



School of nursing

**magnitude of under nutrition and Associated Factors Among
Children with Cardiac Disease at Selected Public Hospitals and
Cardiac Center in Addis Ababa Ethiopia, 2024**

Investigator; Benol Tefera

**A Research thesis submitted to the school of nursing; Presented in Partial
fulfillment of the Requirements for the Degree of Master in Cardio thoracic
surgery nursing; St. Paul Hospital Millennium Medical College**

**August, 2024
Addis Ababa Ethiopia**

Magnitude of under nutrition and associated factors among children with cardiac disease at selected public hospitals and cardiac center in Addis Ababa Ethiopia, 2024

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Abstract

Introduction: Heart disease and under nutrition are linked in a vicious circle. The impact of under nutrition on heart disease in children living in low- and middle-income countries (LMICs) is little understood including Ethiopia. Under nutrition imposes a significant burden on the Ethiopian economy and also impacts societal health.

Objectives: To assess the magnitude of under nutrition and associated factors among children with cardiac disease in selected public hospitals and cardiac center Ethiopia in Addis Ababa city, 2024.

Methods: An institutional-based cross-sectional study was conducted among 381 children with cardiac disease at selected governmental hospitals and the Cardiac Center Ethiopia in Addis Ababa, Ethiopia, in 2024. The study participants were selected using a simple random sampling technique. Data were collected through structured questionnaires administered by interviewers, and anthropometric measurements were performed. Malnutrition was diagnosed according to WHO criteria. Data were analyzed using SPSS version 26. Binary logistic regression was done to select candidate variables for the multivariate logistic analysis at a p-value < 0.25. Multicollinearity tests were conducted to ensure no significant correlation among independent variables. Model fitness was assessed using the Hosmer-Lemeshow goodness-of-fit test. Multivariate logistic regression analysis was employed to determine the strength of association using adjusted odds ratio at 95% confidence level and a p-value of less than 0.05.

Results: The prevalence of stunting, wasting and underweight was 55.9% (95% CI: 50.76, 60.96), 44.36% (95% CI: 39.30, 49.50), and 53.28 % (95% CI: 48.13, 58.40), respectively. Being rural residence (AOR: 1.79, 95% CI: 1.14, 2.81), under two years (AOR: 1.96, 95% CI: 1.0, 4.21), and inadequate dietary diversity (AOR: 1.68, 95% CI: 1.05, 2.68) were significantly associated with stunting. Likewise, being male (AOR: 2.27, 95% CI: 1.39, 3.71), encountering moderate to severe heart failure (AOR: 0.42, 95% CI: 0.24, 0.75), and poor dietary diversity (AOR: 1.59, 95% CI: 1.01, 2.53) were independently associated with wasting. Being male (AOR: 1.75, 95% CI: 1.08, 2.84), aged under twenty-four months (AOR: 4.75, 95% CI: 2.66, 8.48) and

twenty-four to fifty-nine months (AOR: 1.95, 95% CI: 1.13, 3.34), and inadequate dietary diversity (AOR: 2.08 95% CI: 1.28, 3.37) were significantly associated with underweight.

Conclusion: The study revealed that stunting, wasting and underweight are high among children with cardiac disease. Rural residence, under two years, and inadequate dietary diversity increase the odds of stunting. Being male, encountering moderate to severe heart failure and poor dietary diversity were independently increase the risk of wasting. Furthermore, being male, fewer than under-five and inadequate dietary diversity increase the odds of underweight. Therefore, the parents are encouraged to improve the dietary diversity the meal given for children with cardiac disease.

Keywords: Magnitude, under nutrition, stunting, wasting, underweight.

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Acronyms and Abbreviations

AOR	Adjusted Odds Ratio
ASD	Atrial septal defects
BMI	Body Mass Index
CAD	Coronary Artery Disease
CHD	Congenital Heart Disease
CHF	Congestive Heart Failure
CONUT	Controlling Nutritional Status
CVDS	Cardiovascular Diseases
EDHS	Ethiopia Demographic and Health Survey
HF	Heart Failure
HFA	Height For Age
HICS	High-Income Countries
IRB	Institution Review Board
LMICS	Low- And Middle- Income Countries
MAM	Moderate Acute Under Nutrition

MUST	Malnutrition Universal Screening Tool"
RHD	Rheumatic Heart Disease
TOF	Tetralogy Of Fallot
VSD	ventricular septal defects
WFA	Weight for Age

1. INTRODUCTION

1.1. Background

Cardiac disease refers to a range of disorders affecting the heart and blood vessels, encompassing conditions such as coronary artery disease, heart failure, and anomalies. These conditions pose significant risks, including various cardiac problems and heart diseases(1). A study conducted in the U.S on congenital heart diseases, an estimated of babies born each year have CHD(2). A study conducted in Belgium shows that the burden of cardiac disorders is 48% mild, 41% moderately complex, and 11% complex heart diseases, with the most prevalent defect being VSD (21%), followed by ASD (11%)(3). A research on cardiac disease conducted among children seeking treatment at tertiary hospitals in Southern Nigeria found that 83.6% of cases were congenital heart disease, with only 16.4% being acquired. Down syndrome (trisomy 21) is connected with many congenital heart defect instances, with a frequency of 6.4% depending on the kind of abnormality(4).

According to an Indian study, the prevalence of congenital heart CHD (62.77%) were identified between the ages of one month and six, cyanotic CHD was 27.14%, and the incidence of cyanotic CHDs was 72.86%,The most prevalent cyanotic CHD discovered was a VSD (26.24%), which was followed by ASD, TOF 13.57% of all cyanotic CHD cases found followed by double-outlet right ventricle (2.84%) (5). Another study conducted in Chinese study, on CHD show the same result for a total prevalence of 62.77%, the prevalence of CHD in low- and middle-income nations is comparable to that of high-income nations, if not higher (6).

According to an Indian study, the prevalence of congenital heart CHD (62.77%) were identified between the ages of one month and six, cyanotic CHD was 27.14%, and the incidence of cyanotic CHDs was 72.86%,The most prevalent cyanotic CHD discovered was a VSD (26.24%), which was followed by ASD, TOF 13.57% of all cyanotic CHD cases found followed by double-outlet right ventricle (2.84%) (7). Pediatric rheumatic heart disease data from the Global Burden of Disease Study 2019 indicate that, between 1990 and 2019, the number of incidence and prevalence cases of RHD in children grew globally by 41.89% and 40.88%, respectively (8). Compared to boys, girls bore a noticeably greater burden of RHD. The age group of 10–14 years old had the largest RHD burden at the age level(9). Rheumatic heart disease is a particularly

serious public health problem, contributing to significant mortality and morbidity in children(9). The leading cause of heart failure (HF) was structural heart disease (144, 66.7%), followed by congenital heart disease (CHD), 64 (44.5%), and rheumatic heart disease (RHD), 52%. and 12 (5.6%) of the cases of HF were induced by anemia and renal problems; infectious endocarditis (18.8%) and pneumonia (42.9%) were the most frequent precipitating/comorbid conditions with HF; and HF had a case fatality rate of 13.9%(10). Children with heart disease in Africa have little or no access to treatment of any kind, and cardiac surgical services. There is little reliable data concerning the prevalence of congenital or acquired heart disease in African children, but there is sufficient information to indicate that the burden of cardiac disease is vast. This major non-communicable disease is largely hidden, overshadowed by the incidence of communicable diseases. There is as yet little evidence of the hoped-for epidemiological transition toward non-communicable diseases amongst children in Africa(11).

1.2. Statement of the problem

Nutritional status, defined as the body's condition resulting from the balance of nutrient intake, absorption, and utilization influenced by physiological and pathological factors, is critical for children's health(12). Under nutrition, characterized by inadequate nutrient intake to sustain optimal health, is a significant public health concern affecting children aged 6–59 months globally(13). Heart disease and under nutrition are linked in a vicious circle. The impact of under nutrition on heart disease in children living in low- and middle-income countries (LMICs) is little understood including Ethiopia. Under nutrition imposes a significant burden on the Ethiopian economy and also impacts societal health(14).

Under nutrition manifests as underweight (low weight for age), stunting (low height for age) wasting (low weight for height), and thinness (low body mass index for age) (15). Children with advanced heart failure and pulmonary hypertension are particularly susceptible to growth failure and under nutrition(16). Early identification of growth failure and under nutrition in children with cardiac diseases is crucial for timely medical or surgical interventions to mitigate congestive heart failure and improve prognosis (17).

Cardiovascular diseases are strongly linked to under nutrition, which can lead to chronic somatic growth impairment, increased susceptibility to infections like pneumonia, frequent hospitalizations, and poorer outcomes following cardiac surgery(18).For example, an estimated 47 million children under five suffer from moderate or severe wasting globally, with substantial regional disparities(19). Geographical variations in undernutrition prevalence among children with congenital heart disease (CHD) highlight the need for localized intervention strategies(20).

Studies underscore the adverse health outcomes associated with under nutrition in conditions like heart failure, stroke, cancer, and chronic renal disease(21). While high-income countries have extensively researched the nutritional status of children with CHD, there is a paucity of data from low- and middle-income countries, particularly in Sub-Saharan Africa(22). Addressing this gap, this study aims to assess the nutritional status and associated factors among children with cardiac disease in selected hospitals in Addis Ababa, Ethiopia.

1.3. Significance of the study

The findings of this study will have significant implications for stakeholders and policymakers, as they can help standardize management protocols, thereby reducing the risk of patient complications and enhancing quality of life.

Patients stand to benefit from improved treatment outcomes, better quality of life, and reduced healthcare expenditures. Furthermore, this study serves as a valuable resource for researchers, stimulating further research into this critical issue. Early identification and management of high-risk patients could profoundly impact their outcomes.

Healthcare providers can also utilize these findings to make informed decisions in caring for cardiac patients affected by under nutrition. Moreover, the study's results are pertinent to all pediatric cardiac patients in Addis Ababa, offering guidance for targeted management strategies aimed at minimizing risks and complications within hospital settings and addressing existing knowledge gaps.

2. LITERATURE REVIEW

2.1. The Prevalence of Stunting, under nutrition, and Wasting among RHD Children

2.1.1. *Stunting*

Stunting defined as low height for age, is a major public health issue among children with RHD. The prevalence of stunting among these children can be alarmingly high. For instance, studies have reported stunting rates as high as 48% in some populations of children with RHD(23). In Ethiopia, the prevalence of stunting among children with RHD has been found to be significantly higher than the national average for all children indicating a severe impact of RHD on growth(24). This high prevalence is often attributed to chronic illness, recurrent infections, and inadequate dietary intake, which are common among children with RHD(25). The global burden of stunting among RHD children underscores the need for targeted nutritional interventions to address this issue effectively(26).

2.1.2. *Under nutrition*

Under nutrition, characterized by insufficient intake of calories, proteins, and essential nutrients, is prevalent among children with RHD. Estimates suggest that between 15% and 64% of children with RHD experience some form of under nutrition(27). This condition exacerbates the severity of cardiac diseases, leading to poor treatment outcomes and increased morbidity(28). For example, a study conducted in India found that under nutrition was prevalent in 45% of children with RHD, significantly higher than in children without cardiac conditions(29). Under nutrition impairs the immune system, making children more susceptible to infections, which further complicates their health status(30). Addressing under nutrition in children with RHD is crucial for improving their overall health and treatment outcomes(31).

2.1.3. *Wasting*

Wasting defined as low weight for height, is also a common issue among children with RHD. Prevalence rates of wasting among this population have been reported to range from 18% to 42%, depending on the region and population studied(32). Wasting indicates acute malnutrition and is often a result of inadequate dietary intake, increased metabolic demands due to chronic illness, and frequent infections(33). For instance, a study in Nigeria found that 30% of children

with RHD were wasted, highlighting the dire need for nutritional interventions(34). These high rates of wasting indicate a critical need for improved nutritional support and management for children with RHD to ensure better health outcomes and quality of life(35).

2.2. Factors Associated with Stunting, under nutrition, and Wasting among RHD Children

Factors Associated with Stunting among RHD Children Several factors contribute to stunting among children with RHD. These include:

Socioeconomic Status: Lower socioeconomic status is strongly correlated with higher rates of stunting due to limited access to nutritious food and healthcare(36). Families with lower income levels often struggle to provide a diverse and nutrient-rich diet for their children, leading to chronic malnutrition and stunting(37).

Inadequate Dietary Diversity: A lack of variety in diet significantly increases the risk of stunting (38). Diets that rely heavily on staple foods with minimal inclusion of fruits, vegetables, and proteins fail to meet the nutritional needs of growing children. **Rural Residence:** Children living in rural areas are more likely to experience stunting due to reduced availability of healthcare services and nutritious food(39). Rural areas often lack the infrastructure and resources necessary to support adequate nutrition and healthcare, exacerbating the risk of stunting among children with RHD(40).

2.2.1. Factors Associated with under nutrition among RHD Children

The factors contributing to under nutrition among RHD children include:

Chronic Illness: The chronic nature of RHD often leads to prolonged periods of inadequate nutrient intake and absorption(41). Chronic illness can reduce appetite, increase metabolic demands, and impair the body's ability to absorb and utilize nutrients effectively(42).

Frequent Infections: Repeated infections, common in children with RHD, can hinder nutrient absorption and utilization, leading to under nutrition(43). Infections such as pneumonia and

gastrointestinal infections are prevalent among children with RHD and significantly impact their nutritional status(44).

Poor Socioeconomic Conditions: As with stunting, lower socioeconomic status is a significant risk factor for under nutrition(45). Economic constraints limit access to a balanced diet, healthcare, and other resources necessary for proper growth and development. 1.3.3 Factors Associated with Wasting among RHD Children Factors associated with wasting in children with RHD includes:

Severe Heart Failure: Advanced stages of heart failure in RHD significantly increase the risk of wasting due to elevated metabolic demands and decreased appetite. Heart failure increases the body's energy expenditure, making it difficult for children to maintain an adequate nutritional status(46).

