CLINICAL PROFILES, INITIAL MANAGEMENT AND OUTCOMES OF MALNOURISHED CHILDREN PRESENTING TO THE EMERGENCY MEDICINE DEPARTIMENT OF MUHIMBILI NATIONAL HOSPITAL, DAR ES SALAAM

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By

Prosper Bashaka

A dissertation / Thesis Submitted in (Partial) Fulfilment of the Requirement for the Degree of Master of Medicine (Emergency Medicine) of the

Muhimbili University of Health and Allied Sciences
October, 2017

CERTIFICATION

The undersigned certify that he has read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences of a dissertation entitled: **"*Clinical profiles, Initial management and Outcomes of malnourished children under 5 years presenting to Emergency Department of Muhimbili National Hospital Dares salaam - Tanzania*"** in (partial) fulfilment of the requirement for the degree of Master of Medicine (Emergency Medicine) of the Muhimbili University of Health and Allied Sciences.

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DECLARATION AND COPYRIGHT

I, **Prosper Bashaka**, declare that this dissertation is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature ……..……. **Date**…….

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DEDICATION

This work is dedicated to my beloved wife Stella Prince Mwankenja, thank you for encouragement and love that gave me strength to pursue my dream and my lovely sister Witness Jasson Bashaka (Specialist in Public Health, Nutrition and Food Safety) for encouragement and emotional support that made me follow my dreams.

ABSTRACT

Background: In Tanzania, the burden of malnourished children presenting to Emergency Departments, their management and outcomes are unknown.

Aim of the study: To describe the clinical profiles, initial management and outcomes of acutely ill malnourished children aged under 5 years presenting to the Emergency Medicine Department of Muhimbili National Hospital (EMD-MNH).

Methods and Material: This was an eight weeks prospective cohort study of children aged 1-59 months presenting to the EMD-MNH from July, 2016 and August, 2016. A consecutive sample of children under 5years were screened using standardized World Health Organization (WHO) growth charts ('Weight for Height/length', 'Height for Age', and 'Weight for Age'), children below minus one SD z-score were recruited. Case report forms (CRF) were completed to obtain demographic, clinical presentation, initial interventions and outcomes of the enrolled children. Data was summarized using descriptive statistics and analyzed using counts, percentages, median, interquartile ranges (IQR), 95% confidence interval (CI), relative risk (RR) and P-value.

Results: A total of 449 children were screened, of which 153 (34.1%) met definitions for malnutrition. 146 (95.4%) were enrolled. Of those enrolled, 42 (28.8%) mild, 51 (34.9%) moderate, and 53 (36.3%) had severe malnutrition. 46 (31.5%) were under 12 months old. Common co-morbidities included congenital heart disease 29 (19.9%), cerebral palsy 19 (12.8%), and hydrocephalus 5 (3.4%). The most common complaints were fever 36 (24.7%), cough 35 (24%) and weight loss 28 (19.2%). Within 24-hours follow up, 4 (2.9%) children died. At 30 days, 18 (13.3%) children had died, and eleven (7.5%) lost to follow up. Malnourished children under 5 years with low AVPU score (GCS <15) had statistical significance increased risk of mortality.

Conclusion and Recommendation: More one third of acutely ill children under 5 years presenting to EMD-MNH have malnutrition, and mortality rate in these children is high. EMD physician should be educated on early recognition and management of malnourished children to optimise outcome

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LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
ALT	Alanine Transferase
AST	Aspartate Transferase
AVPU	Alert, Verbal, Pain, Unresponsive
BP	Blood Pressure
CHD	Congenital Heart Diseases
CNS	Central Nervous System
CP	Cerebral Palsy
CRF	Case Report Form
CVS	Cardiovascular System
CXR	Chest X-ray
EBF	Exclusive Breastfeeding
ED	Emergency Department
E-FAST	Extended - Focused Assessment with Sonography for Trauma
EMD	Emergency Medicine Department
FBP	Full Blood Picture
GCS	Glasgow Coma Scale
Hb	Haemoglobin
HC	Head Circumference
HCC	Health Care Centre
HEENT	Head, Eyes, Ear, Nose and Throat
HFA	Height for Age
HIV	Human Immunodeficiency Virus
ID.No	Identification Number
IRB	Institutional Review Board
IVD	Immunization and Vaccination Development
IVF	Intravenous Fluids
LMICs	Low - and Middle-Income Countries

MNH	Muhimbili National Hospital
MoH	Ministry of Health
MR.No	Medical Record Number
mRDT	malaria Rapid Diagnostic Test
MUAC	Mid-Upper Arm Circumference
MUHAS	Muhimbili University of Health and Allied Sciences
MZRH	Mbeya Zonal Referral Hospital
NRBM	Non Re-breather Mask
PR	Pulse Rate
PTB	Pulmonary Tuberculosis
RBG	Random Blood Glucose
ReSoMaL	Oral Rehydration Solution for Malnutrition children
RR	Relative Risk
RS	Respiratory System
RUTFs	Ready to Use Therapeutic Foods
SA	South Africa
SAM	Severe Acute Malnutrition
SD	Standard Deviation
SES	Social Economical Status
SSA	Sub-Saharan Africa
UNICEF	United Nations Children's Fund
USA	United State of America
USS	Ultrasound
VBG	Venous Blood Gases
WBC	White Blood Cell
WFA	Weight For Age
WFH	Weight for Height
WHO	World Health Organization

DEFINITION OF KEY TERMS

Acutely ill malnourished children: Children aged 0 to 59 months whose weight for height (WFH)or Height for Age (HFA) or Weight for Age (WFA) is less than minus one Standard Deviation (< -1SD) presenting at acute intake areas or casualty (1,2).

Immunization: A medical process of inducing immunity against a specific disease (2).

Mild malnutrition: Malnutrition in children aged 0-59 months measured by WFH or WFA or HFA- ≤ 2SD score<-1SD (1–3).

Moderate malnutrition: Malnutrition in children age 0-59 months measured by WFH or WFA or HFA -3≤ SD score <-2SD (1–3).

Severe malnutrition: Malnutrition in children age 0-59 months measured by WFH or WFA or HFA< -3SD (1–3).

CHAPTER ONE

1.0 INTRODUCTION

Malnutrition is a debilitating condition, which affects multiple organs and entire body system, including impairment of the immune system (2,4). This predisposes children to opportunistic infections and an increased risk of severe illness including sepsis, acute upper respiratory infection and pneumonia (2,4,5). This causes most of the acutely ill, malnourished children to present to acute intake areas or casualty with life threatening medical conditions such as dehydration, shock, hypoglycaemia, hypothermia, severe infections, electrolyte abnormalities, and/or micronutrient deficiencies, all of which require prompt and dedicated care to optimize their outcomes (2,5,6). Most children with malnutrition will not be recognized until the time of acute illness by trained health care providers or at presentation to acute intake areas (7). Early recognition, stabilization and treatment of acutely ill malnourished children at acute intake area or emergency department (ED) have shown to improved survival within the first 48 hours of presentation (8). However there is a wide variability both in terms of care, resources, and local protocols. Furthermore, most of these settings lack dedicated emergency care protocols or management strategies, and there are few documented reports on the clinical presentation and management of malnourished children under age 5 years presenting to the Emergency Medicine Department (EMD) (8).

In Tanzania, Muhimbili National Hospital (MNH) is the only public hospital with a full capacity EMD. Emergency medicine is a new specialty with six (6) years since its establishment (9). Emergency medicine physicians have the opportunity for early recognition, stabilization, treatment, and proper disposition of acutely ill, malnourished children, thereby potentially reducing morbidity and mortality (7,9,10). However, the characteristics, management and outcomes of acutely ill, malnourished children in the EMD-MNH are unknown. Thus, this study aims to describe the clinical profiles, initial management and outcomes of acutely ill, malnourished children under the age of 5 years when presenting at EMD-MNH.

1.1 Literature review

Globally, it is estimated that 195 million children under the age of 5 years are affected with malnutrition, and more than 50% these children are residing in Southern Asia while and 33% lives in sub-Saharan Africa (SSA) (11–13). The 2013 United Nations Children's Funds report on the burden of childhood mortality states that 6.6 million children died worldwide, of those died, more than 50% under age of 5 years death each year were complicated by malnutrition while the remaining were caused by diarrhoea illness and pneumonia (1) The Millennium Development Goals, 2015 report; Goal Number 2 states that malnutrition remains a major co-morbidity in children under the age of 5 years that contributes to significant morbidity and mortality (14). The Sustainable Development Goals also highlight malnutrition as a major barrier to child health (15). In Tanzania, the burden of childhood malnutrition under the age of 5 years has improved from 44% in 1999 to 30% in 2014 (11,16). Despite this significant improvement, the in hospital mortality rate of 8% is still unacceptably high compared to World Health Organization (WHO) rate of less than 5% amongst this population (16).

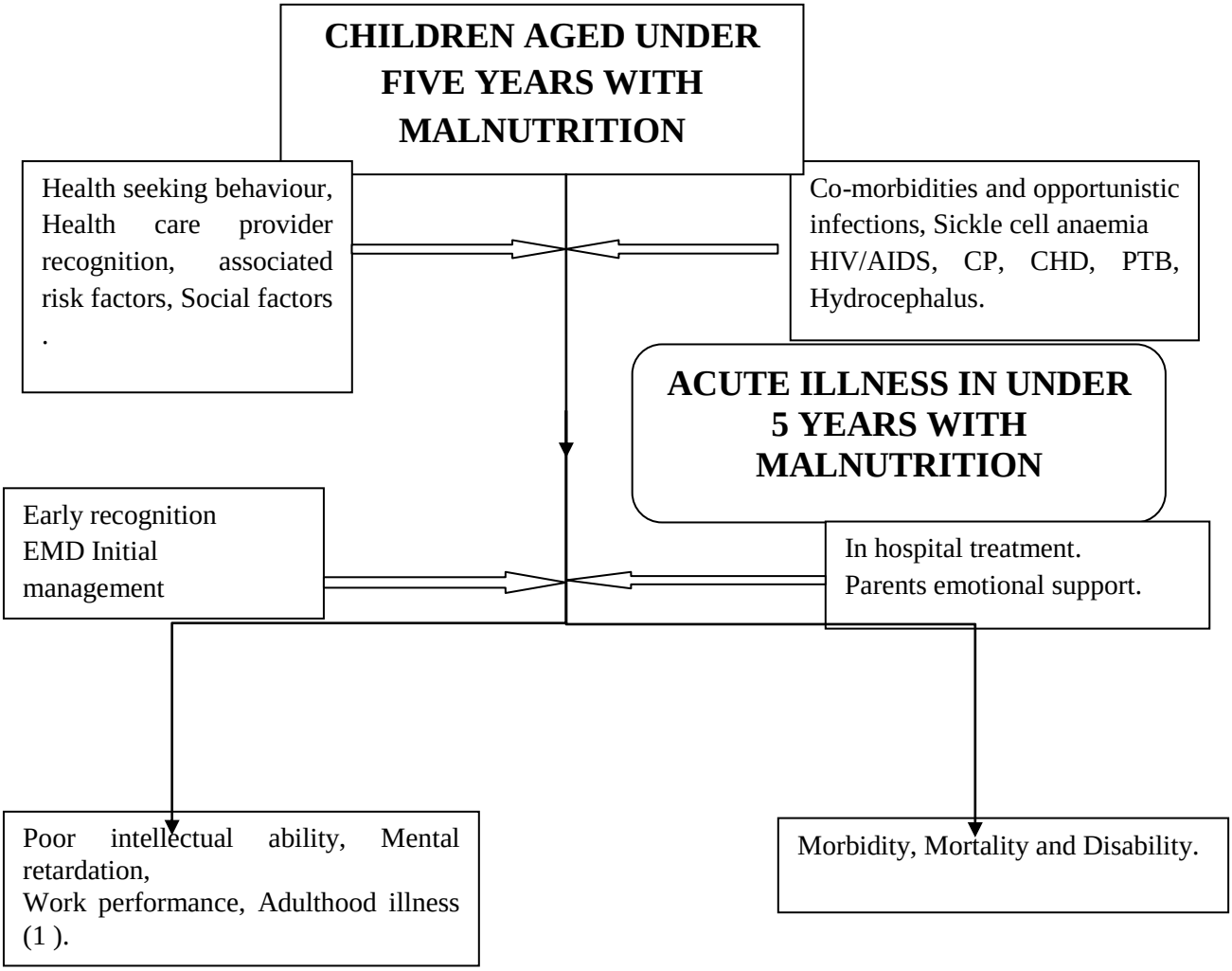
In low and middle income countries (LMICs), children have disproportionately high rates of malnutrition for several identified risk factors; family socioeconomic status, mother's level of education, access to health care, number of siblings in the family, poor feeding practices, immunization status and seasonal and or month variations (17–19). The disproportional rate is also affected by other disease conditions which are more prevalent in LMICs; diarrhoea, pneumonia, malaria, HIV/AIDS, sickle cell anaemia, and congenital malformations like heart diseases (16,20–22). A hospital based retrospective study conducted by *Ubesie et al* in Nigeria looking at prevalence, risk factors, co-morbidities, and mortality in malnourished children under 5 years showed that diarrhoea and malaria were the most associated common infections co-morbidities by 72.2% and 43.9% respectively, followed by pneumonia, severe anaemia, tuberculosis and HIV/AIDS (23). Additionally, *Sa'ad et al* who studied morbidity and mortality patterns at a Paediatric Emergency Unit in a Tertiary Hospital in North Eastern Nigeria, found that malnutrition was the second most common cause of admission and death in the paediatric population, the most common being malaria (24). Furthermore, children

under age of 5 years with congenital abnormities of the heart disease, central nervous system (cerebral palsy and hydrocephalus) are at high risk of developing malnutrition because of in ability to feed and poor digestive metabolism (20,21) . To the best of researcher's knowledge, there are no documented clinical data on malnourished childhood mortality in the EMD as compared to both widely available in-hospital and community data. The recent multi-centre study by *Ngallaba et al* looking on the effectiveness of treatment and outcome of in hospital malnourished children of Mwanza city showed that the mortality rate was 8% in those using WHO guideline (16,25).

