for the under five HIV infected children at time of entry in to the follow up, at the time of ART initiation for them and at the time of conducting this survey. Two boys were excluded from the assessment of underweight status at the time of the data collection because they were having edema at that time.

Table 3 and figures 1-3 illustrate the magnitude of malnutrition among the children. Out of the 241 HIV infected under five children who were eligible for assessment of being underweight at the time of the survey, 37 (15.4%; 95% CI=10.8-19.9) of them were found to be underweight. Among the underweight children, 54% were boys. Ten children (4.1%; 95% CI= 1.6- 6.7) were severely underweight at the time of the survey. Stunting affected 62.1% (95% CI=56.0-68.2) of the children while only 2.5% (95% CI= 0.5- 4.4) of the children were having Global Acute Malnutrition (GAM) at the time of the survey. Two (0.8%) children (both male) were found to have Severe Acute Malnutrition (SAM) and they were having bilateral pitting pedal edema.

Documented anthropometric measurement value at the time the children started follow up in the hospitals was obtained for the 243 sampled HIV infected under five children. Using this anthropometric value, prevalence of underweight among the children at that time was 43.2% (95% CI=37.0-49.4) while 62.6% (95% CI=56.5-68.6) of the children were stunted. More than half (57.1%) of the underweight children were boys. GAM was detected in 17.7% (95% CI=12.9-22.5) of the children. About half of the children who had GAM were also having SAM and more than half of the children who were stunted were severely stunted.

Among the 202 children who were on ART at the time of the survey, the prevalence of underweight, stunting and wasting by the time ART was initiated for them were 47.5% (95% CI=40.6-54.4), 71.3% (95% CI=65.0-77.5) and 16.3% (95% CI=11.2-21.4) respectively. Among the boys 60.5% of them were stunted while 57.9% of the girls were stunted. At that time 24.8% (95% CI=18.8-30.7) of children were severely underweight while 44.6% (95% CI=37.7-51.4) of the children were severely stunted. SAM was diagnosed in 7.9% (95% CI=4.2-11.6) of the children. Prevalence of underweight, stunting and wasting was slightly higher among boys than among girls.

Table 3: prevalence of the different types of malnutrition among the under five HIV infected children assessed using the anthropometries taken at three occasions in the five public hospitals, Addis Ababa, Sep 2013. (N=243)

Time of anthropometric measurement	Types of malnutrition	Total number of cases	Prevalence of malnutrition	Mean ±SD of Z-score
At the time this study was conducted	stunting	243	62.1	-2.46±1.17
	Severe stunting	243	35.0	
	Under weight	241*	15.4	-0.98±1.12
	Severe under weight	241	4.1	
	GAM	243	2.5	0.67±1.34
	SAM	243	0.8	
At the time ART was initiated for the children	stunting	202**	71.3	-2.97±1.68
	Severe stunting	202	44.6	
	Under weight	202	47.5	-1.83±1.62
	Severe under weight	202	24.8	
	GAM	202	16.3	-0.14±2.05
	SAM	202	7.9	
At the time the children started follow up in the hospitals	stunting	243	62.6	-2.60±1.79
	Severe stunting	243	39.5	
	Under weight	243	43.2	-1.62±1.66
	Severe under weight	243	20.2	
	GAM	243	17.7	-0.10±1.97
	SAM	243	7.0	

*two children were excluded from the assessment of being underweight because they were having edema at the time of the data collection.

**only 202 of the sampled children were taking ART at the time of the data collection.

Figure 1(a, b, c): Graphical representation of weight for height (1a), weight for age (1b) and height for age (1c) z-scores of HIV infected under five children in the five public hospitals of Addis Ababa at the time of the survey relative to the 2006 WHO growth standard curve, Addis Ababa Sep 2013.

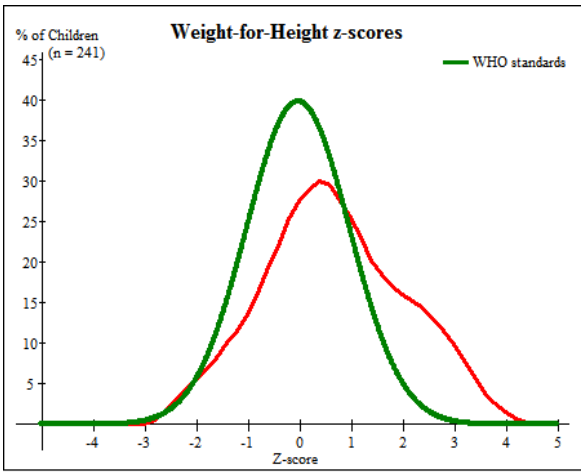


Figure 1a

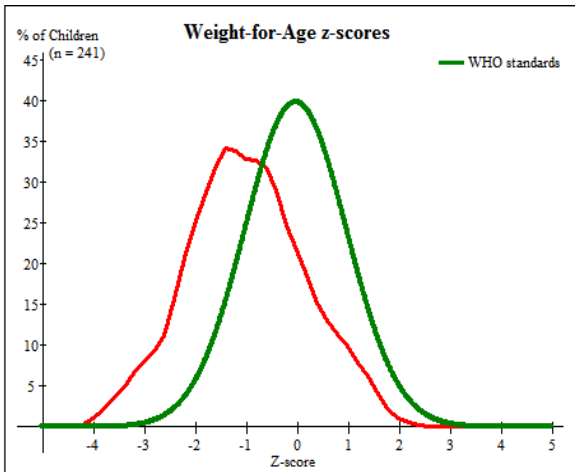


Figure 1b

Figure 1c

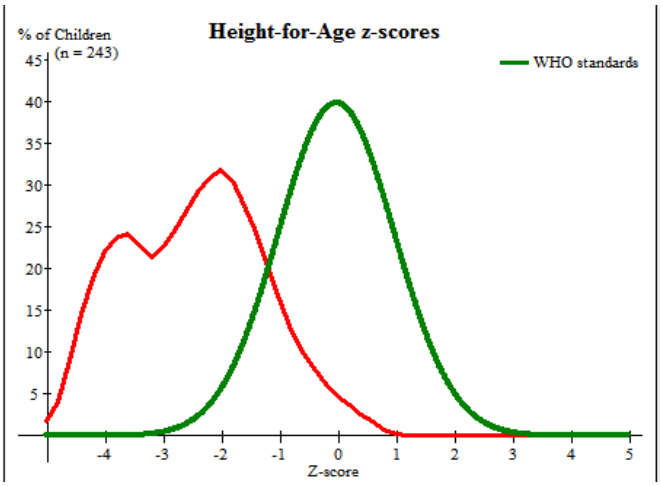


Figure 2(a, b, c): Graphical representation of weight for height (2a), weight for age (2b) and height for age (2c) Z-scores of HIV infected under five children in the five public hospitals of Addis Ababa at entry to HIV care in the hospitals in comparison to the 2006 WHO growth standard curve, Sep 2013.