Inadequate Nutritional Intake: Insufficient intake of calories and proteins directly contributes to wasting. Children with RHD may have reduced appetite and difficulty consuming sufficient quantities of food to meet their energy and nutrient needs(47).

Male Gender: Studies have indicated that male children with RHD are more prone to wasting compared to their female counterparts. This gender disparity may be due to differences in metabolic rates, hormonal influences, and cultural practices affecting dietary intake and healthcare access(48).

Children with chronic hypoxia and CCHD were more likely to be stunted. In comparison to CCHD, ACHD was higher in both centers. Tetralogy of Fallot (TOF) was more prevalent among CCHD in both centers (49).

The ratio of men to women and socioeconomic status were similar. The majority showed signs of acute and chronic malnutrition, which is recognized to be a risk factor for unfavorable outcomes. They were also underweight, stunted, and wasted. VSD was more common than ASD, and ACHD was more common than CCHD(50). A study conducted in Uganda One hundred and forty-five (74.7%) children were aged 0–5 years, and 111 of 194 (57.2%) were female. Forty-five of 145 (31.5%) children aged 0–5 years were wasted; 77 of 181 (42.5%) children aged 0–10

years were underweight; 88 of 194 (45.4%) children were stunted; and 53 of 194 (27.3%) children were thin (BMI for age z score < -2). Moderate to severe anemia (RR 1.11, 95% CI: 1.01–1.22) and moderate to severe heart failure (RR 1.24, 95% CI: 1.13–1.36) were associated with wasting and underweight, respectively. Stunting was associated with moderate to severe heart failure (RR 1.11, 95% CI: 1.01–1.21), while thinness was associated with moderate to severe heart failure (RR 1.12, 95% CI: 1.04–1.21) and moderate to severe anemia (RR 1.15, 95% CI: 1.06–1.25)(51).

Globally, the prevalence of childhood obesity has sharply grown. A total of 143 clinical records, including weight, height, and respiratory viruses identified during hospitalization, were examined from children between the ages of 2 and 18 who were admitted to Clínica Dávila between 2014 and 2018(52). According to age, the Z score, or body mass index, was used to measure nutritional status. Eighty-three youngsters (or 58% of the total) tested positive for several respiratory viruses(53).

2.3. Socio demographic related factors

The prevalence of overweight and obesity among children in low-income and middle-income countries (LMICs) is currently accelerating(54). In Nepal, a study was carried out to examine the relationship between nutritional status and socioeconomic status. The rates of, underweight, and stunting among school-age children were 7%, and 17%, respectively. Compared to men, girls had a higher likelihood of being overweight or obese (20% vs. 13%). Across all socioeconomic categories, the percentage of underweight individuals was distributed evenly, but it was twice as high in males (10%) as in females (5%). This study found that around one in four children and adolescents in the research environment were undernourished. So Compared to those from Lower SES or Upper SES families, participants from Middle SES households tended to be less overweight. The same individual was overweight and stunted, but people from poorer socioeconomic backgrounds were far more likely to be stunted(55).

Compared to their counterparts in the top socioeconomic class, children from lower socioeconomic classes had poorer nutritional status. Children with a BMI below the fifth percentile made up 41% of the lower class and 19.28% of the upper class(56). Compared to children of literate mothers (20%), the prevalence of malnutrition was 42.3% among children of

illiterate mothers. Children from lower socioeconomic classes tend to have poorer health outcomes due to a number of major underlying variables, including poverty, low literacy rates, big families, food insecurity, food safety, and women's education. To enhance children's nutritional condition, economic, political, and social reforms are needed, along with adjustments for personal growth primarily through educational possibilities(57).

A study conducted in bangladesh key risk factors of multiple concurrent forms of under nutrition include children in the older age group (3 years and above); those in the lowest socioeconomic quintile; have fathers who are currently unemployed that differs by a single form of under nutrition, to some extent, additionally with children in the younger age group (3years and below); have mothers with no formal education (when fathers are educated) and fathers that are labourers(58). A study conducted in Libya Effect some selected socio-demographic variables are significant on the nutritional status of Libyan children. Height, Weight and BMI are positively related with age, gender and father's occupation .This study will help local governments, educators and community groups develop programs to assist underweight children in schools(59).

A systematic review study (63.3%) focused on under nutrition during the first 2 years of life: LBW, PTB and stunting. Lower maternal education, maternal unemployment and lower household wealth index were the SES factors most commonly associated with adverse birth outcomes and infant under nutrition. Maternal marital status was not associated with any infant outcomes(60).

A study conducted in in Portugal Socio-economic status (SES) is commonly described by three main aspects: education, employment and income. Socioeconomic inequalities in health influence every phase of the life course, from birth to older ages. A lower SES is associated with every major cause of premature mortality, whilst the higher the level of family income, education or occupational ranking, the lower the risk of morbidity and mortality(61).

2.4. Dietary habit related factors

Inadequate breast feeding children with defects that require complex surgical palliation, or definitive repair, face many challenges in achieving optimal short-term and long-term growth.

The presence of associated chromosomal abnormalities, cyanosis, and cardiac failure adds to the complexity and challenge(62). Some infants refuse to suck, whereas others suck for only a short time. Swallowing, which should be present in the foetus by 16 weeks, is expected to be normally functioning at birth in normal healthy babies. Laryngopharyngeal dysfunction, however, has been reported in up to half of those undergoing the Norwood procedure, inevitably leading to difficulties in feeding(63).

Child caring practices

A cross-sectional investigation carried out in Khartoum Inadequate washing of raw food (9%) improper hand washing after coughing (65%), not washing hands after handling trash (11%), raw food in contact with/and ready-to-eat food (58%), family food exposed to insects and rodents (24%), mothers/caretakers not covering their mouth and nose after coughing (59%), buying pre-packaged/processed children's food without checking the expiration date (63%), and caregivers using public restrooms (48%) were the most significant factors that were reported to significantly affect nutritional status. Less than six months of exclusive breastfeeding reduced a child's risk of stunting by 1.6 times compared to non-exclusive breastfeeding(64).

A recent study done in 21 countries in the world include Asian countries like Japan show that 87.9% of 6-12 months were breastfed at this time(65). Study conducted in Vietnam 2023 a total of 383 aged under five years revealed that the determinant factors for under-five children were duration of breastfeeding, types of food giving to the child, age of initiation of complementary feeding and times of feeding per day are significant (66).

2.5. Dietary factors

According to a research done in a slum region of Dhaka City, Bangladesh between February and April of 2015, youngsters who ate meals one to two times a day also had higher chances of stunting. An additional research conducted in the Udupi area of Karnataka, India, indicated a statistically significant correlation between mothers who limited specific meals for their children during their youth and malnourished children, with an odds ratio of 2.57%. Similar findings were observed between moms who fed their kids healthy food during their early years and those who gave them bakery goods, candy, or chocolates. The mothers who followed the first strategy had children with normal weights (67).

According to a research conducted in rural western Sudan's the Kordofan , having three meals a day is likely to positively correlate with having a greater amount of protein and energy than having just two. In these remote areas, meals that supplied more energy were not seen, with a chance of 0.104(86). A research conducted in the Dewa Cheffe Oromia Zone in the Amhara Regional State indicated that children from homes with one or more female heads and families with children larger than six had a higher likelihood of consuming insufficient energy. In contrast, children whose moms were housewives showed lower probabilities of consuming insufficient amounts of energy(67). According to a research conducted in April and May 2017 on school-age children (6 to 14 years old) in Arba Minch HDSS, Southern Ethiopia, children who regularly skipped meals were less likely to be stunted. Furthermore, compared to their counterparts with DDS of <4 food categories, thinness was 63% less likely in children with DDS of > 4 food groups(68).

2.6. Environmental factors

A case control study done in Udipi district of Karnataka, India indicates that Children practicing open defecation were more among cases (14.7%) than in controls (6.8%), and they also tend to have a 2.3 times higher risk of being malnourished, compared to children using a sanitary latrine. Children whose families had open drain-age system around the house was noted to be more incases (74.7%) than controls (58.2%), and were at 2.0 times at a higher risk of being malnourished than families that had underground and piped drainage system(69).

A research conducted in a Bangladeshi slum revealed that children who did not drink cooked water had a greater risk of stunting than those who did. Furthermore, children who smoked, used temporary latrines, and did not routinely take baths had a considerably increased chance of being stunted (p-value <0.05)(70). A community based cross-sectional study in Amhara region Lay Arma-chiho district from December, 2016 to January, 2017 reveal that availability of latrine and hand washing practice were significantly and in dependently associated with stunting. The likelihood of stunting was 1.58 times higher among children aged 10–14 years [AOR = 1.58, 95% CI: 1.17, 2.12] compared to their counterparts(71). The lack of a toilet facility [AOR =1.60; 95%CI: 1.17, 2.20)] increased the odds of stunting by 1.60 times. Decreased odds of stunting were illustrated among school aged children who had had hand washing habit before eating (72).

Another study carried out in the Humbo district of Southern Nation Nationality between March and April of 2015 revealed that children from households disposing of domestic waste in the field had a 2.7-fold increased risk of stunting when compared to children whose households disposed of the waste by burning it or turning it into compost or biogas(71).

2.3. Conceptual framework

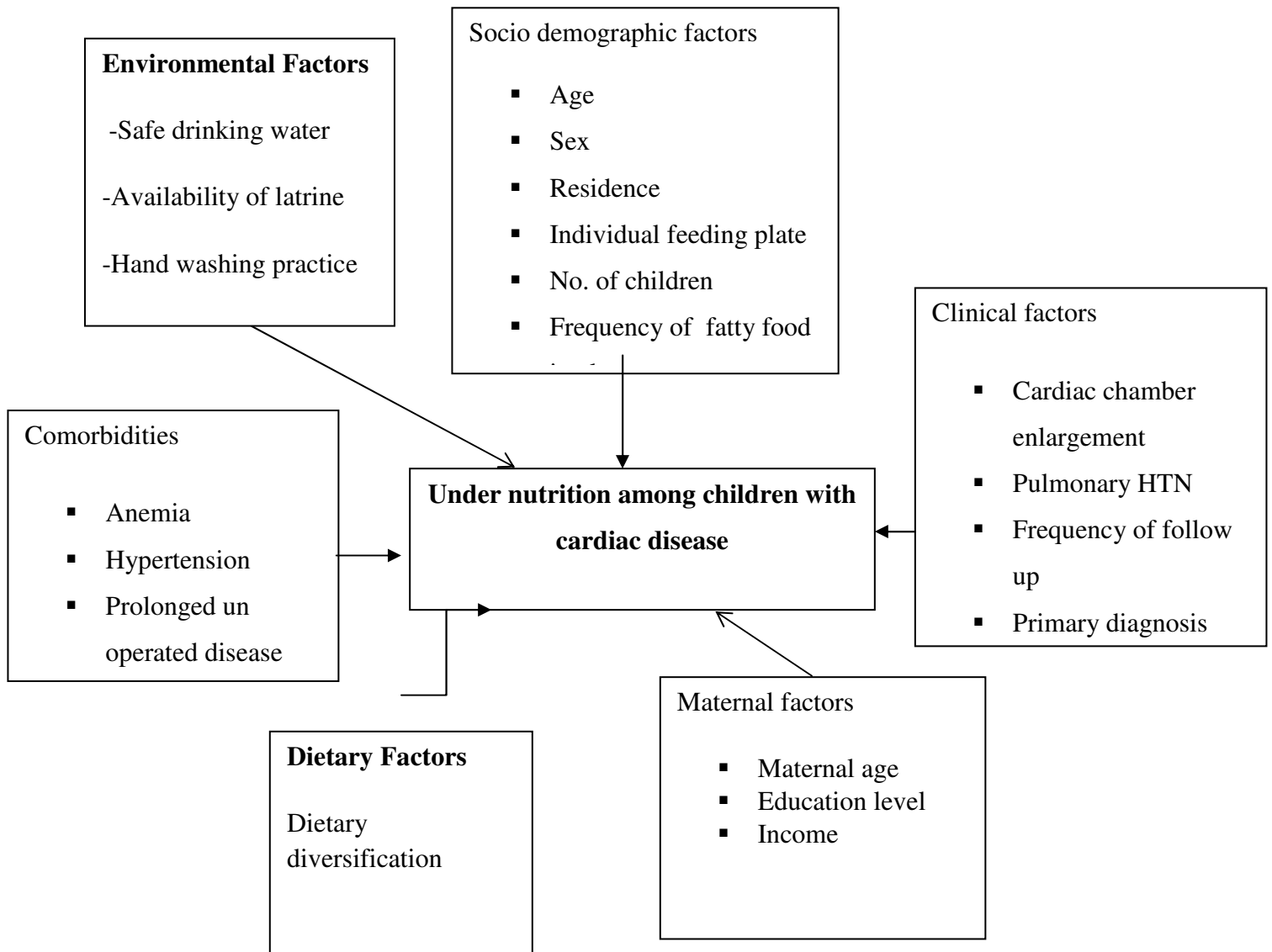


Figure 1:diagrammatic presentation of a conceptual framework adapted from different literatures (53), (54), (56), (57), (61), (65), (68), (69), (71), (72)

3. OBJECTIVES

3.1 General objective

- To assess the prevalence of under nutrition and associated factors among children with cardiac disease in selected governmental hospitals and cardiac center Ethiopia in Addis Ababa, 2024

3.2 Specific objectives

- To determine the prevalence of stunting among children with cardiac disease in selected governmental hospitals and cardiac centers in Addis Ababa, 2024.
- To determine the prevalence of wasting among children with cardiac disease in selected governmental hospitals and cardiac centers in Addis Ababa, 2024.
- To determine the prevalence of underweight among children with cardiac disease in selected governmental hospitals and cardiac centers in Addis Ababa, 2024.
- To identify factors associated with stunting among children with cardiac disease in selected governmental hospitals and cardiac centers in Addis Ababa, 2024.
- To identify factors associated with wasting among children with cardiac disease in selected governmental hospitals and cardiac centers in Addis Ababa, 2024.
- To identify factors associated with underweight among children with cardiac disease in selected governmental hospitals and cardiac centers in Addis Ababa, 2024.

