Severe malnutrition in children <7 months of age in Mnazi Mmoja Hospital, Zanzibar, Tanzania

Degree Project in Medicine

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1. Abbreviations

BF	Breastfeeding
CF	Complementary feeding
CRF	Case record form
EBF	Exclusive breastfeeding
FFT	Failure to thrive
MMH	Mnazi Mmoja Hospital
MUAC	Mid-upper arm circumference
SAM	Severe acute malnutrition
WAZ	Weight-for-age Z-score
WHO	World Health Organization
WHZ	Weight-for-height Z-score
WLZ	Weight-for-length Z-score

2. Abstract

Master Thesis, Programme in Medicine

Andrea Olivegren, 2020

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Background: Severe acute malnutrition (SAM) is the most critical form of undernutrition. Young infants pose an extra challenge, but the knowledge is scarce and the WHO management guidelines hold low evidence. Feeding practices play a crucial role in the development of SAM in infants but despite the clear recommendation of exclusive breastfeeding (EBF) and no other food for the first 6 months, the adherence is poor.

Aim: To describe the inpatient management of severely malnourished infants <7 months of age in Mnazi Mmoja Hospital and explore caretakers' perceptions and common feeding practises.

Method: An observational cross-sectional study with data collection from charts and interviews was performed. 32 infants and their caretakers were included.

Results: Common reasons for admission were symptoms of infection or poor weight gain. Diagnoses frequently posed during admission were SAM, failure to thrive, pneumonia and diarrhea. Twenty-eight patients were discharged by hospital staff, 1 defaulted and 1 died. Two-thirds reached the target weight. The rate of EBF was low at 3%. Ninety-four percent of the patients had been given liquids the day before the interview and 47% had been given solid food at some point. Almost all of the mothers perceived that their breastmilk was not enough and 40% believed that insufficient breastmilk was the reason for malnutrition.

Conclusion: The management guidelines were used, but not completely followed. Adherence to feeding recommendations was poor. Cultural beliefs and poor knowledge were barriers to EBF. Further studies in the local setting are needed to develop strategies to decrease infant undernutrition. Establishing evidence-based guidelines for young infants is an urgent matter.

Keywords: severe acute malnutrition, infant, breastfeeding, guidelines

3. Introduction

3.1 Background

3.1.1 Definitions

There are many important terms and definitions to have in mind when reading a paper about malnutrition. The most frequent terms used in this paper are explained in table 1.

Table 1. Explanations and definitions of terms used in this paper.

Term	Explanation
Malnutrition	In a broader perspective this term refers to both overnutrition and undernutrition, and the latter can be divided into macro- and micronutrient deficiencies. In this paper the term 'malnutrition' is used as a synonym of macronutrient-related undernutrition.
Anthropometry	Direct body measurements, e.g. weight, length, height, circumference.
Length	Length of the body measured in lying position. Used for children <2 years (1).
Height	Length of the body measured in standing position. Used for children >2 years (1).
Mid upper arm circumference (MUAC)	Circumference of the upper arm. Often measured with a specific coloured MUAC-tape. Currently only used for assessing malnutrition in children >6 months and adults.
WHO Child Growth Standards	Standard references for normal child growth during optimal environmental conditions established by WHO in 2006 (2). Used for calculating Z-scores for weight-for-age, weight-for-length/height and length/height-for-age in this paper.
Z-score	Number of standard deviations (SD) from the reference median (WHO Child Growth Standards)
Wasting	Thinness. Deficiency in energy intake and/or uptake lead to loss of muscle and fat tissue and results low weight for body length. Often simplified as 'acute malnutrition'. Formerly called marasmus. Definition: weight-for-length/height (WLZ/WHZ) <-2 Z-scores or MUAC <125 mm.
Severe wasting	Severe thinness. Definition: weight-for-length (WLZ) or weight-for-height (WHZ) <-3 Z-scores or MUAC <115 mm
Stunting	Short statue. Longer periods of nutrient deficiencies, in some cases with onset antenatally, result in linear growth failure and low body length for age. Stunting is often simplified as 'chronic malnutrition'. Definition: length-for-age (LAZ) or height-for-age (HAZ) <-2 Z-scores.
Severe stunting	Severe linear growth failure. Definition: length-for-age (LAZ) or height-for-age (HAZ) <-3 Z-scores.
Underweight	Low weight for age. The result of wasting, stunting or a combination. Definition: weight-for-age (WAZ) <-2 Z-scores.
Nutritional oedema	Bilateral oedema of the feet caused by malnutrition. Present when indentation remains after applying pressure to the dorsum of the foot.
Kwashiorkor	Fulminant condition of severe malnutrition with presence of nutritional oedema, skin lesions, hair changes, enlarged liver and cerebral impact.
Severe acute malnutrition (SAM)	Severe undernutrition. Defined by WHO as severe wasting and/or presence of bilateral pitting oedema (3). Divided into non-oedematous and oedematous form.
Failure to thrive (FFT)	Poor weight gain compared to the reference growth curves for age and sex, often used for infants.
Severe malnutrition	In this paper the term 'severe malnutrition' is used for all malnutrition-related conditions that led to admission to the paediatric ward at the study site, since it was not always certain that the condition met the criteria for SAM as the length was rarely measured. Examples of conditions comprised by this term are SAM, FFT, moderate wasting and bilateral pitting oedema.
Exclusive breastfeeding (EBF)	The practice of only feeding the child breastmilk and no other liquid (including plain water), semi-solid or solid food. Medicine or vitamins prescribed by a health care worker do not interfere with exclusive breastfeeding.
Complementary feeding (CF)	The practice of giving liquid, semi-solid or solid food as a complement to breastfeeding, including formula feeding.

3.1.2 Malnutrition

3.1.2.1 Global perspective

Global child mortality has in the last decades decreased (4) but still poses a great challenge, especially in low-income countries. Under-five mortality is often used as an indicator of the development level of a country, as it is affected by the presence of fundamental resources, e.g. access to clean water, sanitation and health services like vaccination programmes and infection treatment, but it also correlates to maternal education level (5). The first year is the most dangerous period of life, accounting for a majority of all deaths in children under 5 years (6). One of the main causes of the high child mortality is undernutrition, which contributes to almost half of the child deaths every year (4). A cross-sectional study from 2011 with the aim to calculate the prevalence of wasting in infants <6 months estimated the number of severely wasted children <5 years in all developing countries to 19.8 million and the number of severely wasted infants <6 months to 3.8 million (7). The authors identify these young infants as a group often overlooked in previous malnutrition research and management guidelines and emphasize the need for increased focus on this particular age group.

In 2015 the United Nations General Assembly set up 17 new goals, the Sustainable Development Goals (SDG), to supersede the old Millennium Development Goals. Two of the goals aim to “end hunger, achieve food security and improved nutrition and promote sustainable agriculture” (goal 2) and “ensure healthy lives and promote well-being for all at all ages” (goal 3) (8). Two essential targets are to end all forms of malnutrition and end preventable deaths in children below 5 years of age until the year of 2030. Research on child malnutrition is one important step towards reaching these goals.

3.1.2.2 Pathophysiology

Severe acute malnutrition (SAM) is a result of protein and energy shortage in relation to the body's demands. It is understood to be caused by "an interplay between social, political and economic factors, the presence of chronic infections and inflammation" (9). Malnutrition can be caused by insufficient nutrient intake, such as actual lack of food, loss of appetite or ignorance of optimal feeding practises, but chronic and recurrent infections common in low-income settings also play a crucial role, for example increased basal metabolic rate during fever episodes and decreased nutrient uptake due to diarrhoeal disease (10). The correlation of infection and malnutrition is a vicious cycle and is illustrated in figure 1.

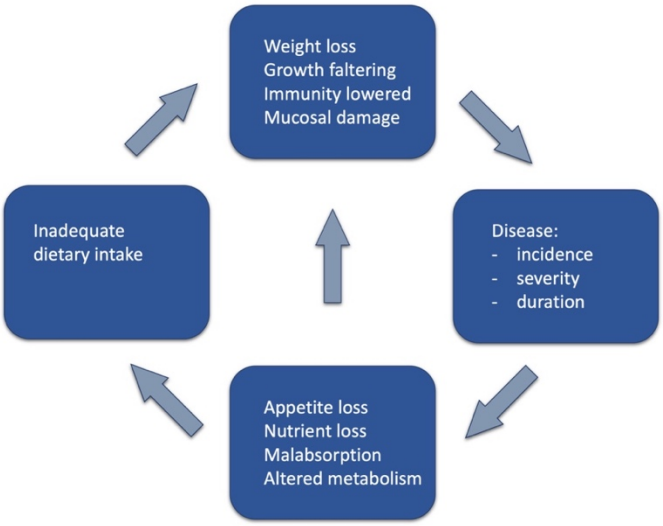

Figure 1. The mechanisms of correlation between malnutrition and infection presented by Tomkins and Watson in 1989 (11).