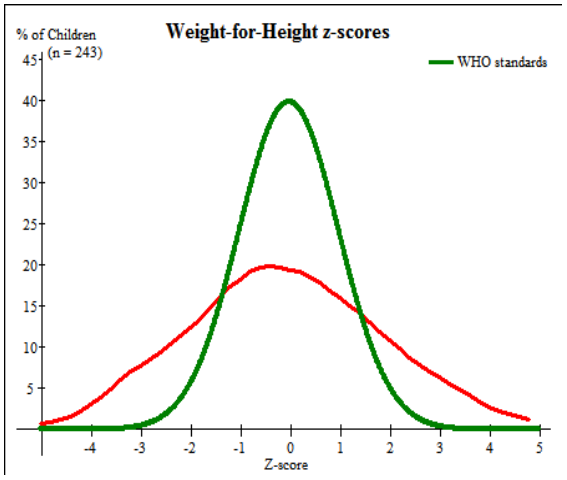


Figure 2a

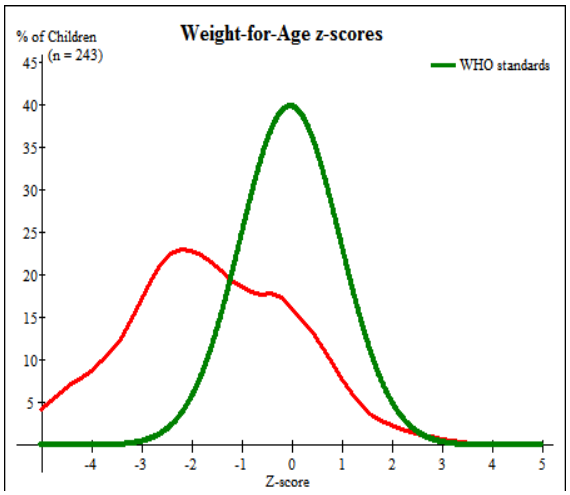


Figure 2b

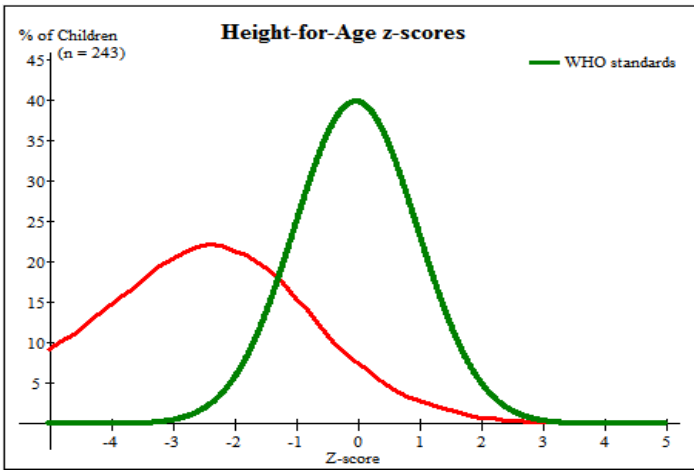


Figure 2c

Figure 3(a, b, c): graphic representation of weight for height (3a), weight for age (3b) and height for age (3c) z-scores of the HIV infected under five children in the five public hospitals in Addis Ababa by the time ART was initiated for them in comparison to the 2006 WHO growth standard curve, Sep 2013.