The management of children with acute malnutrition (moderate or severe forms) varies from one centre to another in SSA, and it depends on severity, associated complications and available resources. For example, the department of health in SA has a dedicated protocol used for children with malnutrition when present to ED and it has shown improvement of survival *(Appendix 4)* (8), however most acute intake areas or EDs in Tanzania use the combined WHO recommended protocol for outpatients, inpatients and community-based protocol for uncomplicated acutely malnourished children (6,26,27)**.** In addition to the WHO protocol, the initial management of these children may involve routine laboratory tests for all children with a diagnosis of acute malnutrition to assist in the diagnosis of acute life threatening conditions, unknown co-morbidities, disease complications and treatment response (5,8,26).

In Tanzania, the role of the EDs in the management acute malnutrition has not been documented, and there are no standardized guidelines for the assessment and management of these children when they present at the acute care areas or EDs . Emergency medicine is a recognized specialty in Tanzania that is rapidly growing across the country, and provides an opportunity for incorporating the management of childhood malnutrition when children present with acute illness (9). However, the clinical profiles, initial management and outcomes of acutely ill, malnourished children under age of 5 presenting to the EMD remains unknown.

1.2 Conceptual framework



Conceptual Framework: This conceptual framework displays the risk factors, associated co-morbidities, healthcare provider practice and knowledge, and healthcare system issues that relate to morbidity and mortality in malnourished children with acute illness (1,5,6,8,11,16–19,24,27).

1.3 Problem statement

Malnutrition continues to be a serious public health problem worldwide. In Sub-Saharan Africa (SSA), Tanzania is the country with the 3rd highest rate of malnutrition, with a 30% childhood malnutrition rate and an 8% mortality rate despite the improved prevalence of malnutrition from 38% in 2004 to 30% in 2014 (11,16). Amongst acute malnutrition, severe acute malnutrition (SAM) carries the highest risk of mortality as compared to moderate acute malnutrition (28,29). Acutely ill, malnourished children present to the hospital with medical emergencies complicated by dehydration, shock, hypothermia, hypoglycaemia, infections, and metabolic or electrolyte imbalances leading to high mortality (5). These conditions are potentially manageable with well-equipped, trained providers and proper early recognition and management of the condition (8).

The role of ED in the management of malnutrition is not well defined in the literature and guidelines from authoritative world bodies or textbooks. However, acute intake areas are more likely to attend these patients who present with undifferentiated illness, and hence early recognition of malnutrition is very vital (8).

In Tanzania, similar to other developing countries, there is no standardized approach in the management of acutely ill malnourished children when presenting at acute intake areas or ED but these facilities commonly use the general WHO ten steps approach (5,6). MNH is the only public hospital with full capacity EMD that attends to a substantial portion of acutely ill children (9), some of whom are acutely malnourished. However, the clinical profiles, initial management strategies and outcomes of acutely ill malnourished children under age of 5 years remain unknown.

1.4 Rationale

The care of malnourished children is different from well-nourished children and such differences in care are even greater when they present with acute illnesses in the ED (5). Overtreatment and under treatment can result in poor outcomes (28). Initial stabilization of children with malnutrition often starts in the EMD and the care has been shown to greatly impact the outcome for these children in the first 48 hours of hospitalization (8). This study aims to describe clinical characteristics, initial management interventions and outcomes of acutely ill, malnourished children who present to the EMD-MNH. The results of this study will shed light on the burden of acutely ill children with malnutrition seeking care at EMD-MNH and various acute intake care areas in Tanzania. Furthermore, the results will provide an opportunity to clearly define the role of Emergency Medicine in providing initial management for children with acute illnesses which is crucial to assisting the providers in the development of guidelines for managing these children in EMD.

1.5 Research question

What are the clinical profile, initial management, and outcomes of acutely ill, malnourished children under age of 5 years presenting to the Emergency Medicine Department (EMD) at Muhimbili National Hospital (MNH)?

1.6 Study Objectives

1.6.1 Broad objective

To describe the clinical profiles, initial management, and outcomes of acutely ill, malnourished children under age of 5 years presenting to the Emergency Medicine Department of Muhimbili National Hospital.

1.6.2 Specific objectives

1. To determine the proportion of acutely ill, malnourished children aged 1 month -59 months presenting to the EMD-MNH.
2. To describe common clinical presentations and initial EMD management of acutely ill malnourished children aged 1month -59 months presenting at EMD-MNH.
3. To describe risk factors and co-morbidities associated with acutely ill malnourished children aged 1month -59 months presenting at EMD-MNH.
4. To describe the disposition, EMD mortality, and in-hospital mortality of acutely ill, malnourished children ages 1month -59 months presenting to the EMD.

CHAPTER TWO

2.0 STUDY METHODS AND MATERIALS

2.1 Study design

This was a descriptive prospective cohort study of acutely ill, malnourished children aged between 1 month-59 months presenting at EMD-MNH conducted from July, 2016 to August, 2016

2.3 Study settings

The study was conducted at the EMD-MNH, located in the Ilala-District of Dar es Salaam, Tanzania. MNH serves as a National Referral Hospital, Research Centre and University Teaching Hospital. The hospital has 29 departments, EMD inclusive. EMD-MNH is the only public, full capacity EMD in Tanzania. It is the receiving department for all acutely and clinically ill emergency referral cases to MNH. The department operates 24 hours and attends 150 to 200 critically ill patients a day, with approximately 25% being children below the age of 18 years. The department is staffed by Emergency Medicine specialists who oversee the care provided by residents, registrars and intern doctors. The critical care nurses supervise nursing care of the patients. Paediatric patients are cared for in resuscitation and treatment rooms specially dedicated for only children. In these rooms senior residents and registrars render care to patients under direct supervision of the specialist.

2.4 Target population

Acutely ill, malnourished children under the age of 5 years presenting to acute intake areas of tertiary referral hospital in Tanzania.

2.5 Accessible population

Acutely ill, children under age of 5 years presenting to the Emergency Medicine Department-Muhimbili National Hospital - Dar es Salaam.

2.6 Study population

Acutely ill, malnourished children aged 1 month - 59months presenting to the Emergency Medicine Department - Muhimbili National Hospital and whose parent or caretaker consented to participate in the study.

2.7 Study subjects

2.7.1 Inclusion criteria

- The study included acutely ill malnourished children aged between 1 month-59 months presenting at EMD - MNH

2.7.2 Exclusion criteria

- The study excluded children whose parents/caretaker did not consent, or were not able to communicate in Swahili or English to provide consent, as our hospital does not have interpreter services.
- The study excluded children who were dead on arrival to the EMD-MNH, as they proceed directly to the mortuary and were not available to be evaluated for malnutrition.

2.8 Variables of interest

For all patients who met inclusion criteria and consented, the following data were collected.

- Child and parent demographic data: age, sex, address, level of education, occupation, marital status, and number of siblings in the family.
- Place of delivery: home, health care centre (HCC).
- Immunization status as per IVD program: immunised, not immunized.
- Exclusive breast feeding (EBF): still breast feeding, 6 weeks or > 6 months.
- Anthropometric measurements: weight, height or length, weight/height ratio, weight for age ratio and height/age ratio.

- Child's clinical presentation: lower limb/ body swelling, abdominal pain/distension, failure to thrive, weight loss, fever, diarrhoea, vomiting, abdominal pain, poor feeding, difficulty in breathing, cough and skin lessions.
- Duration of illness: ≤ 2 weeks, > 2 weeks
- Child's vital signs: systolic blood pressures (SBP), pulse rate (PR), respiratory rate, temperature (T), Oxygen saturation (SPO2), AVPU score (GCS).
- Child's laboratory investigations: random blood glucose (RBG), malaria Rapid Diagnostic Test (mRDT), electrolytes (Na, K), haemoglobin (Hb), white blood cells (WBC), rapid HIV test, lactate and pH
- Child's co-morbidities: HIV/AIDS, PTB, congenital heart disease (CHD), cerebral palsy (CP), hydrocephalus.
- Initial EMD management: fluid bolus- normal saline (NS)/ringer lactate (RL) for dehydration and or shock resuscitation, dextrose solution for hypoglycaemia antibiotics, electrolyte repletion (K, Na), oxygen therapy and rewarming.
- Disposition: Died at EMD, admitted in paediatrics wards or discharged home
- Final physician diagnosis.
- Mortality: EMD, 24-hours, 48-hours, 30-days, and overall mortality.

2.9 Study sampling

The consecutive sampling technique was used to enrol all acutely ill malnourished children aged 1month - 59 months presenting at EMD-MNH, meeting inclusion criteria available during the study time.

2.10 Sample size

The sample size of this study was estimated using Kish &Lisle formula. In-hospital mortality rate for malnourished children in Tanzania using the WHO protocol was found to be 8 % (16). Since MNH is also in Tanzania and uses the WHO protocol, the mortality rate of 8%was a good estimate used to calculate the sample size.

$N = ((Z^2P (100-P))/E2$

Whereby,

N= Minimum sample size

Z = Standard normal deviate which is 1.96 for 95% confidence interval (CI).

P = The mortality rate of malnutrition in children aged under 5 years in Tanzania, 8% (16).

E = Margin of error (which is 5%)

$N= (((1.96)^2 * 8 (100-8)/ (5)^2)))$

N=114

NOTE. Assuming a 10% loss to follow-up rate

ADJUSTING FOR NON RESPONSE= N * Adjusted factor

= 114* (100/100-10) =127

Therefore, the minimum required sample size was 127 children presenting at EMD-MNH.

2.11 Data management

Data collection tool

Case report form **(**CRF) with pre written patient information was used to collect information of all legible children from parents or caretaker and patient's chart (*Appendix 1*). The CRF were printed and given identification numbers. Each of the CRF was completed for each acutely ill malnourished child aged between 1month-59 months who present at EMD.

Patient recruitment, data collection and confidentiality

Enrolment of study participants was completed by the principal investigator together with one trained research assistant, who completed CRF by recording all participants' information aged 1 month -59 months presenting at EMD-MNH during the study period. The patient's information was obtained both from patient computerized data chart WELLSOFT (Version 11,

Wellfsoft Corporation, Somerset, NJ, USA), and by interviewing parent or caregiver during the study time. The patient's body weight and height/length were also collected. With the help of parent or caretaker child's body weight was measured using standardized *mechanical baby weighing scale*, adjusted to zero before patient measurement while patient height/length was measured using standardized *Height-Length measuring board (shorrBoard)*. The obtained measurement was used to calculate WFH, WFA and HFA. Using WHO standardized growth chart the obtained WFH, WFA and HA were used to interpret the type of malnutrition by estimating the appropriate Z-score as either mild when Z score is -2 ≤SD score -1<SD, moderate when – 3 ≤ SD score <-2or severe when SD score <-3) malnutrition (*Appendix* 7). All admitted acutely ill, malnourished children were followed up in the specific specialized admitted ward and through direct cell phone call with caregiver to determine their treatment outcome at EMD, 24-hours, and 30-days. The information and data collected from parent or caregiver and WELLSOFT hospital information system were known to the research team participating in this study. All data were treated with strict confidentiality, stored in a locked cabinet and in the computer with password known by the researcher only.

2.12 Data analysis

The study data from the written CRF were entered into Microsoft Office Excel, 2007 spread data sheet (Microsoft Corporation, Redmond, WA, USA) for analysis. Using excel spread data sheet patient's descriptive statistics (counts, median, interquartile range (IQR), sum and percentages) of demographic characteristics, clinical features, initial management and outcomes of acutely ill malnutrition children were computed to summarize the results. An online calculator for calculating-confidence interval for proportions was used to obtain 95% confidence interval (CI) and relative risk (RR) for significance of various variables (30). Multiple cross tabulation were obtain between child's or parent's demographics, clinical features, child's malnutrition risk factors, initial management interventions at EMD and types of under-five malnutrition. P-values of < 0.05 was considered statistically significant.

2.13 Ethical consideration

Ethical clearance was sought from Muhimbili University of Health and Allied Sciences' Institutional Review Board (MUHAS-IRB), and permission to collect data was obtained from relevant authorities of MUHAS, and MNH. Parents or caretaker of all acutely ill malnourished children aged 1 month -59 months were given an opportunity to participate in the study, and those who provided written and informed consent were enrolled in the study. The data collected were not disclosed to any person without direct involvement in the study research team. The data were handled with strict confidentiality, stored in a locked cabinet and in a protected computer with passwords known by researchers only.