Severe acute malnutrition in children is divided into the non-oedematous and oedematous form. Wasting is the non-oedematous form of malnutrition where fat and muscle tissue waste away, resulting in an emaciated body. Kwashiorkor is the oedematous form with development of nutritional oedema and several other manifestations, for example skin lesions and hair changes. Both forms are caused by energy deficiency but it is not known why some children develop oedema and some do not. Kwashiorkor was for a long time primarily understood as a

disease caused by lack of essential amino acids in the diet, but this was never fully proven (12) and several studies have shown that a protein-poor diet is not the primary cause of the oedema. Although the aetiology and pathophysiology of kwashiorkor has been the focus in many studies over the years, it is still considered to be mainly unknown. Compared with its globally widespread distribution, kwashiorkor is grossly understudied and since it is often missed in studies of SAM, the global prevalence of kwashiorkor is hard to estimate (13). However, a retrospective study from Zambia of inpatient treatment for SAM in children <5 years showed that a vast majority, 78%, of all children had oedema (14) and in a reply in Lancet, Ndekha argues that kwashiorkor is the predominant form of severe malnutrition in children in southern and eastern Africa (15). The case fatality rate of inpatient care for severe acute malnutrition is reported to be higher for children with the oedematous form than the non-oedematous form of malnutrition, perhaps because of the higher risk for developing complications, such as heart failure and metabolic changes (15, 16).

The pathophysiology of undernutrition is complex and not fully understood. In normal state, the energy metabolism in the body is maintained by insulin and glucagon. When fasting, the body glucagon levels increase which leads to several metabolic shifts; glycogenolysis and gluconeogenesis in the liver, breakdown of triglyceride in adipose tissue to free fatty acids and glycerol and degradation of proteins in muscle cells to amino acids (9). The glycogen stores are depleted after the first day. In the absence of oxaloacetate, as during fasting, free fatty acids are transformed into ketone bodies, which can be used as energy in many different cell types immediately, for example cardiac muscle, skeletal muscle and renal cortex (17). After some days the brain tissue has adapted to an increased ketone body utilization, both through increased permeability of the blood-brain-barrier and upregulated enzymes (18).

When the starvation persists for several days, thyroid hormones, growth hormone, catecholamines and corticosteroids become more important for controlling the metabolism. Initially during nutritional deprivation, the fuel used comes primarily from adipose tissue but in longer periods of starvation these stores are depleted and the body has to use the energy stored in muscle proteins and the body is slowly wasting away (9).

Severe malnutrition affects nearly all organ systems in the child's body. One of the most apparent and acute conditions is impairment of the immune system, which contributes to higher susceptibility to infections as well as more severe conditions and higher mortality, for example pneumonia and diarrhoeal diseases. A retrospective study from two Gambian hospitals showed that the overall case fatality rate for all diseases (consisting mainly of infections such as malaria, pneumonia, gastroenteritis and meningitis) was almost twice as high for children with severe acute malnutrition (weight-for-height <-3 SD) than for children with weight-for-height >-2 SD (19). The immune system in children with severe malnutrition is affected in numerous ways, for example impaired skin and mucosal barriers, dysfunction and/or reduced levels of some types immune cells and low levels of secretory IgA in saliva and tears, but the underlying mechanisms for these changes are not fully explained (20).

3.1.2.3 Malnutrition in infants <6 months of age

Malnourished infants under 6 months of age is an extra challenging group to manage. Most of the previous research, and hence the guidelines for diagnosis, treatment and follow up, has been focusing on children over 6 months of age, as until recently children below 6 months were recognised as a group that rarely presented with severe acute malnutrition (SAM). The year 2013 was the first time when WHO dedicated a specific paragraph to SAM in infants <6 months in the guidelines for management of malnutrition (21). However, the quality of evidence underlying most of these new guidelines is considered to be 'low' or 'very low' (22,

23). For example, the diagnostic criteria for SAM in infants <6 months are the same as for the older children, i.e. weight-for-length <-3 SD (WLZ). However, the mid-upper arm circumference (MUAC) measurement and weight-for-age (WAZ) has been proven by Mwangome et al to be better predictors of mortality in this age group than WLZ (24). They suggested MUAC <110 mm as a cut-off for diagnosing SAM in infants. Furthermore, the WHO Child Growth Standards only allow calculation of WLZ for lengths >45 cm, which excludes many of the young infants. To decide on a useful definition of SAM in infants <6 months of age has been pointed out as the most urgent research priority by the MAMI (Management of Acute Malnutrition in Infants aged less than six months) Working Group (25). Case fatality rates for inpatient treatment of SAM are higher in this age group compared to children 6-59 months (23, 26), although kwashiorkor is less common among infants <6 months of age (27). Another dilemma with the anthropometric measurements in infants is their inability to distinguish between the small but healthy children that are born either with low birth weight, are premature, or are small-for-gestational age. They follow their own growth curves, whereas the children with malnutrition are stagnating. The latter group has an increased mortality risk and hence are in greater need of immediate interventions while the small but healthy children do not have increased risk of death (24).

The cause of malnutrition in infants is, like in older children, multifactorial and not fully explained, but feeding practises, especially breastfeeding, play a crucial role (28). Infants have a very high growth rate in the first months of life and thus require optimal nutrition to maintain the rapid development. Insufficient nutrient intake can be caused by the mother's ignorance or inability to feed the infant properly or depend more on the infant (29). Some infants are too weak to suckle (e.g due to prematurity or infection) while some have

underlying conditions obstructing nursing, such as developmental disorders and malformations of the mouth or tongue.

3.1.2.4 Breastfeeding

Breastfeeding (BF) practises are very important for infant and young child nutrition. The benefits and possible disadvantages with breastfeeding have been researched thoroughly in the past decades and the result is clear: breastmilk is the best food for children in the first months of life. The optimal duration of exclusive breastfeeding (EBF) and the time for initiation of complementary feeding (CF) have been evaluated in numerous of studies and it is now well established. WHO recommends that breastfeeding should be initiated within the first hour after birth (so called 'early initiation') and that the infant should be exclusive breastfed for the first 6 months of life with continued partial breastfeeding up to at least 2 years of age. At the age of 6 months, complementary foods should be introduced and the amount gradually increased. The child should be breastfed on demand and the use of bottles is discouraged in favour of cups or spoons if needed, for hygienic reasons (30). Early initiation of breastfeeding is a success factor for exclusive breastfeeding for 6 months and associated with lower morbidity and mortality rates in infants (31, 32). Breastfeeding is both beneficial for the health of the child and the mother, but also for the economic situation of the household, especially in low-income and middle-income countries. Compared to early initiation of complementary feeding, exclusive breastfeeding for 6 months leads to better infant health and reduced mortality by improving nutritional status and protecting against some of the most common infections in the these settings; gastrointestinal, respiratory and otitis media infections (33). This is likely both due to the composition of the human milk, with essential nutrients and components important for the infant's immune system, as well as through a delayed exposure to food- and water- borne pathogens (33, 34). Exclusive breastfeeding also leads to prolonged lactational amenorrhea in the mother which in turn can

contribute to increased birth spacing (35). If effective breastfeeding is not possible, the infant needs to be fed with breast milk substitute, such as commercial infant formula. However, in many settings, infant formula is given as a complement to, or instead of, effective breastfeeding, and this practice tend to increase with higher socioeconomic status (36). Global commercial campaigns for promoting breast milk substitutes has contributed to the high use, but is since 1981 well regulated by WHO through the International Code of Marketing of Breast-milk Substitutes (37). Infant formula feeding in low-income settings is problematic due to difficulties in hygienic preparation, use of contaminated water and over-diluting (38).

Despite the strong evidence and the clear recommendation, EBF practices in all countries are considered suboptimal. Rates of breastfeeding, both exclusive and partial, are considerably higher in low-income countries than in middle-income and high-income countries (36). Results from the Tanzania Demographic and Health Survey (TDHS) from 2016, showed that 59% of all infants aged 0-6 months were exclusively breastfed and that only 27% of infants at the age of 4-5 months were exclusively breastfed (39). These results are fairly consistent with two regional studies from Tanzania, which showed EBF rates at 6 months of 29% and 24% respectively (40, 41). Over 50% of infants aged 4-5 months in Tanzania were given solid or semi-solid food as a complement to breastmilk (39).

Several previous studies have aimed to explore barriers to exclusive breastfeeding, both through quantitative and qualitative methods. Studies from the Tanzania mainland show that, like in other low-income and middle-income countries, one of the most prominent reasons for not exclusively breastfeeding the infant is the mothers' perception of the breastmilk to be insufficient for the baby (40, 41). Family members, often elderly women, encourage the mother to introduce complementary food before the age of 6 months. Other barriers to

exclusive breastfeeding include work commitments, fear of getting sagged breasts, cultural beliefs like fear of "the evil eye" when breastfeeding in public and that abdominal pain, called "chango", is linked to breastfeeding and must be treated with traditional drugs (42). Discontinuation of EBF is higher among mothers with lower attendance to antenatal care and who are not supported by the family and community (43) while knowledge about EBF among the mothers tend to increase the success rate (41). Common complementary food given to infants in mainland Tanzania is water, porridge made of cassava or maize, traditional herbal drugs and cow's milk (40, 41). Several studies have investigated infant feeding practises on the mainland, but due to cultural differences, the practises in Zanzibar may not be the same. To our knowledge, no other studies have been carried out to explore feeding practises and perceptions about infant feeding in Zanzibar, hence this is an important contribution to the study setting.