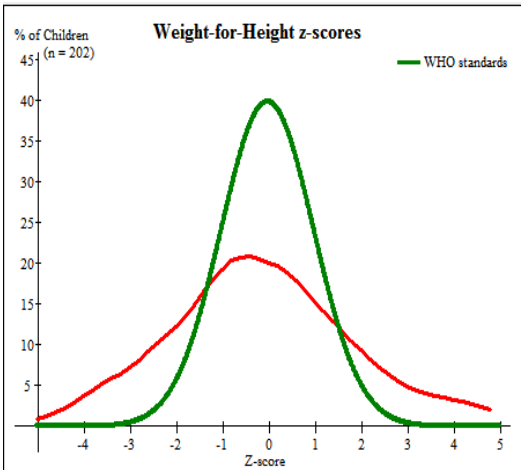


Figure-3a

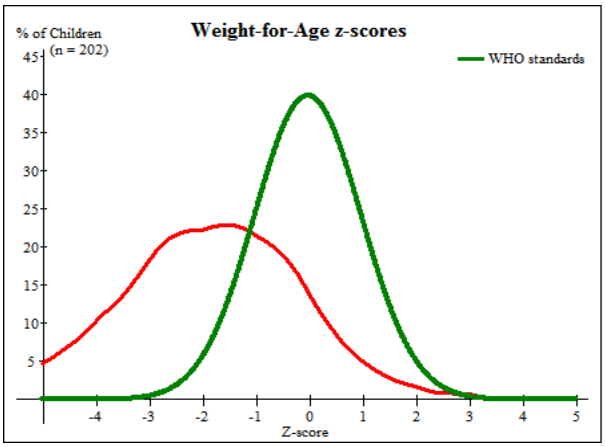


Figure 3b

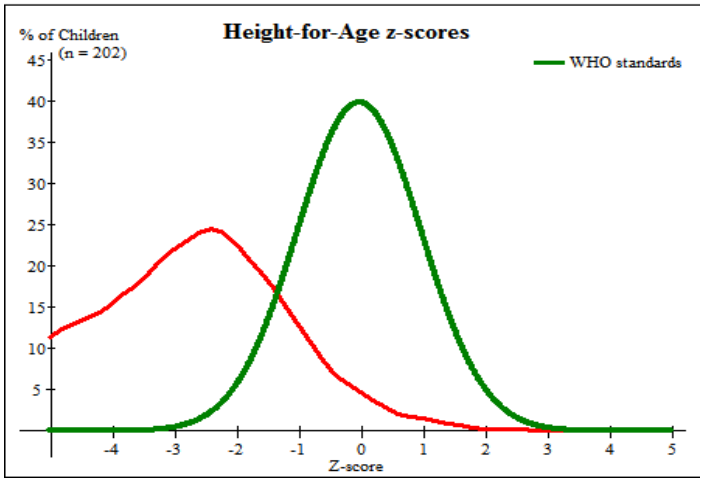


Figure 3c

6.4. Factors associated with child nutritional status

6.4.1. Factors associated with Stunting

This study examined the relationship between the socio demographic characteristics and the presence of stunting. The likely hood for the presence of stunting was lesser among the HIV infected children whose feeding frequency in past 24 hours preceding the date of survey was four to six times (OR=0.42; 95% CI:0.23,0.77) or more than six times a day (OR=0.26; 95% CI; 0.17,0.54), literate mother (OR=0.37; 95% CI: 0.19,0.72), and mother attended school up to grade nine to twelve (OR=0.45; 95% CI:0.22,0.98) or above grade twelve(OR=0.16, 95% CI:0.03,0.80) than their referents. Similarly the odds of stunting by the socio demographic characteristics was higher to statistically significant level among the children whose family was not getting always enough food as compared to those children whose family had enough food in kind and amount over the past 12 months preceding the survey (OR=4.73; 95% CI: 2.01,11.15). However, as shown in table four there was not a significance difference in the presence of stunting by difference in child's age and sex, maternal death, maternal age, family size and receiving supplemental nutrition from institutions.

The odds of the presence of severe stunting among the children by maternal age was lesser to statistically significant level in mothers of age 36 to 49 years than those of mothers age 19 to 24 years old (OR= 0.22; 95% CI:0.05,0.89). However, its odds of presence was higher to statistically significant level among the children whose family didn't have enough food to eat over the past 12 months preceding the survey than in those whose family was getting enough food in kind and amount (OR=3.09; 95% CI: 1.18,8.13).

Table 4: Selected socio demographic characteristics by stunting of HIV infected under five children who had follow up in the five public hospitals in Addis Ababa, Sep. 2013.

Socio demographic characteristics	Stunting		Crude OR(95% CI)
	No	Yes	
	Number(%)	Number(%)	
Sex of the child (n=243)			
Male	46(35.7)	83(64.3)	1.00
Female	46(40.4)	68(59.6)	0.82(0.49,1.38)
Age of the child (n=243)			
0-24 month	18(45.0)	22(55.0)	1.00
25-35 month	11(37.9)	18(62.1)	1.34(0.51,3.55)
36-59 month	63(36.2)	111(63.8)	1.44(0.72,2.89)
Is mother of the child alive (n=243)			
Yes	79(38.9)	(124(61.1)	0.76(0.37,1.55)
No	13(32.5)	27(67.5)	1.00
Maternal age (n=203)			
19-24 years	6(33.3)	12(66.7)	1.00
25-35 years	57(37.5)	95(62.5)	0.83(0.30,2.34)
36-49 years	16(48.5)	17(51.5)	0.53(0.16,1.75)
Child's family size (n=236)			
1-3 persons	34(31.2)	75(68.8)	1.00
>3 persons	55(43.5)	72(56.7)	0.59(0.35,1.01)
Child gets nutritional supplement from institutions (n=243)			
Yes	36(40.4)	53(59.6)	0.84(0.49,1.44)
No	56(36.4)	98(3.6)	1.00

Among the clinical characteristics, comparison in the presence of stunting was made by the level of the CD4 percentage value of the children. The chance of stunting was lower to a statistically significant level among the children who had CD4 percentage value above or equal to 25% (OR=0.35; 95% CI:0.20,0.60) as compared to CD4 percentage value less than 25%. However, as shown in table five the odds of stunting was not different among children who had difference in receiving cotrimoxazol prophylactic treatment or not, WHO clinical HIV/AIDS stage, receiving ART treatment or not, presence of ART toxicity or not, history of hospital admission or not and presence of diarrheal illness or not.

The chance of being diagnosed to have severe stunting was also lower to a statistically significant level among the children who had CD4 percentage value above or equal to 25% (OR=0.31; 95% CI:0.17,0.58).

Table 5: Stunting of HIV infected under five children who had follow up in the five public hospitals in Addis Ababa by selected clinical characteristics, Addis Ababa, Sep. 2013.

Clinical characteristics	Stunting		Crude OR(95% CI)
	No	Yes	
	Number(%)	Number(%)	
Taking cotrimoxazol (n=243)			
Yes	87(37.5)	145(62.5)	1.39(0.41,4.69)
No	5(45.5)	6(54.5)	1.00
WHO clinical HIV/AIDS stage (n=243)			
I	13(43.3)	17(56.7)	1.00
II	32(34.0)	62(66.0)	1.48(0.64,3.43)
III	41(41.8)	57(58.2)	1.06(0.47,2.43)
IV	6(28.6)	15(71.4)	1.91(0.58,6.29)
CD4 percentage value (n=239)			
<25	42(28.0)	108(72.0)	1.00
≥25	47(52.8)	42(47.2)	0.35(0.20,0.60)
On ART (n=243)			
Yes	75(37.1)	127(62.9)	1.20(0.61,2.38)
No	17(41.5)	24(58.5)	1.00
Presence of ART toxicity (n=202)			
Yes	7(58.3)	5(3.9)	0.40(0.12,1.30)
No	68(35.8)	122(64.2)	1.00
History of hospital admission (n=243)			
Yes	20(38.5)	32(61.5)	0.97(0.52,1.82)
No	72(37.7)	119(62.3)	1.00
Presence of diarrhea (n=243)			
Yes	15(36.6)	26(63.4)	1.07(0.53.2.14)
No	77(38.1)	125(61.9)	1.00

6.4.2. Factors associated with underweight

After examining the relationship between socio demographic backgrounds and presence of child underweight, the likelihood of being underweight was lesser among children whose maternal age was between 36 to 49 years (OR=0.06; 95% CI:0.01,0.58) than their referents. There was not a statistically significant difference in becoming underweight by difference in sex and age of the child, orphanhood status, family size, getting nutritional supplement from institutions or not, mother alive or not and mother literate or not as shown in table six below.