4 METHODS and MATERIALS

4.1 Study Area and Study Period

The study was conducted in Addis Ababa, the capital city of Ethiopia. Addis Ababa lies at an altitude of 2,300 meters above sea level and was established in 1889. The estimated city population was 6.6 million inhabitants in 2016 .there are four federal and three cardiac centers under the city administration for the treatment of cardiac diseases. These are St. Peter hospital, St. Paul hospital, Alert hospital, TikurAnbessa hospital, and Ekakotebe hospital under federal centers; and Tirunesh Beijing, Yekatit 12 hospital, and Zewditu memorial hospital under the city administration. Among the cardiac centers, saint Paulo's hospital millennium medical college,cardiac center Ethiopia and Yekatit 12 cardiac hospitals were simple random sampling method. The study was conducted from April1- May 1, 2024.

Data was collected from April-1 to may2024.

4.2 Study Design:

- Institutional based cross-sectional study was employed.

4.3 Population.

4.3.1 Source population

- All pediatric cardiac patients under cardiac follow-up clinic at public hospital in Addis Ababa and cardiac center Ethiopia , Ethiopia, 2024

4.4.2. Study population

- All selected pediatric cardiac patients who meet inclusion criteria were included in the study.

4.4. Eligibility Criteria

4.4.1 Inclusion criteria

- All selected pediatric cardiac patients ≤ 18 years under cardiac follow-up clinic were included in the study.

4.4.2. Exclusion Criteria

- Cardiac patient's ≥ 18 years under cardiac follow-up clinic were excluded from the study.
- Who were critically ill during data collection period

4.5 Sample Size determination and sampling technique

The study participants were selected by using simple random sampling. The sample size is associated factors of under nutrition among children with cardiac disease from a previous study conducted in Ethiopia (91).

$$n = \frac{(z^2)(pq)}{d^2}$$

$$n = \frac{1.96^2(0.657)(0.343)}{(0.05)^2} = \dots\dots\dots 347.$$

By considering non-response rate as 10% the total sample size required to conduct the research Swere 382. Where,

n=minimum sample size required

$Z_{\alpha/2}$ = standard normal distribution corresponding 95% confidence interval = 1.96

P= proportion of under nutrition among children with cardiac disease from previous study was 65.7% = 0.657(92).

d= desired precision = 5%

Sample size estimation using epi info version 7 for second objective

Table 1: Sample size estimation for Nutritional status and associated factors among children with cardiac disease at selected public hospital and cardiac center Ethiopia

Variables	(AOR)	Power	% outcome in unexposed group	Ratio (exposed: unexposed)	Sample size	CI	Reference
Pulmonary hypertension	3.82	80%	47.1%	1	92	95%	98
ROSS/NYHA class (moderate to severe)	4.64	80%	38.5	1	70	95%	98
Cardiac chamber enlargement	2.91	80%	30%	1	132	95%	98

4.5.1 Sampling Technique and procedure

Among 12 public hospitals in Addis Ababa 3 hospitals and cardiac center Ethiopia selected intentionally, namely, SPHMMC, yekatiti 12 hospital, and cardiac center Ethiopia. The average number of patients flow per month in those hospitals used for proportional allocation to reach the required sample size. A simple random sampling technique were used to collect data from the study participants.

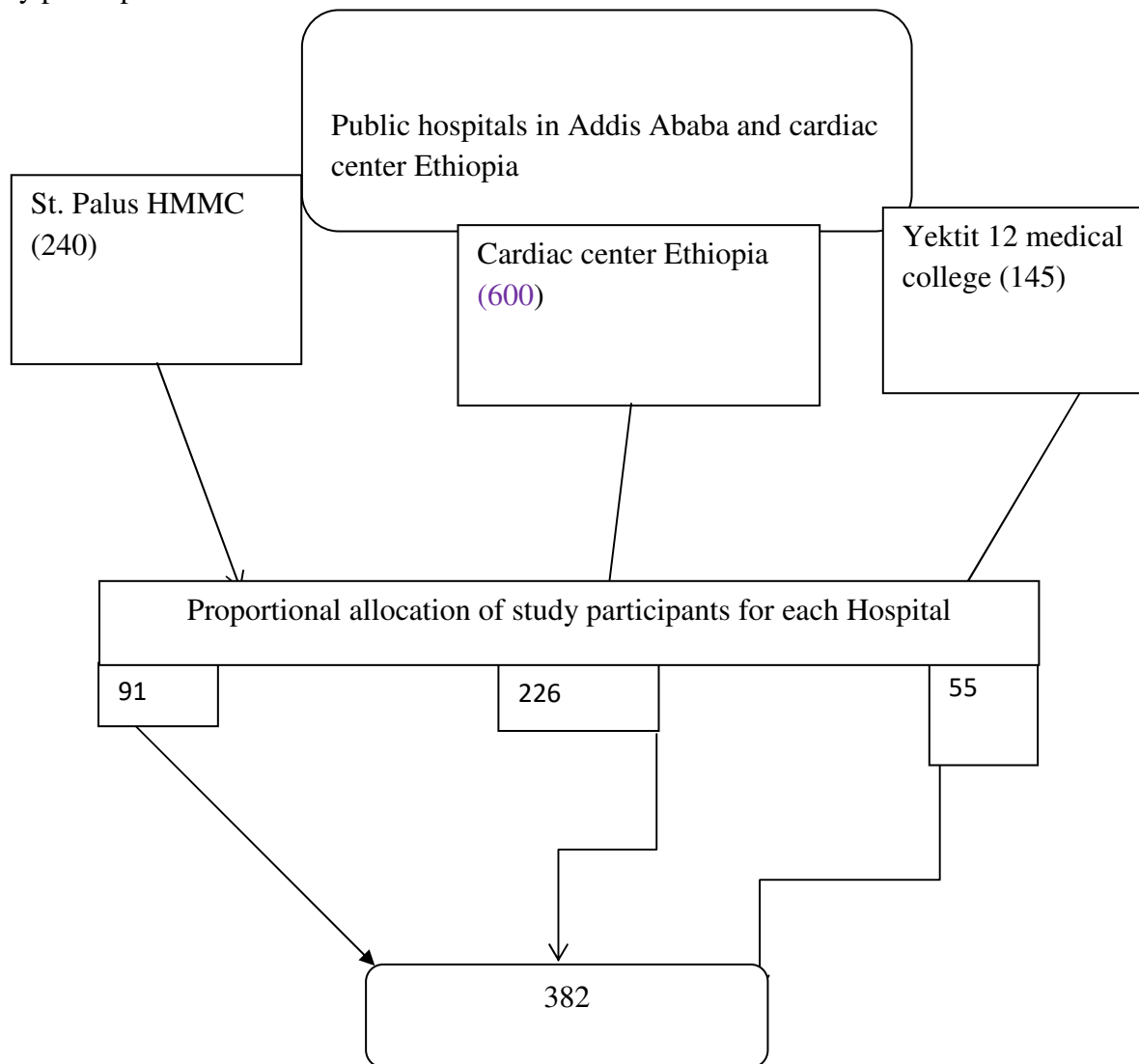


Figure 2: schematic presentation of the sampling procedure for the study on nutritional status and associated factors among children with cardiac disease in selected public hospitals in Addis Ababa and cardiac center Ethiopia, Ethiopia, 2024.

4.6. Study variables

4.6.1 Dependent variables

- Under nutrition

4.6.2 Independent variables

Socio demographic factors: Age, Sex, Residence, Individual feeding plate, No. of children and Frequency of fatty food intake

Clinical factors; Cardiac chamber enlargement, Pulmonary HTN, Frequency of follow up, Primary diagnosis

Co morbidity; Anemia, Hypertension, Prolonged UN operated disease

Maternal factors: Maternal age, Education level, Income, Health seeking behavior

Dietary Factors: Dietary diversification

Environmental Factors: Safe drinking water, Availability of latrine and Hand washing practice

4.7 Operational Definitions and Definition of terms

Under nutrition; in this study under nutrition is to mean wasting, underweight, or stunting status of children. WHO Anthro and WHO AnthroPlus software were used to calculate the Zscore for under five and five to 19 years children.

Stunting: Children with z-scores of less than -2 standard deviations (SDs) for HFA by Anthro plus software measurement(93).

Under nutrition: Children with at least one or more measurements z-scores of less than -2 standard deviations (SDs) of WFH, WFA, and HFA measurements(93).

Underweight: Children with z-scores of less than -2 standard deviations (SDs) for WFA (93).

Wasting: Children with z-scores of less than -2 standard deviations (SDs) for (93).

Dietary Diversity Score: It is the sum of the number of food groups consumed by the individual over the 24-hour recall period then classified into Good dietary diversity if they consume four or above out of seven food group item and Poor dietary diversity if they consume less than four food group item (94).

4.8 Data Collection methods.

4.8.1. Data collection instruments

The questionnaires developed in English and then translated into Amharic and finally translated in to English by language experts for their consistency. The questioner consists of information on demographic and socioeconomic characteristics, clinical related factors, comorbidity were taken from charts and maternal factors, dietary factors, environmental related factors, dietary intake was assessed by using food frequency questionnaires which developed based on an interview of the key informant who know the culture and language of the study area. Data was collected through a face-to-face interview by structured questionnaires and anthropometric measurements were taken as well by the data collectors. Height and weight of the child were measured by trained nurses.

4.8.2. Data collection techniques/procedure

The data was collected by four trained BSc nurses by using a data abstraction form by assessing the available information by face-to-face interview for the socio demographic, clinical factors and comorbidity were taken from charts, maternal factors, environmental factors, dietary history data and anthropometric measurement were made.

Materials

Height: Measurements of height was carried out in cm using portable Stadio-meter. The study subjects were asked to stand straight on leveled surface with shoes off, heels together; eyes looking straight ahead, hands freely by the side, head, shoulder blades and buttocks were against the board/wall. The moving head piece of the stadio-meter was lower to rest flat on the top of the head and reading was noted to the nearest 0.1cm.

Weight: Measurement of weight was done by using a battery powered an electronic personal weighing balance to the nearest 0.1kg. It was calibrated against known weight regularly and error of the weighing scale was checked before taking the weight and corrected when required before each session. Both height and weight were taken twice and their mean was consider as final and measurement scales was handled carefully. And daily calibration was applied before data collection

4.9 Data Quality Control and Management:

Intensive training was given to the data collectors and supervisors for one day for effective and quality of data collection based on the objectives, consent, confidentiality, relevant of the study, participant rights, and methods and techniques of interviewing. 5% of pretest was on the sample size that was not including the final study at cardiac center Ethiopia prior to one month before actual data collection. Then inconsistency and incorrect questions were corrected and modified before the actual data collection. Voluntary participation and privacy of the patients were protected by the study procedures. To ensure the consistency and completeness of the collected data, the data collectors and supervisors were followed every day. Anthropometric measurement was using standardized technique and equipment. During data analysis a frequency check were done to control errors.

4.10. Data Analysis and Procedures:

The data was checked for completeness, code and entered in to kobo tool box and exported in to SPSS version 26 and Variables were checked for missing values before analysis. The WHO Anthro and WHO AnthroPlus software were used as a standard reference for classifying children nutritional status using WHO standard cut off point below -2 SD using Z-scores. The anthropometric measures; weight, height/length and age values were converted to Z-score of the indices; height-for-age (HFA), weight –for-height (WFA) weight –for-age, (WAZ) and Body-mass-index for age (BAZ). The WHO classifies the nutritional status of the children. A low height-for –Age below-2SD of the reference population indicates stunting. A low weight for height below -2SD of the reference population, indicates wasting. A child with a weight-for-Age below-2SD the reference population is underweight.

All assumptions, such as the ratio of variables to cases, normality of continuous variables, consistency of variables, and measures of sampling adequacy, were checked. Descriptive statistical data were summarized in texts, tables, and figures. Model fitness was assessed using the Hosmer-Lemeshow model test, and multicollinearity among independent variables was evaluated with variance inflation factors (VIF) < 7 for all candidate variables. Both bivariate and multivariable logistic regression analyses were employed. Variables with a 95% Confidence Interval (CI) and P-value < 0.25 in bivariate analysis were included in the multivariable analysis. Crude (COR) and adjusted odds ratios (AOR) with corresponding 95% CI were calculated to

identify the risk factors for stunting, wasting and underweight. Statistical significance was declared at a p-values < 0.05 .

4.11. Ethical Consideration

Prior to data collection ethical approval was obtained from SPHMMC ethical review board. The data collectors were explained the objective of the study to the children's parents furthermore, collectors were informed care giver that no name of the participant written on the questionnaire and confidentiality is protected, and verbal consent was obtained.

4.12. Dissemination of Results

The result of the study will be presented to all concerned bodies and will also be published in peer reviewed journals, and will be presented in research symposium.

3. RESULTS

5.1. Socio-Demographic Characteristics of Participants

A total of 381 children with cardiac disease were participated in this study with a response rate of 99.7%; one respondent was not correctly filled out the questionnaire. The mean ($\pm$ SD) age of the participants was 68.29 ± 49.17 months. Of the participants, 261(68.5%) were male, 245(64.3%) were from urban dwellers. The average household monthly income was below and 3500 Ethiopian Birr (ETB) for half (52.49%) of the participants. Family sizes were typically small, with 87.7% having five or fewer members. Majority of the children's mothers (81.4%) and father (84.3%) attend primary and secondary education, respectively (**Table 2**).