3.1.2.5 Guidelines for management of severe acute malnutrition

Chapter 7 in "Pocket book of hospital care for children" by WHO is dedicated to the management of severe acute malnutrition (21). The pocket book can be found and downloaded in full from the WHO website (44) and the subsequent section is only a brief summary of the guidelines. The chapter focuses mainly on children >6 months of age but a short section covers the differences for infants <6 months regarding admission and discharge criteria and treatment. The initial assessment consists of a detailed history concerning medical conditions, symptoms and feeding practises, a clinical examination, including conduction of appetite test, and locally available laboratory tests. The diagnostic criteria for SAM in children are severe wasting (WLZ or WHZ <-3) and/or bilateral pitting oedema of the feet. For children >6 months of age MUAC <115 mm is also a diagnostic criterion for severe wasting. Weight-for-age (WAZ) is currently not used for diagnosing SAM. Children with complicated SAM shall be admitted and managed as inpatients while children with

uncomplicated SAM can be treated in outpatient department. For children >6 months, SAM is considered complicated when there is appetite loss or any medical complications. The WHO guidelines (21) state that for infants <6 months with SAM, the complicating factors that call for admission are any of the following:

- General danger signs or serious clinical condition as outlined for infants 6 months or older
- Recent weight loss or failure to gain weight
- Ineffective breastfeeding (attachment, positioning or suckling) directly observed for 15–20 min, ideally in a supervised separated area
- Any bilateral pitting oedema of the feet
- Any medical problem needing more detailed assessment
- Any social issue requiring detailed assessment or intensive support (e.g. disability or depression of caretaker or other adverse social circumstances)

The first criterion refers to the Integrated Management of Childhood Illness (IMCI) general danger signs; unable to drink or breastfeed, vomits everything, has had convulsions or convulsing now and lethargic or unconscious (45).

The inpatient treatment of SAM in children starts with a stabilization phase which later transitions into a rehabilitation phase and consists of important steps. Those are diagnosing, treating, monitoring and preventing hypoglycaemia, hypothermia, dehydration, electrolyte disturbances, infection and micronutrient deficiencies. All children admitted due to SAM shall be given broad-spectrum antibiotics. The importance of sensory stimulation is also stressed. Therapeutic feeding is divided into two phases. The initial feeding phase focuses on stabilization and gradual re-feeding with a therapeutic milk with 75 kcal per 100 ml, called F-75. The later rehabilitation phase focuses on catch-up growth with gradual shift from F-75 to F-100 (therapeutic milk with 100 kcal per 100 ml), and later for children above 6 months to solid ready-to-use-therapeutic food (RUTF), such as Plumpy'Nut®. Mothers who are still breastfeeding are encouraged to put the child to the breast before giving therapeutic food. The difference in these guidelines between older children and infants <6 months regarding feeding

is that re-establishing effective exclusive breastfeeding is the first recommendation for infants <6 months. The second-best option is expressed breastmilk, but if not possible or in insufficient amount, commercial infant formula or therapeutic milk should be given. If breastmilk supply is insufficient, a supplementary suckling technique can be used to stimulate lactation. The infant feeds expressed breastmilk or formula milk from a cup through a feeding tube. The tube is put along the breast with the end close to the nipple and while suckling the infant stimulates the nipple. For infants <6 months, F-75 or an extra diluted F-100 formula, called 'specially diluted therapeutic milk' (STDM) or just 'diluted F-100', is used. The solid RUTF is only used for children >6 months of age. Children in the rehabilitation phase can often be treated as outpatients, coming for weekly follow-ups to monitor weight gain and clinical condition.

When the infant <6 months admitted for SAM is clinically stable (e.g all complications, including oedema, are resolved), is breastfeeding effectively or feeding well and has satisfactory weight gain (e.g above the median of the WHO growth velocity standards or more than 5g/kg per day for at least 3 successive days), he or she can be discharge from inpatient care and continue treatment as outpatient. An acceptable simplification of the weight gain criterion is to use a target weight of 15% gain from admission weight (3).

3.1.3 Tanzania and Zanzibar

3.1.3.1 Overview

Tanzania is a former British colony which gained its independency in 1961. The commonly spoken language is Swahili, but English is still used as an academic language. Zanzibar is a semi-autonomous region of Tanzania, consisting of the islands of Unguja (often called Zanzibar), Pemba and some smaller islands. The population of Zanzibar was calculated to 1.300.000 people in 2012 (46) and almost all of them are Muslims, compared to the rest of

Tanzania where a majority are Christians. The life expectancy in Zanzibar is 67 years and the infant mortality rate is 45 in 1000 live births. Almost half of the population is under 18 years of age and 84% percent of all adults are literate. The average number of births per woman is 4.6. HIV prevalence in Zanzibar is low, only 1.5% (47). Overall, comparisons of the socioeconomic factors between Zanzibar and mainland Tanzania indicate that Zanzibar is slightly more developed than the rest of the country. However, the rate of wasting is almost twice as high in Zanzibar (7,1%) as on the mainland (4,4%) (39). The reason for the higher rate of wasting in Zanzibar is not known.

3.1.3.2 Health Care System

The public health care system in Zanzibar consists of primary, secondary and tertiary health care facilities. On primary level there are 119 primary health care units (PHCU), 34 PHCU+ (with some additional services) and 4 primary health care centres (PHCC) which function as cottage hospitals (48). The 3 district hospitals on secondary level are all located on Pemba, while the only tertiary facility, Mnazi Mmoja Hospital (MMH) is located on Unguja. MMH has a bed capacity of 546 and functions both as a primary and secondary facility for people living in the area and as a referral hospital for the population in remote parts of Unguja and Pemba (49). The health care is officially free of charge in Zanzibar, but the actual cost for health care is reported to be almost one-third of the household economy (48).

3.1.3.3 Malnutrition ward at Mnazi Mmoja Hospital

The paediatric department has 75 beds, of which 12 belong to the malnutrition ward, where both infants and older children are admitted. The mothers stay with their children in the ward during hospitalization. The chart is kept in a file with handwritten notes on blank papers. When the patient is discharged, a summary of the hospitalization is written in the patient's personal book and the chart is discarded. After discharge from inpatient care for severe malnutrition, the caretaker is supposed to bring the child for follow-ups weekly.

3.1.4 Research gap and contribution

Severe malnutrition in young infants is scarcely researched and is pointed out as a high priority field. Childhood malnutrition is a great problem in Zanzibar but, like in the rest of the world, most of the research covers older children. To our knowledge no other research has been done to describe the inpatient care of the young malnourished infants in Zanzibar. This study will provide a first description of the situation and possibly identify subjects that need to be studied further.

3.2 Aim

The aim of this study was to describe the management and treatment of children <7 months of age admitted to the paediatric ward at Mnazi Mmoja Hospital due to severe malnutrition and to explore feeding practises and caretakers' perceptions.

3.3 Specific objectives

The first research question concerning the inpatient treatment of children <7 months was to describe the reasons for admitting the patients, to describe the diagnoses posed during admission and to describe the outcome of the hospital care. The second research question was to describe caretakers' perceptions, common feeding practises and barriers to exclusive breastfeeding.

4. Methodology

4.1 Study design

To meet the objectives, an observational and questionnaire-based cross-sectional study of young infants admitted to the paediatric ward at MMH for severe malnutrition was conducted. It was approximated that a sample size of 50 patients was enough in this first pilot study to provide a description of the so far unstudied patient group. A specific case record form

(CRF), consisting of three sections, was designed (see appendix 1). The first part contained questions about the patient background and information about initial assessment and treatment, obtained from the admission note in the chart. The second part was a questionnaire to the caretaker (usually the mother) about the background, living standard, breastfeeding and complementary feeding practises and perceived cause of malnutrition. The final part of the CRF contained questions about the outcome and clinical data, obtained from the discharge note.

To increase the response rate and the reliability of the answers of the caretakers, as well as to avoid problems with illiteracy, it was decided to verbally ask the questions to the caretaker in an interview, with the help of a local Swahili speaking translator. The questions were mainly closed-ended but a few were open-ended to better explore perceptions and minimize observer bias. A consent form in English with information about the study was constructed and translated into Swahili by members of the study team.

4.2 Study population

The data collection was carried out in February through May 2020 and a total of 32 patients were enrolled during ongoing admission for severe malnutrition, either in the malnutrition ward or in the other paediatric wards. All patients admitted to the malnutrition unit during the study period were assessed for eligibility. Health care staff in the other paediatric wards were asked, and reminded weekly, to report any patients admitted due to malnutrition and these patients were also checked for the inclusion criteria. Hereby, 2-3 patients were also enrolled from the diarrhoea ward. If all inclusion criteria were met, the translator read the consent form, answered any questions and the caretaker was asked for a signature.

4.3 Inclusion and exclusion criteria

The patient could be included if he or she was between 0-<7 months of age and was admitted to the paediatric ward at MMH during the study period, with severe malnutrition as one of the reasons for admission. The patient was excluded if the caretaker was unable or unwilling to provide informed consent. At first, only infants below 6 months were supposed to be studied, but to reach sufficient sample size, the inclusion criteria had to be widened to include children who had passed 6 months of age but had not yet turned 7 months.

4.4 Data collection procedures

A translator was needed, both for interpretation but also to assist in the whole process of finding potential study participants in the wards, asking for consent and collect data. Therefore, a graduated medical student, familiar with the work at MMH, was employed. Data was collected by the primary investigator and the translator as planned between February 19 and March 16 2020. Due to the Covid-19 pandemic and the following insecure situation, the primary investigator had to end the visit and return to Sweden earlier than expected. The supervisor abroad, also co-investigator of the study, continued to collect data between March 17 and May 4 2020 and transferred it to Sweden, where the results were compiled. The enrolled patients were given consecutive identification numbers and a code key with the names and numbers was kept safely.

Data was collected from the admission note but answers to any laboratory tests and radiological examinations were found on separate sheets. The interview with the caretaker took approximately 10 minutes and were supposed to be held in a more private space outside the ward, although some caretakers preferred to answer the questions in the ward. The answers to open-ended questions were condensed by the translator or co-investigator. When

the patient was discharged, data was collected from the discharge note. The data was entered to SPSS® continuously during the study period.