Table 6: underweight among the HIV infected under five children who had follow up in the five public hospitals in Addis Ababa by selected socio demographic characteristics, Sep. 2013.

Socio demographic characteristics	Underweight		Crude OR(95% CI)
	No	Yes	
	Number(%)	Number(%)	
Sex of the child (n=241)			
Female	94(82.5)	20(17.5%)	1.38(0.68,2.78)
Male	110(86.6)	17(13.4)	1.00
Age of the child (n=241)			
0-24 month	33(82.5)	7(17.5)	1.00
25-35 month	21(75.0)	7(25.0)	1.57(0.48,5.12)
36-59 month	150(86.7)	23(13.3)	0.72(0.29,1.83)
Is mother alive (n=241)			
Yes	169(84.1)	32(15.9)	1.33(0.48,3.64)
No	35(87.5)	5(12.5)	1.00
Is mother literate (n=201)			
Yes	122(87.1)	18(12.9)	0.50(0.23,1.08)
No	47(77.0)	14(23.0)	1.00
Family size (n=234)			
>3 persons	111(88.8)	14(11.2)	1.00
1-3 persons	87(79.8)	22(20.2)	0.50(0.24,1.03)
Is child orphan (n=241)			
Yes	19(86.4)	3(13.6)	0.86(0.24,3.06)
No	185(84.5)	34(15.5)	1.00
Is child getting nutritional supplement from institutions (n=241)			
Yes	78(88.6)	10(11.4)	0.60(0.28,1.30)
No	126(82.4)	27(17.6)	1.00

The likelihood of being underweight was lesser among the children whose CD4 percentage value was above or equal to 25% compared to the children whose CD4 percentage value was less than 25% (OR=0.48; 95% CI: 0.29,0.99). But the odds of being underweight among the children who had co-morbid illness other than HIV/AIDS disease was higher to statistically significant level than those who didn't have co-morbid illness (OR=5.16; 95% CI: 1.49,17.89). There was not a significant difference of being underweight in having diarrhea or not, and having history of hospital admission or not as illustrated on table seven below.

Table 7: underweight among the HIV infected under five children who had follow up in the five public hospitals in Addis Ababa by selected clinical characteristics, Sep. 2013.

Clinical characteristics	**Underweight**		**Crude OR(95% CI)**
	No	**Yes**	
	Number(%)	**Number(%)**	
CD4 percentage value (n=237)			
<25	120(81.1)	28(18.9)	1.00
≥25	80(89.9)	9(10.1)	0.48(0.29,0.99)
Presence of oral lesion (n=241)			
Yes	18(81.8)	4(18.2)	1.25(0.40,3.94)
No	186(84.9)	33(15.1)	1.00
History of hospital admission (n=241)			
Yes	41(82.0)	9(18.0)	1.28(0.56,2.92)
No	163(85.3)	28(14.7)	1.00
On ART (n=241)			
Yes	167(83.5)	33(16.5)	1.83(0.61,5.48)
No	37(90.2)	4(9.8)	1.00
Presence of co morbid illness (n=241)			
Yes	6(54.5)	5(45.5)	5.16(1.49,17.89)
No	198(86.1)	32(13.9)	1.00

6.4.3. Factors associated with wasting (GAM)

The chance of getting GAM was not statistically significantly different among the children with CD4 percentage value above or equal to 25% than the children with CD4 percentage value less than 25% (OR=0.33; 95% CI: 0.04,2.88). But the chance of getting GAM by girls was significantly lower than the boys (OR=0.95; 95% CI: 0.92,0.99). However as shown on table eight there was no a statistically significant association between wasting among the children and child getting nutritional supplement from institutions or not, having diarrhea or not, taking ART or not, taking cotrimoxazol prophylactic therapy or not, and having history of hospital admission or not.

Table 8: wasting of HIV infected under five children who had follow up in the five public hospitals in Addis Ababa by selected socio demographic and clinical characteristics, Sep. 2013.

Characteristics	Wasting		p-value
	No	Yes	
	Number(%)	Number(%)	
Is child getting nutritional supplement from institutions (n=243)			
Yes	86(96.6)	3(3.4)	0.672
No	151(98.1)	3(1.9)	
Is mother literate (n=203)			
Yes	138(98.6)	2(1.4)	0.076
No	59(93.7)	4(6.3)	
History of hospital admission (n=243)			
Yes	49(94.2)	3(5.8)	0.114
No	188(98.4)	3(1.6)	
Presence of diarrhea (n=243)			
Yes	38(92.7)	3(7.3)	0.062
No	199(98.5)	3(1.5)	
On ART (n=243)			
Yes	197(97.5)	5(2.5)	1.000
No	40(97.6)	1(2.4)	

6.5. Change in nutritional status after ART

Two hundred two children were taking ART at the time of the data collection. A paired t-test was done to see the change in nutritional status by comparing the mean Z-scores of the children before and after the ART. As shown on table nine comparing the mean difference of WAZ scores, HAZ score, and WHZ scores of the children at the start of ART and at the time of the data collection using paired t-test found out the mean difference to be statistically significant.

Table 9: Mean difference of Z-scores of WAZ, HAZ, and WHZ of the HIV infected under five children in the five public hospitals in Addis Ababa before and after ART using paired sample t-test, Sep. 2013.