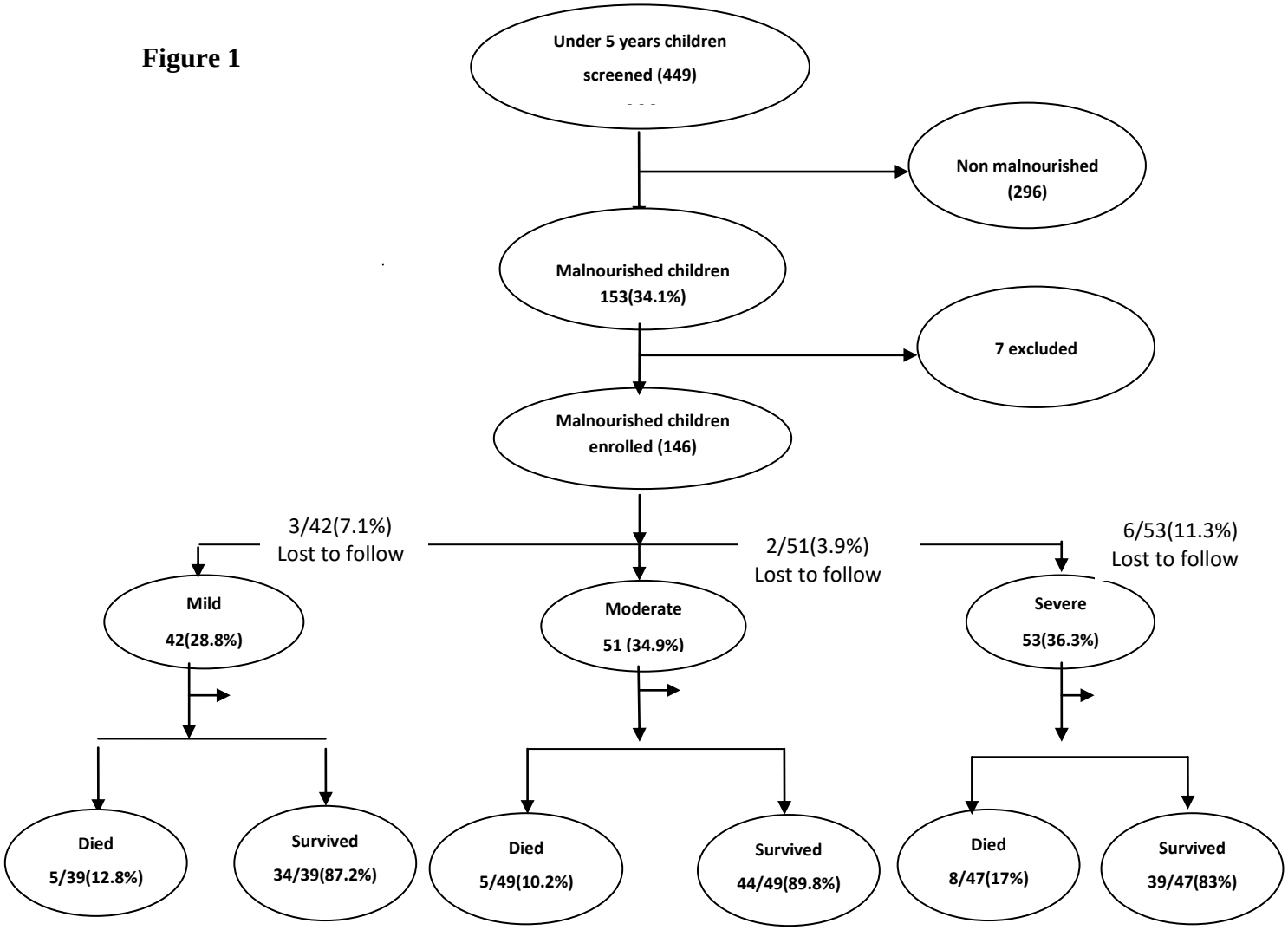
CHAPTER THREE

3.0 STUDY RESULTS

3.1 Malnourished children under 5 years prospective cohort study flow chart

During the study period, 449 children under 5 years who presented to EMD were screened. Of these 153 (34.1%) had malnutrition as defined by our criteria. Among children under 5 years with malnutrition, 146 were enrolled and 7 excluded due to lack of consent. Among those enrolled, 42 (28.8%) had mild, 51 (34.9%) moderate, and 53 (36.3%) had severe malnutrition **(Figure 1).** At 30 days, 18 (13.3 %) malnourished children died, and eleven (7.5%) patient were loss to follow up.

Figure 1



3.2 Demographic characteristics of malnourished children under 5 years.

Among the 146 under 5 years with malnutrition enrolled in the study, 82 (56.2%) were male. The overall median age was 19months (IQR=10-31 months), and 46 (31.5%) were aged 1-12 months and almost half of malnourished children (45.5%) had more than 2 weeks duration of illness. Ninety-nine (68.5%) children were referral from peripheral health facilities (**Table1)**.

Table 1.Demographic characteristics and types of malnutrition

Characteristics	**Overall (N=146)** n (%)	**Mild (N=42)** n (%)	**Moderate (N=51)** n (%)	**Severe (N =53)** n (%)
Age in groups				
1-12 month	46(31.5%)	8(19.0%)	13(25.5%)	25(47.2%)
13-24 month	39(26.7%)	16(38.1%)	16(31.4%)	7(13.2%)
25-36 month	29(19.9%)	6(14.3%)	13(25.5%)	10(18.9%)
37-48 month	20 (13.7%)	5(11.9%)	7(13.7%)	8(15.1%)
49-59 month	12(8.2%)	7(16.7%)	2(3.9%)	3(5.7%)
Child's sex				
Male	82(56.2%)	22(52.4%)	31(60.8%)	29(54.7%)
Duration of illness				
Less than 2 weeks	81(55.5%)	24(57.1%)	35(68.6%)	22(41.5%)
More than 2 weeks	65(44.5%)	18 (42.9%)	16(31.4%)	31(58.5%)
Referred status				
Referred	100(68.5%)	31(73.8%)	26(51.0%)	43(81.1%)
Self referral	46(31.5%)	11(26.2%)	25(49.0%)	10(18.9%)

3.3 Risk factors of malnourished children under 5 years.

Majority (94.4%) of children enrolled in this study were born in hospital and 145 (99.3%) were immunized as per IVP guideline. Furthermore, 117 (80.1%) children were exclusively breastfed for six (6) week. CHDs, 29 (19.9%) was the most common co-morbid identified (**Table2)**.

Table 2.Malnutrition risk factors and types of malnutrition

Risk factors	Over all (N=146) n/N (95%CI)	Mild(N=42) n/N(95%CI)	Moderate(N=51) n/N(95%CI)	Severe(N=53) n/N(95%CI)
Child's co-morbidities				
Congenital heart disease (CHDs)	29/146(19.9%CI 14.2- 27.1%)	4/42(9.5%CI 4-22%)	8/51(15.7%CI 8-28%)	17/53(32.1%CI 21-45%)
Cerebral palsy (CP)	19/146(13.0%CI 8.5-19.4%)	4/42(9.5% CI 4-22%)	7/51(13.7%CI 7-26%)	8/53(15.1%CI 8-27%)
Hydrocephalus	5/146(3.4%CI 1.5-7.8%)	0	4/51(7.8%CI 3-19%)	1/53(1.9% CI 0.3-2%))
Pulmonary tuberculosis	1/146(0.7%CI 0.1-3.8%)	0	0	1/53(1.9% CI 0.3-2%))
HIV/AIDS	1/146(0.7% CI 0.1-3.8%)	0	0	1/53(1.9%CI 0.3-2%)
Others (e.g. bone malformations)	3/146(2.1%CI 0.7-5.9%)	1/42(2.4%CI 0.4-12%)	2/51(3.9%CI 1-13%)	0
EBF time				
Still breast feeding,	23/146(15.8%CI 10.7-22.5%)	2/42(4.8%CI 1-16%)	7/51(13.7%CI 7-26%)	14/53(26.4%CI 16-40%)
Six(6) weeks	117/146(80.1%CI 72.9-85.8%)	39/42(92.9%CI 81-98%)	42/51(82.4%CI 70-90%)	36/53(67.9%CI 55-79%)
Less than six(6) week	4/146(2.7%CI 1.1-6.8%)	1/42(2.4%CI 0.4-12%)	1/51(2.0%CI 0.4-10%)	3/53(5.7%CI 2-15%)
Not applicable	2/146(1.4%CI 0.4-4.9%)	0	1/51(2.0% CI 0.4-10%))	1/53(1.9%CI 0.3-2%)
Immunization history				
Immunized	145/146(99.3%CI 96.2-100%)	42/42(100%CI 92-100%)	5/51(98.0%CI 4-21%)	53/53(100%CI 93-100%)
Not immunized	1/146(0.7%CI 0.1-3.8%)	0	1/51(2.0% CI 0.4-10%)	0

3.4 Clinical features of malnourished children under 5 years

Fever was the most frequent presenting complain seen in 36 (24.7%) of the enrolled children while lower limb swelling (6.2%) and poor feeding (6.2%) were the least common complaints. Most, 77 (58.8%) of the enrolled children had abnormal findings on exposure (**Table 3).**

Table 3.Chief complaints and frequency of abnormal findings of primary assessment

Clinical presentation	Overall(N=146) n/N(95%CI)	Mild(N=42) n/N (95%CI)	Moderate(N=51) n/N(95%,CI)	Severe(N=53) n/N (95%CI)
Chief complains				
Fever	36/146(24.7%CI 18.4-32.2%)	14/42(33.3%CI21-48%)	13/51(25.5%CI 16-39%)	9/53(17.0%CI 9-29%)
Cough	35/146(24.0%CI 17.8-31.5%)	9/42(21.4%CI 12-36%)	12/51(23.5%CI 14-37%)	14/53(26.4%CI 16-40%)
Weight loss	28/146/(19.2%CI 13.6-26.3%)	7/42(16.7%CI 8-31%)	8/51(15.7%CI 8-28%)	13/53(24.5%CI 15-38%)
Difficulty in breathing	26/146(17.8%CI 12.5-24.8%)	7/42(16.7% CI 8-31%)	7/51(13.7% CI 7-26%)	13/53(24.5% CI 15-38%)
Failure to thrive	15/146(10.3%CI 6.3-16.3%)	2/42(4.8%CI 1-16%)	7/51(13.7%CI 7-26%)	6/53(11.3%CI 5-23%)
Primary assessment				
Airway	3/145(2.1%CI 0.7-5.9%)	2/42(4.8%CI 1-16%)	0	1/53(1.9%CI 0.3-10%)
Breathing	25/145(17.2%CI 12.0-24.2%)	4/42(9.5%CI 4-22%)	8/50(16.0%CI 8-29%)	12/53(22.6%CI 13-36%)
Circulation	9/144(6.3%CI 3.3-11.5%)	3/42(7.1%CI 2-19%)	3/49(6.1%CI 2-17%)	3/53(5.7% CI 2-15%)
Disability (AVPU score)*	23/141(16.3%CI 11.1-23.3%)	8/42(19.0%CI 10-33%)	8/48(16.7%CI 9-30%)	7/51(13.7%CI 7-26%)
Exposure	77/131(58.8%CI 50-66.8%)	23/41(56.1%CI41-70%)	22/44(50.0%CI 36-64%)	32/46(69.6%CI 55-81%)

* AVPU- Alert, Verbal, Pain and Unresponsive

3.5 EMD initial intervention (abnormal vital signs and laboratory values)

Overall, 9/144 (6.3%) of children had hypoxia, 29/146 (19.9%) high temperature, and 35/142 (24.6%) were tachycardic. 19/35 (54.3%) had lactate >2, 3/58 (5.2%) were hypoglycaemic, 29/39 (74.4%) had hyponatremia and 12/39 (30.8%) had hypokalemia (**Table4)**.