4.5 Statistical methods

The statistical methods used were mainly descriptive and was performed in SPSS 26® and Excel®. 95% confidence intervals were compared for some interesting variables and Mann-Whitney U test was performed for median comparisons. P-values <0.05 was considered statistically significant.

4.6 Ethical considerations

The study was performed in accordance with the principles stated in the declaration of Helsinki and International Conference on Harmonisation-Good Clinical Practice (ICH-GCP). The study protocol was approved by the Zanzibar Health Research Ethical Committee (ZAHREC) at Zanzibar Health Research Institute (ZAHRI).

5. Results

5.1 Enrolment

A total of 33 patients were enrolled, whereof 11 by the student and 22 by the co-investigator. One patient was excluded because the consent form was not signed and thus the remaining 32 patients were included in the analysis.

5.2 Participant background characteristics

Background characteristics of the enrolled patients can be seen in table 2. Eighteen (56%) of the patients were female and the median age was 4.5 months. In total, 26 (87%) of 30 patients had been delivered at a health facility. Seven (22%) of the patients were the mother's first

child and 6 (19%) of the patients had a twin sibling. The median age of the youngest sibling was 2 years with a maximum of 11 years.

Table 2. Patient characteristics.

Number of enrolled patients	**n=32**
Age (months)	**n=31**
0-<1 n (%)	0 (0)
1-<2 n (%)	3 (10)
2-<3 n (%)	7 (23)
3-<4 n (%)	3 (10)
4-<5 n (%)	6 (19)
5-<6 n (%)	5 (16)
6-<7 n (%)	7 (23)
Birth weight (g)[1]	**n=32**
Median (min-max)	2700 (700-4000)
<1500 n (%)	2 (6)
1500-<2500 n (%)	4 (16)
≥2500 n (%)	25 (78)
Previously admitted to hospital	**n=29**
No n (%)	17 (59)
<1 month ago n (%)	3 (10)
≥1 month ago n (%)	9 (31)

The number of patients (**n=x**) included in the calculation for each variable can be seen in bold text above the result. The rest (n=32-x) is missing data.

1. Birth weight categories according to WHO: <1500g = very low, <2500g = low, ≥2500 = normal

The caretaker who brought the child to the hospital and to whom the questions were asked was the mother of the child in 31 of the 32 (97%) cases. In the last case the mother had died and the baby was taken care of by an aunt. Background characteristics of the mothers are presented in table 3.

In 17 (53%) of the households, the main source of drinking water was a public tap or well. Second most common (n=13, 41%) was water from a tap inside the house and less common was river or spring water (n=1, 3%) and bottled water (n=1, 3%). All caretakers reported that they had a toilet at home and a majority of the households (n=24, 75%) had traditional flush toilets, also called squat toilets, while the rest (n=8, 25%) had pit latrines. Twenty-four (75%) of the caretakers owned a mobile phone.

Table 3. Characteristics of the biological mother to the patient. In the aunt being the caretaker, she was asked about the characteristics of the biological mother.

Number of enrolled participants	**n=32**
Age	**n=32**
<20 n (%)	3 (9)
20-<30 n (%)	14 (44)
30-<40 n (%)	9 (28)
≥40 n (%)	6 (19)
Level of education	**n=31**
No school education n (%)	2 (7)
<10 y n (%)	8 (26)
10-12y n (%)	21 (68)
≥13y n (%)	0 (0)
Number of antenatal visits during pregnancy	**n=31**
1 n (%)	0 (0)
2 n (%)	2 (7)
3 n (%)	5 (16)
4 n (%)	19 (61)
≥5 n (%)	5 (16)
Number of parities	**n=32**
1 n (%)	8 (25)
2 n (%)	5 (16)
3 n (%)	4 (13)
4 n (%)	5 (16)
≥5 n (%)	10 (31)

The number of patients (**n=x**) included in the calculation for each variable can be seen in bold text above the result. The rest (n=32-x) is missing data.

5.3 Breastfeeding and complementary feeding practises

The second research question aimed to explore barriers to EBF and common feeding practises in the infants. The reports of feeding practises were separated into two age categories and the results are listed in table 4. The rate of partial breastfeeding was high but exclusive breastfeeding was not common. Of the 30 mothers answering this question, 28 (93%) reported that they had insufficient amount or quality of breastmilk and 7 (24%) reported that the baby had problems with suckling. Less common problems related to breastfeeding were nipple pain (n=2, 7%) and not having enough time due to work or domestic work (n=2, 7%). The problems with breastfeeding was similar in the age groups. Of the infants aged 0-<4 months, 93% (95% CI 61-93) had been given some kind of liquid, other than breastmilk and therapeutic milk, the day before the interview and the equivalent proportion for infants aged 4-<7 months was 94% (95% CI 70-95). Thirty-one percent (95% CI 7-52) of the infants 0-<4 months had been given solid food at some point in their life, compared to 56% (95% CI 29-

71) in infants aged 4-<7 months. More than half, 21 (68%), of all infants had been given infant formula at some point in their life.

Table 4. Breastfeeding and complementary feeding practiced by the caretaker.

	All ages	0-<4 months	4-<7 months
Number of enrolled patients[1]	**n=32**	**n=13**	**n=18**
Breastfeeding	**n=32**	**n=13**	**n=18**
No breastfeeding n (%)	3 (9)	2 (15)	1 (6)
Partly breastfeeding n (%)	28 (88)	10 (77)	17 (94)
Exclusive breastfeeding n (%)	1 (3)	1 (8)	0 (0)
Liquids given day before[2]	**n=32**	**n=13**	**n=18**
Yes n (%)	30 (94)	12 (93)	17 (94)
No n (%)	2 (6)	1 (8)	1 (6)
Type of liquids given day before[3]			
Plain water n (%)	28 (88)	11 (85)	16 (89)
Infant formula n (%)	10 (31)	6 (76)	4 (22)
Tinned, powdered or fresh animal milk n (%)	5 (16)	4 (31)	0 (0)
Clear broth n (%)	3 (9)	1 (8)	2 (11)
Thin porridge/gruel	13 (41)	5 (39)	7 (39)
Traditional drugs n (%) (data missing = 16)	11 (69)	4 (50)	6 (86)
Solid food ever given	**n=32**	**n=13**	**n=18**
Yes n (%)	15 (47)	4 (31)	10 (56)
No n (%)	17 (53)	9 (69)	8 (44)
Type of solid food given[3]			
Grain or cassava porridge n (%)	5 (16)	2 (15)	2 (11)
Ugali, rice or potato n (%)	4 (13)	0 (0)	4 (22)
Fruit or vegetables n (%)	12 (38)	2 (15)	9 (50)

The number of patients (**n=x**) included in the calculation for each variable can be seen in bold text above the result. The rest (n=32-x) is missing data.

1. One case with missing age category
2. Other liquid than breastmilk and therapeutic milk.
3. It was possible to answer several types of liquid or solid food. Frequencies were calculated for each category

5.4 Admission

The admission notes written in the charts generally followed a structure including main complaints, medical history, clinical signs, measurements, reason for admission, laboratory tests and treatment. The most common symptoms reported were poor weight gain/weight loss (n=12), cough (n=10), poor feeding (n=10) and diarrhoea (n=6). Common clinical signs included developmental delay (n=20), emaciation (n=10), fever (n=7), pallor (n=5), ill looking (n=5) and abnormal lung sounds (n=5). Some patients had multiple symptoms and clinical signs.

The first research question aimed to explore why doctors admitted infants <7 months as malnutrition patients. Severe malnutrition was an underlying condition in all cases, but the doctors often only mentioned the complicating factors that led to admission. The reasons reported in the admission notes were categorized into some common themes. For some patients, several reasons were mentioned, and these answers are represented in more than one theme. There was one case with missing data. Twelve (39%) of the patients were admitted due to respiratory symptoms or pneumonia, 11 (35%) because of gastrointestinal symptoms, 10 (32%) due to fever and 10 (32%) due to poor weight gain or weight loss. For 7 (23%) patients, failure to thrive (FFT) or severe acute malnutrition (SAM) were mentioned as reason.

A summary of the patient chart data from the day of admission is listed in table 5. There was a high rate of missing information in the charts and hereby also missing data for this study, for example length. Z-scores for weight-for-age (WAZ) and weight-for-length (WLZ) were usually not written in the charts. Hence, and all scores presented here were calculated afterwards. WAZ and WLZ were possible to calculate in 30 and 10 cases respectively (data missing was 2 and 22). According to WHO Child Growth Standards, 28 of 30 (93%) patients had WAZ <-3, 9 of 10 (90%) patients had WLZ <-3, i.e. qualified as SAM, and 1 (10%) had a normal weight-for-length. In addition to length, other variables with high rates of missing data were loss of appetite (data missing = 10), presence or absence oedema (data missing = 9), HIV test (data missing = 20) and malaria test (data missing = 23). All of the patients with recorded result to HIV test and malaria test were negative.