Table 2: Socio-demographic characteristics of children with cardiac disease in selected governmental hospitals and cardiac center in Addis Ababa, Ethiopia, 2024 (n = 381)

Variables	Category	Frequency	Percentage
Sex	Male	261	68.5
	Female	120	31.5
Age in months	< 24	93	24.4
	24-59	87	22.8
	60-143	147	38.5
	≥ 144	54	14.2
Residence	Urban	245	64.3
	Rural	136	35.7
Average household monthly income in ETB	≤ 3500	200	52.49
	3501-4000	89	23.36
	≥ 4000	92	24.15
Family size	≤ 5	334	87.7
	>5	47	12.3
Maternal education	No formal education	3	0.8
	Primary education (1-8)	310	81.4
	Secondary education	50	13.1
	Tertiary and above	18	4.7
Fathers education	Able to read & write	1	0.3
	primary education	37	9.7
	secondary and above	321	84.3
	Tertiary and above	22	5.8
Maternal occupation	Employed	189	49.6
	House wife	180	47.2
	Merchant	12	3.1

5.2. Clinical characteristics of the participants

Nearly half, 175 (45.9%) of the children had co-morbid illnesses, and 298 (78.2%) had a monthly appointment follow-up. The majority, 303(79.5%), of the participants had mild heart failure and the rest experienced moderate to severe cases. Nearly all participants had chamber enlargement (97.6%) and pulmonary hypertension (97.9%) (**Table 3**).

Table 3: Clinical factors of children with cardiac disease in selected governmental hospitals and cardiac center in Addis Ababa, Ethiopia, 2024 (n = 381)

Variables	Category	Frequency	Percentage
Comorbid disease	Yes	175	45.9
	No	206	54.1
Frequency of follow up	Monthly	298	78.2
	Every 2 month	14	3.7
	Every 3 month and above	69	18.1
Heart failure	Mild	303	79.5
	Moderate to severe	78	20.5
Chamber enlargement	No	9	2.3
	Yes	372	97.6
Pulmonary hypertension	Yes	373	97.9
	No	8	2.1

5.3. Child caring practice

Nearly all participants, 378 (99.2%) reported as they breastfeed their children daily, and most exclusively breastfed for the first six months (97.3%). Artificial feeding was universally introduced (100%), with cow milk (42%) and milk powder (56.2%) being the most common complementary foods. The preparation methods varied, with a range of milk powder to water ratios being used: 36.7% prepared with a ratio of 1 cup powder to 1 cup water. Bottles were the primary utensil for feeding for 76.6% of the participants followed by cups (21.8%). Handwashing during feeding was practiced most (96.5%) of the participants (**Table 4**).

Table 4: Child caring practice among cardiac disease patients in selected governmental hospitals and cardiac center in Addis Ababa, Ethiopia, 2024 (n = 381)

Variables	Category	Frequency	Percentage
Breast feeding per day	Yes	378	99.2
	No	3	0.8
Only breast milk for the first 6 months	Yes	371	97.3
	No	10	2.7
Time artificial feeding started the	Yes	381	100
Type of Complementary feeding the child took	Cow milk	160	42
	Milk powder	214	56.2
	Porridge	7	1.8
How food prepared	1 cup of milk powder + 1 cup of H2O	140	36.7
	2 cup of milk powder + 1 cup of H2O	116	30.4
	1 cup of milk powder + 2 cup of H2O	125	32.8
What are the materials you used to give complementary feeding to the child?	Bottle	292	76.6
	Cup	83	21.8
	Mother's hand	1	0.3
	Spoon	5	1.3
Do you wash your hands when you are feeding your child?	Yes	368	96.5
	No	13	3.5

5.4. Dietary Diversity practice

The minimum acceptable dietary diversity score (MDDS) among children with cardiac disease was 11.5%, meaning 44 participants met this criterion. The MDDS assessment included the following food groups: starchy staples, legumes and nuts, dairy, organ meat, eggs, flesh foods, vitamin-A rich dark green leafy vegetables, other vitamin A-rich vegetables and fruits, and other fruits and vegetables. Among the participants, the most frequently consumed foods were starchy staples (99.7%) and legumes and nuts (77.4%) (**Table 5**).

Table 5: Dietary Diversity among children with cardiac disease in selected governmental hospitals and cardiac center in Addis Ababa, Ethiopia, 2024 (n = 381)

Food groups	Responses	Frequency	Percentage
Starchy Staples	Yes	380	99.7
	No	1	0.3
Legumes and Nuts	Yes	295	77.4
	No	86	22.6
Diary	No	370	97.1
	Yes	11	2.9
Any Organ Meat	Yes	19	4.9
	No	362	95.1
Any Eggs	No	357	93.7
	Yes	24	6.3
Flesh Foods	Yes	75	19.7
	No	306	80.3
Vitamin-A Rich Dark Green Leafy Vegetables	Yes	129	33.9
	No	252	66.1
Other Vitamin A-Rich Vegetables and Fruits:	Yes	67	17.6
	No	314	82.4
Other Fruits and Vegetables	Yes	108	28.3
	No	273	71.7

Under nutrition Among Children Compared to WHO Child Growth Standards

The "BMI for Age or Weight for Height" graph provides a detailed assessment of the nutritional status of children with cardiac disease in Addis Ababa, Ethiopia, based on data collected in 2024. The graph utilized WHO child growth standards for children aged birth to 60 months and WHO reference standards for children aged 61 months to 19 years. The high prevalence of stunting, wasting, and underweight among these children necessitates urgent nutritional interventions and strategies to improve their health outcomes. The results revealed the need for targeted policies to address the specific nutritional needs of these vulnerable children.

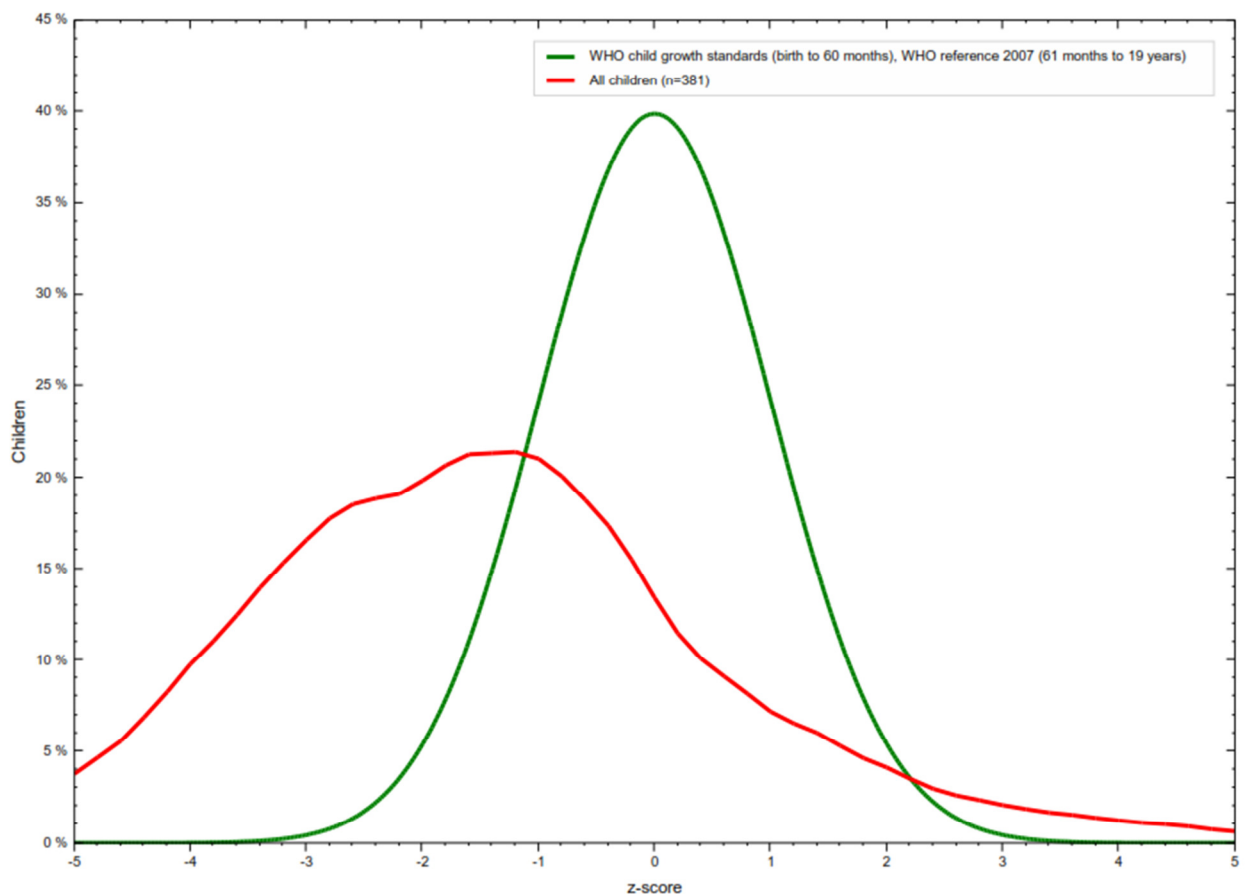


Figure 3 BMI for age or weight for height

The "Length/Height for Age" graph provides an overview of the growth status of children with cardiac disease in Addis Ababa, Ethiopia, as part of a study conducted in 2024. This

graph adheres to the WHO child growth standards for children aged birth to 60 months and the WHO reference standards for children aged 61 months to 19 years. The "Length/Height for Age" graph underscores the critical issue of stunting among children with cardiac disease in Addis Ababa, Ethiopia. The high prevalence of stunting across both younger and older age groups points to significant, long-term nutritional challenges. Addressing these issues requires targeted interventions to improve dietary diversity and overall nutritional intake, especially for children in rural areas and those under two years of age. The findings emphasize the need for comprehensive strategies to combat chronic malnutrition and promote healthy growth among these vulnerable children.

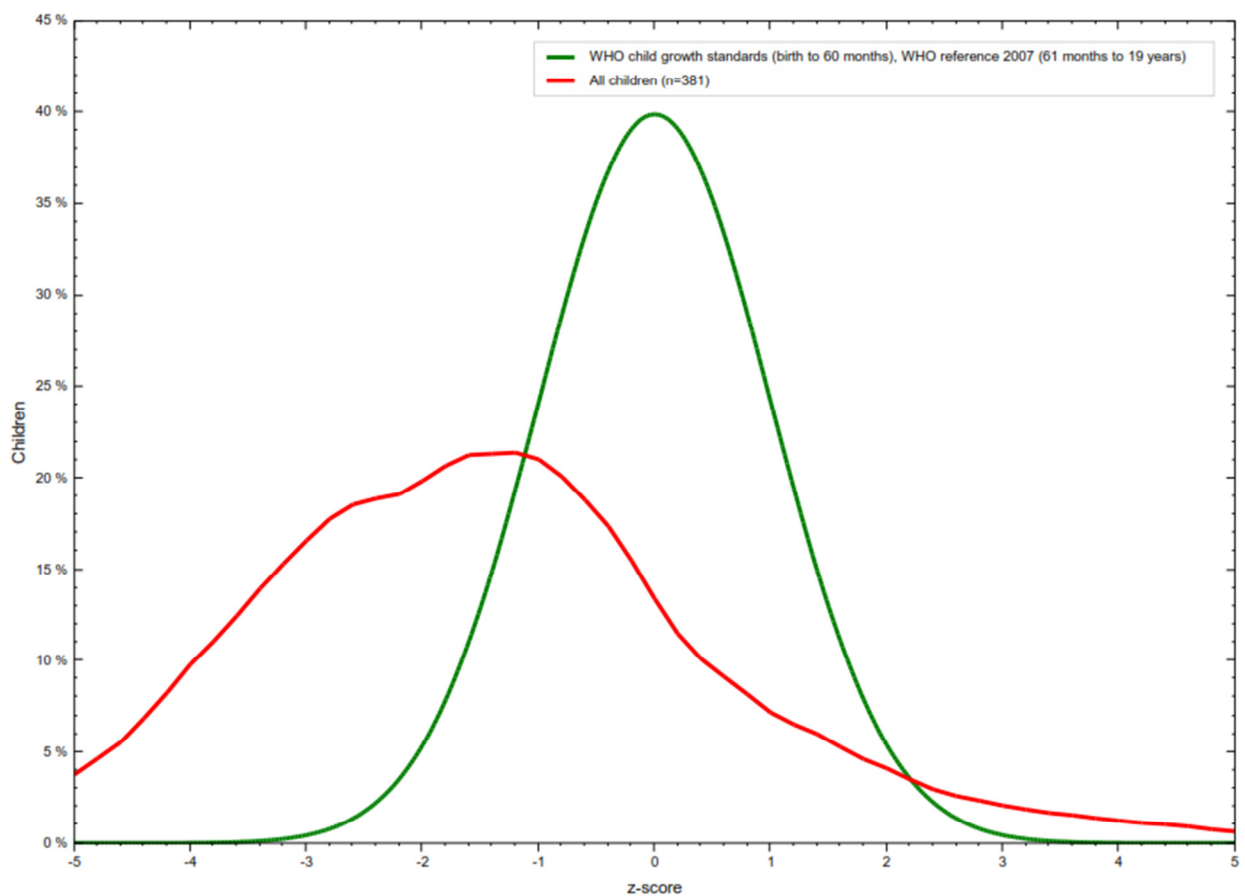


Figure 4 Length/Height for Age

The "Weight for Age" graph provides an analysis of the weight status of children with cardiac disease in Addis Ababa, Ethiopia, as part of a study conducted in 2024. This graph is based on the WHO child growth standards for children aged birth to 60 months

and the WHO reference standards for children aged 61 months to 19 years. The results revealed the critical issue of underweight among children with cardiac disease in Addis Ababa, Ethiopia. The high prevalence of underweight across both younger and older age groups points to significant, ongoing nutritional challenges. Addressing these issues requires targeted interventions to improve dietary diversity and overall nutritional intake, particularly for children in rural areas and those under two years of age. The findings highlight the urgent need for comprehensive strategies to combat malnutrition and promote healthy growth among these vulnerable children.

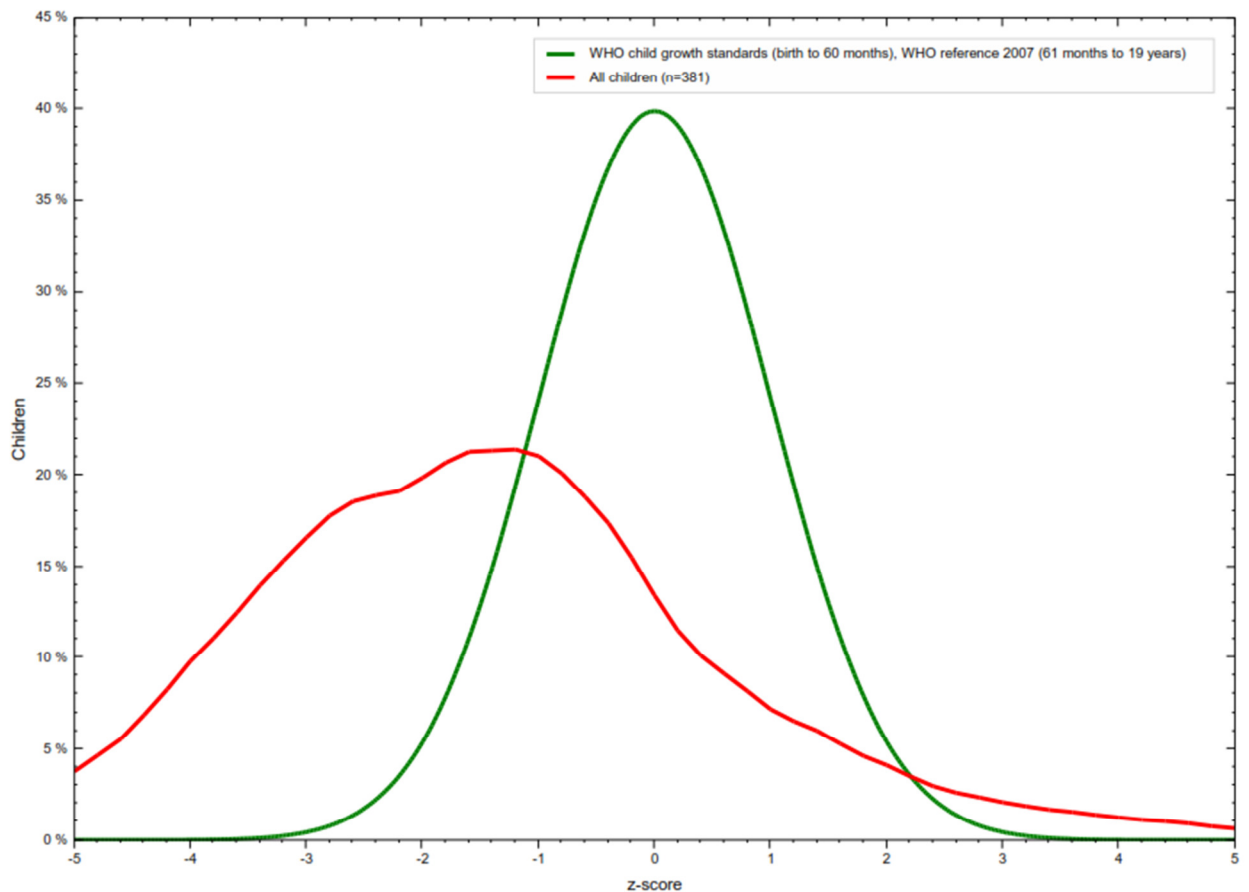


Figure 5 Weight for Age

5.5. Prevalence of Undernutrition among Children

In this study, the prevalence of stunting, wasting and underweight was 213 (55.91%, 95% CI 50.76, 60.96), 169 (44.36%, 95% CI: 39.30, 49.50), and 203 (53.28%, 95% CI: 48.13, 58.40), respectively. Among the participants, 201(52.76%) were five to nineteen years old children, of

them 47.26%, 45.27%, 42.29% encounter stunting, wasting and underweight, respectively (Figure 3).

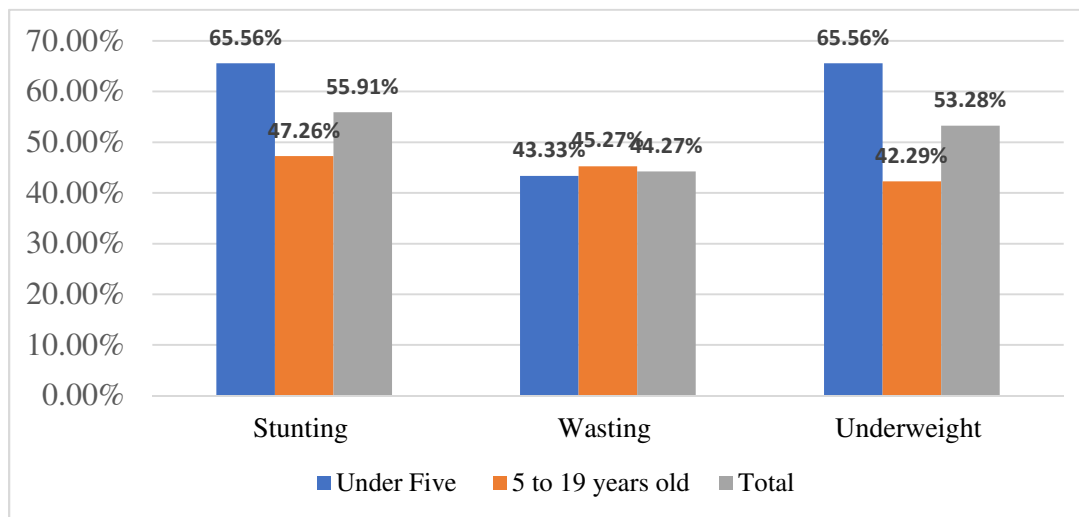


Figure 3: Prevalence of undernutrition among under five and five to 18 years old in Addis Ababa, Ethiopia, 2024 (nU5 = 180, n5to19=201, n=381)

5.6. Factors Associated with Stunting

In the multivariable analysis, residence, age of the child and minimum dietary diversity (MDD) were significantly associated with stunting. The odds of stunting among children with cardiac disease were 1.79 times (AOR: 1.79, 95% CI: 1.14, 2.81) higher among rural residents compared to urban dwellers. Under two years children were 1.96 times higher odds of encountering stunting (AOR: 1.96, 95% CI: 1.0, 4.21) compared to infants aged twelve years and above. In addition, the odds of stunting were 1.68 times (AOR: 1.68, 95%CI: 1.05, 2.68) higher among children who did not fulfil the MDD (**Table 6**).

Table 6: Factors associated with stunting among children with cardiac disease in selected governmental hospitals and cardiac centers in Addis Ababa, Ethiopia, 2024 (n = 381)

Variable	Category	Stunting		COR (95% CI)	AOR (95% CI)	P-value
		Yes	No			
Sex	Male	154	107	1.49(0.96, 2.30)	1.51(0.95, 2.41)	0.080
	Female	59	61	1	1	
Residence	Urban	126	119	1	1	
	Rural	87	49	1.68(1.09, 2.58)	1.79(1.14, 2.81)	0.012*
Age in month	≤ 24	63	30	1.95 (0.98, 3.88)	1.96 (1.0, 4.21)	0.051*
	25-59	55	32	1.60(0.80, 3.18)	1.50 (0.73, 3.06)	0.266
	60-143	67	80	0.78(0.42, 1.45)	0.73 (0.38, 1.39)	0.336
	≥ 144	28	26	1	1	
Heart failure	Mild	160	143	1	1	
	Moderate/severe	53	25	1.89(1.12, 3.21)	1.59 (0.91, 2.76)	0.104
Birth order	1 st	98	62	1.63(0.92, 2.89)	1.42(0.77, 2.60)	0.260
	2 nd	82	72	1.17(0.66, 2.08)	1.02(0.55, 1.86)	0.960
	3 rd and above	33	34	1	1	
MDD ^{\$}	Yes	134	125	1	1	
	No	79	43	1.71(1.10, 2.67)	1.68(1.05, 2.68)	0.030*

* Significant at P value < 0.05 , ^{\$} minimum dietary diversity, Howsmer Lemshow goodness of fit = 0.6380

5.7. Factors Associated with Wasting

After adjustment, sex of the child, heart failure, and MDD were independently associated with wasting. The odds of stunting were 2 times (AOR: 2.27, 95% CI: 1.39, 3.71) higher among male children compared to female counterparts. Children who encounter moderate to severe heart failure were 58% lower (AOR: 0.42, 95% CI: 0.24, 0.75) risk of wasting compared to children with mild heart failure. Furthermore, the odds of wasting were 1.6 times (AOR: 1.59, 95% 1.01, 2.53) higher among children who did consume adequate dietary diversity (**Table 7**).

Table 7: Factors associated with wasting among children with cardiac disease in selected governmental hospitals and cardiac centers in Addis Ababa, Ethiopia, 2024 (n = 381)

Variable	Category	Wasting		COR (95% CI)	AOR (95% CI)	P-value
		Yes	No			
Sex	Male	130	131	2.06(1.31, 3.24)	2.27(1.39, 3.71)	0.001*
	Female	39	81	1	1	
Residence	Urban	118	127	1	1	
	Rural	51	85	0.65(0.42, 0.99)	0.71(0.44, 1.11)	0.134
Age in month	≤ 24	52	41	1.47 (0.75, 2.89)	1.75(0.86, 3.57)	0.126
	25-59	26	61	0.49(0.24, 1.00)	0.53(0.25, 1.11)	0.091
	60-143	66	81	0.95(0.51, 1.78)	0.93(0.48, 1.79)	0.826
	≥ 144	25	29	1	1	
Maternal occupation	Employed	94	95	0.63(0.42, 0.95)	0.87(0.25, 3.03)	0.831
	Housewife	69	111	1.01(0.31, 3.25)	0.73(0.21, 2.57)	0.627
	Merchant	6	6	1	1	
Heart failure	Mild	144	159	1	1	
	Moderate/severe	25	53	0.52(0.31, 0.88)	0.42 (0.24, 0.75)	0.003*
Birth order	1 st	78	82	1.70(0.95, 3.07)	1.60(0.86, 2.99)	0.141
	2 nd	67	87	1.38(0.76, 2.49)	1.59(0.85, 3.01)	0.146
	3 rd and above	24	43	1	1	
MDD	Yes	106	153	1	1	
	No	63	59	1.54(1.01, 2.38)	1.59(1.01, 2.53)	0.050*
Comorbid disease	Yes	82	93	1.21(0.81, 1.81)	1.17(0.76, 1.82)	0.472
	No	87	119	1	1	

* Significant at P value < 0.05, Hosmer Lemeshow goodness of fit Prob. $\chi^2 = 0.2624$

5.8. Factors Associated with Underweight

After adjustment, sex, age, and MDD were significantly associated with underweight. The odds of underweight were 1.75 times (AOR: 1.75, 95% CI: 1.08, 2.84) higher among male children compared to female counterparts. The odds of underweight were 5 times (AOR: 4.75, 95% CI: 2.66, 8.48) and 2 times (AOR: 1.95, 95% CI: 1.13, 3.34) higher among children aged under twenty-four months and twenty-four to fifty-nine months compared to children aged 60 and above months. In addition, inadequate dietary diversity increases the odds of underweight by two-fold (AOR: 2.08 95% CI: 1.28, 3.37) (**Table 8**).

Table 8: Factors associated with underweight among children with cardiac disease in selected governmental hospitals and cardiac centers in Addis Ababa, Ethiopia, 2024 (n = 381)

Variable	Category	Underweight		COR (95% CI)	AOR (95% CI)	P-value
		Yes	No			
Sex	Male	149	112	1.63(1.05, 2.51)	1.75(1.08, 2.84)	0.023*
	Female	54	66	1	1	
Residence	Urban	133	112	1	1	
	Rural	70	66	0.89(0.58, 1.36)	0.93(0.59, 1.46)	0.750
Age in month	≤ 24	69	24	3.92(2.28, 6.75)	4.75 (2.66, 8.48)	0.001*
	24-59	49	38	1.76(1.06, 2.92)	1.95 (1.13, 3.34)	0.016*
	≥ 60	85	116	1	1	
Heart failure	Mild	157	146	1	1	
	Moderate/severe	46	32	1.34(0.81, 2.21)	1.08(0.62, 1.89)	0.789
Birth order	1 st	103	57	1.98(1.11, 3.52)	1.86(0.99, 3.47)	0.052
	2 nd	68	86	0.86(0.49, 1.54)	0.83(0.45, 1.55)	0.557
	3 rd and above	32	35	1	1	
MDD	Yes	123	136	1	1	
	No	80	42	2.12(1.34, 3.29)	2.08 (1.28, 3.37)	0.003*
Comorbid disease	Yes	96	79	1.12(0.75, 1.68)	1.01(0.61, 1.49)	0.843
	No	107	99	1	1	

* Significant at P value < 0.05, Hoesmer Lemshow goodness of fit, Prob. chi2 = 0.3167

6. Discussion

Under nutrition among children, particularly in children with cardiac disease is a major public health problem and increased the likelihood of child death (95). This study revealed that the prevalence of stunting, wasting and underweight among children with CHD was 55.91%, 44.36%, and 53.28%, respectively. In the current as well as previous studies children with cardiac disease have several reasons to have undernutrition such as metabolic demand, inadequate intake, associated comorbidities like recurrent respiratory infection, gut dysfunction and genetic syndromes. This study also identified the risk factors of each nutritional problems. Poor dietary diversity increases the likelihood of all the three nutritional problems. In addition, residence, age of the child increases the risk of stunting. Sex of the child, heart failure independently increases wasting. Furthermore, sex and age of the child increase the odds of underweight.