Pairing	**Number**	**Mean difference**	**t**	**df**	**p-value**
WAZ at start of ART **with** WAZ at time of data collection	200	-0.86	-7.451	199	0.000
HAZ at start of ART **with** HAZ at time of data collection	202	-0.52	-4.835	201	0.000
WHZ at start of ART **with** WHZ at time of data collection	200	-0.79	-5.404	199	0.000

6.6. Comparing child nutritional status among the hospitals

As shown in table ten among the five public hospitals where the children were having the follow up, the largest proportion of children with chronic malnutrition (stunting) was found in ALERT hospital (68.1%) while the smallest proportion of malnutrition (stunting) was found among the children having follow up in St Paul hospital (40.0%). But bivariate analysis of malnutrition (stunting and underweight) with respect to the hospitals using the Chi-Square test didn't reveal statistical association between the two factors.

Table 10: Nutritional status (stunting) of HIV infected under-five age children who had follow up in the five public hospitals of Addis Ababa versus the name of the hospital they were having the follow up, Addis Ababa Ethiopia, Sep. 2013. (N=243)

Hospital	stunting		underweight	
	Yes		Yes	
	number	Percent within the hospital	number	Percent within the hospital
Tikur Anbessa	30	54.5	7	12.7
Yekatit Twelve	26	61.9	4	9.5
ALERT	62	68.1	17	18.9
Zewditu Memorial	27	67.5	8	20.5
St Paul	6	40.0	1	6.7
total	151	62.1	37	15.4
Chi-square value	6.352*		4.168**	
p-value	0.174		0.384	

*Pearson Chi-Square value.

**Likelihood Ratio value

6.7. Factors associated with malnutrition

Variables which showed statistically significant associations with the various forms of nutritional disorders in the bivariate analysis were entered in to a multivariate logistic regression model to see the independent effect of each potential determinant while controlling for possible confounders. As can be seen from table 11, the odds of stunting was lower for those children with CD4 percentage values equal to or above 25% compared to those with values below 25% (AOR=0.35; 95% CI:0.20,0.62). The perceived adequacy (in amount and kind) of food eaten in the child's house in the past 12 months preceding the date of the survey was an independent predictor of stunting. The odds of stunting in children from households with inadequate food eaten throughout the year were about five times higher in comparison to children from households with enough food to be eaten in kind and amount (AOR=4.64; 95% CI: 1.91,11.25).

As shown on table 12, the crude association found between CD4 percentage value and co morbid illness with underweight was refuted while the age of the mother of the child from 36-49 years of age that was found to be predictive in the crude analysis in preventing underweight was retained after adjusting for the variables.

Also the lower chance of being wasted (GAM) among girls found in the crude analysis was also retained while the lower chance of being wasted among children with CD4 percentage value equal to or above 25% was refuted after adjusting for the factors as shown on table 13.

Table 11: comparison of socio economic and clinical factors by stunting among the HIV infected under five children in the five public hospitals in Addis Ababa, Sep. 2013.

Characteristics (n=239)	Crude OR(95% CI)	Adjusted OR(95% CI)*
Description of food eaten in the child's home in the past 12months		
Enough food in kind and amount	1.00	1.00
Enough but not the kind the family wants	1.66(0.66,4.17)	1.70(0.66,4.42)
Sometimes no enough food	1.26(0.44,3.60)	1.22(0.41,3.64)
Always no enough food	4.73(2.01,11.15)	4.64(1.91,11.25)
CD4 percentage value		
<25	1.00	1.00
≥25	0.35(0.20,0.60)	0.35(0.20,0.62)

*Adjusted for CD4 percentage value of the child and description of food eaten in the child's home in the past 12 months preceding the survey.

Table 12: comparison of socio demographic and clinical factors by underweight among the HIV infected under five children in the five public hospitals in Addis Ababa, Sep. 2013.

Characteristics (n=197)	Crude OR(95% CI)	Adjusted OR(95% CI)*
Maternal age in years		
19-24	1.00	1.00
25-35	0.40(0.14,1.17)	0.35(0.12,1.05)
36-49	0.06 (0.01,0.58)	0.06(0.01,0.57)
CD4 percentage value		
<25	1.00	1.00
≥25	0.48(0.29,0.99)	0.53(0.22,1.25)
Presence of co morbid illness		
Yes	1.00	1.00
No	5.16 (1.49,17.89)	3.28(0.69,15.75)

*adjustment for maternal age, presence of co morbid illness and CD4 percentage value of the child.

Table 13: comparison of demographic and clinical factors by wasting (GAM) among the HIV infected under five children in the five public hospitals in Addis Ababa, Sep. 2013.

Characteristics	Crude OR(95% CI)	Adjusted OR(95% CI)*
Sex of the child		
Male	1.00	1.00
Female	0.95(0.92,0.99)	0.00(0.00)
CD4 percentage value		
<25	1.00	1.00
≥25	0.33(0.04,2.88)	0.43(0.05,3.82)

*adjustment for sex of the child and CD4 percentage value of the child.

7. Discussion

7.1. Magnitude of malnutrition

This study tried to assess the nutritional status of HIV infected under five age children who had follow up in the five public hospitals in Addis Ababa and the factors affecting their nutritional status. The magnitude of chronic malnutrition (stunting) among the children was very high. Its prevalence was 62.6% by the time the children started follow up in the hospitals, 71.3% by the time ART was initiated for them and 62.1% by the time this study was done. Whereas the prevalence of underweight and Global Acute Malnutrition among the children were 15.4% and 2.5% respectively. The high magnitude of stunting in the study population is a cause for concern.

The magnitude of stunting among the study group was much higher than the 2011 EDHS prevalence report of stunting (22.0%) among the under five children in Addis Ababa [11]**.** But our finding of the prevalence of stunting was almost similar to the rate of stunting (58%) among children infected with HIV reported from India [25]. Also previous study that was conducted in a hospital setting in Ethiopia reported prevalence of 55.6% stunting among HIV infected children[17].