Table 5. Clinical patient data obtained from the admission note in the chart

Number of enrolled patients	**n=32**
Admission weight (g)	**n=31**
Median (min-max)	3200 (1600-5200)
1000-<2000 n (%)	4 (13)
2000-<3000 n (%)	7 (23)
3000-<4000 n (%)	14 (45)
4000-<5000 n (%)	5 (16)
≥5000 n (%)	1 (3)
Length (cm)	**n=10**
Median (min-max)	56 (50-65)
<50 n (%)	0 (0)
50-<60 n (%)	8 (80)
≥60 n (%)	2 (20)
Axillary temperature (°C)	**n=31**
Median (min-max)	37.1 (36.1-38.7)
<37 n (%)	12 (39)
37-<38 n (%)	13 (42)
≥38 n (%)	6 (19)
Loss of appetite	**n=22**
Yes n (%)	10 (45)
No n (%)	12 (55)
Bilateral oedema	**n=23**
Yes n (%)	1 (4)
No n (%)	22 (96)
Saturation (%)	**n=25**
<90 n (%)	1 (4)
90-94 n (%)	5 (20)
95-100 n (%)	19 (76)
Hb (g/dl)	**n=21**
<6.0 n (%)	0 (0)
6.0-<10.0 n (%)	13 (62)
≥10.0 n (%)	8 (38)

The number of patients (**n=x**) included in the calculation for each variable can be seen in bold text above the result. The rest (x=32-n) is missing data.

All patients with available data (n=29 for this variable) received therapeutic milk on admission. F-75 was given to 15 (52%) of them and diluted F-100 to 14 (48%). Twenty-six (96%) of 27 patients were given antibiotic. The combination of penicillin and aminoglycoside was the most common regimen. Two (9%) patients had a blood transfusion.

5.5 Discharge

Out of 30 patients, for which the outcome of the admission was noted, one patient passed away. Twenty-eight (93%) were discharged by hospital staff, and one patient was discharged against medical advice. Two-thirds (n=20, 67%) of the patients reached the weight goal used in the malnutrition ward at MMH, which is 15% weight gain from admission weight. The

deceased patient and the one taken from hospital by the caretaker were among the 10 patients that did not reach the target weight, but the remaining patients were discharged by staff. The median duration of admission was significantly longer (13.5 days) in the group of patients who reached the discharge weight goal than among those who did not (8.5 days) (p=0.01, by Mann Whitney U test). Other data regarding the admission period and the patient status at time of discharge is presented in table 6.

Table 6. Duration of hospitalization, clinical patient data obtained from the discharge note in the chart and feeding practises at the time of discharge.

	All ages	**0-<4 months**	**4-<7 months**
Number of enrolled patients[1]	**n=32**	**n=13**	**n=18**
Duration of admission in days	**n=30**		
Median (min-max)	11.5 (3-24)		
<5 n (%)	3 (10)		
5-<10 n (%)	7 (23)		
≥10 n (%)	20 (67)		
Discharge weight (g)	**n=30**		
Median (min-max)	3600 (1600-5600)		
1000->2000 n (%)	1 (3)		
2000->3000 n (%)	5 (17)		
3000->4000 n (%)	14 (47)		
4000-<5000 n (%)	8 (27)		
≥5000 n (%)	2 (7)		
Loss of appetite	**n=21**		
Yes n (%)	2 (10)		
No n (%)	19 (90)		
Bilateral oedema	**n=23**		
Yes n (%)	0 (0)		
No n (%)	23 (100)		
Breastfeeding practises at discharge	**n=27**	**n=9**	**n=17**
No breastfeeding n (%)	2 (7)	1 (11)	1 (6)
Partly/mixed breastfeeding n (%)	20 (74)	5 (56)	14 (82)
Exclusive breastfeeding n (%)	5 (19)	3 (33)	2 (12)
Complementary feeding at discharge	**n=28**	**n=9**	**n=18**
No complementary food n (%)	12 (43)	5 (56)	7 (39)
F-75 n (%)	1 (4)	1 (11)	0 (0)
F-100 diluted n (%)	3 (11)	0 (0)	3 (17)
Infant formula n (%)	5 (18)	3 (33)	2 (11)
RUTF n (%)	7 (25)	0 (0)	6 (33)

The number of patients (**n=x**) included in the calculation for each variable can be seen in bold text above the result. The rest (n=32-x) is missing data.

1. One case with missing age category.

Some (n=11) patients had multiple diagnoses posed from admission to discharge and three cases lacked all information about diagnoses. Severe acute malnutrition (SAM) was diagnosed in eleven cases, moderate acute malnutrition in one case, malnutrition in one case and failure to thrive (FFT) in eleven cases. Eight patients were diagnosed with pneumonia, 4 with acute watery diarrhoea, 3 with septicemia, 1 with kwashiorkor and 1 with hypoglycaemia. Two patients had cerebral palsy (CP), 1 patient had patent ductus arteriosus (PDA) and 1 patient had intrauterine growth restriction (IUGR) as underlying conditions.

5.6 Thoughts and perceptions

Two open-ended questions to the caretakers aimed to explore the reasons for seeking care and the perceptions of the cause of malnutrition in their child. The answers were condensed by the translator during the interview and later categorized into different themes. The reason for visiting a health care facility was not usually due to worries about the baby's weight or growth but more commonly because of other complaints. Sixteen (50%) of the caretakers mentioned fever and the second most common reason was respiratory symptoms (e.g cough, difficulty breathing, runny nose) and gastrointestinal symptoms (e.g diarrhoea, vomiting, abdominal pain and sore mouth) reported by 9 (28%) of the caretakers respectively. Only 6 (19%) went to a health care facility due to weight or feeding related problems (e.g poor weight gain, weight loss and unable to suck). In at least 9 (28%) cases the child was first brought to a PHCU or PHCU+ and then referred to Mnazi Mmoja Hospital, sometimes because of failure to thrive or weight loss rather than the main caretaker complaints.

Figure 2 shows the perceptions of cause of malnutrition as mentioned by the caretakers and can be compared to figure 3, which shows the perceptions of the doctor at the time of discharge. The latter information could not be found in the chart, hence all thoughts presented regard the cases collected by the co-investigator.

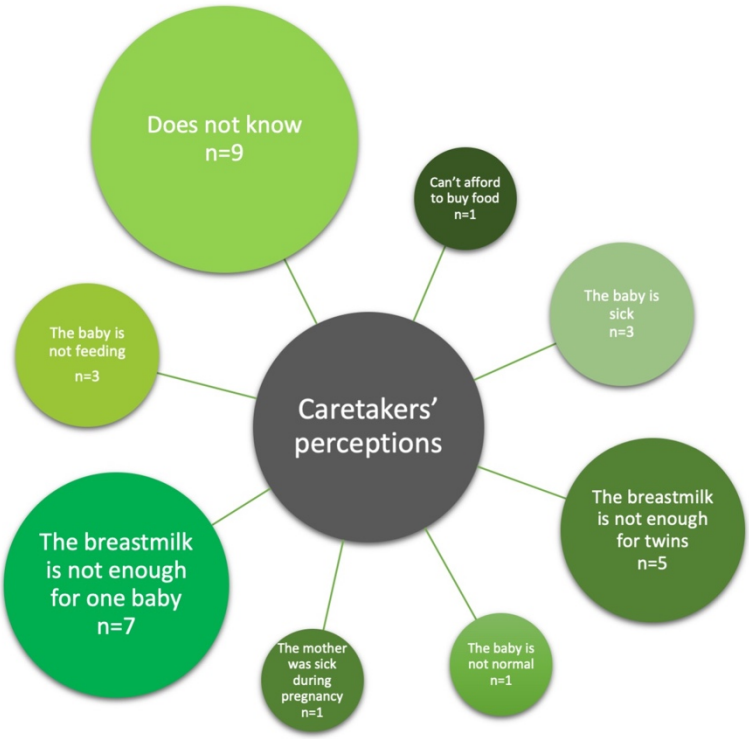

Figure 2. The caretakers' answers to the question "Why do you think your child is malnourished?" categorized in themes. Every answer was categorized in only one theme. Data missing = 2.

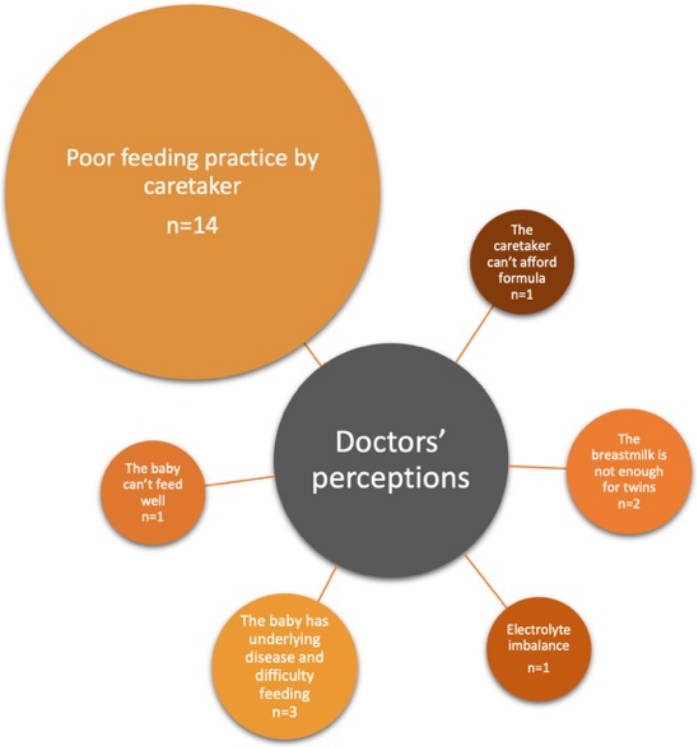

Figure 3. The doctor's thoughts of the reason for the patient being malnourished. Every answer was categorized in only one theme. Data missing = 10.

6. Discussion

This pilot study describes the inpatient care of severely malnourished infants <7 months of age admitted to the paediatric wards at Mnazi Mmoja Hospital by focusing on reasons for admission, diagnoses and outcome. It also gives a picture of common feeding practises and beliefs among caretakers. To our knowledge, this is the first study on malnutrition in young infants in Zanzibar.