According this study, 55.91% of children were stunted. This finding is in line with the study conducted in Ethiopia (59.5%) (103), Indonesia (47.8%) (95). This higher than the studies conducted in Ethiopia (43%) (97), Dessie, Ethiopia (36.8%) (109), Gondar (39.7%) (96), Uganda (42.5%) (46), and China (21.3%) (100). These discrepancies could be attributed to the socio-demographic status of the participants, availability of nutritional interventions, the severity of the cardiac disease condition, and the health services difference in the countries.

According this study, 44.36% of children were wasted. This finding is in line with the study conducted in Ethiopia (41.3%) (97), and Gondar (53.9%) (96). this higher than the study conducted in China (29.7%) (100). On the other hand, this finding is lower that the study conducted in Ethiopia (54.1%) (103). The difference could be attributed to the condition of children, economic status of the family to fulfill their nutritional needs and food preparation skills.

According this study, 53.28% of children were underweight. This finding is in line with the studies conducted in Ethiopia (49.1-54.5%) (96, 97, 103), Indonesia (49%) (95). This higher than the studies conducted in Ethiopia (27.6%) (109), Indonesia (31.4%) (95), and China (36.1%) (100). These discrepancies could be attributed to the quality of care given for women and children starting from the preconception to the postpartum period.

This study also identifies factors associated with stunting, wasting and underweight. In our study, the odds of stunting, wasting, and underweight are 1.68, 2, and 1.6 times higher among children who did fulfill the minimum DDS as compared to their counterparts. This could be due to the fact that limited financial resources available to purchase a diverse and nutritious diet. Leads to less nutritious foods, leading to deficiencies in essential nutrients necessary for growth and development. A diet lacking in dietary diversity is less likely to provide all essential nutrients required for healthy growth, leading to all kinds of nutritional problems.

In this study, stunting among children with cardiac disease is 1.79 times higher among rural residents compared to urban dwellers. The possible justification is that inappropriate feeding practices is common in the rural communities that negative affect the child growth and development, especially in developing countries, where the accessibility of basic health service is not sufficient.

According to this study, under two years children are 1.96 times higher odds of encountering stunting compared to infants aged twelve years and above. In our study, the odds of underweight are five times and two times higher among children aged under twenty-four months and twenty-four to fifty-nine months compared to children aged 60 months and above. This could be due to the fact that under two years children are the most fragile age group and very sensitive to nutritional problems.

This study demonstrated that the odds of stunting were 2 times higher among male children compared to female counterparts. The odds of underweight are also 1.75 times higher among male children compared to female counterparts. This finding is supported by a number of studies in Ethiopia (94, 109) This could be due to the fact that in addition to the disease conditions males' growth and development is more influenced by environmental and nutritional stress than females.

This study demonstrated that children who encounter moderate to severe heart failure are 58% higher risk of wasting compared to children with mild heart failure this is supported by the study conducted in Gondar (96). The possible explanation is that as the disease advance it activates the sympathetic nervous system, leading to decreased appetite and increased caloric demand.

In general, this study identifies the burden of under nutrition among cardiac patients and associated factors. The findings are crucial to address these problems both at the clinical set-up and the communities

7. Strengths of the Study and limitations

Comprehensive Analysis: The study provides a detailed analysis of under nutrition, specifically focusing on stunting, wasting, and underweight among pediatric cardiac patients, offering a comprehensive understanding of these issues.

Large Sample Size: With 381 participants, the study boasts a robust sample size that enhances the reliability and generalizability of the findings within the target population.

Clinical Relevance: The findings have direct clinical implications, potentially guiding healthcare providers in better identifying and managing under nutrition among pediatric cardiac patients, thereby improving patient outcomes.

Limitations of the Study: this study is limited to hospitals and cardiac centers in Addis Ababa. Therefore, the results of this study could not be generalized to the countryside or other places. This study designs may potential for recall and social desirability bias in the frequency of dietary habits.

8. Conclusion and Recommendation

8.1. Conclusions

This study highlighted the he prevalence of under nutrition (stunting, wasting and underweight) very high in the study health facilities. Being rural residence, less than two years, and inadequate dietary diversity were significantly associated with stunting. Likewise, being male, encountering moderate to severe heart failure, and poor dietary diversity were independently associated with wasting. Being male, aged under twenty-four months and twenty-four to fifty-nine months, and inadequate dietary diversity were significantly associated with underweight.

Policy and Practice Implications: The study's results can inform policymakers and healthcare administrators about the prevalence and risk factors of under nutrition, aiding in the development of targeted interventions and standardized management protocols.

Foundation for Future Research: The study lays a solid foundation for future research, highlighting areas that require further investigation and encouraging the exploration of long-term implications of under nutrition in pediatric cardiac patients.

8.2. Recommendations

Based on the findings of this study, the following recommendations are provide.

- These results call for targeted interventions that address both the economic and healthcare needs of families. This could involve improving access to diverse and nutritious food, enhancing healthcare services in rural areas, and providing comprehensive management for children with comorbidities. These steps are crucial towards mitigating the high rates of malnutrition in this vulnerable population.
- Recommendations for health institute
 - Educate caregivers on proper preparation methods for complementary foods, ensuring adequate nutritional content and safety.
 - Offer continuous health education and counseling sessions for caregivers on optimal infant and young child feeding practices. Emphasize the importance of balanced nutrition and hygiene.
 - Implement community-based interventions that involve local healthcare providers, community health workers, and caregivers. This can ensure sustainable improvements in feeding practices and child nutrition.
 - Strengthen the integration of nutritional care into the overall management of cardiac patients, ensuring that it is a standard component of cardiac rehabilitation and follow-up programs.
 - Collaborate with healthcare providers to understand the specific nutritional needs and dietary requirements of the cardiac patient.
 - Encourage and assist the patient in adhering to prescribed nutritional supplements or specialized diets.

Recommendations for Researchers:

- Investigate the prevalence, risk factors, and underlying causes of wasting, stunting, and underweight in cardiac patients, considering factors such as disease severity, comorbidities, and socioeconomic status.
- Expand the study by increasing the number of participants and possibly changing the study design to enhance the robustness of findings.
- Explore the long-term implications of these nutritional issues on the overall health and quality of life of cardiac patients.
- Collaborate with healthcare professionals to establish standardized diagnostic criteria and assessment tools for the identification and monitoring of wasting, stunting, and underweight in cardiac patients.
- Translate research findings into clinical practice to improve patient care and outcomes.

References

1. 1. Liu Y, Huang Y, Xu C, An P, Luo Y, Jiao L, et al. Mitochondrial dysfunction and therapeutic perspectives in cardiovascular diseases. *Int J Mol Sci.* 2022;23(24):16053.
2. 3. Ombelet F, Goossens E, Willems R, Annemans L, Budts W, De Backer J, et al. Creating the BELgian COngenital heart disease database combining administrative and clinical data (BELCODAC): rationale, design and methodology. *Int J Cardiol.* 2020;316:72–8.
3. 4. Chinawa AT, Chinawa JM. Compendium of cardiac diseases among children presenting in tertiary institutions in southern Nigeria: a rising trend. *Libyan J Med.* 2021;16(1).
4. 5. Vyas PM, Oswal NK, Patel I V. Burden of congenital heart diseases in a tertiary cardiac care institute in Western India: Need for a national registry. *Hear India.* 2018;6(2):45–50.
5. 6. Musa NL, Hjortdal V, Zheleva B, Murni IK, Sano S, Schwartz S, et al. The global burden of paediatric heart disease. *Cardiol Young.* 2017;27(S6):S3–8.
6. 10. Laudari S, Subramanyam G. A study of spectrum of rheumatic heart disease in a tertiary care hospital in Central Nepal. *IJC Hear Vasc.* 2017;15:26–30.
7. 11. Bode-Thomas, F., Ige, O. O., & Yilgwan, C. (2013). Childhood acquired heart diseases in Jos, north central Nigeria. *Nigerian Medical Journal: Journal of the Nigeria Medical Association*, 54(1), 51.
8. 12. Nigussie B, Tadele H. Heart failure in Ethiopian children: mirroring the unmet cardiac services. *Ethiop J Health Sci.* 2019;29(1).
9. 13. Hewitson J, Zilla P. Children's heart disease in sub-Saharan Africa: challenging the burden of disease: children's heart disease. *Sa Hear.* 2010;7(1):18–29.
10. 14. Satpathy M, Mishra BR. Clinical diagnosis of congenital heart disease. Jaypee Brothers Medical Publishers; 2021.
11. 15. Zhang X, Sun Y, Zhu J, Zhu Y, Qiu L. Epidemiology, prenatal diagnosis, and neonatal outcomes of congenital heart defects in eastern China: a hospital-based multicenter study. *BMC Pediatr.* 2020;20(1):1–8.
12. 17. Arvind B, Ramakrishnan S. Rheumatic fever and rheumatic heart disease in children. *Indian J Pediatr.* 2020;87:305–11.
13. 18. World Health Organization. (2003). *Diet, nutrition, and the prevention of chronic diseases: Report of a joint WHO/FAO expert consultation* (Vol. 916). World Health Organization.

14. 22. Rana R, Mavalankar D V. Effectiveness of nutrition interventions on World Health Organization global nutrition targets: An evidence summary. *Indian J Community Med Off Publ Indian Assoc Prev Soc Med*. 2021;46(1):157.
15. 23. El-Koofy N, Mahmoud AM, Fattouh AM. Nutritional rehabilitation for children with congenital heart disease with left to right shunt. *Turk J Pediatr*. 2017;59(4).
16. 24. Arodiwe I, Chinawa J, Ujunwa F, Adiele D, Ukoha M, Obidike E. Nutritional status of congenital heart disease (CHD) patients: Burden and determinant of malnutrition at university of Nigeria teaching hospital Ituku–Ozalla, Enugu. *Pakistan J Med Sci*. 2015;31(5):1140.
17. 25. Zhang M, Wang L, Huang R, Sun C, Bao N, Xu Z. Risk factors of malnutrition in Chinese children with congenital heart defect. *BMC Pediatr*. 2020;20:1–7.
18. 26. Costello CL, Gellatly M, Daniel J, Justo RN, Weir K. Growth restriction in infants and young children with congenital heart disease. *Congenit Heart Dis*. 2015;10(5):447–56.
19. 27. Lenters L, Wazny K, Bhutta ZA. Management of severe and moderate acute malnutrition in children. *Reprod Matern newborn, child Heal Dis Control priorities 3rd Ed* Washington, DC World Bank. 2016;205–23.
20. 28. Shrivastava, S. (2008). Malnutrition in congenital heart disease. *Indian Pediatrics*, 45(7), 535.
21. 29. Amare H, Hamza L, Asefa H. Malnutrition and associated factors among heart failure patients on follow up at Jimma university specialized hospital, Ethiopia. *BMC Cardiovasc Disord*. 2015;15(1):1–6.
22. 30. Medoff-Cooper, B., & Ravishankar, C. (2013). Nutrition and growth in congenital heart disease: A challenge in children. *Current Opinion in Cardiology*, 28(2), 122–129.
23. 33. Omilola B, Sanogo NA. Health, nutrition, and economic development in Africa. *Public Heal Open J*. 2020;5(1):14–6.
24. 34. Organization WH, UNICEF. WHO/WB Joint Child Malnutrition Estimates (JME) group released new data for 2021. World Heal Organ <https://www.who.int/news/item/06-05-2021-the-unicef-who-wbjoint-child-malnutrition-estimates-group-released-new-data-for-2021>. 2022;
25. 35. Ricci C, Asare H, Carboo J, Conradie C, Dolman RC, Lombard M. Determinants

- of undernutrition prevalence in children aged 0–59 months in sub-Saharan Africa between 2000 and 2015. A report from the World Bank database. *Public Health Nutr.* 2019;22(9):1597–605.
26. 36. Rahman MA, Utamayasa IKA, Hidayat T, Irawan R, Elizabeth R. Antropometric Profile of Children with Cyanotic and non-Cyanotic Congenital Heart Disease. *Media Gizi Indones.* 2020;15(1):1–6.
 27. 44. Varan B, Tokel K, Yilmaz G. Malnutrition and growth failure in cyanotic and acyanotic congenital heart disease with and without pulmonary hypertension. *Arch Dis Child.* 1999;81(1):49–52.
 28. 45. Chen S-C, Yang Y-L, Wu C-H, Huang S-S, Chan WL, Lin S-J, et al. Association between preoperative nutritional status and clinical outcomes of patients with coronary artery disease undergoing percutaneous coronary intervention. *Nutrients.* 2020;12(5):1295.
 29. 46. Batte A, Lwabi P, Lubega S, Kiguli S, Otworld K, Chimoyi L, et al. Wasting, underweight and stunting among children with congenital heart disease presenting at Mulago hospital, Uganda. *BMC Pediatr.* 2017;17(1):1–7.
 30. 47. Rwebembera J, Beaton AZ, de Loizaga SR, Rocha RTL, Doreen N, Ssinabulya I, et al. The global impact of rheumatic heart disease. *Curr Cardiol Rep.* 2021;23:1–10.
 31. 48. Islam AKMM, Majumder AAS. Rheumatic fever and rheumatic heart disease in Bangladesh: a review. *Indian Heart J.* 2016;68(1):88–98.
 32. 49. Rabbani, A. (2014). Household food security in Bangladesh: Going beyond poverty measures. *Bangladesh Development Studies*, 37(1 & 2), 103–125.
 33. 50. Bhowmik J, Biswas RK, Hossain S. Child marriage and adolescent motherhood: A nationwide vulnerability for women in Bangladesh. *Int J Environ Res Public Health.* 2021;18(8):4030.
 34. 51. Desta TT, Gezachew A, Eshetu K. Descriptive Analysis of Rheumatic Heart Disease Related Complications in Pediatric Patients at Tertiary Hospital, Addis Ababa, Ethiopia. *Pediatr Heal Med Ther.* 2023;45–57.
 35. 52. Weisstaub, G., Medina, M., Pizarro, F., & Araya, M. (2008). Copper, iron, and zinc status in children with moderate and severe acute malnutrition recovered following WHO protocols. *Biological Trace Element Research*, 124, 1–11.

36. 53. Akhtaruzzaman, M., Khan, M. N. I., & Islam, S. N. (2013). Nutrition, health and demographic survey of Bangladesh-2011. Dhaka: Institute of Nutrition and Food Science, University of Dhaka.
37. 54. Syam DR, Yosy DS, Bakri A, Nova R. Epidemiologic profiles of subclinical rheumatic heart disease in children. *Paediatr Indones*. 2020;60(6):334–40.
38. 55. Larson-Nath C, Goday P. Malnutrition in children with chronic disease. *Nutr Clin Pract*. 2019;34(3):349–58.
39. 56. Slater N, Spader M, Fridgen J, Horsley M, Davis M, Griffin KH. Weaning from a feeding tube in children with congenital heart disease: a review of the literature. *Prog Pediatr Cardiol*. 2021;62:101406.
40. 57. Singh SK, Srivastava S, Chauhan S. Inequality in child undernutrition among urban population in India: a decomposition analysis. *BMC Public Health*. 2020;20(1):1–15.
41. 58. Anand PK, Kumar K. Skilling, Fulcrum of a Proactive Multidimensional Poverty Tracker Pathway. RIS, Discussion Paper; 2021.
42. 59. Mahdavi-Roshan M, Salari A, Hasandokht T, Rahbar-Taramsari M. Malnutrition status and associated factors in cardiac patients admitted to heart hospital, in the north of Iran. *Hosp Top*. 2019;97(2):60–5.
43. 60. Okoromah, C. A. N., Ekure, E. N., Lesi, F. E. A., Okunowo, W. O., Tijani, B. O., & Okeiyi, J. C. (2011). Prevalence, profile and predictors of malnutrition in children with congenital heart defects: A case-control observational study. *Archives of Disease in Childhood*, doi:10.1136/archdischild-2011-300176.
44. 61. Hassan BA, Albanna EA, Morsy SM, Siam AG, Al Shafie MM, Elsaadany HF, et al. Nutritional status in children with un-operated congenital heart disease: an Egyptian center experience. *Front Pediatr*. 2015;3:53.
45. 63. Van Der Linde, D., Konings, E. E. M., Slager, M. A., Witsenburg, M., Helbing, W. A., Takkenberg, J. J. M., ... Roos-Hesselink, J. W. (2011). Birth prevalence of congenital heart disease worldwide: A systematic review and meta-analysis. *Journal of the American College of Cardiology*, 58(21), 2241–2247. <https://doi.org/10.1016/j.jacc.2011.08.025>
46. 64. Assefa B, Tadele H. Severe acute malnutrition among unoperated Ethiopian children with congenital heart disease: a wake-up call to reverse the situation, a retrospective cross-sectional study. *Ethiop J Health Sci*. 2020;30(5).

47. 65. Marpaung LNSM, Tobing TCL, Saragih RAC. Characteristic quality of life children with rheumatic heart disease. *Open Access Maced J Med Sci*. 2021;9(T3):270–3.
48. 66. Longo-Mbenza, B., Bayekula, M., Ngiyulu, R., Kintoki, V. E., Bikangi, N. F., Seghers, K. V., ... Kizito, K. (1998). Survey of rheumatic heart disease in school children of Kinshasa town. *International Journal of Cardiology*, 63(3), 287–294. [https://doi.org/10.1016/S0167-5273\(98\)00060-8](https://doi.org/10.1016/S0167-5273(98)00060-8).
49. 68. Bain, L. E., Awah, P. K., Geraldine, N., Kindong, N. P., Siga, Y., Bernard, N., ... Tanjeko, A. T. (2013). Malnutrition in Sub-Saharan Africa: burden, causes and prospects. *Pan African Medical Journal*, 15(1). <https://doi.org/10.11604/pamj.2013.15.1.2536>
50. 70. Organization WH. Nutrition Landscape Information System (NLIS) country profile indicators: interpretation guide. 2019;
51. 71. Elizabeth KE, Rabiya N, Geetha V. Clinical Pattern and Malnutrition among Children with Congenital Heart Disease (CHD) Attending Two Centres Under the RBSK Scheme. *New Indian J Pediatr*. 2018;7(4):221–8.
52. 74. Babar, N. F., Muzaffar, R., Khan, M. A., & Imdad, S. (2010). Impact of socioeconomic factors on nutritional status in primary school children. *Journal of Ayub Medical College Abbottabad*, 22(4), 15–18.
53. 75. Kabir R, Islam S, Islam MS, Kader M. Mohammad Rocky Khan Chowdhury, Hafiz TA Khan, 2 Mamunur Rashid, 3.
54. 76. Eljamay SM, Elshalwi HE. *African Journal of Advanced Pure and Applied Sciences (AJAPAS)*. *Appl Sci*. 2022;1(3).
55. 79. Medoff-Cooper, B., Naim, M., Torowicz, D., & Mott, A. (2010). Feeding, growth, and nutrition in children with congenitally malformed hearts. *Cardiology in the Young*, 20(S3), 149–153.
56. 91. Asrade M, Shehibo A, Tigabu Z. Magnitude of undernutrition and associated factors among children with cardiac disease at University of Gondar hospital, Ethiopia. *BMC Nutr*. 2021;7:1–6.
57. 95. Murni IK, Patmasari L, Wirawan MT, Arafuri N, Nurani N, Sativa ER, Nugroho S, Noormanto. Outcome and factors associated with undernutrition among children with congenital heart disease. *PLoS One*. 2023 Feb 23;18(2):e0281753. doi:

- 10.1371/journal.pone.0281753. PMID: 36821565; PMCID: PMC9949631.
58. 96. Asrade M, Shehibo A, Tigabu Z. Magnitude of undernutrition and associated factors among children with cardiac disease at University of Gondar hospital, Ethiopia. *BMC nutrition*. 2021 Dec;7:1-6.
 59. 97. Tsega T, Tesfaye T, Dessie A, Teshome T. Nutritional assessment and associated factors in children with congenital heart disease-Ethiopia. *Plos one*. 2022 ;17(9):e0269518. DOI: 10.1371/journal.pone.0269518. PMID: 36149845; PMCID: PMC9506638.
 60. 98. Woldesenbet R, Murugan R, Mulugeta F, Moges T. Nutritional status and associated factors among children with congenital heart disease in selected governmental hospitals and cardiac center, Addis Ababa Ethiopia. *BMC Pediatr*. 2021 Dec 2;21(1):538. doi: 10.1186/s12887-021-03023-1. PMID: 34856935; PMCID: PMC8638350.
 61. 99. Xiaorui Ruan , et al, 2024, Associated factors of undernutrition in children with congenital heart disease: a cross-sectional study, 2024, *Sec. Pediatric Cardiology*, Volume 12 - 2024
 62. 100. Ruan X, Ou J, Chen Y, Diao J, Huang P, Song X, Wei J, Sun M, Shi H, Li L, Tang J, Liu H, Qin J. Associated factors of undernutrition in children with congenital heart disease: a cross-sectional study. *Front Pediatr*. 2024 Jan 29;12:1167460. <https://doi.org/10.3389/fped.2024.1167460>. PMID: 38348213; PMCID: PMC10859474.
 63. 101. Batte A, Lwabi P, Lubega S, Kiguli S, Otworld K, Chimoyi L, Nabatte V, Karamagi C. Wasting, underweight and stunting among children with congenital heart disease presenting at Mulago hospital, Uganda. *BMC Pediatr*. 2017 Jan 11;17(1):10. doi: 10.1186/s12887-017-0779-y. PMID: 28077108; PMCID: PMC5225644.
 64. 102. Batte A, Lwabi P, Lubega S, Kiguli S, Otworld K, Chimoyi L, Nabatte V, Karamagi C. Wasting, underweight and stunting among children with congenital heart disease presenting at Mulago hospital, Uganda. *BMC Pediatr*. 2017 Jan 11;17(1):10. doi: 10.1186/s12887-017-0779-y. PMID: 28077108; PMCID: PMC5225644.
 65. 103. Tesfaye K, Tsega T. Short-Term Impact of Cardiac Intervention on the Nutritional Status of Malnourished Children with Congenital Heart Disease – A Report from a Developing African Country, Ethiopia. *Pediatric Health Med Ther*. 2023;14:465-475, <https://doi.org/10.2147/PHMT.S431164>
 66. 104. Li Z, Kim R, Vollmer S, Subramanian SV. Factors Associated With Child Stunting,

Wasting, and Underweight in 35 Low- and Middle-Income Countries. *JAMA Netw Open*. 2020;3(4):e203386. doi:10.1001/jamanetworkopen.2020.3386

67. 105. Tang X, Zhao Y, Liu Q, Hu D, Li G, Sun J, Song G. The Effect of Risk Accumulation on Childhood Stunting: A Matched Case-Control Study in China. *Frontiers in Pediatrics*. 2022 May 31;10:816870.
68. 106. Sasaki KI, Fukumoto Y. Sarcopenia as a comorbidity of cardiovascular disease. *Journal of cardiology*. 2022 May 1;79(5):596-604.
69. 107. Soysaler, Cezara-Andreea, Cătălina Liliana Andrei, Octavian Ceban, and Crina-Julieta Sinescu. 2023. "Comorbidity Patterns in Patients at Cardiovascular Hospital Admission" *Medicines* 10, no. 4: 26. <https://doi.org/10.3390/medicines10040026>
70. 108. Tesfaye, K., & Tsega, T. (2023). Short-Term Impact of Cardiac Intervention on the Nutritional Status of Malnourished Children with Congenital Heart Disease—A Report from a Developing African Country, Ethiopia. *Pediatric Health, Medicine and Therapeutics*, 465-475.

ANNEXES

Assurance of Principal Investigator

I the undersigned agree to accept all responsibilities for the scientific and ethical conduct of the research project. I will provide timely progress report to my advisor and seek the necessary advice and approval from my primary advisors in the course of the research. I will communicate timely to my advisors all stakeholders involved in the study including any source of funding for this research.

Name of the student: _____

Signature: _____

Date: _____

Approval of the Primary Advisor

Name of the primary advisor: _____

Signature: _____

Date: _____

Approval of the Primary Co-Advisor

Name of the Co-advisor: _____

Signature: _____

Date: _____

Annexes

Annex I: Participants Information Sheet and Consent Form

Participants' information sheet

Dear participants:

My name is Benol Tefera and I am a cardio thoracic nurse student. I am currently doing my research on “nutritional status and associated factors among children with cardiac diseases in selected public hospital and cardiac center Addis Ababa, Ethiopia. “The purpose of this study is to assess the nutritional status and associated factors among children with cardiac diseases. Questionnaire is designed to collect data regarding your socio demographic characteristics and anthropometric measurement it is strictly for academic purposes. The collected data will only be used for the purpose of this study. Your correct and genuine response or answer to the questions can make the study achieve its goal. Therefore, you are kindly requested to respond very voluntarily with patience. The questionnaire may take 15 to 20 minutes. We assure you that this study is surely confidential, thus writing your name is not needed.

Email: benoltefera80@gmail.com

Cellphone +251939408680

Are you Volunteer to participate in this study? Yes No

Consent form

Code number _____

I'm clear with that the purpose of this study is to assess nutritional status and associated factors among children with cardiac disease. Similarly, I understand that participating in this study is completely voluntarily and my privacy is guaranteed and not exposed to the third party. I promise to answer honestly to all questions and not provide any false information or in any other way purposely mislead the researcher.

Signature of participant _____ Date _____

Name of the data collector who sought the consent_____ .

Annex II. Questionnaires

Directions: Please indicate your response by thick the appropriate information in the space provided. You can skip any questions that you feel are not applicable to you. Thank you!

Signature_____

Data collection instrument

PART TWO; Clinical factors of children with cardiac disease

S.NO			Remark
201	Duration of symptom before Diagnosis (in months)	< 6	
		> =6	

S.NO	Variables	Category	
101	Sex	Female	
		Male	
102	Residence	Rural	
		Urban	
103	Age (in months)	< 24	
		24–59	
		60–143	
		> =144	
104	Maternal occupation	Employed	
		Housewife	
		Merchant	
105	Maternal education	Unable to read& write	
		able to read& write	
		Primary education	
		Secondary education	
		Tertiary education &above	
106	Father education	Unable to read& write	
		Primary education	
		Secondary education	
		Tertiary education &above	
107	Individual feeding plate	1.yes	
		2. No	
108	Number of family members	< =3	
		4–5	
		6–7	
		8 and above	
110	No. of children	First	
		2nd	

202	Co morbid disease	Yes	
		No	
203	Frequency of follow up	Monthly	
		Every 3 month and above	
		Every 2 month	
204	Heart failure	No	
		Mild	
		Moderate to severe	
205	Chamber enlargement	Yes	
		No	
206	Pulmonary hypertension	Yes	
		No	
207	Type of cardiac disease	Congenital	
		Acquired	
208	Height		
209	Weight		

PART 3; maternal factor

Part 4 Child caring practice

No			Response
301	Maternal age	>=36	
302	Education level	Unable to read& write	
		Primary education	
		Secondary education	
		Tertiary education &above	
303	Income	ETB	
s.No	Questionnaires	Answers	
401	What is your child birth order?	-----	
402	Did you breast feed your child per day?	A. Yes B. No	
403	How many times you breastfeed your child per day?	-----	

404	Did you give your child only breast milk for the first 6 months?	1. Yes 2. No	
405	Did you give your child artificial feeding?		
406	What time you started the artificial feeding? (in months)	1. Yes 2. No	
407	What is the type of food you give as a Complementary feeding to your child?	A. Cow milk B. Milk powder C. Porridge D. Other kinds, (Specify)	
408	How you prepare it proportionally?	A. 1 cup of milk powder + 1 cup of H ₂ O B. 2 cup of milk powder + 1 cup of H ₂ O C. 1 cup of milk powder + 2 cup of H ₂ O	
	How many times you give it?		
409	What are the materials you used to give Complementary feeding to the child?	A. Bottle B. cup C. Mother's hand D. spoon	
410	Do you wash your hands when you are feeding your child?	A. Yes B. No	

Part 5 Dietary related questioner

S.NO	Food groups	Responses	Code
501	All starchy staples: white potatoes, yams,	Yes.....1	

	manioc, cassava or any other foods made from roots or tubers , bread, kita, porridge, injera, spaghetti ,kolo, rice, biscuits or any other foods made from maize, millet, wheat, teff, barely, oat, sorghum	No.....2	
502	All legumes and nuts: beans, peas, lentils, nuts, any other foods made from these group	Yes.....1 No.....2	
503	All diary: milk or other milk products, cheese, yogurt	Yes.....1 No.....2	
504	Any organ meat: Liver, kidney, heart or other organ meats or blood-based foods	Yes.....1 No.....2	
505	Any eggs	Yes.....1 No.....2	
506	Flesh foods and other miscellaneous small animal protein: any beef, lamb, goat, chicken, or other birds	Yes.....1 No.....2	
507	Vitamin-A rich dark green leafy vegetables: cabbage, lettuce, spinach	Yes.....1 No.....2	
508	Other vitamin A-rich vegetables and fruits: pumpkin, carrot, or sweet potato, red sweet pepper, lemon, avocado, mango, papaya or banana and 100% fruit juice made from these sources	Yes.....1 No.....2	
509	Other fruits and vegetables: wild fruits and 100% fruit juice made from these, tomato, onion and other locally available	Yes.....1 No.....2	

Part 6 Environmental Questionnaire

s.no	Question	Response	Code	
601	What is the source of Water?	1 Safe source 2.Unsafe source		
602	Have you hand washing practice of child's mother or children after	1 Not washed		

	toilet?	2 Using only water 3 Sometimes soap/ash Always soap/ash		
603	What is your Waste disposal system?	1 Proper 2. Improper		
604	Latrine availability in the house hold?	1 Unimproved facility 2. Improved facility		
605	Have you separated kitchen?	1 yes 2. No		

Annexes I: የተሳታፊዎች መረጃ ወረቀት እና የስምምነት ቅጽ የተሳታፊዎች መረጃ

ሉህ

ውድ ተሳታፊዎች:-

ስሜ ቤኖል ተፈራ እባላላሁ እና የካርዲዮ thoracic ነርስ ተማሪ ነኝ። በአሁኑ ጊዜ ምርምርዬን እያደረግሁ ነው “የልብ ሕመም ባለባቸው ሕፃናት መካከል ባለው የአመጋገብ ሁኔታ እና ተያያዥ ምክንያቶች በአዲስ አበባ፣ ኢትዮጵያ በተመረጠ የሕዝብ ሆስፒታል እና የልብ ማዕከል።” የዚህ ጥናት ዓላማ የልብ ሕመም ያለባቸውን ልጆች የአመጋገብ ሁኔታ እና ተያያዥ ምክንያቶችን ለመገምገም ነው። መጠይቁ የተነደፈው የእርስዎን ማህበራዊ ስነ-ሕዝብ ባህሪያት እና አንትሮፖሎጂንትሪክ መለኪያን የሚመለከቱ መረጃዎችን ለመሰብሰብ ነው። የተሰበሰበው መረጃ ለዚህ ጥናት ዓላማ ብቻ ጥቅም ላይ ይውላል። ለጥያቄዎች የሰጡት ትክክለኛ እና እውነተኛ ምላሽ ወይም መልስ ጥናቱ ግቡን እንዲመታ ያደርገዋል። ስለዚህ በትእግስት በጣም በፈቃደኝነት ምላሽ እንዲሰጡ በአክብሮት ተጠይቀዋል። መጠይቁ ከ15 እስከ 20 ደቂቃዎች ሊወስድ ይችላል። ይህ ጥናት በእርግጠኝነት ሚስጥራዊ መሆኑን እናረጋግጣለን፤ ስለዚህ ስምዎን መጻፍ አያስፈልግም።

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በዚህ ጥናት ለመሳተፍ ፈቃደኛ ነህ? አዎ አይ

ተ.ቁ	ተለዋዋጮች	ምድብ
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የፍቃድ ቅፅ

ኮድ ቁጥር _____

የዚህ ጥናት ዓላማ የልብ ሕመም ያለባቸውን ልጆች የአመጋገብ ሁኔታን እና ተያያዥ ሁኔታዎችን ለመገምገም እንደሆነ ግልጽ ነኝ. በተመሳሳይ፣ በዚህ ጥናት ውስጥ መሳተፍ ሙሉ በሙሉ በፈቃደኝነት እና ግላዊነት የተጠበቀ እና ለሶስተኛ ወገን ያልተጋለጠ መሆኑን ተረድቻለሁ። ለሁሉም ጥያቄዎች በሐቀኝነት መልስ ለመስጠት ቃል እገባለሁ እና ምንም ዓይነት የውሸት መረጃ ላለመስጠት ወይም በሌላ በማንኛውም መንገድ አጥኚውን ለማሳሳት ቃል እገባለሁ።

የተሳታፊ ፊርማ _____ ቀን _____

ፈቃዱን የጠየቀው የመረጃ ሰብሳቢ ስም _____

Annexes II መጠይቆች አቅጣጫዎች፡ እባክህ ምላሽህን በተሰጠው ቦታ ውስጥ ተገቢውን መረጃ በወፍራም አመልክት። ለእርስዎ የማይተገበሩ የሚመስሏቸውን ማንኛውንም ጥያቄዎች መዝለል ይችላሉ። አመሰግናለሁ!

ፊርማ _____

101	ጾታ	1. ሴት 2. ወንድ
102	መኖሪያ	1. ገጠር 2. ከተማ
103	ዕድሜ (በወራት ውስጥ)	
104	የእናቶች ሥራ	1. ተቀጠረ 2. የቤት እመቤት 3. ነጋዴ
105	የእናቶች ትምህርት	1. ማንበብ እና መጻፍ አልተቻለም 3. ማንበብ እና መጻፍ የሚችል 4. የመጀመሪያ ደረጃ ትምህርት 5. የሁለተኛ ደረጃ ትምህርት 6. ከፍተኛ ትምህርት እና በላይ
106	የአባት ትምህርት ደረጃ	1. ማንበብ እና መጻፍ አልተቻለም 2. የመጀመሪያ ደረጃ ትምህርት 3. የሁለተኛ ደረጃ ትምህርት 4. ከፍተኛ ትምህርት እና በላይ
107	የግለሰብ ምግብ ሰሃን	1 አዎ 2. አይ
108	የቤተሰብ አባላት ብዛት	1. <=3 2. 4-5 3. 6-7 4. 8 እና ከዚያ በላይ
	የልጆች ቁጥር	1. አንደኛ 2. ሁለተኛ

ክፍል ሁለት፣ የልብ ሕመም ያለባቸው ልጆች ክሊኒካዊ ምክንያቶች

ተ. ቁ	ጥያቄ		
201	ምልክቱ ከመመርመሩ በፊት የሚቆይበት ጊዜ (በወራት ውስጥ)	1. <6 2. ≥6	
202	ከ ሞራቢድ በሽታ	1. አዎ 2. አይ	
203	የክትትል ድግግሞሽ	1. ወርሃዊ 2. በየ 2 ወሩ 3. በየ 3 ወሩ እና ከዚያ በላይ	
204	የልብ ድካም	1. አይ 2. የዋህ 3. ከመካከለኛ እስከ ከባድ	
205	የልብ ክፍል መጨመር	1. አዎ 2. አይ	
206	የሳንባ የደም ግፊት	1. አዎ 2. አይ	
207	የልብ በሽታ ዓይነት	1. የተወለደ 2. ተገኘ	
208	ቁመት	cm	
209	ክብደት	cm	
210	የጭንቅላት ዙሪያ		
211	የሰውነት ክብደት ለዕድሜ		

ተ.ቁ	ጥያቄ		
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ተ. ቁ			
301	የእናቶች ዕድሜ		
302	የትምህርት ደረጃ	ማንበብ እና መጻፍ አልተቻለም	1.አዎ 2.አይ
		የመጀመሪያ ደረጃ ትምህርት	1.አዎ 2.አይ
		የሁለተኛ ደረጃ ትምህርት	1.አዎ 2.አይ
		ከፍተኛ ትምህርት ና በላይ	
303	ገቢ	ETB	

212	በላይኛው ክንድ ዙሪያ	cm	
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ክፍል 3; የእናትነት ሁኔታ

401	ልጅ ስነተገናልጂ ነው?	-----	
402	ልጅዎን በቀን ጡት አጠቡት	A. አዎ B. አይ	
403	ልጅዎን በቀን ስንት ጊዜ ጡት ያጠባሉ?	-----	
404	ለመጀመሪያ ጊዜ ለልጅዎ የጡት ወተት ብቻ ሰጥተውታል። 6 ወራት?	1. አዎ 2. አይ	
405	ለልጅዎ ሰው ሰራሽ አመጋገብ ሰጥተውታል?		
406	ሰው ሰራሽ አመጋገብን ስንት ሰዓት ጀመሩ? (በወራት)	1. አዎ 2. አይ	
407	እንደ እርስዎ የሚሰጡት የምግብ አይነት ምንድን ነው ለልጅዎ ተጨማሪ ምግብ?	A. ለም ወተት B. የወተት ዱቄት C. ገንፎ D. ሌሎች ዓይነቶች (ይግለጹ)	
408	በተመጣጣኝ ሁኔታ እንዴት ያዘጋጃሉ?	1. ኩባያ የወተት ዱቄት + 1 ኩባያውሃ 2. ኩባያ የወተት ዱቄት + 1 ኩባያ ውሃ 3. ኩባያ የወተት ዱቄት + 2 ኩባያ ውሃ	
	ምን ያህል ጊዜ ይሰጣሉ?		
409	ለልጁ ተጨማሪ ምግብ ለልጁ ተጨማሪ ምግብ ይጠቀምበት የነበረው ቁስ?	1. ጠርሙስ 2. ኩባያ 3. የእናት እጅ 4. ማንኪያ	

410	ልጅዎን በሚመገቡበት ጊዜ እጅዎን ይታጠቡ?	1. አዎ 2. አይ	
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ክፍል 5 ከአመጋገብ ጋር የተያያዘ ጠያቂ

ተ.ቁ	የምግብ ቡድኖች	ምላሾች
501	ሁሉም ስታረቸኪ ዋና ዋና ምግቦች፡ ነጭ ድንች፣ ያምስ፣ ማኒዮክ፣ ካሳሻ ወይም ማንኛውም ከስር ወይም ሀረጎችና የተሰሩ ምግቦች፣ ዳቦ፣ ኪታ፣ ገንፎ፣ እንጆራ፣ ስፓጌቲ፣ ኮሎ፣ ሩዝ፣ ብስኩት ወይም ከበቆሎ፣ ማሽላ፣ ስንዴ፣ ጤፍ , በጭንቅ, አጃ, ማሽላ	1. አዎ 2. አይ
502	ሁሉም ጥራጥሬዎች እና ለውዝ፡ ባቄላ, አተር, ምስር, ለውዝ, ከእነዚህ ቡድን የተሠሩ ሌሎች ማንኛውም ምግቦች	1. አዎ 2. አይ
503	ሁሉም ማስታወሻ ደብተር፡ ወተት ወይም ሌላ የወተት ተዋጽኦዎች, አይብ, እርጎ	1. አዎ 2. አይ
504	ማንኛውም የአካል ክፍል ስጋ፡- ጉበት፣ ኩላሊት፣ ልብ ወይም ሌላ የሰውነት አካል ስጋ ወይም ደም ላይ የተመሰረቱ ምግቦች	1. አዎ 2. አይ
505	እንቁላል	1 አዎ 2. አይ
506	የስጋ ምግቦች እና ሌሎች የተለያዩ ትናንሽ የእንስሳት ፕሮቲን፡- ማንኛውም የበሬ ሥጋ፣ በግ፣ ፍየል፣ ዶሮ ወይም ሌሎች ወፎች	1.አዎ 2. አይ
507	ሻይታሚን-ኤ የበለፀገ ጥቁር አረንጓዴ ቅጠላማ አትክልቶች፡ ጎመን, ሰላጣ, ስፒናች	1. አዎ 2. አይ
508	ሌሎች በሻይታሚን ኤ የበለጸጉ አትክልቶችና ፍራፍሬዎች፡ ዱባ፣ ካሮት ወይም ድንች ድንች፣ ቀይ ጣፋጭ በርበሬ፣ ሎሚ፣ አሸካይ፣ ማንጎ፣ ፓፓያ ወይም ሙዝ እና 100% የፍራፍሬ ጭማቂ	1. አዎ 2. አይ
509	ሌሎች ፍራፍሬዎችና አትክልቶች፡ የዱር ፍራፍሬ እና 100% የፍራፍሬ ጭማቂ፣ ቲማቲም፣ ሽንኩርት እና ሌሎች በአገር ውስጥ ይገኛሉ	1.አዎ 2.አይ

ክፍል 6 የአካባቢ መጠይቅ

ተ.ቁ	ጥያቄ	ምላሽ	
601	የዉሃ መጠጥ መጠጥከየት ታገኛለቹ?	1.አስተማማኝ ምንጭ 2. ደህንነቱ ያልተጠበቀ ምንጭ	
602	ከመጻዳጃ ቤት በኋላ የልጅ እናት ወይም ልጆች የእጅ መታጠብ ልምድ አለዎት?	1.አልታጠበም። 2.ውሃ ብቻ መጠቀም 3.አንዳንድ ጊዜ ሳሙና / አመድ 4.ሁል ጊዜ ሳሙና/አመድ	
603	የእርስዎ የቆሻሻ አወጋገድ ስርዓት ምንድን ነው?	1.ትክክለኛ 2. ትክክል ያልሆነ	
604	በመኖሪያ ቤት ውስጥ የመጻዳጃ ቤት መኖር?	1.ያልተሻሻለ መገልገያ 2. የተሻሻለ መገልገያ	