Table 4.Abnormal vital signs and laboratory findings with forms of malnutrition

Clinical findings	**Overall(N=146) n/N(%)**	**Mild(N=42) n/N(%)**	**Moderate(N=51) n/N(%)**	**Severe(N=53) n/N(%)**
Abnormal vital signs				
Temperature >37.5^{o}C	29/146(19.9%)	8/42(19.0%)	9/51(17.6%)	12/53(22.6%)
Tachycardia**	35/142(24.6%)	11/41(26.8%)	14/49(28.6%)	10/52(19.2%)
Bradycardia**	5/142(3.5%)	1/41(2.4%)	2/49(4.1%)	2/52(3.8%)
Bradypnea, **	8/143(5.6%)	5/41(12.2%)	2/50(4.0%)	1/52(1.9%)
Hypoxia (SPO_2<90%)	9/144(6.3%)	1/41(2.4 %)	2/50(4.0%)	6/53(11.3%)
Low AVPU (GCS <15)	23/143(16.1%)	8/42(19.0%)	8/48(16.7%)	7/51(13.7%)
Hypoglycaemia <3.5mmol/l	3/58(5.2%)	1/16(6.3%)	1/15(6.7%)	1/27(3.7%)
Acidemia (< 7.35)	17/38(44.7%)	4/10(40.0%)	6/13(46.2%)	7/15(46.7%)
Lactate (>2)	19/35(54.3%)	8/10(80.0%)	4/11(36.4%)	7/14(50.0%)
Hypokalemia **	12/39(30.8%)	2/11(18.2%)	5/12(41.7%)	5/15(33.3%)
Hyponatremia **	29/39(74.4%)	8/11(72.7%)	9/12(75.0%)	12/16(75.0%)
Haemoglobin (< 10.9g/dl)	37/48(77.1%)	13/15(86.7%)	11/13(84.6%)	13/20(65.0%)

Normal values (31,32); ****** Abnormal values per age,:

3.6 EMD initial management in malnourished children under 5 years.

Most of children received antibiotics 37 (25.3%), and fluid bolus [normal saline (NS)/ ringer lactate (RL)] 24 (16.4%) while the least intervention was potassium chloride given to 5 (3.4%) of children (**Table 5).**

Table 5.Initial intervention in malnourished children under 5 years

Intervention	**Overall** n/N(95%CI)	**Mild** n/N(95%CI)	**Moderate** n/N(95%CI)	**Severe** n/N(95%CI)
Medication/Fluids				
Oxygen therapy	18/146(12.3%CI 7.9-18.7%)	3/42(7.1%CI 2.5-19.0%)	6/51(11.8%CI 5.5-23.4%)	9/53(17.0%CI 9.2-29.2%)
Dextrose solution	8/146(5.5%CI 2.8-10.4%)	3/42(7.1%CI 2.5-19.0%)	3/51(5.9%CI 2.0-15.9%)	2/53(3.8%CI 1.0-12.8%)
Fluid (NS/RL)	24/146(16.4%CI 11.3-23.3%	6/42(14.3%CI 6.7-27.9%)	10/51(19.6%CI11.0-32.5%)	8/53(15.1%CI 7.9-27.1%)
Antibiotic	37/146(25.3%CI 19.0-33.0)	9/42(21.4%CI 11.7-35.9%)	11/51(21.6%CI 12.5-34.6%)	17/53(32.1%CI 21.1-45.5%)
Antipyretic	17/146(11.6%CI 7.4-17.9%)	6/42(14.2%CI 6.7-27.9%)	8/51(15.7%CI 8.2-28.0%)	3/53(5.7%CI 2.0-15.4%)
Potassium chloride	5/146(3.4%CI 1.5-7.8%)	1/42(2.4%CI 0.4-12.3%)	1/51(2.0%CI 0.4-10.3%)	3/53(5.7%CI 1.9-15.4%)

3.7 EMD physician's diagnosis and mortality outcome in malnourished children under 5 years.

Among the ten (10) most common physicians diagnoses, CHDs 28 (20.7%) had the highest frequency, and pneumonia 15 (11.1%) while acute malnutrition was diagnosed in only 9 (6.7%) of the children **(Table 6).**

Table 6.EMD physician's final diagnosis and mortality Outcome

Provider's Diagnosis	Number of cases	Died	Survived	RR (95%CI)	P value
Congenital, heart diseases	28/135(20.7%)	2/18(11.1%)	26/117(22.2%)	0.477(0.12-1.96)	0.304
Pneumonia	15/135 (11.1%)	3/18(16.7%)	12/117(10.3%)	1.600(0.52-4.89)	0.410
Cerebral palsy	12/135 (8.9%)	1/18(5.6%)	11/117(9.4%)	0.603(0.09-4.14)	0.607
Acute malnutrition	9/135 (6.7%)	3/18(16.7%)	6/117(5.1%)	2.800(0.99-7.91)	0.052
Tumors	9/135(6.7%)	2/18(11.1%)	7/117(6.0%)	1.750(0.47-6.45)	0.401
Diarrhea	8/135(5.9%)	0/18(0.0%)	8/117(6.8%)	0.384(0.03-5.87)	0.492
Nasal polyps	8/135 (5.9%)	0/18(0.0%)	8/117(6.8%)	0.384(0.03-5.87)	0.492
Hernia	7/135 (5.2%)	0/18(0.0%)	7/117(6.0%)	0.436(0.03-6.59)	0.549
Upper respiratory tracts infection	6/135 (4.4%)	0/18(0.0%)	6/117(5.1%)	0.502(0.03-7.50)	0.617
Anaemia	6/135(4.4%)	0/18(0.0%)	6/117(5.1%)	0.502(0.03-7.50)	0.617

3.8 EMD disposition plan and mortality outcomes of malnourished children under 5 years.

The majority of children 104 (71.2%) were admitted in the hospital wards. Of those, 4 (2.9%) died within 24-hours of EMD stay while overall mortality was 13.3% (**Table 7).**

Table 7.Disposition and mortality outcomes of malnourished children under 5 years

Clinical variables	**Malnourished n/N(%)**	**95% CI**
Admitted	104/146(71.2%)	63.4%-78.0%
EMD discharge	39/146(26.7%)	20.2%-34.4%
EMD mortality	3/146(2.1%)	0.7%-5.9%
24 hours in hospital mortality	4/137(2.9%)	1.1%-7.3%
48 hours in hospital mortality	6/137(4.4%)	2.0%-9.2%
30 days in hospital mortality	14/135(10.4%)	6.3%-16.7%
Overall mortality	18/135(13.3%)	8.6%-20.1%

3.9 The relationship between severity, clinical variables of malnutrition, and mortality outcome of malnourished children under 5 years.

There was statistically significant association between mortality, and children who presented to EMD with low AVPU score (GCS <15) (P-value=0.000) **(Table 8).** No association was found between mortality and severity of malnutrition.

Table 8. The association between severity, clinical variables, and mortality outcome

Clinical variables	Overall	Died	Survived	RR (95%CI)	P-value
Mild malnutrition	39/135(28.9%)	5/18(27.8%)	34/117(29.1%)	0.947(0.36-2.48)	0.911
Moderate malnutrition	49/135(36.3%)	5/18(27.8%)	44/117(37.6%)	0.675 (0.26-1.78)	0.427
Acute malnutrition	47/135(34.8%)	8/18(44.4%)	39/117(33.3%)	1.498 (0.63-3.54)	0.357
Low AVPU score (GCS <15)	21/132(15.6%)	8/18(44.4%)	13/114(11.4%)	4.229 (1.89-9.45)	0.000
Fever (T <35.5^{o}C)	1/135(0.7%)	0/18(0%)	1/117(0.9%)	1.824 (0.16-20.88)	0.629
Fever (T >37.5^{o}C)	28/135(20.7%)	5/18(27.8%)	23/117(19.7%)	1.470 (0.57-3.78)	0.424
Hypotension	8/21(38.1%)	3/8(37.5%)	5/13(38.5%)	0.975 (0.32-3.01)	0.965
Bradycardia	5/134(3.7%)	1/18(5.6%)	4/116(3.4%)	1.518(0.25-9.26)	0.651
Tachycardia	34/134(25.3%)	10/18(55.5%)	24/116(21.6%)	3.677(1.58-8.55)	0.003
Bradypnoea	8/133(6.0%)	1/18(5.6%)	7/115(6.1%)	0.919 (0.14-6.06)	0.930
Hypoglycaemia (RBG<3.5)	3/55(5.5%)	1/16(6.3%)	2/39(5.1%)	1.156 (0.22-6.05)	0.864
Acidemia (pH <7.35)	16/36(44.4%)	5/10(50.0%)	11/26(42.3%)	1.250 (0.44-3.58)	0.677
Lactate >2	18/33(54.5%)	8/11(72.7%)	10/22(45.5%)	2.222 (0.71-6.92)	0.168
Hypokalemia	10/35(28.6%)	3/10(30.0%)	7/25(28.0%)	1.071 (0.34-3.38)	0.905
Haemoglobin (< 10.9g/dl)	36/44(81.8%)	7/10(70.0%)	29/34(85.3%)	0.519 (0.17-1.58)	0.248

CHAPTER FOUR

4.0 DISCUSSION

The proportion of malnourished children under 5 years found in our study is similar to other previous studies in LMIC which have reported the prevalence between 17.7% to 55.8% (10,12,16,33). In accordance with previous studies, we found that most of children were aged less than 24 months and there was male predominance (7,16,23). Similar to previous observations, we found a high prevalence of parents with low socioeconomic status among malnourished children (10,12,34). We believe this could be related to primary caretaker's occupation as majorities were housewives or peasants, who are likely to be dependant from one source of income (husband) in the family. Further to this, we found high counts of children from primary caretakers who were married, as shown in previous studies and our observation in the community when father is the primary decision maker in such family, children are likely to be malnourished (18,19). Our study was similar to a study done in Mwanza, Tanzania, by *Maimuna et at*, when it comes to number of siblings in a single family, we observed a high frequency of malnutrition in children coming from families with less than six (6) siblings (33). However, our findings are different from prior studies in several ways: Previous study has observed malnutrition being common in under 5 years children who were EBF for less than 6 months (18). Most of children who were successfully breastfeed for 6 months had malnutrition in our cohort. While our study was not set to address this question, we believe; in appropriate food preparation, poor hygiene, lack of access to health care and low birth weight could be contributing factors to undernutrition in this group of children (18,35). Furthermore, high frequency of children who were born in the hospital and fully immunized found in our study findings differed from a previous study (18,19), as we did not expect to see malnutrition syndrome in such children. Finally, we found an overwhelming number of primary caretakers whom were mothers and educated among malnourished children, this contrast with previous studies (12,18), as these factors have been shown be a protective in the development of childhood malnutrition. We believe, our findings suggest a

potential gap between the occurrence of malnutrition and education status among primary caretaker (mothers).

We observed a high count of patients with co-morbidities such as congenital heart disease and cerebral palsy among malnourished children. Although our study didn't set up to investigate the link between such co-morbidities and malnutrition, this can be an indication of such a pattern as previous studies(20,21,33) , have demonstrated such as relationship. In addition to this observation, we observed low frequencies of HIV/AIDS and malaria in contrasts with a previous studies (35,36) which has significant number of those cases among malnourished children. However, our findings may be attributed to low testing rate, as ours was an observational study.

Our findings of high frequency of symptoms of fever, cough and weight loss in this cohort, is similar to what is reported in previous studies among malnourished children presenting to the ED or at outpatient clinic (16,35,36). A high frequency of fever, cough, or weight loss in our study, could be the result of acute illness due to sepsis, pneumonia, upper respiratory infections, and malaria which are believed to be associated with undernutrition (5,26). However, the present study also identified vomiting, poor feeding and diarrhoea as chief complaints which are symptoms mostly observed in children with nutritional deficiency, cerebral palsy and hydrocephalus (10,20–22). The findings of hypoxia, pyrexia, bradycardia, tachycardia, tachypnoea, and hypotension is similar to observations made in previous studies, which also found these factors as risks of case fatality rate among malnourished children (33,34,36).

Observed routine investigation findings in care of malnourished children at ED included laboratory findings of low blood glucose, acidemia, hypokalemia, hyponatremia, abnormal white blood cell count, and low haemoglobin, similar to what has been observed in previous malnourished children studies (28,34,37). Urine dip stick, rapid HIV test, stool analysis, blood culture and chest x-ray each were done in less than 4.8%, indicating a potential gap in

adherence to the recommendations for management of malnourished children, per the WHO and other local guidelines in Africa (26,27).

In accordance to SA malnutrition emergency guideline and or WHO treatment guideline for malnourished children for in hospital or outpatients (6,10,16) a fair number of children received intravenous fluid boluses for resuscitation, dextrose-containing fluids, antibiotics, antipyretics, potassium chloride and oxygen therapy. However, none of the children that we surveyed received ReSoMaL (Oral Rehydration Solution for Malnourished children), vitamin A supplement nor was rewarming done for prevention or treatment of hypothermia at our EMD (22,27,34).We were unable to verify if such care was given prior to EMD arrival or after admission to the in-patient services.

In our study, EMD physicians diagnosed malnutrition in only 6.7% while the true proportion of malnutrition was 34.1% during the study time. This is a relatively lower recognition rate, since the care rendered to these children, differs from non-malnourished, and hence to optimise the outcomes, one need to provide a dedicated and unique care taking the diagnosis of malnutrition into consideration. Since we used the documented diagnosis to arrive at the percentages of diagnosis by EMD physicians, we take a note that some of the physicians might have recognised malnutrition and not document it as a primary diagnosis, but still institute the appropriate care. We found a mortality rate of 13.3%, similar to a majority of previous studies in LMIC, which range from 3.4%-40.1% of malnourished children aged under 5 years (16,25,29,33). Of these, 2.9% of deaths occurred within 24-hours of hospitalization. High mortality rate of malnutrition in our study might be contributed by lack of training among health care providers and perhaps late presentation of patient (16,25,38).

Our study was not powered to evaluate on the risks of mortality in this group of children, but we observed high risk feature associated with mortality to be reduced level of consciousness (GCS <15) similar to observations made in the *Maitland et al* study in Kenya (34).

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Over one third of acutely ill children under 5 years presenting to EMD-MNH have malnutrition and those children have high mortality rate. A large proportion of the malnourished children presenting to the EMD-MNH also have significant underlying medical co morbidities. Despite the large number of children with malnutrition seen, EMD-MNH physicians rarely diagnose and/or document malnutrition as part of the medical record.

5.2 Recommendations

1. Emergency medicine physicians need to consider the diagnosis of malnutrition at the EMDs as they require unique care to optimise their outcomes.
2. Further studies should be conducted to determine the effect of initial management of malnourished children aged under 5 years to assist in the development of EDs malnutrition guidelines.
3. As many malnourished children in this study were found to have significant congenital medical conditions, further evaluation of this patient population, and their risks for malnutrition is warranted.

5.3 Study Limitations

1. This was a single centre study conducted at EMD-MNH. The overall clinical picture may not be generalizable to district and regional hospitals due to the fact that, most malnourished children are treated at health centres and district hospitals and patients attending at outpatient department of MNH were not included.
2. Sample Size: The sample size was calculated to evaluate the whole group of malnourished children, and was not powered to perform sub-group analysis. With the initial data gained from our study, future studies can be designed with comparison groups, and larger sub-groups to further explore the issues related to the treatment of children with malnutrition in the EMD-MNH.
3. Derivation of risk factors limited due to study design. We did not have a comparison group of non malnourished group, which would help in defining the association between risk factors, co-morbidities, clinical variables and malnutrition.
4. Incomplete patient charts. We found several pieces of missing data in patient charts. These include physical examination findings, laboratory investigation and interventions in patients discharged home from EMD.
5. Seasonal or monthly variation of malnutrition was not accounted for in our study. It has been reported that, during rainy season children a exposed to bacterial illness which would predispose them malnutrition, however, our study was conducted during months of July and August of the year (not rainy season), thus the data might not represent actual occurrence of malnutrition throughout the year.

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APPENDIXES

Appendix 1: Questionnaire (English Version)

QUESTIONNAIRE FORM

Inclusion criteria: Acutely ill children aged between 1 month to 59 months presenting at Emergency medicine department, Muhimbili National Hospital, with Weight for Height/ length (WFH) or Height for Age (HFA) or Weight for Age (WFA) <- 1 SD.

(Fill in as appropriate){Citation}

PARAMETER		**INDICATOR**	**MALNUTRITION GRADE**
Age(months)		WFH	
Weight(kg)		HFA	
Height(cm)		WFA	
HC(cm)		MUAC(cm)	
Type of malnutrition			

DATE OFRECRUTIMENT (dd/mm/yyyy)/ …...…..……..TIME(24HRS) ……

1. **Patient's particulars(Fill in)**

ID.No			**Name**	
MR.No			Sex(M/F)	
Birth position			Residence	
Informant			Phone No.	1.
				2.

2. **Referral status [Tick (V) as appropriate]**

Self referral	Referred	If referred , reason for refer

3. Pre- Emergency medicine department course of illness

a. How long has the baby been fallingsick (/hours/days) ..……..

b. Did you take the baby to the hospital (Yes/No) ...……....

If yes in (b) above; when did you take the baby to the hospital (hrs/days)....…...

c. Was the baby admitted (Yes/No) ……..

If yes in (c) above, how many day…… ……....

d. Did you give the baby any Local herbs (Yes/No)…….

If yes in (d) Type ……Amount …. ……..Duration..……

4. Pre-EMD treatment

TICK(V)IF GIVEN	FLUID/MEDICATION	TYPE	DOSE
	Intravenous Fluid	1.	
		2.	
	Blood transfusion		
	Antibiotics	1.	
		2.	
	Analgesics		
	Nothing		

5. History of illness

a. Patient's chief complain and associated clinical features

CHIEF COMPLAIN	TICK(V) IF PRESENT	DURATION	NATURE
Lower limb swelling			
Abdominal distension			
Diarrhoea			
Vomiting			
Fever			
Cough			
Poor feeding			
Weight loss			
Failure to thrive			
Others			

b. Patients known co-morbidities or chronic disease [Tick(v)]

1	HIV/AIDS		5	Hydrocephalus	
2	PTB		Others(specify)		
3	Cerebral palsy		6		
4	Congenital heart disease		7		

6. Malnutrition associated risk factors

a. Feeding practices

-Time of exclusive breast-feeding (in months) ...……..…….……..

-Weaning type of food 1…..…….2. …… 3. ……

-Current type of food 1. …..…… 2.…… 3. ……

b. Distance from/to Health care centre (in kilometres) …….…….……..

c. Place of delivery: Home ☐ HCC/hospital ☐

d. Immunization history *(cross check with baby's clinic card if present).*

Immunized per IVD ☐ Not immunized ☐ Unknown ☐

e. Number of siblings ☐

f. Family social history

Primary caretaker (Tick as appropriate)

☐ Mother Fill only if mother is not primary care taker

☐ Father Others……. ☐

Marital status:

☐ Married ☐ Not married

☐ Separated ☐ Divorced

☐ Widowed ☐ Died

Education level

☐ Primary ☐ Secondary

☐ Collage/university

☐ No formal education

Occupation ☐

Marital status:

☐ Married ☐ Not married

☐ Separated ☐ Divorced

☐ Widowed D☐

Education level

☐ Primary ☐ Secondary

☐ Collage/ university

☐ No formal education

Occupation ☐

7. EMD vital signs

VITALS	RESULTS		VITALS	RESULTS
Blood pressure			Temperature	
Pulse rate			Oxygen saturation	
Respiratory rate			AVPU(GCS)	

8. Physical examination findings

SYSTEM	Normal	Abnormal	If abnormal specify
Airway			
Breathing			
Circulation			
Disability			
Exposure			
HEENT			
CNS			
Respiratory			
CVS			
Abdomen			
MSS			
Extremities			
Skin			

9. Imaging studies

Image study	Tick (V) If done	Normal	Abnormal	If abnormal specify
CXR				
E-FAST				
USS				

10. Point of care (POCs), and main laboratory investigations

Investigation	Tick(v) if done	Results		Investigation	Tick(v) if done	Results
RBG				HIV rapid test		
RDT				Urine dipstick		
BS for MPS				Urinalysis		
ALT				Stool analysis		
AST				Creatinine		
Albumin				Urea		

Investigation	Tick(v) if done	Parameter and Results					
VBG		PH-	PCO_2-	HCO3-	BEC-	Lactate-	AG-
FBP		Hb-	WBC-	PLT-	N-	E-	L-
Electrolytes		K-	Na-	Cl-	Mg-	Ca-	P-

Investigation	Tick(V) if done	Bacteria growth present	No bacteria growth	Description of results
Blood Culture and sensitivity				If bacteria growth present 1.Type of bacteria isolated ……. 2. Sensitive antibiotics ……. 3.Resistant antibiotics …….

11. EMD provisional diagnosis

1	
2	
3	

12. EMD initial management

☐ Oxygen therapy: method (Nasal cannula or NRBM) …… Amount (inLts) ……..

☐ Nebulization: medication 1…….Dose ……; 2. …….…… Dose ……..

☐ Intubatation (indication) …..…….……..

☐ Rewarming(hypothermia treatment/prevention), If documented

Method 1 …….…….……Method 2…… …….…….

☐ Fluids, Medication and Feeding

TICK(V) IF GIVEN	FLUID/MEDICATION/FEEDING	TYPE	AMOUNT/DOSE
	IVF-Boluses	1.	
		2.	
	IVF-Dextrose	1.	
		2.	
	IVF-Correction of electrolyte	1.	
		2.	
	Blood transfusion	.	
	Antibiotics	1.	
		2.	
	Nutritional feeding	1.	
		2.	
	Vitamin A		
	Others		

13. **External consultation**

Done	Not done	If done, specify and write down option given

14. EMD Disposition plan

☐ Paediatrics ward …….

☐ Intensive care unit

☐ Discharged home

☐ Transferred out, specify ……., Reason; ……..……..…

☐ Patient died at EMD

15. Treatment outcome

TIME(In hospital)	ALIVE	DIED	If alive where is the patient (hospital/home)
At 24 hrs			
At 48 days			
At 7 days			
At 14 days			
At 28 days			

16. EMD physician's diagnoses

1.	
2.	
3	

Appendix 2: Consent form (English Version)

CONSENT FORM

Dear Madam/Sir

I am Dr. Prosper Bashaka, a postgraduate student in the Emergency Medicine Department at Muhimbili University of Health and Allied Sciences (MUHAS). I am conducting a study on malnourished children under age of 5 years in the department as part of my study program.

The aim of the study

The aim of the my study is to determine the clinical profile, initial management and outcome of acutely ill malnourished children under the age of 5 years presenting at Emergency medicine department, Muhimbili National Hospital

Participation in this study:

This study will involve all acutely ill malnourished children under the age of 5 years presenting to the Emergency Medicine Department of Muhimbili National Hospital. As a parents/care takers am requesting you to consent for a child to be enrolled in the study. The study involves getting information from you and extracting important data from patient's chart.

Risks:

This study will have cause no physical harm to your child as all the information that will be obtained are from routine care necessary for the child as per the attending physician. There will be no procedures or any invasive form of examination that will be done to the child.

Benefits:

As you agree to participate in the study you will be a volunteer and you will not benefit directly by participating in the study, but the results of the study will help to initiate the proper management strategies and improve care of acutely ill malnourished children in the department and the country at large in the future.

Confidentiality:

All information and data collected in questionnaires and hospital register will not be disclosed to any one not related to this study**.** The data will be treated with strict confidentiality and stored in locked cabinets.

Cost:

Patients will not be required to make any payment to participate in this study and but also there will be no financial compensation for participation.

Who to contact:

For further information, questions or queries, you can contact:

Dr. Prosper Bashaka, The Principal Investigator, Department of Emergency Medicine, Muhimbili University of Health and Allied Sciences**,** P. O. Box 65001,Dar es Salaam

Tel: +255 765670125/+255717000161Email: prosperbashaka@gmail.com

Dr. Hendry R. Sawe, Supervisor**,** Department of Emergency Medicine,Muhimbili University of Health and Allied Sciences**,** P. O. Box 65001**,** Dar es Salaam**,** Tel: +255 754 885658**,** Email: hrsawe@gmail.com

Prof. Said Aboud, Directors of Research and Publications, Muhimbili University of Health and Allied Sciences, P.O. Box 65001, Dar Es Salaam. Tel no: 2150302-6, 2152489.

SIGNATURE:

I, …….have read/been told the contents of this form.

My questions have been answered. I agree to participate in this study.

Signature of parent/caretaker …….

Signature of researcher……

Date of signed consent……

Appendix 3: Consent Form (Swahili Version)

FOMU YA RIDHAA YA KUSHIRIKI KATIKA UTAFITI

Habari ndugu,

Mimi ni Dkt Prosper Bashaka, mwanafunzi wa udaktari bingwa wa magonjwa ya dharura katika Chuo Kikuu Cha Afya na Sayansi Shirikishi Muhimbili (MUHAS). Ninafanya Utafiti huu kuhusu watoto wenye utapiamlo chini ya miaka mitano (5) sehemu inayohitajika katika kukamilisha masomo yangu ya ubingwa wa magonjwa ya dharura.

Madhumuni ya utafiti:

Utafiti huu unalenga katika kuangalia tabia za ugojwa wa utapiamlo, matibabu ya awali na matokeo yake kwa watoto chini ya umri wa miaka mitano wanapokuwa wamekuja kutibiwa Hospital ya Taifa Muhimbili kupitia Idara ya magojwa ya dharura.

Ushiriki katika utafiti:

Utafiti huu unawashirikisha watoto wote wenye umri kati ya mwezi 1hadi miezi 59 wanaokuja kutibiwa kupitia katika kitengo cha magonjwa ya dharura cha hospitali ya Taifa ya Muhimbili. Wazazi/walezi wa watoto wanaombwa kuidhinisha kwa maandishi ili mtoto aweze kushiriki katika utafiti. Utafiti huu unahusisha uchukuaji wa maelezo yako na taarifa muhimu za mtoto kutoka kwenye kompyuta yenye jedwali lenye maelezo ya mtoto**.**

Athari:

Hatutarajii kuwepo na athari/hatari yeyote itokanayona na ushiriki katika utafiti huu, kwa sababu hatutatumia njia yoyote ya kumuumiza mgonjwa, na kila kitu kitakachofanyika kwa mtoto itakuwa ni sehemu ya matibabu yanayohitajika na daktari wake na sisi tutachukua taarifa tu ya kile kilichofanyika kutoka kwenye kompyuta. Hali yeyote mbaya au ya kumsumbua mgonjwa itakayotokana na utafiti huu, itashughulikiwa mara moja na ipasavyo.

Faida:

Kwa kushiriki katika utafiti huu,utakuwa umejitolea na hakuna faida ya moja kwa moja atakayopata mgonjwa, bali matokeo yatokanayo na utafiti huu yatasaidia kuboresha huduma kwa watoto wanapatikana na utapiamlo hapa katika kitengo chetu na nchi nzima na hivyo kuwasaidia watoto kupata huduma hii kwa urahisi siku za baadae.

Usiri:

Taarifa zote zitakazokusanywa katika utafiti huu zitakuwa siri, hivyo ushiriki wako hautajulikana na mtu asiyehusika na utafiti huu. Taarifa hizi zitajulikana na timu ya watafiti tuu.

Malipo

Kwa kushiriki kwenye utafiti huu, hautalipwa wala hautalipa chochote.

Ukiwa na swali au tatizo lolote, unaweza kuwasiliana na wafuatao:

Dr. Prosper Bashaka, Mtafiti mkuu, Kitengo cha Magonjwa ya Dharura, Chuo kikuu Muhumbili, S.L.P 65001, Dar es Salaam, Simu: +255765670125/+255717000161

Baruapepe: prosperbashaka@gmail.com

Dr. Hendry Sawe, Msimamizi, Kitengo cha magonjwa ya Dharura, S.L.P Box 65001, Dar es Salaam, Simu: +255 754 885658, Baruapepe: hrsawe@gmail.com

Prof. Said Aboud, Mkurugenzi wa Utafiti na Uchapishaji, Chuo kikuu Muhimbili, S.L.P 65001, Dar es Salaam. Simu: 2150302-6/ 2152489.

SAHIHI YA MAKUBALIANO:

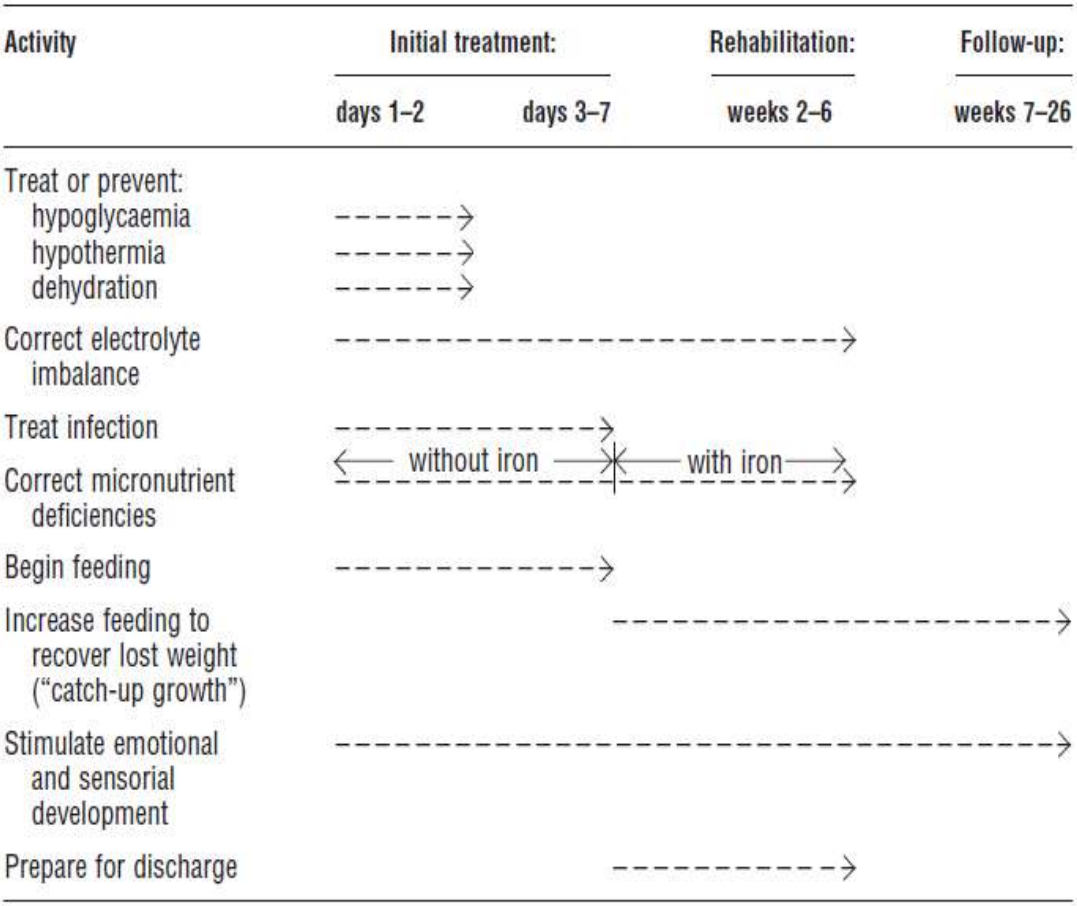
Mimi …….. nimesoma/ nimesomewa maelezo yote yaliyomo kwenye fomu hii na nimeelewa. Maswali yangu yamejibiwa na niko tayari kushiriki.

Sahihi ya Mzazi/ Mlezi……

Sahihi ya Mtafiti Msaidizi ……..

Tarehe …….

Appendix 3: WHO ten steps management of severe acute malnutrition (SAM)



Appendix 4: South Africa management of severe acute malnutrition (SAM) at Emergency settings

SEVERE ACUTE MALNUTRITION
EMERGENCY TREATMENT IN SOUTH AFRICA

Complicated cases of Severe Acute Malnutrition have a very high risk of dying during first 48 hours of admission. Early recognition of emergency signs and early treatment will improve likelihood of survival in hospital.

CONDITION	IMMEDIATE ACTION
Treat shock Shock is suspected in these children if the child is lethargic or unconscious, and cold hands **Plus either:** Weak fast pulse **or** Slow capillary refill (longer than 3 seconds) **Monitor closely:** children in shock need frequent monitoring of vital signs (pulse rate and volume, respiratory rate, urine output, glucose, etc)	**If child is in shock:** 1. Give oxygen. Treat and prevent hypoglycaemia and hypothermia. 2. Give IV 0.9% Normal Saline bolus fluid at 10ml/kg over 10minutes. Monitor response. 3. **If there are signs of improvement** (e.g. slower pulse and respirations) repeat bolus 10ml/kg over 10 minutes, until max 40ml/kg in 1 hour. Each time, check response to previous bolus before giving further fluid. Then switch to oral rehydration if further fluid is needed. **If there are no signs of improvement** assume child has ***septic shock***: ✓ Admit to ICU for CVP line. Start inotropic support. ✓ Start broad-spectrum antibiotics (Ceftriaxone). Treat and prevent hypoglycaemia/hypothermia. ✓ Admit the child to high care bed for monitoring. Discuss further case management with your referral hospital. 4. Only transfer the child to ward once signs of shock have resolved.
Treat very severe anaemia Severe anaemia is Hb<4g/dL	**If very severe anaemia** (or Hb 4-6g/dl AND respiratory distress): 1. Give packed cells 10ml/kg body weight slowly over 4 hours. If signs of heart failure, give 5-7ml/kg packed cells. 2. Give furosemide 1mg/kg IV at the start and end of the transfusion. **NB Keep a close eye for signs of fluid overload: further tachycardia, gallop rhythm, breathing even faster, puffy eyelids, enlarging liver size**
Treat hypoglycaemia Hypoglycaemia is a blood glucose <3mmol/L Assume hypoglycaemia if no dextrostix available	Test blood glucose level 3 hourly, you can stop testing when it is normal and stable for 24 hours provided the child is not severely ill[1]. ▪ If the blood glucose <3 mmol/L in asymptomatic child, give orally or by NG tube: o immediate feed of a "stabilizing feed (F75)", **or** o 50ml bolus of 10% dextrose, **or** o sugar solution 5 ml/kg o Re-Check the Blood Glucose after 30 min, if normal continue normal feeds, monitor blood glucose to see it remains above 3 mmol/L. ▪ If symptomatic or unresponsive hypoglycaemia give dextrose 10%[2]. IV, 2 ml/kg over 2-3 minutes[3]. **Re-Check the Blood Glucose after 30 min, if normal, continue feeds, monitor blood glucose to see it remains above 3 mmol/L.**
Treat hypothermia Hypothermia is axillary/underarm temperature <35^{0}C.	Take temperature at outpatients/casualty and on admission in the ward. (Ensure thermometer is well shaken down). **If the temperature is below 36.5^{0}C:** 1. Begin feeding straightaway (or start rehydration if diarrhoea with dehydration). 2. Active re-warming: Put the child on the mother's bare chest (skin-to-skin contact) and cover them. Cover the child's head. Or clothe the child, apply a warmed blanket and place a heater or lamp nearby. 3. Feed 2-3hourly (8-12 feeds in 24 hours). **Monitor during re-warming** ▪ Take temperature every two hours: stop active re-warming when temperature rises above 36.5^{0}CTake temperature every 30 minutes if heater is used because the child may become overheated.
Emergency Eye Care Corneal Ulceration is a sign of severe Vitamin A deficiency.	**If corneal ulceration:** 1. Give Vitamin A immediately (<6 months 50,000IU, 6-11 months 100,000 IU, 12-59 months 200,000IU) and **repeat** same dose the following day. **Record dose given in prescription chart and RTHB.** 2. Instil one drop atropine (1%) into affected eye to relax the eye and prevent the lens from pushing out. *Note: All children with clinical signs of vitamin A deficiency and children with measles should receive vitamin A on days 1, 2 and 14.*

health

[1] If severely ill continue 3 hrly blood glucose testing

[2] Mix 0.5ml/kg 50% Dextrose with 2 ml/kg of water for injection in a syringe – give 2ml/kg of the resulting 10% dextrose solution/ alternatively give 2ml/kg neonatal maintenance solution which also contains 10% dextrose.

[3] Previously 5 ml/kg – recent APLS suggests 2ml/kg.

Appendix 5: World Health Organization (WHO) standardized growth charts.

a. Weight for height, below 87 cm(BOYS and GIRLS) z-score

Boys' weight (kg)				Length		Girls' weight (kg)			
-4 SD	-3 SD	-2 SD	-1 SD	Median	(cm)	Median	-1 SD	-2 SD	-3 SD	-4 SD
1.7	1.9	2.0	2.2	2.4	45	2.5	2.3	2.1	1.9	1.7
1.8	2.0	2.2	2.4	2.6	46	2.6	2.4	2.2	2.0	1.9
2.0	2.1	2.3	2.5	2.8	47	2.8	2.6	2.4	2.2	2.0
2.1	2.3	2.5	2.7	2.9	48	3.0	2.7	2.5	2.3	2.1
2.2	2.4	2.6	2.9	3.1	49	3.2	2.9	2.6	2.4	2.2
2.4	2.6	2.8	3.0	3.3	50	3.4	3.1	2.8	2.6	2.4
2.5	2.7	3.0	3.2	3.5	51	3.6	3.3	3.0	2.8	2.5
2.7	2.9	3.2	3.5	3.8	52	3.8	3.5	3.2	2.9	2.7
2.9	3.1	3.4	3.7	4.0	53	4.0	3.7	3.4	3.1	2.8
3.1	3.3	3.6	3.9	4.3	54	4.3	3.9	3.6	3.3	3.0
3.3	3.6	3.8	4.2	4.5	55	4.5	4.2	3.8	3.5	3.2
3.5	3.8	4.1	4.4	4.8	56	4.8	4.4	4.0	3.7	3.4
3.7	4.0	4.3	4.7	5.1	57	5.1	4.6	4.3	3.9	3.6
3.9	4.3	4.6	5.0	5.4	58	5.4	4.9	4.5	4.1	3.8
4.1	4.5	4.8	5.3	5.7	59	5.6	5.1	4.7	4.3	3.9
4.3	4.7	5.1	5.5	6.0	60	5.9	5.4	4.9	4.5	4.1
4.5	4.9	5.3	5.8	6.3	61	6.1	5.6	5.1	4.7	4.3
4.7	5.1	5.6	6.0	6.5	62	6.4	5.8	5.3	4.9	4.5
4.9	5.3	5.8	6.2	6.8	63	6.6	6.0	5.5	5.1	4.7
5.1	5.5	6.0	6.5	7.0	64	6.9	6.3	5.7	5.3	4.8
5.3	5.7	6.2	6.7	7.3	65	7.1	6.5	5.9	5.5	5.0
5.5	5.9	6.4	6.9	7.5	66	7.3	6.7	6.1	5.6	5.1
5.6	6.1	6.6	7.1	7.7	67	7.5	6.9	6.3	5.8	5.3
5.8	6.3	6.8	7.3	8.0	68	7.7	7.1	6.5	6.0	5.5
6.0	6.5	7.0	7.6	8.2	69	8.0	7.3	6.7	6.1	5.6
6.1	6.6	7.2	7.8	8.4	70	8.2	7.5	6.9	6.3	5.8
6.3	6.8	7.4	8.0	8.6	71	8.4	7.7	7.0	6.5	5.9
6.4	7.0	7.6	8.2	8.9	72	8.6	7.8	7.2	6.6	6.0
6.6	7.2	7.7	8.4	9.1	73	8.8	8.0	7.4	6.8	6.2
6.7	7.3	7.9	8.6	9.3	74	9.0	8.2	7.5	6.9	6.3
6.9	7.5	8.1	8.8	9.5	75	9.1	8.4	7.7	7.1	6.5
7.0	7.6	8.3	8.9	9.7	76	9.3	8.5	7.8	7.2	6.6
7.2	7.8	8.4	9.1	9.9	77	9.5	8.7	8.0	7.4	6.7
7.3	7.9	8.6	9.3	10.1	78	9.7	8.9	8.2	7.5	6.9
7.4	8.1	8.7	9.5	10.3	79	9.9	9.1	8.3	7.7	7.0
7.6	8.2	8.9	9.6	10.4	80	10.1	9.2	8.5	7.8	7.1
7.7	8.4	9.1	9.8	10.6	81	10.3	9.4	8.7	8.0	7.3
7.9	8.5	9.2	10.0	10.8	82	10.5	9.6	8.8	8.1	7.5
8.0	8.7	9.4	10.2	11.0	83	10.7	9.8	9.0	8.3	7.6
8.2	8.9	9.6	10.4	11.3	84	11.0	10.1	9.2	8.5	7.8
8.4	9.1	9.8	10.6	11.5	85	11.2	10.3	9.4	8.7	8.0
8.6	9.3	10.0	10.8	11.7	86	11.5	10.5	9.7	8.9	8.1

b. Weight for height, 87cm and above (BOYS and GIRLS) z-score

Boys' weight (kg)					Height	Girls' weight (kg)				
-4 SD	-3 SD	-2 SD	-1 SD	Median	(cm)	Median	-1 SD	-2 SD	-3 SD	-4 SD
8.9	9.6	10.4	11.2	12.2	87	11.9	10.9	10.0	9.2	8.4
9.1	9.8	10.6	11.5	12.4	88	12.1	11.1	10.2	9.4	8.6
9.3	10.0	10.8	11.7	12.6	89	12.4	11.4	10.4	9.6	8.8
9.4	10.2	11.0	11.9	12.9	90	12.6	11.6	10.6	9.8	9.0
9.6	10.4	11.2	12.1	13.1	91	12.9	11.8	10.9	10.0	9.1
9.8	10.6	11.4	12.3	13.4	92	13.1	12.0	11.1	10.2	9.3
9.9	10.8	11.6	12.6	13.6	93	13.4	12.3	11.3	10.4	9.5
10.1	11.0	11.8	12.8	13.8	94	13.6	12.5	11.5	10.6	9.7
10.3	11.1	12.0	13.0	14.1	95	13.9	12.7	11.7	10.8	9.8
10.4	11.3	12.2	13.2	14.3	96	14.1	12.9	11.9	10.9	10.0
10.6	11.5	12.4	13.4	14.6	97	14.4	13.2	12.1	11.1	10.2
10.8	11.7	12.6	13.7	14.8	98	14.7	13.4	12.3	11.3	10.4
11.0	11.9	12.9	13.9	15.1	99	14.9	13.7	12.5	11.5	10.5
11.2	12.1	13.1	14.2	15.4	100	15.2	13.9	12.8	11.7	10.7
11.3	12.3	13.3	14.4	15.6	101	15.5	14.2	13.0	12.0	10.9
11.5	12.5	13.6	14.7	15.9	102	15.8	14.5	13.3	12.2	11.1
11.7	12.8	13.8	14.9	16.2	103	16.1	14.7	13.5	12.4	11.3
11.9	13.0	14.0	15.2	16.5	104	16.4	15.0	13.8	12.6	11.5
12.1	13.2	14.3	15.5	16.8	105	16.8	15.3	14.0	12.9	11.8
12.3	13.4	14.5	15.8	17.2	106	17.1	15.6	14.3	13.1	12.0
12.5	13.7	14.8	16.1	17.5	107	17.5	15.9	14.6	13.4	12.2
12.7	13.9	15.1	16.4	17.8	108	17.8	16.3	14.9	13.7	12.4
12.9	14.1	15.3	16.7	18.2	109	18.2	16.6	15.2	13.9	12.7
13.2	14.4	15.6	17.0	18.5	110	18.6	17.0	15.5	14.2	12.9
13.4	14.6	15.9	17.3	18.9	111	19.0	17.3	15.8	14.5	13.2
13.6	14.9	16.2	17.6	19.2	112	19.4	17.7	16.2	14.8	13.5
13.8	15.2	16.5	18.0	19.6	113	19.8	18.0	16.5	15.1	13.7
14.1	15.4	16.8	18.3	20.0	114	20.2	18.4	16.8	15.4	14.0
14.3	15.7	17.1	18.6	20.4	115	20.7	18.8	17.2	15.7	14.3
14.6	16.0	17.4	19.0	20.8	116	21.1	19.2	17.5	16.0	14.5
14.8	16.2	17.7	19.3	21.2	117	21.5	19.6	17.8	16.3	14.8
15.0	16.5	18.0	19.7	21.6	118	22.0	19.9	18.2	16.6	15.1
15.3	16.8	18.3	20.0	22.0	119	22.4	20.3	18.5	16.9	15.4
15.5	17.1	18.6	20.4	22.4	120	22.8	20.7	18.9	17.3	15.6

c. Weight for Age, Birth to 5years (BOYS) z-score

Weight-for-age BOYS
Birth to 5 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
0: 0	0	2.1	2.5	2.9	3.3	3.9	4.4	5.0
0: 1	1	2.9	3.4	3.9	4.5	5.1	5.8	6.6
0: 2	2	3.8	4.3	4.9	5.6	6.3	7.1	8.0
0: 3	3	4.4	5.0	5.7	6.4	7.2	8.0	9.0
0: 4	4	4.9	5.6	6.2	7.0	7.8	8.7	9.7
0: 5	5	5.3	6.0	6.7	7.5	8.4	9.3	10.4
0: 6	6	5.7	6.4	7.1	7.9	8.8	9.8	10.9
0: 7	7	5.9	6.7	7.4	8.3	9.2	10.3	11.4
0: 8	8	6.2	6.9	7.7	8.6	9.6	10.7	11.9
0: 9	9	6.4	7.1	8.0	8.9	9.9	11.0	12.3
0:10	10	6.6	7.4	8.2	9.2	10.2	11.4	12.7
0:11	11	6.8	7.6	8.4	9.4	10.5	11.7	13.0
1: 0	12	6.9	7.7	8.6	9.6	10.8	12.0	13.3
1: 1	13	7.1	7.9	8.8	9.9	11.0	12.3	13.7
1: 2	14	7.2	8.1	9.0	10.1	11.3	12.6	14.0
1: 3	15	7.4	8.3	9.2	10.3	11.5	12.8	14.3
1: 4	16	7.5	8.4	9.4	10.5	11.7	13.1	14.6
1: 5	17	7.7	8.6	9.6	10.7	12.0	13.4	14.9
1: 6	18	7.8	8.8	9.8	10.9	12.2	13.7	15.3
1: 7	19	8.0	8.9	10.0	11.1	12.5	13.9	15.6
1: 8	20	8.1	9.1	10.1	11.3	12.7	14.2	15.9
1: 9	21	8.2	9.2	10.3	11.5	12.9	14.5	16.2
1:10	22	8.4	9.4	10.5	11.8	13.2	14.7	16.5
1:11	23	8.5	9.5	10.7	12.0	13.4	15.0	16.8
2: 0	24	8.6	9.7	10.8	12.2	13.6	15.3	17.1
2: 1	25	8.8	9.8	11.0	12.4	13.9	15.5	17.5
2: 2	26	8.9	10.0	11.2	12.5	14.1	15.8	17.8
2: 3	27	9.0	10.1	11.3	12.7	14.3	16.1	18.1
2: 4	28	9.1	10.2	11.5	12.9	14.5	16.3	18.4
2: 5	29	9.2	10.4	11.7	13.1	14.8	16.6	18.7

d. Weight for Age, Birth to 5years (BOYZ) z-score

Weight-for-age BOYS
Birth to 5 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
2: 6	30	9.4	10.5	11.8	13.3	15.0	16.9	19.0
2: 7	31	9.5	10.7	12.0	13.5	15.2	17.1	19.3
2: 8	32	9.6	10.8	12.1	13.7	15.4	17.4	19.6
2: 9	33	9.7	10.9	12.3	13.8	15.6	17.6	19.9
2:10	34	9.8	11.0	12.4	14.0	15.8	17.8	20.2
2:11	35	9.9	11.2	12.6	14.2	16.0	18.1	20.4
3: 0	36	10.0	11.3	12.7	14.3	16.2	18.3	20.7
3: 1	37	10.1	11.4	12.9	14.5	16.4	18.6	21.0
3: 2	38	10.2	11.5	13.0	14.7	16.6	18.8	21.3
3: 3	39	10.3	11.6	13.1	14.8	16.8	19.0	21.6
3: 4	40	10.4	11.8	13.3	15.0	17.0	19.3	21.9
3: 5	41	10.5	11.9	13.4	15.2	17.2	19.5	22.1
3: 6	42	10.6	12.0	13.6	15.3	17.4	19.7	22.4
3: 7	43	10.7	12.1	13.7	15.5	17.6	20.0	22.7
3: 8	44	10.8	12.2	13.8	15.7	17.8	20.2	23.0
3: 9	45	10.9	12.4	14.0	15.8	18.0	20.5	23.3
3:10	46	11.0	12.5	14.1	16.0	18.2	20.7	23.6
3:11	47	11.1	12.6	14.3	16.2	18.4	20.9	23.9
4: 0	48	11.2	12.7	14.4	16.3	18.6	21.2	24.2
4: 1	49	11.3	12.8	14.5	16.5	18.8	21.4	24.5
4: 2	50	11.4	12.9	14.7	16.7	19.0	21.7	24.8
4: 3	51	11.5	13.1	14.8	16.8	19.2	21.9	25.1
4: 4	52	11.6	13.2	15.0	17.0	19.4	22.2	25.4
4: 5	53	11.7	13.3	15.1	17.2	19.6	22.4	25.7
4: 6	54	11.8	13.4	15.2	17.3	19.8	22.7	26.0
4: 7	55	11.9	13.5	15.4	17.5	20.0	22.9	26.3
4: 8	56	12.0	13.6	15.5	17.7	20.2	23.2	26.6
4: 9	57	12.1	13.7	15.6	17.8	20.4	23.4	26.9
4:10	58	12.2	13.8	15.8	18.0	20.6	23.7	27.2
4:11	59	12.3	14.0	15.9	18.2	20.8	23.9	27.6
5: 0	60	12.4	14.1	16.0	18.3	21.0	24.2	27.9

WHO Child Growth Standards

e. Weight for Age,Birth to 5years (GIRLS) z-score

Weight-for-age GIRLS
Birth to 5 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
0: 0	0	2.0	2.4	2.8	3.2	3.7	4.2	4.8
0: 1	1	2.7	3.2	3.6	4.2	4.8	5.5	6.2
0: 2	2	3.4	3.9	4.5	5.1	5.8	6.6	7.5
0: 3	3	4.0	4.5	5.2	5.8	6.6	7.5	8.5
0: 4	4	4.4	5.0	5.7	6.4	7.3	8.2	9.3
0: 5	5	4.8	5.4	6.1	6.9	7.8	8.8	10.0
0: 6	6	5.1	5.7	6.5	7.3	8.2	9.3	10.6
0: 7	7	5.3	6.0	6.8	7.6	8.6	9.8	11.1
0: 8	8	5.6	6.3	7.0	7.9	9.0	10.2	11.6
0: 9	9	5.8	6.5	7.3	8.2	9.3	10.5	12.0
0:10	10	5.9	6.7	7.5	8.5	9.6	10.9	12.4
0:11	11	6.1	6.9	7.7	8.7	9.9	11.2	12.8
1: 0	12	6.3	7.0	7.9	8.9	10.1	11.5	13.1
1: 1	13	6.4	7.2	8.1	9.2	10.4	11.8	13.5
1: 2	14	6.6	7.4	8.3	9.4	10.6	12.1	13.8
1: 3	15	6.7	7.6	8.5	9.6	10.9	12.4	14.1
1: 4	16	6.9	7.7	8.7	9.8	11.1	12.6	14.5
1: 5	17	7.0	7.9	8.9	10.0	11.4	12.9	14.8
1: 6	18	7.2	8.1	9.1	10.2	11.6	13.2	15.1
1: 7	19	7.3	8.2	9.2	10.4	11.8	13.5	15.4
1: 8	20	7.5	8.4	9.4	10.6	12.1	13.7	15.7
1: 9	21	7.6	8.6	9.6	10.9	12.3	14.0	16.0
1:10	22	7.8	8.7	9.8	11.1	12.5	14.3	16.4
1:11	23	7.9	8.9	10.0	11.3	12.8	14.6	16.7
2: 0	24	8.1	9.0	10.2	11.5	13.0	14.8	17.0
2: 1	25	8.2	9.2	10.3	11.7	13.3	15.1	17.3
2: 2	26	8.4	9.4	10.5	11.9	13.5	15.4	17.7
2: 3	27	8.5	9.5	10.7	12.1	13.7	15.7	18.0
2: 4	28	8.6	9.7	10.9	12.3	14.0	16.0	18.3
2: 5	29	8.8	9.8	11.1	12.5	14.2	16.2	18.7

f. Weight for Age, Birth to 5years (GIRLS) z-score

Weight-for-age GIRLS
Birth to 5 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
2: 6	30	8.9	10.0	11.2	12.7	14.4	16.5	19.0
2: 7	31	9.0	10.1	11.4	12.9	14.7	16.8	19.3
2: 8	32	9.1	10.3	11.6	13.1	14.9	17.1	19.6
2: 9	33	9.3	10.4	11.7	13.3	15.1	17.3	20.0
2:10	34	9.4	10.5	11.9	13.5	15.4	17.6	20.3
2:11	35	9.5	10.7	12.0	13.7	15.6	17.9	20.6
3: 0	36	9.6	10.8	12.2	13.9	15.8	18.1	20.9
3: 1	37	9.7	10.9	12.4	14.0	16.0	18.4	21.3
3: 2	38	9.8	11.1	12.5	14.2	16.3	18.7	21.6
3: 3	39	9.9	11.2	12.7	14.4	16.5	19.0	22.0
3: 4	40	10.1	11.3	12.8	14.6	16.7	19.2	22.3
3: 5	41	10.2	11.5	13.0	14.8	16.9	19.5	22.7
3: 6	42	10.3	11.6	13.1	15.0	17.2	19.8	23.0
3: 7	43	10.4	11.7	13.3	15.2	17.4	20.1	23.4
3: 8	44	10.5	11.8	13.4	15.3	17.6	20.4	23.7
3: 9	45	10.6	12.0	13.6	15.5	17.8	20.7	24.1
3:10	46	10.7	12.1	13.7	15.7	18.1	20.9	24.5
3:11	47	10.8	12.2	13.9	15.9	18.3	21.2	24.8
4: 0	48	10.9	12.3	14.0	16.1	18.5	21.5	25.2
4: 1	49	11.0	12.4	14.2	16.3	18.8	21.8	25.5
4: 2	50	11.1	12.6	14.3	16.4	19.0	22.1	25.9
4: 3	51	11.2	12.7	14.5	16.6	19.2	22.4	26.3
4: 4	52	11.3	12.8	14.6	16.8	19.4	22.6	26.6
4: 5	53	11.4	12.9	14.8	17.0	19.7	22.9	27.0
4: 6	54	11.5	13.0	14.9	17.2	19.9	23.2	27.4
4: 7	55	11.6	13.2	15.1	17.3	20.1	23.5	27.7
4: 8	56	11.7	13.3	15.2	17.5	20.3	23.8	28.1
4: 9	57	11.8	13.4	15.3	17.7	20.6	24.1	28.5
4:10	58	11.9	13.5	15.5	17.9	20.8	24.4	28.8
4:11	59	12.0	13.6	15.6	18.0	21.0	24.6	29.2
5: 0	60	12.1	13.7	15.8	18.2	21.2	24.9	29.5

WHO Child Growth Standards

g. Length for Age, Birth to 2years (GIRLS) z-score

Length-for-age GIRLS
Birth to 2 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
0: 0	0	43.6	45.4	47.3	49.1	51.0	52.9	54.7
0: 1	1	47.8	49.8	51.7	53.7	55.6	57.6	59.5
0: 2	2	51.0	53.0	55.0	57.1	59.1	61.1	63.2
0: 3	3	53.5	55.6	57.7	59.8	61.9	64.0	66.1
0: 4	4	55.6	57.8	59.9	62.1	64.3	66.4	68.6
0: 5	5	57.4	59.6	61.8	64.0	66.2	68.5	70.7
0: 6	6	58.9	61.2	63.5	65.7	68.0	70.3	72.5
0: 7	7	60.3	62.7	65.0	67.3	69.6	71.9	74.2
0: 8	8	61.7	64.0	66.4	68.7	71.1	73.5	75.8
0: 9	9	62.9	65.3	67.7	70.1	72.6	75.0	77.4
0:10	10	64.1	66.5	69.0	71.5	73.9	76.4	78.9
0:11	11	65.2	67.7	70.3	72.8	75.3	77.8	80.3
1: 0	12	66.3	68.9	71.4	74.0	76.6	79.2	81.7
1: 1	13	67.3	70.0	72.6	75.2	77.8	80.5	83.1
1: 2	14	68.3	71.0	73.7	76.4	79.1	81.7	84.4
1: 3	15	69.3	72.0	74.8	77.5	80.2	83.0	85.7
1: 4	16	70.2	73.0	75.8	78.6	81.4	84.2	87.0
1: 5	17	71.1	74.0	76.8	79.7	82.5	85.4	88.2
1: 6	18	72.0	74.9	77.8	80.7	83.6	86.5	89.4
1: 7	19	72.8	75.8	78.8	81.7	84.7	87.6	90.6
1: 8	20	73.7	76.7	79.7	82.7	85.7	88.7	91.7
1: 9	21	74.5	77.5	80.6	83.7	86.7	89.8	92.9
1:10	22	75.2	78.4	81.5	84.6	87.7	90.8	94.0
1:11	23	76.0	79.2	82.3	85.5	88.7	91.9	95.0
2: 0	24	76.7	80.0	83.2	86.4	89.6	92.9	96.1

WHO Child Growth Standards

h. Height for Age, Birth 2 to 5 years (GIRLS) z-score

Height-for-age GIRLS
2 to 5 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
2: 0	24	76.0	79.3	82.5	85.7	88.9	92.2	95.4
2: 1	25	76.8	80.0	83.3	86.6	89.9	93.1	96.4
2: 2	26	77.5	80.8	84.1	87.4	90.8	94.1	97.4
2: 3	27	78.1	81.5	84.9	88.3	91.7	95.0	98.4
2: 4	28	78.8	82.2	85.7	89.1	92.5	96.0	99.4
2: 5	29	79.5	82.9	86.4	89.9	93.4	96.9	100.3
2: 6	30	80.1	83.6	87.1	90.7	94.2	97.7	101.3
2: 7	31	80.7	84.3	87.9	91.4	95.0	98.6	102.2
2: 8	32	81.3	84.9	88.6	92.2	95.8	99.4	103.1
2: 9	33	81.9	85.6	89.3	92.9	96.6	100.3	103.9
2:10	34	82.5	86.2	89.9	93.6	97.4	101.1	104.8
2:11	35	83.1	86.8	90.6	94.4	98.1	101.9	105.6
3: 0	36	83.6	87.4	91.2	95.1	98.9	102.7	106.5
3: 1	37	84.2	88.0	91.9	95.7	99.6	103.4	107.3
3: 2	38	84.7	88.6	92.5	96.4	100.3	104.2	108.1
3: 3	39	85.3	89.2	93.1	97.1	101.0	105.0	108.9
3: 4	40	85.8	89.8	93.8	97.7	101.7	105.7	109.7
3: 5	41	86.3	90.4	94.4	98.4	102.4	106.4	110.5
3: 6	42	86.8	90.9	95.0	99.0	103.1	107.2	111.2
3: 7	43	87.4	91.5	95.6	99.7	103.8	107.9	112.0
3: 8	44	87.9	92.0	96.2	100.3	104.5	108.6	112.7
3: 9	45	88.4	92.5	96.7	100.9	105.1	109.3	113.5
3:10	46	88.9	93.1	97.3	101.5	105.8	110.0	114.2
3:11	47	89.3	93.6	97.9	102.1	106.4	110.7	114.9
4: 0	48	89.8	94.1	98.4	102.7	107.0	111.3	115.7
4: 1	49	90.3	94.6	99.0	103.3	107.7	112.0	116.4
4: 2	50	90.7	95.1	99.5	103.9	108.3	112.7	117.1
4: 3	51	91.2	95.6	100.1	104.5	108.9	113.3	117.7

j. Height for Age, Birth to 2 to 5 years (GIRLS) z-score

Height-for-age GIRLS
2 to 5 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
4: 4	52	91.7	96.1	100.6	105.0	109.5	114.0	118.4
4: 5	53	92.1	96.6	101.1	105.6	110.1	114.6	119.1
4: 6	54	92.6	97.1	101.6	106.2	110.7	115.2	119.8
4: 7	55	93.0	97.6	102.2	106.7	111.3	115.9	120.4
4: 8	56	93.4	98.1	102.7	107.3	111.9	116.5	121.1
4: 9	57	93.9	98.5	103.2	107.8	112.5	117.1	121.8
4:10	58	94.3	99.0	103.7	108.4	113.0	117.7	122.4
4:11	59	94.7	99.5	104.2	108.9	113.6	118.3	123.1
5: 0	60	95.2	99.9	104.7	109.4	114.2	118.9	123.7

WHO Child Growth Standards

k. LengthforAge, Birth to 2years (BOYS) z-score

Length-for-age BOYS
Birth to 2 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
0: 0	0	44.2	46.1	48.0	49.9	51.8	53.7	55.6
0: 1	1	48.9	50.8	52.8	54.7	56.7	58.6	60.6
0: 2	2	52.4	54.4	56.4	58.4	60.4	62.4	64.4
0: 3	3	55.3	57.3	59.4	61.4	63.5	65.5	67.6
0: 4	4	57.6	59.7	61.8	63.9	66.0	68.0	70.1
0: 5	5	59.6	61.7	63.8	65.9	68.0	70.1	72.2
0: 6	6	61.2	63.3	65.5	67.6	69.8	71.9	74.0
0: 7	7	62.7	64.8	67.0	69.2	71.3	73.5	75.7
0: 8	8	64.0	66.2	68.4	70.6	72.8	75.0	77.2
0: 9	9	65.2	67.5	69.7	72.0	74.2	76.5	78.7
0:10	10	66.4	68.7	71.0	73.3	75.6	77.9	80.1
0:11	11	67.6	69.9	72.2	74.5	76.9	79.2	81.5
1: 0	12	68.6	71.0	73.4	75.7	78.1	80.5	82.9
1: 1	13	69.6	72.1	74.5	76.9	79.3	81.8	84.2
1: 2	14	70.6	73.1	75.6	78.0	80.5	83.0	85.5
1: 3	15	71.6	74.1	76.6	79.1	81.7	84.2	86.7
1: 4	16	72.5	75.0	77.6	80.2	82.8	85.4	88.0
1: 5	17	73.3	76.0	78.6	81.2	83.9	86.5	89.2
1: 6	18	74.2	76.9	79.6	82.3	85.0	87.7	90.4
1: 7	19	75.0	77.7	80.5	83.2	86.0	88.8	91.5
1: 8	20	75.8	78.6	81.4	84.2	87.0	89.8	92.6
1: 9	21	76.5	79.4	82.3	85.1	88.0	90.9	93.8
1:10	22	77.2	80.2	83.1	86.0	89.0	91.9	94.9
1:11	23	78.0	81.0	83.9	86.9	89.9	92.9	95.9
2: 0	24	78.7	81.7	84.8	87.8	90.9	93.9	97.0

WHO Child Growth Standards

l. Height for Age, Birth to 2 to 5 years (BOYS) z-score

Height-for-age BOYS
2 to 5 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
2: 0	24	78.0	81.0	84.1	87.1	90.2	93.2	96.3
2: 1	25	78.6	81.7	84.9	88.0	91.1	94.2	97.3
2: 2	26	79.3	82.5	85.6	88.8	92.0	95.2	98.3
2: 3	27	79.9	83.1	86.4	89.6	92.9	96.1	99.3
2: 4	28	80.5	83.8	87.1	90.4	93.7	97.0	100.3
2: 5	29	81.1	84.5	87.8	91.2	94.5	97.9	101.2
2: 6	30	81.7	85.1	88.5	91.9	95.3	98.7	102.1
2: 7	31	82.3	85.7	89.2	92.7	96.1	99.6	103.0
2: 8	32	82.8	86.4	89.9	93.4	96.9	100.4	103.9
2: 9	33	83.4	86.9	90.5	94.1	97.6	101.2	104.8
2:10	34	83.9	87.5	91.1	94.8	98.4	102.0	105.6
2:11	35	84.4	88.1	91.8	95.4	99.1	102.7	106.4
3: 0	36	85.0	88.7	92.4	96.1	99.8	103.5	107.2
3: 1	37	85.5	89.2	93.0	96.7	100.5	104.2	108.0
3: 2	38	86.0	89.8	93.6	97.4	101.2	105.0	108.8
3: 3	39	86.5	90.3	94.2	98.0	101.8	105.7	109.5
3: 4	40	87.0	90.9	94.7	98.6	102.5	106.4	110.3
3: 5	41	87.5	91.4	95.3	99.2	103.2	107.1	111.0
3: 6	42	88.0	91.9	95.9	99.9	103.8	107.8	111.7
3: 7	43	88.4	92.4	96.4	100.4	104.5	108.5	112.5
3: 8	44	88.9	93.0	97.0	101.0	105.1	109.1	113.2
3: 9	45	89.4	93.5	97.5	101.6	105.7	109.8	113.9
3:10	46	89.8	94.0	98.1	102.2	106.3	110.4	114.6
3:11	47	90.3	94.4	98.6	102.8	106.9	111.1	115.2
4: 0	48	90.7	94.9	99.1	103.3	107.5	111.7	115.9
4: 1	49	91.2	95.4	99.7	103.9	108.1	112.4	116.6
4: 2	50	91.6	95.9	100.2	104.4	108.7	113.0	117.3
4: 3	51	92.1	96.4	100.7	105.0	109.3	113.6	117.9

m. Height for Age, Birth to 2 to 5 years (BOYS) z-score

Height-for-age BOYS
2 to 5 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
4: 4	52	92.5	96.9	101.2	105.6	109.9	114.2	118.6
4: 5	53	93.0	97.4	101.7	106.1	110.5	114.9	119.2
4: 6	54	93.4	97.8	102.3	106.7	111.1	115.5	119.9
4: 7	55	93.9	98.3	102.8	107.2	111.7	116.1	120.6
4: 8	56	94.3	98.8	103.3	107.8	112.3	116.7	121.2
4: 9	57	94.7	99.3	103.8	108.3	112.8	117.4	121.9
4:10	58	95.2	99.7	104.3	108.9	113.4	118.0	122.6
4:11	59	95.6	100.2	104.8	109.4	114.0	118.6	123.2
5: 0	60	96.1	100.7	105.3	110.0	114.6	119.2	123.9

WHO Child Growth Standards