We found that common reasons for admitting the infants as malnutrition patients were symptoms of infections and weight related problems. However, even though it is one WHO admission criteria for SAM in young infants, the concept of the IMCI general danger signs (45) was not used in initial assessment and therefore not as reasons for admission. Also, surprisingly, the admission criteria of ineffective breastfeeding (poor attachment, positioning or suckling observed for 15–20 min) stated in the WHO guidelines were not used in this setting. The effectiveness of breastfeeding was not mentioned in the admission note, but breastfeeding assessment is often performed during the morning round the day after admission (personal communication).

As previously mentioned, kwashiorkor is less common among young infants than older children, and consistent with the literature, this study found that only one of 32 patients was diagnosed with kwashiorkor. For the three patients admitted with SAM as one of the reasons for admission, only one had been measured for length, despite that the length is needed to calculate SAM (defined as WLZ <-3) if oedema is not present. This finding is in line with the results from our research question about diagnoses, where SAM was a common diagnose to make but WLZ could only be calculated in half of the cases due to lack of measured length. On the contrary, 4 patients with WLZ <-3 were not given the SAM diagnosis even though the diagnostic criteria were fulfilled. Our findings suggest that in this setting, the diagnosis of SAM in young infants is not always based on the criteria of WLZ <-3 set up by WHO. A

possible explanation to this could be the difficulty in performing anthropometric measurements, especially length, in young infants, as discussed by Grijalva-Eternod et al (26), in combination with scarce resources which could lead to undermanned staff and shortage of measuring equipment. This conclusion is in accordance with field experiences of measuring infants in Kenya, reported by Mwangome and Berkley (50), who as previously mentioned challenged the utility of the WLZ to define SAM. However, lack of knowledge about the WHO guidelines among healthcare workers might be a contributing factor.

In the malnutrition ward at MMH, WAZ was more commonly used than WLZ for grading malnutrition. This is not recommended in the current guidelines, but since WAZ, as well as MUAC, has been proven to be better predictors of mortality in malnourished infants by Mwangome et al (24), this practice may be the future. However, research is needed to establish appropriate cut-offs for both WAZ and MUAC before this can be implemented.

The findings regarding outcome are interesting. Contrary to our prior expectations, only one patient passed away during admission, generating a case fatality rate of 3%, which is within the range 1-5% considered 'good' by WHO (51). Even though fatality rates are considered to be higher for SAM in infants than older children, the case fatality was lower than for children 6-59 months in three studies from Africa, reported by Bilal et al (6%), Warfa et al (14%) and Rytter et al (14%) (52-54). However, the low fatality rate in our study may be due to use of other discharge criteria and shorter admission durations leading to more deaths at home after discharge. It is important to note that our sample size was small compared to the other studies. Nonetheless, a case fatality rate of 6% among infants <6 months, similar to the rate in our study, was presented by Vygen et al in their study of inpatient treatment of young infants with SAM in Niger (55).

Two-thirds reached the weight goal of 15% gain from admission weight. There was a significant difference in admission duration between that group and the group of patients who did not reach the target weight. It is possible that some patients were discharged before reaching the target weight because they were clinically stable and the over-all benefit was considered to be greater if the mother could come home with her child. Still, it is an interesting result.

The interviews with the caretakers led to several important findings. In line with previous studies about breastfeeding practises in Tanzania (39-41), the results from this study show a high rate of partial breastfeeding and a low rate of exclusive breastfeeding. When comparing the rates of EBF in this study and the previous literature, it is important to note that others have applied different methods and study infants of different ages. The 24 hours recall method, used in this study, has been shown to overestimate the prevalence of EBF compared to recall since birth method used in the other studies (56). However, with that in mind it is still possible to make some comparisons. Only 1 out of 32 (3%) of all infants in this study aged 0-<7 months were exclusively breastfed and in the age group of 4-<7 months no patient was exclusively breastfed. This is in contrast to the findings in the previously mentioned studies which showed EBF rates in Tanzania of 27% at 4-5 months (39) and 29% and 24% at 6 months (40, 41). No EBF rate specific for Zanzibar was found. It can be suggested that this difference indicates lower EBF rate among infants with severe malnutrition compared to infants in general and thus possibly a correlation between poor adherence to breastfeeding recommendations and severe malnutrition in infants. This is a subject for further research.

A common problem with breastfeeding reported by the mothers in this study was insufficiency of breastmilk. Recurring statements were “my milk is too thin/light” or “my

milk is not enough for the baby". These results are consistent with those of previous studies, both quantitative and qualitative, which describe barriers to exclusive breastfeeding (40-42). The prevalence of this perception diverges a lot between the two cross-sectional studies and this study; 8%, 69% and 93% respectively, which it is likely due to different sample sizes, different ways of questioning, even though all studies used interviews, and classification of the answers. The other problems with breastfeeding specifically asked in the questionnaire had lower prevalence among the mothers in this study. Only two (7%) reported that they did not have enough time due to work commitment or domestic work, but it is not possible to tell if they were actually able to breastfeed the baby 'on demand' during the whole day as the recommendation says. It would have been interesting to know whether many mothers had to leave their baby to another person while working. Sustaining EBF would then require feeding the baby expressed breastmilk or meeting up for breastfeeding, or to have a wet nurse breastfeeding the baby while the mother is away.

The WHO recommendations about complementary feeding practises are very clear: no other liquid or solid food than breastmilk for the first 6 months of life. However, adherence to these recommendations tend to be poor, both in this study and previous studies.
On the question of complementary feeding, we found that almost all of the infants had been given some liquid other than breastmilk or therapeutic milk the day before, with no difference between infants aged 0-<4 and 4-<7 months. Water was the most common liquid to give in both age groups. Mgongo et al reported that the knowledge about breastfeeding recommendations among mothers in northern Tanzania was good but that "the tradition of giving water early (within the first week after delivery) has made mothers believe that EBF practise include giving water to the child" (42). The explanation to the high prevalence of giving water in our study might be similar to what Mgongo et al discuss but this subject needs

to be researched further in Zanzibar to increase understanding of barriers to EBF in this setting.

Infant formula, thin porridge (locally called '*uji'*) and "other types of milk" (tinned, powdered or fresh animal milk) were also common liquids consumed by the infant the day before. Two-thirds of the caretakers reported to have given the child infant formula some time but the amount given varied a lot. Infant formula is often imported and tend to be relatively expensive. Considering the fact that almost half of the population in Zanzibar is estimated to live below the international poverty line (US$1.9 per day) (57), minimizing the use of infant formula when breastfeeding is possible could be an essential improvement for the household economy in poor families. Altogether, the potential harms with over-use of infant formula in low-income settings are important to consider when developing strategies to improve infant and young child feeding practises in Zanzibar.

A liquid spontaneously mentioned by the caretakers was traditional drugs, in form of decoction of herbs and roots. There was no specific pre-defined question about this in the questionnaire and therefore not all caretakers were asked if the child had received traditional drugs, leading to a high rate of data missing, but among those who were asked, this practice appeared to be common. This finding is consistent with that of Vygen et al, who reported that half of the infants in their study had been given some kind of traditional medicine and that many of the children had been brought to a local medicine man (55). It is possible that local traditions and beliefs can cause caretakers to give traditional drugs or take the sick child to the local doctor before visiting a health care facility. Delay before medical treatment may in some cases worsen the condition.

Somewhat surprisingly, there was no significant difference between the two age categories, 0-<4 and 4-<7 months, regarding how many had been given solid food at some point in their life

(confidence intervals were overlapping). A more expected result would be that the rate of giving solid food increased with age, but it is hard to tell how much the small sample size in this study affected the result. Even though the feeding recommendations are the same for all infants 0-6 months, it is essential to understand that there are differences between ages within the group, with the youngest infants being less capable of processing solid food than the infants just below 6 months. The recommendation of EBF is therefore of even higher importance for the youngest children. Our results, showing that almost one-third of the infants 0-<4 months of age had been given solid food which is against infant feeding recommendations, implicate that further research is needed to understand what reasons lie behind this behaviour that interferes with optimal infant feeding practises.

The problem with infant undernutrition is complex and multifaceted and it is important to study the perspective of the parents since they sometimes are a part of the reason for the condition and in nearly all cases are the link between the infant and the health care.
In this study, the most common reason for seeking care was signs of infection, such as fever, cough and diarrhoea. When these children were examined, they all presented with severe malnutrition and thus required inpatient care, even if the main complaints alone may have been able to treat as outpatients. Weight related concerns or feeding problems were only mentioned as a reason for seeking care by six of the caretakers.
Overall, these findings may indicate that the majority of the caretakers in this study lacked knowledge about signs of infant malnutrition and therefore only took contact with a health care facility when the child showed familiar symptoms. Almost one-third of the caretakers in this study did not know why their child was malnourished but a majority believed that insufficient breastmilk was the reason. This is problematic since this is normally rarely the case. Most mothers are capable of breastfeeding not only one but multiple babies at the same

time with sufficient amount and quality of milk (58). The nutritional status of the mother does not seem to affect the macronutrient composition or the amount of the breastmilk notably and mothers with mild to moderate malnutrition have enough milk to exclusively breastfeed both (59). The perception of the breastmilk to be 'too thin' seems to be deeply rooted in the culture and may be one of the main causes for early introduction of liquid and food. This is a downward spiral with complementary feeding leading to decreased stimulation of the breasts and reduced milk production, which in turn increases the perception of insufficient milk and need for giving other food.