Possible reasons for the high burden of stunting among the children we studied includes inadequate food intake and recurrent illness due to opportunistic infections and other HIV/AIDS related diseases which were the factors described in other studies [26-28]. The fact that this study was a hospital based study could also explain the high prevalence of malnutrition as compared to the 2011 EDHS report since there is a difference in the setting. In general HIV infected children are at increased risk of developing severe malnutrition than HIV negative malnourished children[36].

The magnitude of stunting among the children at the start of follow up in the hospitals and at the time of conducting this survey was almost similar even though the median age of starting follow up in the hospitals and the median age of the children when this study was conducted were 16 and 49 months respectively. This could imply that the burden of stunting was not changed with the follow up care being provided to the children and needs intervention.

When the graphs of anthropometric Z-scores of the studied children at the time of the survey were compared with the 2006 WHO growth standard curve, the graphs of WAZ and HAZ scores of the children were shifted to the left as compared to the WHO growth curve indicating a higher burden of being underweight and stunting among them. The graph of WHZ score is shifted to the right relative to the 2006 WHO growth standard curve as a result of the higher prevalence of stunting among the children together with a decreased acute weight loss that might be prevented through the clinical care the children were getting.

The prevalence of underweight and Global Acute Malnutrition (wasting) in the children by the time this survey was conducted had decreased significantly as compared to its magnitude at the time of starting follow up in the hospitals and at the time of ART initiation for the children. The Prevalence of underweight among the children we studied (15.4%) was higher than the magnitude of underweight among under five children in Addis Ababa (6.4%) while the magnitude of wasting was comparable between the two groups [11]. However a study conducted in a hospital setting in Ethiopia reported 61.1% under weight and 27.3% wasting among HIV infected children[17]. Similarly the study from India reported higher prevalence of underweight (63%) and wasting (16%) in the HIV infected children [25] indicating that the main nutritional problem among the children we studied was not of acute type.

Magnitude of wasting and underweight among the children we studied decreased significantly after ARV drugs were started for them. The lower prevalence of underweight and wasting in our study as compared to the Indian study could be the result of the effect of ARV drugs which can protect the children from acute infection by elevating their CD4 count (percentage) in addition to the chance of getting early treatment of infections by the health care provider. The low prevalence of wasting after HAART in our study is supported by a other reports where incidence of wasting found to decrease after the introduction of HAART [4]. The higher magnitude of stunting among the children we studied is very important as malnutrition can increase mortality of the children as it was reported in other study [17].

7.2. Factors associated with malnutrition

Among the socio economic variables that were looked for their association with stunting maternal literacy status , maternal educational level, feeding frequency of the child within 24

hours preceding the day of the survey, and type of description of food eaten in the child's house in the past 12 months preceding the survey had significant statistical association with stunting. Studies conducted in other areas also found out that some of these socio economic variables were associated with child malnutrition. In Ghana, child malnutrition was associated with maternal educational status among other factors [29]. Possible explanations for these associations include, maternal education can help to prevent child malnutrition through the awareness the mother could get through education on how to provide adequate nutrition to her child.

A large number of the sampled children were either feeding less than or equal to 3 times per day, or their family's income was less than 850 birr per month (<18.89 USD). Similarly in Dare Salam, feeding frequency in HIV infected children was associated with child malnutrition [37]. Decreased frequency of feeding the child can predispose the child to malnutrition since as the frequency of feeding the child in a day decreases, the amount of calorie the child is getting also decreases.

When the respondents were asked to describe the kind and amount of food eaten in the child's home in the previous 12 months preceding the day of the survey, the type of the response had statistically significant association with stunting and other forms of malnutrition. This could reflect the presence of food insecurity in the family of the HIV infected child. Other studies have also shown HIV infected individuals to have higher risk of having food insecurity than the general population [47] and also HIV infection to predispose people to food insecurity [48].

Among the clinical characteristics considered in this research, CD4 percentage value of the children less than 25% was statistically associated with the presence of stunting. Based on findings of a study conducted in India, CD4 percentage was found to correlate significantly with presence of protein energy malnutrition in HIV infected children [38].The reason could be as CD4 percentage value of the child drops, the child will be at increased risk of developing recurrent infections which then predisposes the child to malnutrition. WHO recommends initiation of ART for children 2-5 years old when their CD4 percentage value declines below 25% for those who doesn't have stage 3 or 4 defining illness [7].

Other clinical characteristics of the child that were considered in this study like presence of diarrhea, oral lesion, ARV side effect, presence of co-morbid illness, taking cotrimoxazol prophylactic therapy did not show statistical associations with malnutrition in the child. But studies conducted in other areas revealed these variables were associated with malnutrition in HIV infected patients [12, 37, 42, 44]. The lack of these associations in our study may be a result of the small sample size the study has.

The unexpected finding in this study was the lack of statistical association between the status of taking ART and the presence of both acute and chronic malnutrition. This could be as a result of the small number of HIV infected under five children who were not taking ART at the time of the data collection. Studies conducted in other areas showed either a significant improvement in the nutritional status of the HIV infected children [45] or they can also be overweight after ART was initiated for them [39]**.** Also in this study, the finding of a statistically significant mean difference of anthropometric Z-scores before and after ART initiation could indicate the effect of ART treatment.

7.3. Comparing child nutritional status among the hospitals

When the prevalence of stunting and underweight among the children were compared in the five public hospitals, there was no statistically significant association between the two types of malnutrition and the hospitals. But there is a difference between the hospitals where this study was conducted based on the health tier system of the country where three of them are teaching and referral hospitals while two of them are general hospitals. This might imply that despite the difference between the hospitals based on the health tier system of the country, the care being provided to the children in the five public hospitals was at a similar level in quality.

8. Strengths and limitations of the study

Strengths of the study

The study was a multi center study and tried to include the major public hospitals in Addis Ababa which are providing clinical care service to a large number of the target population. Hence the finding described the magnitude of malnutrition among the HIV infected under five children in Addis Ababa. Nutritional status of the children was assessed using three different anthropometric indices; therefore it was possible to describe the status of the chronic and acute forms of malnutrition among the children. Possible confounding factors were controlled in the analysis.

It also helped us to see whether the existing practices and approaches were working in tackling malnutrition among HIV infected children or not.

Limitations of the Study

This study was a hospital based study where there was a possibility of patient self selection bias which can over estimate the actual prevalence of malnutrition. Some of the clinical data related to the patients were collected from the patient follow up chart. Hence some variables might not be appropriately recorded or measured or could be missed. The study was a cross sectional study hence may not show temporal relationship of exposure and outcome variables.

9. Conclusion

The magnitude of malnutrition among the HIV infected under five children who had follow up in the five public hospitals in Addis Ababa was very high. This might have its own impact on the morbidity and mortality of the children. The fact that the prevalence of acute malnutrition at the time of survey was much less than its prevalence by the time the children started follow up in the hospitals might reflect the effect of the follow up program in addressing this problem; yet the high prevalence of chronic malnutrition at the time of the study reflect the need for an expanded effort to address it deeply. In this study, factors related to food insecurity and CD4 percentage value of the children were the main factors associated with malnutrition which need to be addressed at a wider perspective.

10. Recommendations

1. **To program planners:**

   Devise means of tackling the food insecurity among the children and their families and ways of monitoring nutritional status of the children at the program level.

2. **To the researchers:**

   There is a high magnitude of malnutrition among the children before starting follow up and ART; further study is recommended to see if delay in starting follow up/ART is possible reason for this.

3. **To the clinician:**

   Treat the existing chronic malnutrition among the children.

   Educate parents of the children on how to prevent malnutrition among the children.

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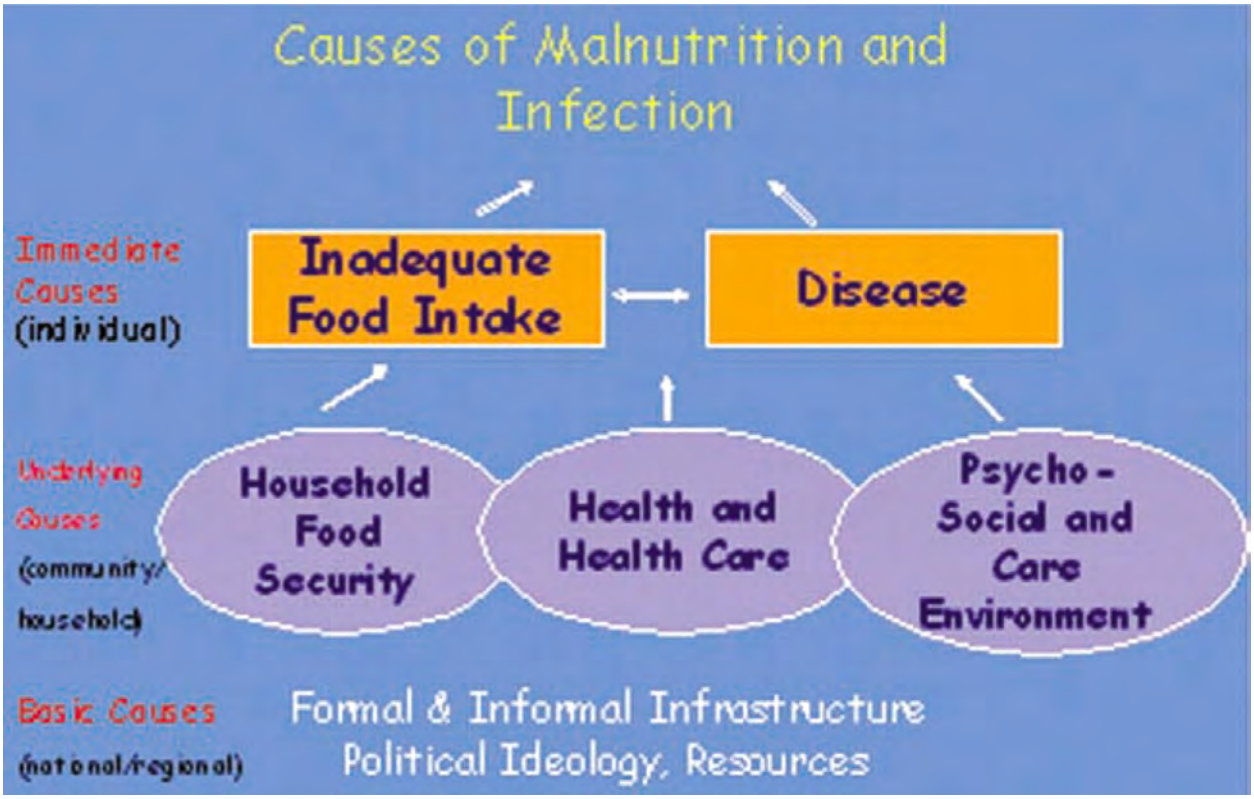
12. Annexes

12.1. Conceptual framework of the determinants of nutritional status



Source: Peter Katona and Judit Katona-Apte. The Interaction between Nutrition and Infection. Clinical Infectious Diseases 2008. 46: p. 1582-8.

Figure. 4

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ADDIS ABABA UNIVERSITY, SCHOOL OF PUBLIC HEALTH QUESTIONNAIRES: Factors affecting the nutritional status of HIV infected under-five age children who have follow up at Tikur Anbessa Specialized Hospital, Yekatit Twelve Hospital, St Paul Hospital, Zewdiru Memorial Hospital and ALLERT Hospital and its programmatic implication, Addis Ababa; Ethiopia.

A. Information sheet

Good morning/good afternoon! My name is Atnafu Mekonnen Tekleab. I am graduate student of Public Health at Addis Ababa University, School of Public Health and we are now conducting a survey in this institution to explore factors affecting the nutritional status of HIV infected under five age children. We believe that this study will help us to bring change in factors affecting the nutritional status of HIV infected under-five age children. You and your child are selected to be one of the participants in this study and you will help us by answering the questions we ask you. We also would like to ask your permission to measure the weight, height and mid upper arm circumference of your child who came today with you to this hospital for his regular follow up. We ask you to participate voluntarily and that there will not be any negative consequences on the services your child is entitled to receive if you refuse to participate. We assure you that whatever answers you give us will be kept strictly secret. We do not need yours and your child name and address. We also inform you that you have the full right to withdraw from the study or stop the interview at any time and /or skip any questions that you don't want to answer. You may find some of the questions too personal and difficult to talk about, but your experience will be very helpful for other people. Also you will not get/receive direct benefit for participating in the study. The interview takes approximately 20-25 minutes.

Do you have any question to ask?
Thank you very much!
Are you willing to participate in this study?

Yes ☐ No ☐
If yes go to next page

B. Consent form

I, the undersigned have been informed that the purpose of this particular research project is to study factors affecting the nutritional status of HIV infected under-five age children.

- I have been informed that I am going to respond to this question by answering what I know concerning the issue.
- Weight and height of my child who is having follow up in this hospital will also be measured for the research purpose.
- I have also been informed that the information I give will be used only for the purpose of this study.
- my identity and the information I give will be treated confidentially.
- I have also been informed that I can refuse to participate in the study or not to respond to questions I am not interested. Furthermore I have been informed that I can stop responding to the questions at the time in the process.

Based on the above information I agree to participate in the research voluntarily with the hope of contributing to the effort of knowing factors affecting the nutritional status of HIV infected under-five age children.

Signature:_____

Date:_____

Address of investigator

Name: Atnafu Mekonnen

Addis Ababa University MPH student

Tel: 0911346601

12.2. Questionnaire

Factors affecting the nutritional status of HIV infected under-five age children who have follow up and treatment at Tikur Anbessa Specialized hospital, Yekatit Twelve Hospital, St Paul Hospital, Zewditu Memorial Hospital and ALERT hospital and its programmatic implication, Addis Ababa, Feb 2013.

Hello, my name is _____ I am one of the data collectors on the study with the above topic. I would like you to cooperate in answering the questions that follow. You have the right to refuse.

Interviewer agreement

I certify that I have filled this questionnaire in accordance to the training I was given. I have checked this questionnaire and confirmed that the information in it is correct.

Name _____Signature_____ Date_____ Supervisor's signature_____

	Part I: Socio demographic characteristics		
No	**Questions**	**Categories**	**code**
101	Name of the hospital	_____	/----/
102	Child card No.	_____	/----/
103	Age of the child in months	_____	/----/
104	Date of birth of the child		/----/
105	Sex of the child	1. male 2. female	/----/
106	Is the mother of the child alive? **If the answer is no, go to Q112**	1. yes 2. no	/----/
107	If the answer to question 105 is yes, what is her age? (completed years)	_____	/----/
108	If the answer to question 105 is yes, what is her occupation?	_____	/----/
109	If the answer to question 105 is yes, has she ever attended school?	1. Yes 2. No	/----/
110	If the mother has gone to school, what is the highest level of school she attended?	_____	/----/
111	If the answer to question 105 is yes, what is her current marital status?	1. Single 2. Married 3. Divorced 4. Widowed 5. Separated	/----/
112	What is the family monthly income in Birr?	_____birr	/----/
113	What is the child's family size?	_____	/----/
114	What is the preceding birth interval of the child in months?	_____months	/----/

115	For how long did the child breast fed in months (only for those less than 1 year)	_____months	/----/
116	How many times did the child eat solid, semi-solid or soft food yesterday during the day or at night? (e.g. enjera, porridge, milk).	_____	/----/
117	Which of the following statement best describes the food eaten in the child's home in the past 12months?	1. Enough of the kinds of food the family want to eat. 2. Enough but not always the kinds of food the family want. 3. Sometimes not enough to eat. 4. Often not enough to eat. 5. Don't know	/----/
118	Does the child receive supplemental nutrition from any organization?	1. Yes 2. No	/----/
119	Is the child orphan (both parents died)?	1. Yes 2. No	/----/

Part II: Anthropometric measurements of the child

No	Questions	Category	code
201	Age of the child when he/she started the follow up(in months)	_____months	/----/
202	Age of the child when he/she started the ART (in months)(if ART is already started for him/her).	_____months	/----/
203	Weight of the child in kilogram when he/she started the follow up (in kg).	_____kg	/----/
204	Weight of the child at the time of ART initiation (if child is already on ART).	_____kg	/----/
205	Current weight of the child in kilogram (to the nearest 0.1kg).	_____kg	/----/
206	Height of the child when he/she started the follow up.	_____cm	/----/
207	Height of the child when ART was initiated (if child is already on ART).	_____cm	/----/
208	Current height of the child in centimeter (to the nearest 0.1cm).	_____cm	/----/
209	Current mid upper arm circumference of the child in centimeter (to the nearest 0.1cm).	_____cm	/----/
210	Does the child have edema currently?	1. Yes 2. No	/----/

Part III: Clinical condition of the child

child Card No. _____

No	Questions	Category	code
301	Does the child have diarrhea lasting for more than 2weeks over the past 6months?	1. Yes 2. No	/----/
302	What was the age of the child when HIV infection was diagnosed (age in months)?	_____months	/----/
303	Does the child have recurrent oral lesion over the past 6 months?	1. Yes 2. No	/----/
304	Does the child have documented history of hospital admission over the past 6 month?	1. Yes 2. No	/----/
305	What is the WHO HIV/AIDS disease stage of the child currently?	_____	/----/
306	Is the child taking cotrimoxazol prophylactic therapy currently?	1. Yes 2. No	/----/
307	What is the current CD4 percentage value of the child (take the recent value over the past 6mon)?	_____	/----/
308	Is the child taking ART drugs currently?	1. Yes 2. No	/----/
309	If the answer to Q308 is yes, how long has been since ART was initiated (in months)?	_____months	/----/
310	What is the recent documented ART adherence status of the child?	1. Poor 2. Fair 3. Good	/----/
311	Does the child have documented ARV drug toxicity over the past 6 months?	1. Yes 2. No	/----/
312	Does the child have co morbid illness currently? (like renal, cardiac, TB, etc)	1. Yes 2. No If yes, mention it_____	/----/

Thank you! This is the end of the questionnaire.