Breastfeeding counselling and support for the mother, both antenatally and postnatally, are likely to be meaningful and effective strategies to improve infant feeding practises. Furthermore, it is also important to include the father and grandmothers in breastfeeding promoting programs since their influence affects the success of exclusive breastfeeding (43, 60).

Data from Tanzania Demographic and Health Survey (TDHS) (39) can be used to make a rough comparison of the socioeconomic situation between the participants in this study and the general population in Zanzibar. It is important to bear in mind that the aim and methods differ substantially, and interpretations should be made with caution.

Overall, it seems like the study participants represent the Zanzibar population reasonably well, perhaps with a concentration in the middle socioeconomic layer of the population. A possible explanation could be that the poorest families cannot afford a hospital stay (transport, mother being away from home, medication) and the richest have less problem with malnutrition and/or higher attendance to private hospitals. The distributions of the main household drinking water source, standards of sanitation, mobile phone possession, and place of delivery are similar in this study in comparison with the TDHS.

However, interestingly, the frequency of twins, 19%, among the patients in this study was very high compared to the population in general where the average rate of twinning in Tanzania is among the highest in the world with over 18 twin births per 1000 (1.8%) live births (61). Still, the high rate of twins in this study is not surprising considering the extra burden, both physically, mentally and economically, multiple births implies, in low-resource settings in particular. Yet, research on this subject is scarce. In 1998, Jaffar et al reported that mortality was higher among twins than singletons in Gambia and that malnutrition was a more common cause of death in twins (62).

The results based on data from the clinical charts had a high rate of missing data. It might be useful to point what type of data often lack in the charts to better understand the inpatient care in the malnutrition ward at MMH. The data with the highest rate of missing data was length, and as a consequence also Z-scores for weight-for-length. This is remarkable since weight-for-length is used as index for SAM and hence important when prioritizing which children to admit for inpatient care. In line with this finding, the questions about loss of appetite and bilateral oedema also lacked a considerable amount of data. In this case though, it is fair to assume that missing data in the chart usually mean that there was nothing to remark, i.e. normal appetite and no oedema. Nevertheless, it is important to negate these two clinical signs when admitting patients to be able to distinguish from “not examined” since they are crucial signs of severity and may require different treatment strategies.

6.7 Limitations and strengths

This study holds several limitations that may have affected the results. Firstly, the CRF was not fully adapted to the local setting and the questionnaire was not pre-tested, hence some variables and questions turned out to be inapplicable. Secondly, the sample size of 32 patients is small and substantially below the expected size of 50 patients. This was mainly due to

lower admission rates during the study period than expected. As a result, few statistical analyses were possible to use and the margin of errors are likely to be large. Secondly, because of the Covid-19 pandemic, the planned data collection was interrupted and had to be finished by another investigator with different background, experience and knowledge. The change of investigators led to different methods of finding data (e.g written in the chart or known by doctor) and interviewing the caretakers (e.g use of translator and ways of questioning). Possible observer bias cannot be rejected for any of the investigators but may differ due to prior knowledge and expectations. Finally, it is impossible to know if all MMH patients fulfilling the inclusion criteria were enrolled, since they may have been admitted to other wards and remained unnoticed to the research team.

Despite the limitations mentioned, this study has important strengths that deserves to be addressed. The method of data collection from patient charts as well as from interviews with the parents resulted in a broader picture of infant malnutrition in Mnazi Mmoja Hospital and made validation of data possible. The use of a combination of closed and open ended questions during the interviews gave high response rates and reliability. This study is a first contribution to an unexplored field and generate important subjects that needs to be further researched.

6.8 Improvements and future research

Relevant improvements of this study, apart from increasing the sample size, would primarily be to re-design the CRF. Some questions proved not suitable and less interesting. Some missing questions could have given more valuable information to this study including additional background characteristic variables to improve the estimation of socioeconomic level and more detailed and profound questions to the caretakers to better understand the reasons and beliefs behind the feeding practices.

This is a first pilot study on infant malnutrition in Zanzibar and future studies are necessary to develop a full picture of the problem in this setting. In addition to bigger quantitative studies about in- and outpatient treatment of infant malnutrition, valuable research includes qualitative studies with health care workers and caretaker. In depth-interviews with mothers to both healthy and malnourished infants are important to explore barriers and facilitators to proper breastfeeding practice, understanding of the concept 'exclusive breastfeeding' and reasons for introducing complementary food before 6 months. An important subject is the influence of members of the family and the close community in this setting, since previous studies have shown that support at home are linked to success of EBF. Also, caretakers' care-seeking behaviour and knowledge about symptoms of malnutrition need to be studied. Furthermore, the perceptions among workers in primary health care and maternal care are also important subjects to study in order to understand the beliefs of optimal infant feeding in this category and how education in breastfeeding counselling can improve the situation. Apart from studies in the local setting, basic research on severe acute malnutrition in infants <6 months is urgent. As mentioned by many before, age-specific admission and discharge criteria, such as establishing cut-offs for MUAC in this age group, and validation of treatment regimens are of greatest importance.

7. Conclusions and implications

This study's main contribution is a first description of the inpatient care and perceptions of caretakers to severely malnourished infants in Zanzibar and knowledge about important objectives for future studies.

Symptoms of infection was the most common reason for seeking care and for admission to the malnutrition ward. The WHO guidelines were used in the ward but not completely

followed and the diagnosis of severe acute malnutrition was not always based on the criteria in the guidelines. The caretakers' adherence to feeding recommendations was poor and many reported problems with breastfeeding, especially perception of insufficient breastmilk. Cultural beliefs and poor knowledge were barriers to exclusive breastfeeding and there was a discrepancy in the perceptions of reason for malnutrition between the caretakers and the doctors. No general recommendations or new strategies can be developed based on solely this study, but the importance of further research in the field is obvious in order to improve the care of this vulnerable patient group. In the long term, developing programs and policies are essential to reduce infant and child malnutrition.

In the local setting, the contribution is to give the health care staff an overview of the care they are practicing and to provide ideas for improvement of the management. A less resource-demanding development is to extend the content in the chart notes to give the responsible doctor more information and consequently better control. Noting presence or absence of appetite and oedema, measuring length and calculate WHZ and WAZ are examples of changes that can be done. It is vital that the hospital staff stay updated on the guidelines for infants <6 months, in particular as they probably are about to get changed within the near future, perhaps to include MUAC as admission criteria, which could simplify measuring of the infants.

Furthermore, continuing the work with breastfeeding counselling and encouraging of mothers to re-establish exclusive breastfeeding are important parts of the malnutrition management, both during admission and visits to the follow-up clinic. Promoting training in feeding counselling for staff working in antenatal, postnatal and primary health care could also be a

meaningful intervention, as well as efforts to increase the participation of fathers and other family members in maternal care visits.

If resources allow, a scale with higher precision, at least 20g as recommended by updated WHO guidelines, should be purchased and used for infants <6 months, since their small daily changes in weight are hard to detect with 100g precision scales.

Continued research will hopefully provide us with greater understanding of the multifaceted problem with malnutrition in young infants, leading to improvements in prevention and treatment and eventually decreasing prevalence of infant and child malnutrition and increased health and well-being.

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9. Populärvetenskaplig sammanfattning på svenska

Svår undernäring hos spädbarn under 7 månaders ålder på Zanzibar, Tanzania

Undernäring hos barn är ett stort problem i världen, framför allt i låg- och medelinkomstländer, och bidrar till nästan hälften av alla dödsfall hos barn under 5 år. Graden av undernäring definieras av vikten i förhållande till längden (alternativt överarmsomkrets) jämfört med friska barn. Svår undernäring kräver sjukvård, antingen på sjukhus eller i öppenvård. Spädbarn är känsligare än äldre barn men forskningen kring denna åldersgrupp är begränsad. Kunskapen om orsaker till undernäring och optimal behandling är därför otillräcklig och Världshälsoorganisationens riktlinjer för behandling av svårt undernärda spädbarn är svagt underbyggda. Låg grad av följsamhet till amningsrekommendationer, liksom hög förekomst av infektioner i dessa miljöer, tros spela en stor roll i utvecklingen av undernäring hos spädbarn. Den gällande rekommendationen är att uteslutande amma barnet upp till 6 månaders ålder, utan att ge någon annan vätska eller fast föda. Från 6 månader till 2 års ålder bör barnet både ammas och ges vanlig mat i upptrappande mängd.

Syftet med denna studie var att ge en överblick över sjukhusvården av svårt undernärda spädbarn på Zanzibar och att beskriva vanliga matningsrutiner och föräldrars uppfattningar om undernäring. Totalt 32 spädbarn under 7 månaders ålder inkluderades från undernäringsavdelningen på Mnazi Mmoja Hospital från februari till maj 2020. Information inhämtades från patientjournalen och via intervjuer med vårdnadshavaren (som var modern i alla fall utom ett).

Resultaten visade att den vanligaste orsaken till att vårdpersonal lade in patienten var infektionssymtom, t ex feber, diarré och luftvägssymtom, och därefter inadekvat viktuppgång. Svår undernäring var en underliggande orsak i alla fall. Av de 30 patienter med tillgänglig

information om utfall skrevs 28 (93%) ut av sjukhuspersonal, en (3%) togs från sjukhuset mot personalens rekommendation och en (3%) avled. Två tredjedelar av alla patienter nådde sin målvikt. Anledningen till att vårdnadshavaren sökte vård för sitt barn var i de flesta fall infektionssymtom. Endast 6 av dem sökte vård pga dålig viktuppgång eller ätsvårigheter. Tolv av vårdnadshavarna trodde att undernäringen berodde på att bröstmjölken var otillräcklig och 9 svarade att de inte visste. Tjugonio av mödrarna ammade sina barn men endast en av dem följde rekommendationen om uteslutande amning. En mycket vanlig uppfattning var att bröstmjölken var ”för tunn” och att barnet därför behövde ges annan föda. De flesta av barnen hade fått vätska dagen före intervjun och nästan hälften av dem hade givits fast föda vid något tillfälle, t ex gröt, ris eller frukt. Av de vårdnadshavare som tillfrågades specifikt om bruk av traditionell medicin hade många givit barnet avkok på örter och rötter.

Slutsatserna som kan dras av denna studie är att vården som bedrivs inte till fullo följer Världshälsoorganisationens riktlinjer men att dödligheten var låg. Vårdnadshavarnas följsamhet till amningssrekommendationerna var förväntat låg och kunskaperna kring amning och undernäring förefaller vara otillräckliga. Ytterligare forskning, både i låginkomstländer som Zanzibar och i övriga världen, behövs för att bättre förstå problemets mekanismer och omfattning och på så sätt kunna utarbeta strategier för prevention och behandling av svår undernäring hos spädbarn.

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11. Appendices

11.1 Appendix 1

CASE RECORD FORM

Severe malnutrition in children <7 months of age in Zanzibar

1. Reference number: |__|__|__|__|__|__|
2. Sex: □Male □Female
3. Age: Months_____Weeks_____
4. Is severe malnutrition one of the reasons for admission? □Yes □No
IF NO = PATIENT EXCLUDED – STOP HERE
5. Has the caretaker been informed and signed the consent form? □Yes □No
IF NO, OBTAIN CONSENT OR EXCLUDE PATIENT
6. Patient included during: □Admission □Follow-up clinic

INFORMATION OBTAINED FROM THE PATIENT CHART AT THE TIME FOR ADMISSION:

7. Date of admission (dd/mm/yyyy): |__|__|/|__|__|/|__|__|__|
8. Temperature: _____°C
□ axillary
□ rectal
□ oral
9. Weight: _____g
10. Length: _____cm
11. Weight-for-length <-3 SD: □Yes □No
12. Bilateral oedema: □No oedema □Grade + □Grade ++ □Grade +++
13. Appetite: □Yes □No
14. Previously admitted to hospital:
□ No
□<1 week ago
□1 week-1month ago
□>1 month ago
15. Reason for admission (according to admitting physician)
_____
_____
_____
16. Physician's cause for malnutrition:
_____
_____
_____
_____
17. Symptoms/history (tick if present):
□Fever/hotness of body □Vomiting □Lethargy
□Diarrhoea <14 days □Diarrhoea >14 days
□Difficulty breathing □Cough <14 days □Cough >14 days
□Convulsions □Altered consciousness

□Developmental delay
□Blood in stool □Rash/skin lesion
□Not feeding □Poor feeding/weight loss
□Body swelling/limb swelling/oedema
□Other (only one complaint, if not covered by above options):
_____

18. Other positive clinical signs on examination (eg. rales, murmur, skin rashes etc):
_____
_____
_____
_____

19. Chest X-ray? □Yes □No
If yes, what result? _____

20. IMCI danger signs at the time for admission:
a. Unable to drink or breastfeed? □Yes □No
b. Vomits everything? □Yes □No
c. Has had convulsions (more than one or prolonged >15 min)? □Yes □No
d. Lethargic or unconscious? □Yes □No
e. Convulsing now? □Yes □No

21. Saturation (SaO2): _____%

22. Test results:
a. Hb: _____g/dL
b. P-glucose: _____mmol/L
c. CRP: _____g/l
d. HIV positive? □Yes □No
e. Malaria RDT result: □Pf Positive □Pan Positive □Pf and Pan Positive □Negative □In-conclusive (despite repeated tests)
f. Other test results:
_____
_____
_____
_____

23. Treatment/management on admission:
a. F-75: □Yes □No
b. F-100 diluted: □Yes □No
c. Antibiotics: □Yes □No If yes, which? _____
d. Antimalarials: □Yes □No If yes, which? _____
e. Iv/po glucose: □Yes □No
f. Blood transfusion: □Yes □No
g. Other:
_____
_____
_____
_____

QUESTIONS TO THE CARETAKER OF THE CHILD:

The caretaker does not need to answer the questions if he/she does not want to.

24. Your relation to the child: □Mother □Father □Grandparent □Aunt/uncle □Sibling <18 □Sibling >18 □Carer (care home) □Other_____

25. Child brought to hospital by: □Mother □Father □Grandparent □Aunt/uncle □Sibling <18 □Sibling >18 □Carer (care home) □Other_____

26. Is the other parent at home? □Yes □No

27. Age of the mother: _____ years

28. Reason for seeking care: _____

_____

_____

29. Caretaker own perceived reason for malnutrition. Ask ”Why do you think your child is malnourished”: _____

_____

_____

_____

30. Have you ever attended school? □Yes □No
If yes, how many years of education: _____ years

31. Do you have a mobile phone? □Yes □No

32. What is the main source of drinking water for the members of your household?
□Tap water inside the house
□Well inside the house
□Private well outside
□Public well
□Public tap
□Bottled water
□River or spring water
□Rain water

33. Does your house have a toilet? □Yes □No
If yes, which type of toilet is it?
□Pit toilet
□Traditional hole toilet
□Other: _____
□Don’t know

34. Number of antenatal visits during pregnancy: _____□Don’t know

35. Place for delivery of the child: _____

36. Child crying directly after birth? □Yes □No

37. Birth weight: _____g □Don’t know

38. How many times was the child vaccinated?
□0 □1 □2 □3 □4

39. Mother parity: _____

40. Age of the youngest sibling: _____ years

41. Are you/the mother breastfeeding? □Yes □No
If no, when did you/the mother stop? _____
Why did you/the mother stop? _____

_____

_____

42. Are you/the mother partly breast feeding? □Yes □No

43. Which problems have you/the mother experienced with breastfeeding?

a. Perceived insufficiency of breast milk: □Yes □No
b. Baby has problems with suckling: □Yes □No
c. Nipple pain: □Yes □No
d. Does not have time due to job or domestic work: □Yes □No
e. Other: _____
_____
_____
_____

44. Read the following to the caretaker:
"Sometimes babies are fed breast milk in different ways, for example by spoon, cup or bottle. This can happen when the mother cannot always be with her baby.
Sometimes babies are breastfed by another person, or given breast milk from another person by spoon, cup or bottle or some other way. This can happen if a mother cannot breastfeed her own baby. Did (NAME) consume breast milk in any of these ways yesterday during the day or at night?" □Yes □No □Don't know

45. Have you given complementary milk formula? □Yes □No

a. If, yes for how long? _____
b. How much (estimate)? _____%

46. Read the following to the caretaker:
"Next I would like to ask you about some liquids that (NAME) may have had yesterday during the day or at night. Did (NAME) have any of the following?" (read the list)

a. Plain water? □Yes □No
b. Infant formula such as [insert local examples]? □Yes □No
c. Milk such as tinned, powdered or fresh animal milk? □Yes □No
d. Juice? □Yes □No
e. Clear broth? □Yes □No
f. Yoghurt? □Yes □No
g. Thin porridge? □Yes □No
h. Any other liquids such as [list local water-based]? □Yes □No
i. Any other liquids? _____

47. Have the child had any solid foods? □Yes □No
If yes, what type?

a. Grain porridge? □Yes □No
b. Cassava porridge? □Yes □No
c. Ugali? □Yes □No
d. Rice? □Yes □No
e. Fruit? □Yes □No
f. Vegetables? □Yes □No
g. [Insert other local food]? □Yes □No If yes, what?_____
h. Other: _____

INFORMATION ABOUT OUTCOME OBTAINED FROM THE PATIENT CHART AT THE TIME FOR DISCHARGE:

48. Date of discharge or death: |__|__|/|__|__|/|_|_|_|_|

49. Duration of admission: Weeks_____ Days_____

50. Probable cause of malnutrition: _____
_____
_____

51. Diagnoses during admission: _____
_____
_____

52. Outcome:

a. Deceased: □Yes □No
If yes, what is the probable cause of death? _____

b. Discharged from hospital by health care staff: □Yes □No

c. Caretaker ended admission: □Yes □No

53. WHO standards for discharge of malnourished children <6 months:

a. Breastfeeding effectively or feeding well with replacement feeds: □Yes □No

b. Adequate weight gain: □Yes □No

c. Weight-for-length ≥–2 SD: □Yes □No

54. Feeding on discharge:

a. Exclusive breastfeeding? □Yes □No

b. Partly breastfeeding? □Yes □No

c. F-75? □Yes □No

d. F-100 diluted? □Yes □No

e. Other: _____

55. Reached the weight/length goal: □Yes □No

56. W/L: _____SD

57. Weight: _____g

58. Length: _____cm

59. Bilateral oedema: □No oedema □Grade + □Grade ++ □Grade +++

60. Appetite: □Yes □No

61. Test results:

a. Hb: _____g/dL

b. P-glucose: _____mmol/L

c. CRP: _____g/l

d. HIV positive? □Yes □No

e. Malaria RDT result: □Pf Positive □Pan Positive □Pf and Pan Positive □Negative □In-conclusive (despite repeated tests)

f. Other test results:
_____
_____
_____
_____

Notes for the investigator: