MALNUTRITION AND COMORBIDITIES AMONG CHILDREN UNDER FIVE YEARS IN SOS HOSPITAL MOGADISHU, SOMALIA

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Malnutrition and Comorbidities among Children Under Five Years in SOS Hospital Mogadishu, Somalia

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

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DEDICATION

I dedicate this research dissertation with all my love and respect to my wife, Khadija Abdi Omar, my son, Mohamed, my daughter, Bushra, and my son Mazin, my parents and my friends who made a lot of sacrifice during the entire duration of the course. May the almighty Allah bless them now and forever.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

AIDS	Acquired immunodeficiency syndrome
ARI	Acute Respiratory Infection
BCG	Bacille Calmette-Guerin
BMI	Body Mass Index
CBC	Complete Blood Count
ESR	Erythrocyte Sedementation Rate
FAO	Food and Agriculture Organization
HFA	Height For Age
HIV	Human Immunodeficiency Virus
IDPs	Internally-Displaced Persons
IFAD	International Fund for Agricultural Development
MDGs	Millennium Development Goals
MUAC	Mid-Upper Arm Circumference
OTP	Out-Patient Therapeutic Program
PEM	Protein Energy Malnutrition
PTB	Pulmonary Tuberculosis
RBS	Random Blood Sugar
SAM	Severe Acute Malnutrition
SC	Stabilization Center
SD	Standard Deviation

SFP	Supplementary Feeding Program
SOS	Societas Socialis (Social Society)
SPSS	Statistical Package for the Social Science
TB	Tuberculosis
UNICEF	United Nations Children's Fund
UTI	Urinary Tract Infection
WFA	Weight For Age
WFH	Weight For Height
WFP	World Food Program
WHO	World Health Organization

ABSTRACT

Malnutrition is defined as a lack of proper nutrition. The vast majority of the world's hungry people live in developing countries, where 12.9% of the population are undernourished. It is prevalent in children particularly those in developing countries where one person out every four there is undernourished. Mortality is related to the severity of the malnutrition. In Somalia, child malnutrition remains a major health problem where the proportion of under-five children who were underweight in 2013 was 40% and 21% in rural and urban areas respectively. The purpose of this study was to investigate malnutrition and comorbidities among children under five years in SOS Hospital in Mogadishu, Somalia. The study employed a cross-sectional hospital survey targeting a population of under five children who were diagnosed as malnutrition cases at SOS Hospital in Mogadishu, Somalia. Probability systematic random sampling was used to obtain a sample size of 384 malnourished children. Data was collected from caregivers of malnourished children by use of a structured questionnaire and also review of patients' medical records. Data collected was analyzed using SPSS software (version 20.0) to describe and identify significant associations between different variables. Descriptive summary statistics and graphical summaries in tables and charts were used to present the study findings. The most prevalent forms of malnutrition among children admitted to SOS Hospital were marasmus (52.6%) and underweight (43.0%). Key study findings revealed are: poor household income (P-value = 0.000); large household size (P-value = 0.002); counselling of the caregiver/mother on healthy eating (P-value = 0.004); age of child (P-value = 0.001); vitamin A supplementation (P-value = 0.048); age up-to when the child was breastfed (P-value = 0.001); type of the milk the baby is fed on particularly Cows milk (P-value = 0.012) with most significant and positively related comorbidities among the malnourished children admitted to SOS hospital were urinary tract infection (P-value = 0.032, which was significant at 5% level of confidence), bronchopneumonia (P-value = 0.007, which was significant at 5% level of confidence), measles (P-value = 0.006, which was significant at 5% level of confidence) and malaria (P-value = 0.005, which was significant at 5% level of confidence) and based on the above findings, the following conclusion and recommendations were made: caregivers need to improve their poor household income through creating a good daily income source for them; encouraging mothers to practice birth control methods by to regulate their birth rates and thus the large household size; community-based counseling of the mother/caregiver on healthy eating and food fortification should be established and implemented at all community levels; supplementation of vitamins particularly vitamin A and other essential vitamins should be offered to all under five children; encouraging mothers to breastfed their children particularly first 6 months and avoiding Cow's milk supplementation to their babies in the first year; early detection and treatment of infections in under five children like urinary tract infection, bronchopneumonia, measles and malaria.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

The term malnutrition generally refers both to undernutrition and overnutrition (WHO, 2019), but in this study the term was used to refer soley to a deficiency of nutrition. The vast majority of the world's hungry people live in developing countries, where 12.9% of the population are undernourished. Malnutrition or lack of proper nutrients prevalent in children particularly those in Sub-Saharan countries, where one person in four there is undernourished (FAO, 2015). Somalia is one of countries with highest malnutrition prevalence due to poverty, instability, food insecurity and many other factors.

Malnutrition is associated with many health problems from birth to later in life. It is one of the leading cause of child mortality and morbidity in developing countries.Taking into account all underlying causes of death, studies suggest that malnutrition was an associated cause in about one half of all child deaths in developing countries (WHO, 2019).

Malnutrition in children, whatever the cause, affects negatively growth and development patterns where it can cause physical, cognitive and psychological impairment and consequently long-term disabilities including learning disabilities. Malnourished children have lowered resistance to infection; they are more likely to die from common childhood ailments like diarrheal diseases and respiratory infections; and reduction in malnutrition would lead to a reduction in child mortality (WHO, 2019).

1.2 Statement of the Problem

Malnutrition is a major cause of child death globally. Malnutrition is a major determinant of morbidity and mortality in infancy and childhood. It has long term impacts on health outcome of the child. Malnutrition is a public health problem

especially in developing countries. Mortality is related to the severity of the malnutrition (WHO, 2019).

Some 805 million people in the world do not have enough food to lead a healthy active life that's one in nine people in the earth (FAO, 2015). Worldwide, 99 million children under age 5 were underweight in 2013 ((UNICEF *et al*., 2014). As at 2013, the percentage of underweight in under-five children in rural Latin America was at 8% , in rural Sub-Saharan Africa 26% and in Somalia 40% and 21% in rural and urban areas respectively (UNICEF, 2014). In Somalia, some 236,000 children under the age of five are malnourished, more than two thirds of them in the south of Somalia including Mogadishu where the problem was worst (IFAD, 2013). In 2016, Over 160,000 severely malnourished children reached through UNICEF supported programmes (UNICEF, 2017).

Even though the causes of malnutrition can be broadly categorized into immediate, underlying and basic causes, they differ from area to area (UNICEF, 2014). In Somalia, the causes of child malnutrition are multifactorial with major concern on dietary intake and food insecurity, health and care; and the comorbidities associated with malnutrion are not identified for Mogadishu malnourished children. In this research, the study aimed at finding out the malnutrition and comorbidities among children under five years in SOS Hospital in Mogadishu, Somalia.

1.3 Research Questions

1. Which socio-demographic factors are associated with malnutrition among children under five years in SOS Hospital in Mogadishu, Somalia ?
2. Which maternal and child factors are associated with malnutrition among children under five years in SOS Hospital in Mogadishu, Somalia ?
3. Which associations are between comorbidities and malnutrition among children under five years in SOS Hospital in Mogadishu, Somalia ?

1.4 Objectives of the study

1.4.1 Broad objective

The broad objective of the study was to investigate malnutrition and comorbidities among children under five years in SOS Hospital in Mogadishu, Somalia.

1.4.2 Specific Objectives

i) To determine the socio-demographic factors associated with malnutrition among children under five years in SOS Hospital in Mogadishu, Somalia.
ii) To investigate maternal and child factors associated with malnutrition among children under five years in SOS Hospital in Mogadishu, Somalia.
iii) To determine association between comorbidities and malnutrition among children under five years in SOS Hospital in Mogadishu, Somalia.

1.5 Justification of the study

A high case fatality (ranging from 20% for all types of severe protein energy malnutrition to more than 50% in Kwashiorkor) is seen with severe malnutrition and oedema which includes infection and metabolic complications (WHO, 2019). Despite the efforts of care for malnourished children, patients continue to die due to several factors e.g; treatment failure, disease such as respiratory infections, opportunistic infections, hypothermia and diarrhea. Some of these diseases are leading causes of malnutrition and others are secondary to malnutrition. The understanding of these comorbidities will be essential for organisations such as UNICEF, WHO and Ministry of Health Somalia in the development of strategies to counter malnutrition problem in the region. This study provides information on malnutrition and comorbidities associated with each category of malnutrition in order to control these comorbidities and gives appropriate recommendations to the relevant authorities, and with proper treatment of impacts of malnutrition, the outcome is thus, improved. Therefore this study will was a need to investigate malnutrition and comorbidities among children under five years.

1.6 Scope of the study

The study focused on the geographical area of Benadir region and the target group was under 5 years malnourished children attending at SOS Hospital in Mogadishu Somalia. The study was conducted at SOS Hospital which is one of the referral hospitals, located in the North part of Mogadishu in Heliwa District and provided specialty care in paediatrics and obstetrics & gynaecology. Most of patients in this facility come from Benadir region. It has a bed capacity of 124. The Paediatric wards have 82 bed capacities with 4 subunits namely, out-patient department (OPD) unit, pediatric emergency and semi-intensive care unit, general pediatric ward (including a unit for malnutrition), premature and neonatal intensive care unit (NICU). The malnutrition unit is subdivided into 4 core units: Supplementary Feeding Program(SFP) unit, Out-Patient Therapeutic Program (OTP) unit, Stabilization Center (SC) unit and community mobilization unit. All children diagnosed as severe acute malnutrition (SAM) with complications are admitted for care and follow up in the malnutrition SC unit which has 24 beds. On average, about three children are admitted per day with severe acute malnutrition. Nurses and doctors supervise daily the malnutrition unit for care and feeding.

1.7 Limitations of the study

Limitations of the study included poor security, cultural influence and limited access to the internet and books.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Malnutrition is a risk factor for death, with millions of young children being affected due to diseases, poor and inadequate diet. Malnutrition may increase or worse the severity of the diseases. The most vulnerable group for malnutrition are infants and young children because they have increased nutritional demands in this age for growth as well as development. Statistics have shown that both undernourished children and severe malnutrition children have increased risk of death compared to children with good nutritional status (WHO, 2019). The term "malnutrition" is usually used to describe Protein Energy Malnutrition (PEM). The severe forms of PEM include marasmus, kwashiorkor and marasmic-kwashiorkor. The term SAM combines all the different forms of PEM. The different forms have different causes and are therefore have different management (Simon *et al*., 2016).

The nutritional status of children is improving globally except in sub-Saharan Africa because of poverty, infection, week governance and security instability. Although undernutrition cases have decreased globally, the malnutrition statistics for East Africa including Somalia are increasing (Cartmell *et al.*, 2005). Leading causes of death in under-five children are preterm birth complications, pneumonia, birth asphyxia, diarrhoea and malaria. About 45% of all child deaths are linked to malnutrition (WHO, 2014).

Despite the efforts done in malnutrition , the number of cases hasn't changed over the last two decades with approximately 30 percent of all children in low- and middle-income countries being underweight (Mother and child nutrition, 2007). Malnutrition is still (and will be) a major health problem in developing countries particularly sub-Saharan Africa because of increased prevalence of HIV/AIDS with marasmic malnutrition occurring more commonly in HIV-infected children (Rose *et al*., 2014).

Many factors will have an impact on development of malnutrition in children. The child's birth-weight, breastfeeding status and duration, maternal nutritional knowledge, frequency of food intake particularly protein-energy rich foods will influence the nutrition (UNICEF, 2014). Mortality of malnourished patients are influenced by parental education, child factors as residence location (urban or rural), age, and gender, relationship between patient and providers and system of care (Rose *et al*., 2014). Treatment course interruption have also impact on mortality as child care givers may drop out from malnutrition centers with clinical improvement of the child's condition without meeting discharge criteria. Geographic proximity to treatment centers, cost of transportation, substance abuse of care givers may also contribute to the discontinuation of treatment.The interaction between undernutrition and infection creates a potentially lethal cycle of worsening illness and deteriorating nutritional status (UNICEF, 2014).

The strongest and most consistent relation between malnutrition and an increased risk of death was observed for diarrhoea and acute respiratory infection. The evidence, although limited, also suggests a potentially increased risk for death from malaria. A less consistent association was observed between nutritional status and death from measles. Although some hospital-based studies and case–control studies reported an increased risk of mortality from measles, few community-based studies reported any association (Rice *et al*., 2000).

On September 2014, UNICEF, WHO and the World Bank (WB) updated their joint database on child malnutrition and released new global and regional estimates for 2013. Globally, 161 million under-five year olds were stunted in 2013. The global trend in stunting prevalence and numbers affected is decreasing. Between 2000 and 2013, stunting prevalence declined from 33% to 25% and numbers declined from 199 million to 161 million. In 2013, about half of all stunted children lived in Asia and over one third in Africa (UNICEF *et al*., 2014).

Globally, 51 million under-five year olds were wasted and 17 million were severely wasted in 2013. Globally, wasting prevalence in 2013 was estimated at almost 8%

and nearly a third of that was for severe wasting, totaling 3%. In 2013, approximately two thirds of all wasted children lived in Asia and almost one third in Africa, with similar proportions for severely wasted children (UNICEF *et al*., 2014).

Globally, 99 million under-five year olds were underweight in 2013, two thirds of which lived in Asia and about one third in Africa. The global trend in underweight prevalence continues to decrease; going from 25 per cent to 15 per cent between 1990 and 2013. Africa has experience the smallest relative decrease, with underweight prevalence of 17% in 2013 down from 23% in 1990, while in Asia for same period it reduced from 32% to 18% and in Latin America and the Caribbean from 8% to 3%. This means Asia and Latin America and the Caribbean are likely to meet the MDG while Africa is likely to fall short, reaching about only half of the targeted reduction (UNICEF *et al*., 2014). The percentage of underweight in under-five children in rural area of Somalia is 40% and in urban area is 21% (UNICEF, 2014).

Recent estimates suggest that malnutrition (measured as poor anthropometric status) is associated with about 50% of all deaths among children. Although the association between malnutrition and all-cause mortality is well documented, the malnutrition-related risk of death associated with specific diseases is less well described. There is a relation between malnutrition and child mortality from diarrhoea, acute respiratory illness, malaria and measles, conditions that account for over 50% of deaths in children worldwide (Rice *et al*., 2000).

Child stunting, wasting, and underweight have been individually associated with increased mortality. It is unclear how multiple anthropometric deficits amplify the risk of mortality and which combination is associated with the greatest risk. However, children with multiple deficits are at a heightened risk of mortality and may benefit most from nutrition and other child survival interventions (McDonald *et al*., 2013).

The severity of malnutrition depends on the timing and duration of the nutritional stress. Malnutrition increases a child's susceptibility to illnesses, such as infections,

which doesn't necessarily lead to death, but it can contribute to mortality due to the other illnesses (WHO, 2019). The life-threatening complications that accompany severe malnutrition include jaundice, severe anaemia, respiratory distress, neurological and consciousness alterations and hypothermia (Ross, 2014).

Child mortality rather than infant mortality can give a better idea of the association between malnutrition and death. The nutritional status of the child affects the risk of death due to diarrhoea, respiratory infection and malaria (WHO, 2019). Marasmus is associated with a lower mortality than kwashiorkor (Gibney *et al*., 2009). The difference between the long-term effects of severe malnutrition and persistent socio-economic deprivation are difficult to separate (WHO, 2019). There is no clear evidence to show that the damage done by malnutrition and poor living environment cannot be corrected in a good, stimulating environment (Ross, 2014).

Mortality rates are also associated with the quality of treatment. With adequate treatment a mortality rate of 5% or less can be achieved. Severe anthropometric deficiencies are associated with a higher mortality rate. Mortality rates can be as high as 40% but with adequate treatment it can be reduced to less than 10% (Ross, 2014).

2.2 Theoretical review

Factors that can cause malnutrition are broad and different. The main causes of malnutrition can be understood and addressed with the aid of the UNICEF conceptual framework. The framework, which the nutrition community has been using for programming for the past 25 years, identified three levels of causes of undernutrition: immediate causes operating at the individual level, underlying causes influencing households and communities and basic causes around the structure and processes of societies (Lancet, 2008).

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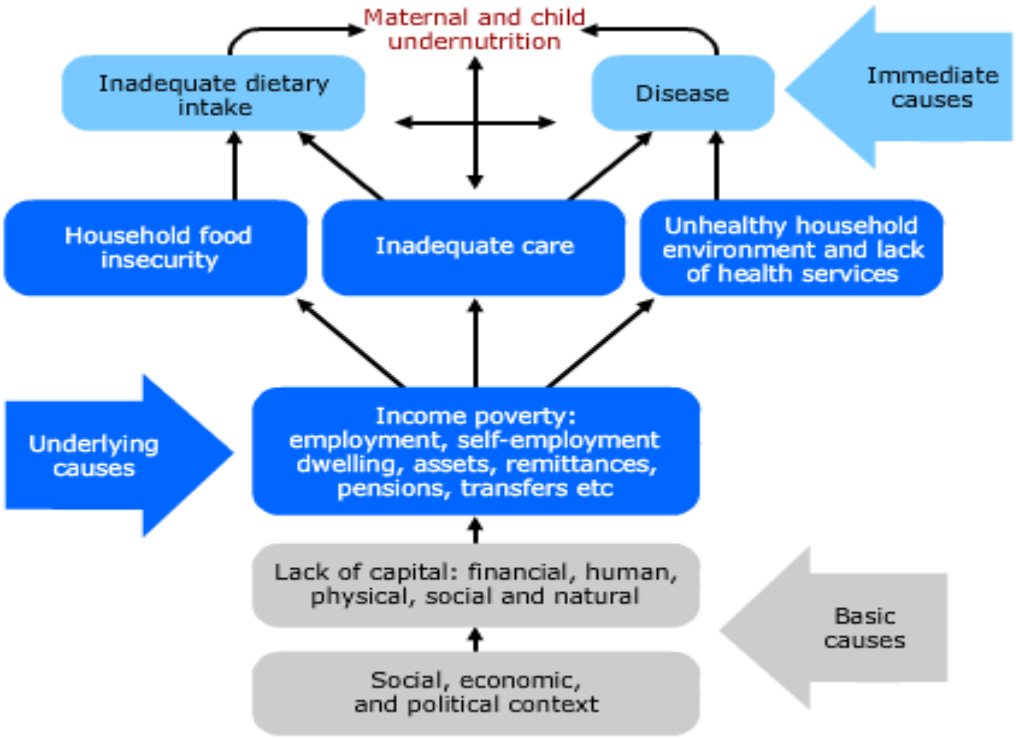

Figure 2.1: UNICEF Conceptual framework for causes of malnutrition

(Adopted from Lancet, 2008).

2.2.1 Immediate factors contributing to malnutrition

The immediate causes of child undernutrition are inadequate dietary intake and disease.

2.2.1.1 Inadequate diet

Dietary sufficiency in terms of energy and essential nutrients is critical for the normal growth and development of infants and young children. Undernutrition does not only refer to a child's lack of protein and energy, also micronutrients play a major role. It is found that especially lack of zinc is associated with increased morbidity and mortality from infectious disease including diarrhea. A lack of vitamin A is associated with increased morbidity and mortality from diarrhea too (Black *et al.*, 2008). Iron deficiencies can cause anemia which when very severe increases the

risk of childhood mortality. Furthermore chronic iron deficiencies are shown to cause irreversible cognitive impairment (Lozoff *et al*., 2006). Not all children suffering from undernutrition will die of the condition, although undernutrition is estimated to contribute to 1/3 of child deaths globally (UNICEF, 2009).

2.2.1.2 Disease

Infection has the effect of increasing the body's requirements for nutrients, reducing appetite and reducing the absorption of nutrients from the intestine. Undernutrition and infection often occur at the same time. Undernutrition can increase the risk of infection while infection can cause undernutrition leading to a vicious cycle of undernutrition and infection (Walson and Berkley, 2018).

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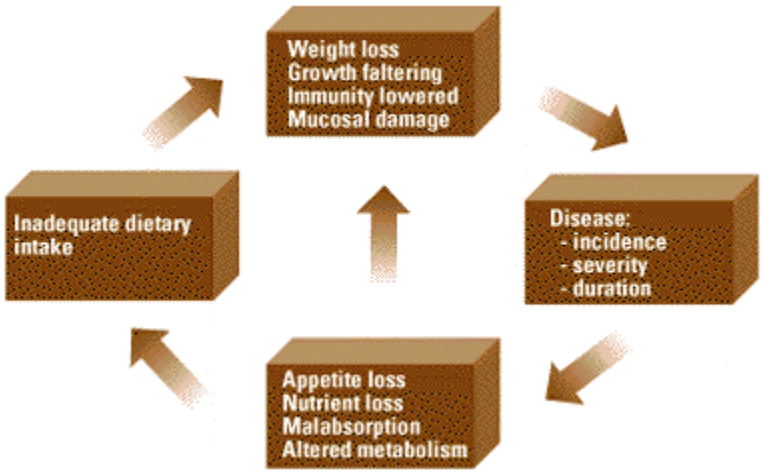

Figure 2.2: The Cycle of Undernutrition and Infection .

Eventually, as a result of infection and disease, a child often experiences weight loss and growth altering, or in other words - undernutrition. Whether one or the other starts the vicious circle is unknown and likely it differs from child to child (Walson & Berkley, 2018). Diarrhea, malaria, measles and Acute Respiratory tract Infections (ARI) were the four infectious diseases killing most children in Africa in 2008 (Black *et al.*, 2010). Undernutrition is shown to put children in increased risk of

developing diarrhea, have more severe episodes and persistent diarrhea, which increase the risk of mortality. Diarrhoeal disease also affects nutritional status by reducing absorption and child's appetite. In the case of malaria it is shown that undernutrition exacerbate malaria and considerably increases the likelihood of mortality. Malaria affects nutritional status by reducing appetite; increasing metabolic rate; destroying red blood corpuscles leading to anaemia and impairing foetal development leading to low birth weight. Undernutrition exacerbate measles by increasing duration of the disease; increasing its severity, especially if deficient in vitamin A, and consequently increases risk of death. On the other hand, measles reduces appetite, decreases levels of plasma vitamin A and prolonging immune suppression resulting in increased risk of ARI and diarrhoea.Undernourished children have an increased incidence of ARI and the nutritional status increases the severity of the ARI and the risk of dying (Marwa *et al*., 2017).

In Somalia, these diseases are prevalent and common causes of morbidity and mortality are diarrhoeal diseases, including cholera; respiratory infections particularly Tuberculosis; malaria, which affects mainly pregnant women and children under five; and measles (WHO, 2017).

2.2.2 Underlying factors contributing to malnutrition

Underlying factors contributing to malnutrition include house hold food insecurity; inadequate care; unhealthy household environment and lack of health services and income poverty.

2.2.2.1 House hold food security

The household food security is comprised of four factors: availability, access, stability and utilization. A household should at all times have enough food immediately available, have the sufficient resources to acquire it and be able to consume it, in order to have an active and healthy life (Smith *et al*., 2000). It is important that the household is food secure, and therefore it does not help us much to

look at the national average, other than if it determines a de facto deficit (Gartaula *et al.*, 2017).

The size and composition of the family, gender equity, rules of food distribution within the household, income, availability and access to food (Bantamen *et al.*, 2014; Vorster & Hautvast, 2009) and poverty (Mason *et al.*, 2005) can all contribute to food insecurity. Food insecurity can also occur due to poor agriculture production, destruction of infrastructure and markets and therefore loss of income, loss of livestock and insufficient land for food production. Families will also increase their credit to try and survive. These factors influence the quantity and quality of food available (FAO, 1996).

A Survey about household food security in Central Somalia (WFP, 2014) have showed that: In August, an upward trend in the share of respondents with poor or borderline food consumption from 12.9% in May (3.7% poor and 9.2% borderline) to 21.9% in August (9.4% poor and 12.5% moderated) as shown in the figure 1.3 below.

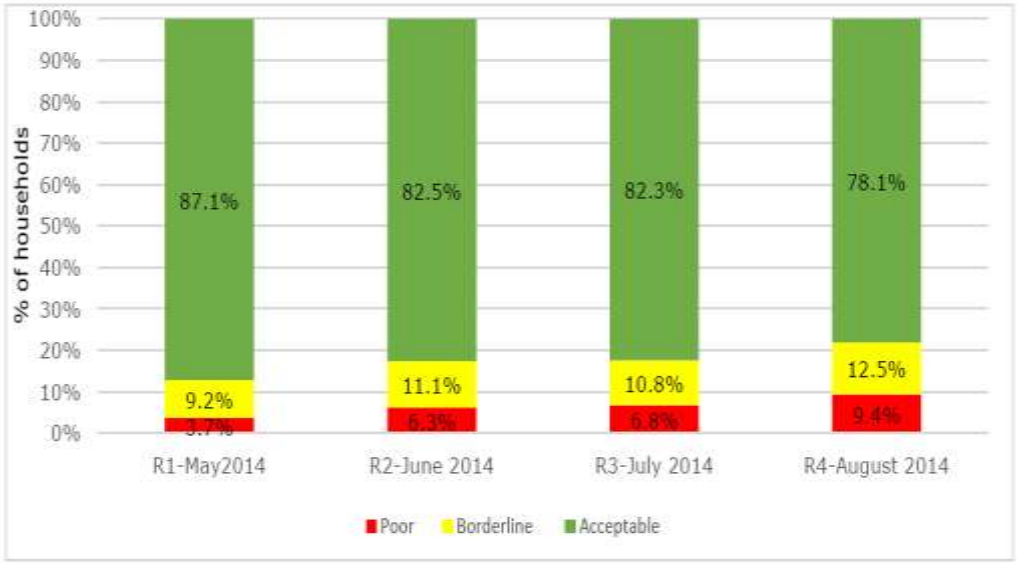

Figure 2.3: Food Consumption Score. Source: WFP phone surveys, 2014

2.2.2.2 Inadequate maternal and child care

Inadequate care is often an underlying cause of child undernutrition. Care for children is defined as: "The practices of caregivers that affect nutrient intake, health and cognitive and psychosocial development of the child" (Engle *et al*., 1999).

Mothers should be protected against malnutrition, seeing as healthy mothers are needed for raising healthy children. Care includes breastfeeding, diagnosing illnesses, and introduction of solids, stimulating language and other cognitive capabilities and emotional support. Care affects the child's nutritional status through better infant feeding practices and breastfeeding, preparation of healthy food, hygiene and through support of the mother so that she has sufficient time to care for the child (FAO, 1996).

In a study in Eldoret, Kenya, the social risk factors for PEM included being a single mother and a young mother aged 15- 25 years (Ayaya *et al*., 2004). In Somalia there is a poor access, availability and quality of maternal, neonatal and child care. The child and maternal mortality rates for Somalia are amongst the highest in the world; one out of every ten Somali children dies before seeing their first birthday. One out of every 12 women dies due to pregnancy related causes. Access to maternal services is low with only 9% of births being attended by a skilled birth attendants. Modern contraceptive rate is around 1% only. The high fertility rate in Somalia puts the women at a high risk of mortality and morbidity around child birth especially with the low access to basic health services including family planning (UNICEF, 2016).

2.2.2.3 Unhealthy household environment and lack of health services

Sanitation and hygiene are also important factors to address when bearing in mind that this is the primary way to reduce the spread and control the severity of infections within the household and community (Cairncross *et al.,* 2010). The direct correlation between personal hygiene, sanitation, clean water and malnutrition is well documented especially in young children (Golden *et al.,* 2000; Checkley *et al*., 2004; Fewtrell *et al*., 2005). Therefore, unhealthy environments, overcrowding, lack of

water and unclean water and poor sanitation, directly lead to malnutrition through infections (FAO, 1996). SAM occurs mainly in families living in unhygienic conditions and with limited access to food. The above mentioned conditions increase the risk of repeated infections (WHO, 2014).

Most foodborne illnesses originate from unsafe food-handling practices in the home. The most frequently reported unsafe practices include eating raw cookie dough, tasting foods during preparation, licking fingers while eating, drinking beverages left by family members, and eating food left by family members (Barclay *et al*., 2001). Poor household hygiene practices are critical in preventing infectious diseases. Child waste inside the house, prolonged storage of cooked food, feeding with unwashed hands and storage of food and water in uncovered containers can cause diarrhoea among malnourished children. These poor hygiene practices lead to contaminated food and fluids (Abate *et al*., 2001).

Malnutrition rates in the developing world are still high because of the lack of access to health services (Rose *et al*., 2014). Even though patients have little or no access to formal health services, there is still the problem that patients do not make use of the services available (Müller and Krawinkel, 2005). There is a need for improved public health services and improved immunization and growth monitoring programmes. For example, incomplete immunizations is a risk factor for the development of malnutrition (Bantamen *et al.*, 2014). The education and promotion of important vaccinations can reduce the occurrence of PEM (Bantamen *et al.*, 2014).

When it comes to child undernutrition caused by lack of health services, it is the primary health service level that functions insufficiently (UNICEF, 2014). The job of the primary health service is to deliver treatment to all children for simple infections as pneumonia, malaria and diarrhea, as well as deliver advice and education to caretakers about care practices. Thereby they could prevent and treat disease and secure sound child development and avoid the development of child undernutrition. The services should be available to all people, also rural inhabitants living in remote areas, and when considering developing countries, it should be free of cost, in order

for the people to be able to seek help at any relevant occasion. This is critical in order to reach every child with needed public health interventions such as immunization, vitamin A supplementation and in the case of undernutrition, supplementary food and information for caretakers (UNICEF, 2014).

2.2.2.4 Income poverty

The problem of income poverty and hunger is directly correlated. Income poverty and unemployment are also very closely linked, and by default unemployment and hunger are correlated. In countries with a high unemployment rate, often results in a large part of the population being dependent on subsistence farming. Little extra income is generated and the rural population can become increasingly food insecure and it can thereby affect dietary intake, as well as the access to health facilities. Therefore an employment is a good way to relieve the household of the vulnerability of lacking availability (Gartaula *et al.*,2017).

2.2.3 Basic factors contributing to malnutrition

The third level, the basic causes of undernutrition, are a broad set of factors that operate at the sub-national, national and international levels and range from structural and natural resources, social and economic environments to political and cultural contexts. Basic causes, also called national or root causes, of malnutrition include poor availability and control of resources (political, social, ideological and economic), environmental degradation, poor agriculture, war, political instability, urbanization, population growth and size, distribution, conflicts, trade agreements and natural disasters, religious and cultural factors (Ross *et al.*, 2014; UNICEF, 2014). Other basic causes include market failures due to economic decline, conflict and political upheavals that can lead to a reduction in food yields and price increases. Loss of food after a harvest can also occur when storage conditions are poor and food is inadequately distributed (Ross *et al.*, 2014). If issues related to the economic position of the family are affected negatively, it can influence the chances of a child being stunted and underweight (Zere & McIntyre, 2016; UNICEF, 2014).

2.2.4 Classification of malnutrition

Malnutrition can be classified in six different ways: Gomez, Water-low, WHO (Wasting), WHO (Stunting), Kanawati and Cole as in Table 1.1 (Firman, 2010). Modified Wellcome Classification uses weight for age (Gomez classification system) and the presence or absence of oedema to classify PEM. This classified PEM into kwashiorkor, underweight; marasmus, marasmic kwashiorkor as in Table 1.2 (Firman, 2010). Marasmus and the various forms of kwashiorkor are part of the recently defined Severe Acute Malnutrition (SAM) by the World Health Organization (WHO). The WHO defined SAM by a very low weight for height (below -3z scores of the median WHO growth standards), visible severe wasting or the presence of nutritional oedema (WHO, 2015).

Table 2.1: Classification of malnutrition (Firman, 2010)

Classification	**Definition**	**Grading**	
Gomez	Weight below % median WFA	Mild(grade1) Moderate(grade2) Severe (grade 3	75%–90%WFA 60%–74%WFA <60% WFA
Waterlow	z-scores(SD) below median WFH	Mild Moderate Severe	80%–90%WFH 70%–80%WFH <70% WFH
WHO (wasting)	z-scores (SD) below median WFH	Moderate Severe	-3%</= z-score <-2z-score < -3
WHO (stunting)	z-scores (SD) below median HFA	Moderate Severe	-3%</= z-score <-2z-score < -3
Kanawati	MUAC divided by occipitofrontal head circumference	Mild Moderate Severe	<0.31 <0.28 <0.25
Cole	z-scores of BMI for age	Grade1 Grade2 Grade3	<-1 z-score <-2 z-score < -3 z-score

Table 2.2: Modified Wellcome Classification (Firman, 2010)

Weight for Age (Gomez)	With Edema	Without Edema
60-80%	Kwashiorkor	Underweight
< 60%	Marasmic-kwashiorkor	Marasmus

2.2.5 Assessment of nutritional status

The nutritional status of a child can be evaluated using specific measures called anthropometric measures (weight for age, weight for height, mid-upper arm circumference, etc.) in addition to dietary history, physical and biochemical signs for malnutrition (WHO, 2019).

2.2.5.1 Anthropometric measures

Anthropometric measurements that can be used for nutritional assessment are indicated in Table 1.3 (Bates *et al*., 2005). Assessment of nutritional status according to weight-for-height (or length), height (or length)-for-age and oedema is summarized in Tables 1.4. (Torún, 2006), while assessment according to mid-upper arm circumference (MUAC) is found in Table 1.5 (Golden & Golden, 2000).

Table 2.3: Anthropometric measurements for nutritional assessment (Bates et al., 2005)

AGE (YEARS)	**PRACTICAL FIELD OBSERVATIONS**	**MORE DETAILED OBSERVATIONS**
0 – 1	Weight Length	Head and arm circumference Triceps and subscapular skinfolds
1 – 5	Weight Length / Height Arm circumference	Triceps and subscapular skinfolds
5 – 20	Weight Height Arm circumference	Triceps, subscapular and medial calf skinfolds Calf circumference
> 20	Weight Height	Arm and calf circumference Triceps, subscapular and medial calf skinfolds Waist and hip circumference (overnutrition only) Demispan (elderly subjects)

Table 2.4: Classification of severity of current ("wasting") and past or chronic ("stunting") PEM in infants and children, based on the weight for height and height for age and oedema (Torún, 2006)

	NORMAL	MILD	MODERATE	SEVERE
Weight for height (deficit = wasting)	90-110 (+ 1 Z-score)	80-89 (-1.1 to –2 Z score)	75-79 (-2.1 to –3 Z-score)	< 75, or with oedema (< -3 Z-score)
Height for age (deficit = stunting)	95-105 (+ 1 Z-score)	90-94 (-1.1 to –2 Z-score)	85-89 (-2.1 to –3 Z-score)	<85 (< -3 Z-score)

Table 2.5: Classification of malnutrition in children aged 1-5 years by mid upper arm circumference (Golden & Golden, 2000)

Circumference (cm)	Level of nutrition
> 14	Normal
12.5 – 14.0	Mild / moderate malnutrition
< 12.5	Severe malnutrition

2.2.5.2 History and physical examination

A checklist for taking the child's medical history and conducting the physical examination is given in Appendix II (WHO, 2019). An infant with marasmus is extremely underweight with loss of subcutaneous fat. The body has a "skin and bones" appearance, and the child is profoundly weak and highly susceptible to infections. The cause is a diet very low in calories from all sources (including

protein), often from early weaning to a bottled formula prepared with unsafe water and diluted because of poverty. Poor hygiene and continued depletion lead to a vicious cycle of gastroenteritis and deterioration of the lining of the gastrointestinal tract, which interferes with absorption of nutrients from the little food available and further reduces resistance to infection. If untreated, marasmus may result in death due to starvation or heart failure (Encyclopedia Britannica, 2015).

Kwashiorkor, a Ghanaian word meaning the disease that the first child gets when the new child comes, is typically seen when a child is weaned from high-protein breast milk onto a carbohydrate food source with insufficient protein. Children with this disease, which is characterized by a swollen belly due to edema (fluid retention), are weak, grow poorly, and are more susceptible to infectious diseases, which may result in fatal diarrhea. Other symptoms of kwashiorkor include apathy, hair discoloration, and dry, peeling skin with sores that fail to heal. Weight loss may be disguised because of the presence of edema, enlarged fatty liver, and intestinal parasites; moreover, there may be little wasting of muscle and body fat (Encyclopedia Britannica, 2015).

Malnourished child is susceptible for selected nutrient-deficiency diseases such as xerophthalmia (vitamin A deficiency), rickets (vitamin D deficiency), beriberi (thiamine deficiency), pellagra (niacin deficiency), scurvy (vitamin C deficiency) and iron-deficiency anemia (iron deficiency). Therefore, the child should be evaluated for symptoms and signs associated with above nutrient deficiencies.

2.2.5.3 Laboratory tests

Where facilities permit, the laboratory tests given in Appendix III (WHO, 2019) may help to diagnose specific problems. They are not needed, however, to guide or monitor treatment. The interpretation of test results is frequently altered by malnutrition. For this reason, laboratory tests may misguide inexperienced workers (WHO, 2019). Investigations for associated comorbidities such as HIV/AIDS and those for selected nutrient deficiencies, if appropriate, may be ordered depending on the availability of the test at the facility.

2.2.6 Management of Severe Malnutrition

Management in severe malnourished children includes stabilization and rehabilitation phases (Appendix IV). In stabilization phase, initial treatment begins with admission to hospital and lasts until the child's condition is stable and his or her appetite has returned, which is usually after 2–7 days. If the initial phase takes longer than 10 days, the child is failing to respond and additional measures are required. The principal tasks during initial treatment are to treat or prevent hypoglycaemia (blood glucose <54 mg/dl or <3 mmol/l) and hypothermia (rectal temperature is below 35.5 ℃ (95.9 °F) or the underarm temperature is below 35.0 ℃ (95.0 °F)); to treat or prevent dehydration and restore electrolyte balance; to treat incipient or developed septic shock, if present; to start to feed the child; to treat infection; to identify and treat any other problems, including vitamin deficiency, severe anaemia and heart failure (WHO, 2019). If hypothermia is present, the child should be warmed by using a warming blanket or by close contact with the mother's body. Diarrhea can cause death due to either dehydration or electrolyte imbalance (Mitra *et al*., 2000).Whenever possible, a dehydrated child with severe malnutrition should be rehydrated orally with oral rehydration (rehydration solution for malnutrition or ReSoMal) that contains high potassium concentration and low sodium concentration. IV infusion easily causes overhydration and heart failure and should be used only when there are definite signs of shock. If intravenous hydration is necessary, as in case of septic shock, Half-strength Darrow's solution with 5 percent glucose is preferred (WHO, 2019) and observe the child carefully (every 5–10 minutes) for signs of overhydration and congestive heart failure. If infection is present, oral antibiotics like amoxycillin 50mg/kg in 3 divided doses or trimethoprim-sulfamethoxazole 'TMP-SMX' 5 mg of trimethoprim/kg + 25 mg of sulfamethoxazole orally twice daily for 5 days is recommended for treatment of non-complicated infections like UTI. Children with complications (septic shock, hypoglycaemia, hypothermia, skin infections, respiratory or urinary tract infections, or who appear lethargic or sickly) should be treated with intravenous broad spectrum of antibiotics: ampicillin, 50mg/kg IM or IV every 6 hours for 2 days, followed by amoxicillin, 15mg/kg orally every 8 hours for 5 days (if amoxicillin is unavailable,

give ampicillin, 25mg/kg orally every 6 hours) and gentamicin, 7.5 mg/kg IM or IV once daily for 7 days (WHO, 2018). Children who do not require other emergency treatment, especially for hypothermia, dehydration or septic shock, should immediately be given a formula diet. They should also continue to be breastfed. Feeding should be initiated using a formula containing 75-kcal/100mls (known as F-75 formula) soon after the child reaches the hospital. Infants are fed orally using a cup, spoon or syringe and nasogastric tube if there is impaired consciousness or there is vomiting, tachypnea, or painful stomatitis. If the child's appetite improves, treatment has been successful.

The initial phase of treatment ends when the child becomes hungry (Ashworth *et al*., 2003). This indicates that infections are coming under control, the liver is able to metabolize the diet, and other metabolic abnormalities are improving. The child is now ready to begin the rehabilitation phase. This usually occurs after 2–7 days. Some children with complications may take longer, whereas others are hungry from the start and can be transferred quickly to F-100. Nevertheless, the transition should be gradual to avoid the risk of heart failure which can occur if children suddenly consume large amounts of feed (WHO, 2019). Replace the F-75 diet with an equal amount of F-100 for 2 days before increasing the volume offered at each feed. Mineral supplements are also recommended in the rehabilitation phase. Folic acid, vitamin A and zinc are recommended during admission while Iron is given only in the rehabilitation phase. Emotional and physical stimulation through play programmes that start during rehabilitation and continue after discharge can substantially reduce the risk of permanent mental retardation and emotional impairment. A child may be considered to have recovered and be ready for discharge when the child's weight-for-height Z-score is >–1 SD. has reached -1 SD (WHO, 2013b). Training of the mother should focus on areas that need to be strengthened, especially feeding practices, mental and physical stimulation of the child. Follow up of the child is done for about six months at a special clinic (WHO, 2019).

2.3 Conceptual Framework (Relationship between variables)

The conceptual framework consists of both independent and dependent variables. The independent variables are socio-demographic factors, maternal & child factors and comorbidities while the dependent variable is malnutrition among children under five years.

2.3.1 The Socio-demographic factors

Examples of socio-demographic factors are income poverty; parental education; household size and composition and sanitation and drinking water

2.3.1.1 Income poverty

Income poverty (due to unemployment, low wages, or lack of education) can lead to household food insecurity, inadequate care, "unhealthy household environment, and lack of health services." People of low socioeconomic status are most vulnerable to food insecurity since purchasing power serves as a main determinant of the ability-to-afford nutritional food sources. Households that cannot attain nutritious foods due to income poverty are most associated with the inadequate diet and disease that leads to malnutrition (Horton *et al.,* 2008).

Somalia is among the five least developed countries of 170 countries listed in the 2012 Human Development Index. It faces several obstacles, including long-term civil conflict, the lack of a fully functioning government, and natural disasters. More than 70% of the population is under the age of 30. Almost 20% of children do not survive past their fifth birthday. About 40% of the population lives in extreme poverty, in rural areas this figure exceeds 50%. In 2012, 62% of the population was rural. Overall, where there is less instability – such as in the northern regions of Somaliland and Puntland – the rural poverty and food security situation is less critical. In much of the country, insecurity and lack of functional infrastructure have exacerbated already low crop yields. Poor access to irrigation is another contributing factor. In central and southern Somalia, irrigation is restricted to the relatively fertile

areas around the Shabelle River, where the main crops are maize, rice, sesame, cowpeas, bananas, papayas, lemons, grapefruit and mangoes. Currently, only 20 to 30% of land that was irrigable prior to the civil war can be irrigated. Livestock is essential to the economy and is the chief source of food and foreign exchange income. Over 60% of the population depends on livestock for food and income. The 2011 drought led to the worst famine in 60 years. Worst affected were the Shabelle, Bay and Bakool regions. Despite the official end of the famine, 2.1 million people remain food-insecure and 236,000 children malnourished, 70% of them in southern Somalia (IFAD, 2013).

2.3.1.2 Parental education

The role of parental education in determining children's health and nutritional status is two-fold. First, ignorance is directly associated with poor infant and child rearing practices, misconceptions about food, inadequate feeding during illness (especially infectious diseases and diarrhea), improper food distribution among family members (Torún, 2006), poor maternal care (James *et al.*, 1999) and high birth rates.

Second, better education should translate into higher incomes. In studies where income is not included as a separate variable, then this effect should exert a positive effect on the coefficient of parental education variables. Even when income is included in the estimated equation, schooling that is more parental could be beneficial for child health and nutrition. Better educated parents are likely be able to make better use of available information about child nutrition and health, partly as being educated themselves may increase their preference for child quality over quantity (a decision which can also reflect the increased opportunity cost of the mother's time). Most likely, successful completion of primary schooling or functional literacy is sufficient in this context, and post-primary school education might only add limited benefits, though this depends on the quality of schooling. Furthermore, education might be a signal for parents' innate intellectual abilities, leading to a positive coefficient even if education itself possesses no value. Of particular interest in the analysis of education is the differential impact maternal and

paternal schooling might have. Since it is mainly mothers who care for children, while men are presumably working outside of the household, mothers' ability to access information and make use of existing health care facilities is likely to be more important. Female education should thus be directly relevant, whereas paternal education should affect child health and nutritional status mainly through its income generating properties (World Bank, 2016).

2.3.1.3 Household size and composition

Household size and composition can have different effects. What usually matters is the dependency ratio that is the ratio of non-working to working (or total) household members. If a household is large because it comprises a large number of able-bodied people of working age then, partly by virtue of economies of scale in consumption, the welfare of household members should, ceteris paribus, be higher and so child health and nutrition status better. However, if there are many young children they compete for resources, children of higher birth order being particularly vulnerable. Anthropologists writing of different continents have documented how parents reluctantly practice triage, neglecting the care of certain children who die as a result, or even actively intervene to bring about death usually of daughters (Venkatramani, 2018).

2.3.1.4 Sanitation and drinking water

The provision of sanitation and drinking water is seen as an essential complement to the availability of food in preventing child malnutrition. Even if the food supply for children is sufficient, diarrhea hampers the intake of calories and micronutrients and thereby prevents adequate nutritional outcomes and increase the likelihood of mortality. By reducing the risk of bacterial infections and diarrheal diseases, sanitation and clean water will indirectly contribute to a child's nutrition. The reduction in infections from contaminated water and the lack of hygiene may also have spill-over effects to other households in the neighborhood as the probability cross-infections will fall. The rise in the availability of these services may thus even affect households that do not have direct access to them. Sharing of piped water, and

probably to a much lesser extent toilet facilities, may also contribute to this (World Bank, 2016).

2.3.2 Maternal and child factors

Examples of maternal and child factors are maternal nutrition; breast-feeding; child-care practice; age and sex of the child and vaccination.

2.3.2.1 Maternal nutrition

Poorly nourished mothers give birth to babies with low birth weight and those babies who were born underweight are more likely to be growth retarded in childhood. Further, children of malnourished mothers were more likely to be malnourished in their childhood. Hence, finding determinants of maternal malnutrition is of vital importance to ensure that malnutrition does not become an intergenerational problem. Many interrelated factors influence a mother's nutritional status, ranging from her physiological utilization of food and nutrients during pregnancy and lactation, through to the socioeconomic influences on food availability (World Bank, 2016).

In this context, it is important to understand that malnourished mothers can still breastfeed. Moderate malnutrition has little or no effect on milk production. However mothers should be provided with extra food and fluids to rebuild their own nutrient stores, and may need micronutrient supplements. Severely malnourished mothers need therapeutic care and skilled support to continue breastfeeding (UNICEF, 2016).

2.3.2.2 Breast-feeding

Early and exclusive breastfeeding helps children survive, but it also supports healthy brain development, improves cognitive performance and is associated with better educational achievement at age of 5 years. Breastfeeding is the foundation of good nutrition and protects children against disease. In this way, breastfeeding allows all children to thrive and develop to their full potential. Yet, less than half of the

world's newborns benefit from early breastfeeding and even fewer are exclusively breastfed for the first six months (UNICEF, 2018).

Optimal breastfeeding of infants under two years of age has the greatest potential impact on child survival of all preventive interventions, with the potential to prevent over 800,000 deaths (13 per cent of all deaths) in children under five in the developing world (Lancet, 2013).

Breastfed children have at least six times greater chance of survival in the early months than non-breastfed children. An exclusively breastfed child is 14 times less likely to die in the first six months than a non-breastfed child, and breastfeeding drastically reduces deaths from acute respiratory infection and diarrhoea, two major child killers (Lancet, 2008).

Infants are particularly vulnerable during the transition period when complementary feeding begins. Ensuring that their nutritional needs are met thus requires that complementary foods be timely, adequate, safe and properly fed. Appropriate complementary feeding depends on accurate information and skilled support from the family, community and health care system (WHO & UNICEF, 2014).

2.3.2.3 Childcare practice

Childcare practices also include protecting the children's food and drinks from contamination to reduce the risk of infections. A caregiver's unwashed hands can cause infections such as diarrhea (Abate *et al.,* 2001). When the household income decreases, usually the women try earning extra wages. This causes the mother to have less time for childcare and ensuring the children eat healthy food. If the female children are also sent out to look for work, this results in poor school attendance, which influences education, leading to poor knowledge and caring practices for her own family (UNICEF, 20014).

2.3.2.4 Sex of child

Mortality is found to be higher among male infants compared to female infants, a result that seems particularly striking in East Asia. However, male children are less likely to die than female children are, and in no studies of child, mortality does being male have a positive effect. Nearly half the nutrition studies find that male children are less well nourished than females –this is true of almost all of the studies in East and Southern Africa. This means that roughly half of the authors do not find a significant gender effect. Sex of child is always an insignificant determinant of nutrition in the Latin American studies reviewed. In Asia, the experience is mixed and no strong conclusions can be drawn, even for individual countries (World Bank, 2016).

2.3.2.5 Age of child

Age of child is an important determinant of malnutrition; a study done in Kenya, the mean age was 29.5 months in 1993, 28.3 months in 1998 months, 27.8 months in 2003, and 28.7 months in 2008-09. (Masibo, 2013). In a systemic review on timing of mortality in malnutrition children, majority occur before the age of two years because during this period, the child has increased nutritional needs to support rapid growth and development, is more susceptible to infections, and is totally dependent on others for nutrition (UNICEF, 2014). A study conducted in Nigeria showed that the most common age groups with PEM were 6 to 12 months (55.7%) followed by 13 to 24 months (36.8%) and the lower household socio-economic class was found to be significantly associated with mortality of child malnutrition (Ubesie *et al.*, 2012).

2.3.2.6 Child vaccination

More than 30 million children are unimmunized either because vaccines are unavailable, because health services are poorly provided or inaccessible, or because families are uninformed or misinformed about when and why to bring their children for immunization. Pneumonia, diarrhoea, malaria, measles, HIV/AIDS and malnutrition are the primary killers of children in the developing world. These

children die because they are poor, they do not have access to routine immunization or health services, their diets lack sufficient vitamin A and other essential micronutrients, and they live in circumstances that allow pathogens (disease-causing organisms) to thrive (UNICEF, 2017).

2.3.3 Comorbidities in malnutrition

Comorbidities such as diarrhea, measles, acute respiratory illness, malaria and HIV/AIDS may be associated with malnutrition.

2.3.3.1 Diarrhea

Diarrheal disease is the second leading cause of death in children under five years old, and is responsible for killing around 760 000 children every year. Diarrhea can last several days, and can leave the body without the water and salts that are necessary for survival. Most people who die from diarrhea actually die from severe dehydration and fluid loss. Children who are malnourished, or have impaired immunity as well as people living with HIV are most at risk of life-threatening diarrhea. Children who die from diarrhea often suffer from underlying malnutrition, which makes them more vulnerable to diarrhea. Each diarrheal episode, in turn, makes their malnutrition even worse. Diarrhea is a leading cause of malnutrition in children under five years old (WHO, 2018).

2.3.3.2 Measles

Measles**,** a viral respiratory infection, killed over 500,000 children in 2003, more than any other vaccine-preventable disease. The measles death children in Africa is so high – every minute one child dies – that many mothers don't give children real names until they have survived the disease. Measles weakens the immune system and renders children very susceptible to fatal complications from diarrhea, pneumonia and malnutrition. Those that survive may suffer blindness, deafness or brain damage (UNICEF, 2017).

The WHO Integrated Management of Childhood Illness initiative is based on the premise that combining efforts to promote the appropriate case management of serious infectious diseases with nutritional interventions, immunization programmes, and other disease prevention and health promotion activities. This will be more effective in decreasing child mortality than implementing any one of the components alone (WHO, 2018).

2.3.3.3 Acute respiratory illness

The synergistic relation between malnutrition and infection is well known, and nutritional interventions have been recognized as an important approach for reducing mortality from acute respiratory illness and diarrhoea (Jamison *et al*., 2006). Malnutrition is an important risk factor for acute respiratory infection (ARI), which is a leading cause of mortality and morbidity among children aged < 5 years.

2.3.3.4 Malaria

The relation between malnutrition and malaria is controversial. On the one hand, malaria may cause malnutrition, whereas on the other hand, malnutrition itself may modulate susceptibility to the disease. A study done in Kenya on malaria and nutritional status in children living on the coast of Kenya concluded that the effect of malaria on nutritional status appears to be greatest during the first 2 y of life (Nyakeriga *et al*., 2004).

2.3.3.5 HIV/AIDS

Undernutrition is common among people living with HIV/AIDS. The HIV/AIDS pandemic combined with drought, floods, soaring food prices, decades of conflict, economic decline and cuts in social services, have overwhelmed families in many parts of sub-Saharan Africa, leaving them with few coping mechanisms. Weight loss and low micronutrient levels are associated with increased progression to AIDS in adults living with HIV. This crisis in Africa has underscored the dire nutritional needs of all children who are HIV positive or affected by HIV/AIDS, such as

orphans and those living in households with infected family members. Many are left to fend for themselves, while others live with HIV-infected parents who can no longer provide food for their families. Undernutrition rates are increasing and orphans are hardest hit. Without treatment, almost 50 per cent of infected infants will die before age two. In 2012, 646,852 children 0-14 aged were receiving antiretroviral therapy in low and middle-income countries. Many HIV-infected children also suffer from undernutrition (UNICEF, 2014).

In asymptomatic adults with HIV infection, loss of lean body mass is not a common finding. However, in infants and young children with HIV infection, including those without secondary/opportunistic infections, growth failure secondary to low rates of lean tissue synthesis is common along with inability to down-regulate protein catabolism (Enwonwu, 2006).

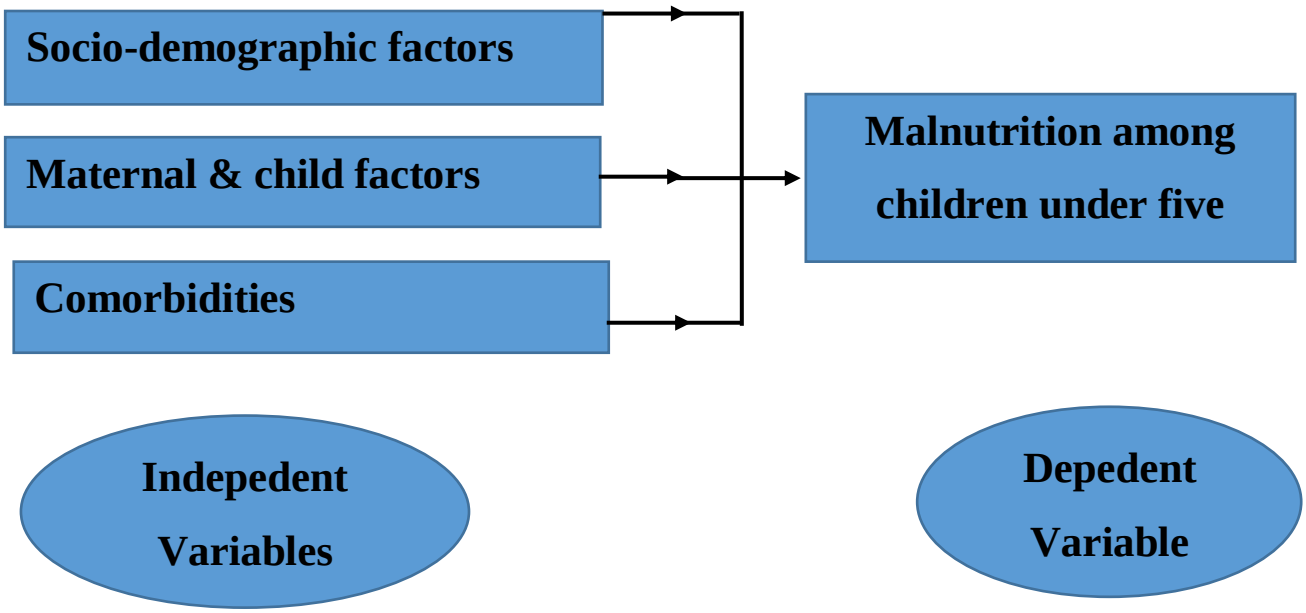

Figure 2.4 Study Conceptual Framework

2.3.4 Critique of existing literature

There are conflicting reports from previous studies in the developing countries on comorbidities and malnutrition among children under five years. A study in South-east Nigeria published in June 2012, a sample of 212 patients were used in this study and researchers use data from PEM admissions at the paediatric ward of the University of Nigeria Teaching Hospital (Ubesie *et al*., 2012). The methodology used mostly focused on individual level factors especially patient related factors without emphasizing on comparison and relationship between malnutrition and child relating factors.

A case control study in Northwest Ethiopia in 2014, a total of 102 cases and 201 controls were included in the study and researchers found that sixty five (63.20%) of cases and 49 (24.40%) controls had fathers that cannot read and write. Thirty nine (38.23%) of cases and 44(21.89%) of controls had history of diarrheal episode. Those children whose family uses drinking water from unprotected source were 3 times more likely to have malnutrition as compared to those children whose family use drinking water from protected source (Bantamen *et al.,* 2014).

A population-based, multicenter case-control study in Namin city of Iran in 2011, seventy-six children with malnutrition and 76 children without malnutrition were randomly recruited for case and control groups. The results of this study indicate four main factors (poverty, small maternal height, female gender, and absence of hygienic latrines in the home) as underlying factors in malnutrition of children under the age of 6 years (Sharghi *et al.,* 2011).

2.3.5 Research gaps

Although there has been other studies done by other researchers, there is a small number of literature review on comorbidities and malnutrition among children under five years particulary in Somalia. None of the studies reviewed has addressed the aspect of comorbidities and malnutrition in sub-Saharan Africa and particularly Somalia extensively. The findings of this study therefore, not only contribute to the existing body of literature but also present country specific results for Somalia on the comorbidities and malnutrition in children under five years.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

Research methodology refers to ways of obtaining, organizing and analyzing data. This chapter presented the methodology that the study followed, the research design, target population, sample size, sampling method and procedures, study instrument, data analysis method used and ethical issues observed. The main focus of the study was to investigate comorbidities and malnutrition among children under 5 years in SOS Hospital in Mogadishu, Somalia. Data was collected using a questionnaire.

3.2 Research design

The study design employed a cross-sectional hospital survey.

3.3 Target population

The study focused on under five children who were diagnosed as malnourished at SOS Hospital.

3.3.1 Inclusion criteria

Malnourished children under 5 years, admitted to paediatric units at SOS Hospital, whose mother/caregiver were willing to participate in the study by signing the informed consent were included in the study.

3.3.2 Exclusion criteria

Malnourished children under five years in SOS Hospital who are in critical condition or whose caregivers not willing to participate in the study.

3.4 Sampling technique and sampling frame

The researcher used systematic random sampling technique. The sampling frame was the names of malnourished patients attending SOS Hospital and the study population (N) was estimated to be 1000 malnourished children in a period of 3 months of the study. The sample size (n) of 384 was calculated. Then N/n = 1000/384 = ~3. A starting point of second were chosen to start interview of the caregivers and the caregiver of every third malnourished child was interviewed until the desired sample size of 384 was reached. The results of this sample were used to draw conclusion about the entire population. A confidence interval of 95% was used to make inferential analysis between the variables and draw conclusions.

3.5 Sample size determination

The sample size was calculated as below.

(Cochran, 1963) method was used to calculate the sample size. Thus,

$$\mathbf{n = z^2pq/d^2}$$

Where

n = the desired sample size(if the target population is greater than 10,000).

z= the standard normal deviate at the required confidence level (95% =1.96).

p= the proportion in the target population estimated to have characteristics being measured.

q=1-p

d= the level of statistical significance test.

$n= z^2pq/d^2$

$= (1.96)^2(.50)(.50)/(.05)^2$

$=384.16 = 384$

3.6 Instruments

Data collection from caregivers of under five malnourished patients was achieved by use of a structured questionnaire and review of patients' medical records whose caregivers have given consent to participate in the study. The questionnaire was administered to the study respondents with the help of research assistants,who were trained on the study tool before carrying out the study.

3.7 Operational definitions

3.7.1 Socio-demographic status of mother/caregiver

Socio-demographic status of the mother/caregiver included the age; gender; marital status; education; occupation; income; household size; head of the household; location of residence of the family; type of house and number of rooms; source of drinking water and hand-washing practice.

3.7.2 Maternal and child factors

Maternal/caregiver factors included mother/caregiver nutritional status; if the mother still alive & with whom the child lives; mother/caregiver heath education & counselling on certain topics like breastfeeding,complementary feeding & hygiene; mother/caregiver TB or medical treatment; maternal antenatal care; maternal drugs, alcohol or smoking during pregnancy; place of delivery; regular visits to hospital after birth for child check up; number of live births to the child's mother including this child (birth rate) and birth order of the child.

Child factors included the child's age and sex; child's birth weight & whether the child was born prematurely; child's vaccination & vitamin A supplementation; whether the child is breastfed or not; at what age solid foods introduced; twenty-four hours dietary recall; number of meals per day; child's history of current illness, child's history of known chronic diseases and past hospitalization; child's anthropometric measures to assess child's nutritional statu and child's nutritional diagnosis.

3.7.3 Comorbidities

For the purpose of this study, comorbidities included; urinary tract infection, chronic suppurative otitis media, bronchopneumonia, sepsis, TB, measles, malaria, diarrhea, severe anaemia and HIV. Whether the child received treatment for the comorbidity or not was also asked.

Urinary Tract Infection (UTI) were diagnosed using a urine test, which can detect bacteria and blood in the urine. Diagnosis of chronic suppurative otitis media was suspected clinically and confirmed by culture of ear swab. Diagnosis of bronchopneumonia was confirmed using chest X-ray anterior posterior view and reading was done by experienced radiologist. Sepsis was defined as clinical features of systemic inflammatory response (fever, tachycardia, tachypnea, leukocytosis or leukopenia) associated with infection. Diagnosis of tuberculosis was made in the presence of chronic cough that have lasted for more than three weeks supported by varied combination of the following: positive family history of tuberculosis, positive mantoux, suggestive chest X-ray and elevated erythrocyte sedimentation rate. Diagnosis of measles was based on presence of a maculopapular skin rash and checking for symptoms that are characteristic of the disease, such as white spots in the mouth, fever, cough, and sore throat. Diagnosis of malaria was confirmed using blood film. Diarrhea was defined as passage of watery or loose stools or an increase in frequency above normal for a child. Severe anaemia was defined using a packed cell volume of less than 15% or haemoglobin of less than 5g/dl. Diagnosis of HIV was made using determine and unigold.

3.7.4 Anthropometric measures

For the purpose of this study anthropometric measurements included weight, length/height and MUAC in children. Measurements taken of the mothers / caregivers included weight and height to determine BMI.

Weight was measured with minimal clothing using a digital electronic scale, accurate to the nearest 0.1kg for mother/caregiver while children below 2 years were weighed with an infant scale with minimal clothing. The scales were adjusted to zero before each measurement. If an infant scale is not available, the mother/caregiver and child were weighed together. The weight of the child was then subtracted from the mother/caregiver's weight to get the weight of the child.

For children less than two years, length was measured using a length board in the recumbent position by two examiners. For those above two years and mother/caregiver, height was measured while standing using a height meter. Weight for height/length Z score of less than -1 was indicated as mild, -2 was indicated as moderate and -3 was indicated as severe wasting. The researcher used a non- stretch measuring tape at midpoint between acromion and olecranon process of the left arm to the nearest 1 mm to measure MUAC. Children with MUAC of 12.5-13.5cm were mild, 11.0 to 12.5cm were moderate and less than 11cm were considered as severe malnourished.

For mothers / caregivers, body mass index (BMI) refers to the current weight (kg) divided by the height$(m)^2$. For the purpose of this study, mothers/caregivers with BMI of less than 18.5 kg/ m^2 were classified underweight,18.5 to 24.9 kg/m^2 were classified normal or healthy weight, 25- 29.9 kg/m^2 were classified overweight, 30-34.9 kg/m^2 were classified under class I obesity 35-39.9 kg/m^2 were classified under class II obesity and above 40 kg/m^2 were classified under class III obesity.

3.7.5 Diagnosis of malnutrition

Diagnosis of malnutrition was based on the Modified Wellcome Classification because it was the method that was used for clinical diagnosis by the clinicians in SOS Hospital. This classified PEM into underweight, marasmus, kwashiorkor, marasmic-kwashiorkor and there was also provision for unclassified PEM.

3.8 Data collection procedure

Data collection is the systematic process of gathering information relevant to the study and was used to address research objectives and answer research questions. After sampling, a list of all participants was made using their names from admission register of the hospitals with date of admission. The researcher and the researcher assistant introduced himself or herself to the mothers/caregivers of the study participant(s) and also introduced the research objectives, rights of the participant and details of the person to be contact in case of further clarification in the future. When consent was given by the mother/caregiver of the participant, he or she was asked to sign or fingerprint on the consent form. Where the subject refuse to participate, the interview was not be conducted. The questionnaire was administered by completing all the necessary details using the language the participant understood well. The research assistant ticked the appropriate boxes after each response. The filled questionnaires were reviewed on weekly basis to ensure that responses are entered correctly and feedback was given to the research assistants. All duly filled and consented questionnaires were kept in a safe place with access control.

3.9 Pilot test

Pre-testing of the questionnaire was done in Benadir Hospital in Mogadishu (Appendix X), and corrections were made accordingly for validity and reliability of the data. The same questionnaire and measurements that were used in the main study were also implemented in Benadir Hospital for pilot study. Twenty cases were included in the pilot study. The same inclusion criteria were used for the pilot study. A trained nutrition nurse filled in the questionnaires and the same procedure that was used in the main study was also be followed for the pilot study. No real problem during pilot study were documented. On completion of the pilot study, some of the questions in the questionnaire were reviewed and some questions were rephrased to guarantee that the interviewee gives the correct information. The interviews took about 40 minutes to conduct with the mother /caretaker.

3.10 Data processing and analysis

It's the process of categorizing, manipulating and summarizing data in order to answer research question and to make a meaning out of data collected and draw conclusion. After all participants interviewed, raw data collected was checked for completeness, the data was entered into MS excel spread sheet and later analyzed using SPSS software (version 20.0) to describe and identify significant correlations between different variables. Descriptive summary statistics and graphical summaries in tables and charts were presented in the results chapter that follows.

3.11 Ethical considerations

Permission to proceed was observed by obtaining a notice from Jomo Kenyatta University of Agriculture and Technology research committee (Appendix VIII) and permission to proceed in carrying out the research from SOS Hospital (Appendix XII) and Benadir Hospital (Appendix X) where the study was carried out for the validity and reliability of the data. Ethical issues like voluntary participation, informed consent, anonymity and confidentiality, risk of harm, benefits and being in a position to withdraw without being victimised were observed.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the results regarding socio-demographic factors, maternal and child factor as well as on the comorbidities associated with malnutrition in children under five years admitted to SOS hospital as well the associations among the said factors examined and results portrayed.

4.2 Socio-demographic factors for caregivers of malnourished children

The study examined the socio-demographic factors of the children's caregivers and the findings were as follows.

Table 4.1: Socio-demographic factors for the caregivers

Characteristic	Category	Number	%	Chi-Square Value	P-Value	Malnutrition Category (%)				
						Un-W	MAR	KWA	M-KW	Un-S
Gender	Male	11	2.9	6.6018	0.155	24.0	42.0	22.0	8.0	4.0
	Female	373	97.1	6.7345	0.135	40.0	41.7	5.3	4.0	9.0
Age	19 – 25	165	43	17.9655	0.536	21.0	63.0	6.0	4.0	6.0
	26 – 34	167	43.5	35.7676	0.389	32.0	52.0	6.0	3.0	7.0
	35 – 44	42	10.9	15.8765	0.465	26.7	30.0	31.0	2.3	10.0
	Above 44	10	2.6	2.8754	0.765	22.0	10.0	31.0	22.0	15.0
Marital status	Single	7	1.8	0.5435	0.974	32.3	26.9	17.7	16.1	7.0
	Married	305	79.4	0.5987	0.156	34.2	39.0	11.0	10.8	5.0
	Divorced	60	15.6	4.8754	0.468	28.1	45.8	12.1	7.4	6.6
	Widowed	11	2.9	5.8796	0.476	27.0	56.8	12.0	1.2	3.0

	Others	1	0.3	0.5489	0.375	100	0.00	0.00	0.00	0.00
Mother's literacy	Illiterate	299	77.9	6.6017	0.158	83.6	2.0	5.4	5.6	3.4
	Literate	85	22.1	6.8768	0.163	16.4	41.0	36.0	3.0	3.6
Father's literacy	Illiterate	242	63.1	8.9865	0.179	12.0	56.0	19.0	7.1	5.9
Mother's ocupation	Literate	142	36.9	9.8753	0.164	35.6	18.0	33.9	7.5	5.0
	Housewife	345	89.8	5.8685	0.148	24.0	33.1	28.3	2.9	11.7
	Merchant	31	8.1	6.8985	0.755	18.0	28.4	45.1	4.7	3.8
	Employed	8	2.1	5.7849	0.849	39.0	28.0	17.3	2.8	12.9
Source	Salary/wage	264	68.8	5.7648	0.254	17.0	27.8	13.7	21.5	20.0
of income	Pension	7	1.8	8.5795	0.189	27.6	13.8	12.9	22.1	23.6
	Disab. grant	13	3.4	9.4862	0.546	23.7	48.6	14.5	12.0	1.2
	Child support	32	8.3	4.8754	0.276	34.2	30.0	23.0	9.9	2.9
	Other source	68	17.7	6.6859	0.454	23.4	34.8	15.0	12.0	14.8
Level of daily income	0 - $5	342	89.1	36.5681	**0.000**	34.6	45.6	11.1	4.8	3.9

	$6 - $10	41	10.7	5.0786	0.176	23.8	12.5	11.1	45.0	7.6
	Above $10	1	0.3	7.8543	0.234	0.00	0.00	0.00	0.00	100.0
Household size	≤ 3 persons	72	18.7	5.8987	0.354	23.6	29.4	29.0	12.0	6.0
Household head	> 3 persons	312	81.3	16.4547	**0.002**	28.6	45.0	12.0	6.5	7.9
Household	Male	309	80.5	5.8267	0.576	30.6	50.8	11.0	4.0	3.6
Location	Female	75	19.5	8.9563	0.689	41.5	21.0	25.0	6.0	6.5
	IDPs	67	17.4	4.5764	0.765	13.7	34.6	11.0	23.0	17.7
Type of house	Near town	170	44.3	9.8077	0.279	46.0	12.8	17.9	12.1	11.2
	Far town	147	38.3	7.9846	0.159	23.9	25.9	13.2	11.0	26.0
Number of rooms	Ticuna	86	22.4	5.8593	0.874	38.0	21.0	12.0	24.0	5.0
(sleeping)Source of water	Corrug. iron	277	72.1	7.8745	0.456	45.0	43.0	5.0	4.0	3.0
	Other	21	5.5	5.8562	0.781	23.5	56.0	4.5	5.0	11.0
Hand washing practice	1 – 2	255	66.4	13.7347	0.089	11.0	45.0	4.8	34.2	5.0
(n=384)	3 – 4	98	25.5	9.5632	0.157	34.0	17.2	5.6	23.6	19.6

	More than 4	31	8.1	14.8745	0.832	18.0	57.0	10.5	11.6	2.9
Hand washing	Unprotected	352	91.7	2.4836	0.648	38.0	29.0	11.8	12	9.2
method	Protected	32	8.3	4.6579	0.473	73.0	12.0	9.0	4.0	2.0
	After latrine use	33	8.6	6.9854	0.648	27.0	11.0	18.0	38.9	5.1
	Before food pr. After child clea.	32	8.3	8.5368	0.751	9.0	19.0	56.0	11.0	5.0
	After lunch	34	8.9	9.9845	0.852	37.9	23.8	11.3	12.6	14.4
	After all above	24	6.2	15.8967	0.584	39.0	38.0	13.0	2.0	8.0
	Only with water	261	68.0	6.9845	0.142	29.1	10.2	12.8	34.8	13.1
	Soap/sometimes	103	26.8	7.8567	0.357	39.3	21.8	19.3	12.9	6.7
	Soap/always	191	49.7	5.8757	0.576	16.0	15.9	16.3	17.5	34.3
		90	23.4	6.9845	0.263	11.0	19.2	12,4	13.9	43.5

KEY: Un-W: underweight, MAR: marasmus, KWA: Kwashiorkor, M-KW: marasmic-kwashiorkor, Un-S: unclassified

The results in the (**Table 4.1**) above show that majority of the children's caregivers, 97.1% were females while male caregivers accounted for only 2.9% of all the caregivers.

The caregivers were of different age groups with majority of them within the age groups 26 – 34years (43.5%) and 19 – 25years (43.0%). This means that majority of the children caregivers (86.5%) were below the age of 35years and only 13.5% of the caregivers were 35 years and above.

As regards the marital status of the caregivers, 79.4% of the caregivers were married, 15.6% of the caregivers had divorced while only 2.9%, 1.8% and 0.3% of the caregivers were widowed, single and others respectively. This reveals that in this study majority of the malnourished patients were under care of the married caregivers. The proportions of malnutrition categories among children under care of married caregivers were marasmus (39.0%), underweight (34.2%), kwashiorkor (11.0%), marasmic-kwashiorkor (10.8%) and unclassified (5%); among children of divorced caregivers the proportions were marasmus (45.8%), underweight (28.1%), kwashiorkor (12.1%) marasmic-kwashiorkor (7.4%) and unclassified (6.6%); among children of widowed caregivers the proportions were marasmus (56.8%), underweight (27%), kwashiorkor (12.0%) marasmic-kwashiorkor (1.2%) and unclassified (3%) and among children of single mothers, the proportions of underweight, marasmus, kwashiorkor, marasmic-kwashiorkor and unclassified forms of malnutrition were 32.3%, 26.9%, 17.7%, 16.1% and 7.0% respectively. The study findings also revealed that the illiteracy status (inability to read and write) of the parents of the child was high among the mothers (77.9%) as compared to fathers (63.1%). Only 36.9% and 22.1% of the child fathers and mothers respectively could read and write.

In relation to the child's mother occupation, majority of the mothers (89.8%) were housewives while only 2.1% and 8.1% of the mothers were salaried employees and Merchants, respectively. As far as the source of child's family income was concerned, 68.8% of the families obtained their income from wages and salaries,

8.3%, 3.4% and 1.8% of the families had their income source as child support grant, disability grant and old pension grant, respectively while 17.7% of the families depended on other undefined sources of income. Majority of the families (89.1%) with the malnourished children who participated in this study had a daily income of not more than $5 and this poor household income (< $5/day) was significantly associated with malnutrition as shown in the **p-value of 0.000,** while only 10.7% and 0.3% of the families had a daily income of $6 - $10 and above $10 respectively. According to malnutrition categories, poor household income (< $5/day) was found mainly in marasmus (45.6%) and underweight (34.6%) cases compared to Kwashiorkor (11.1%), marasumic-kwashiorkor (4.8%) and unclassified (3.9%) cases.

As regards the household size, only 18.7% of the households had three persons while the majority (81.3%) households had more than three persons. Large household size (> 3 persons) was significantly associated with malnutrition as shown in the **p-value of 0.002**. According to malnutrition categories, marasmus (45.0%) and underweight (28.6%) forms were common among children coming from families with large household size; this is followed by kwashiorkor (12.0%), unclassified (7.9%) and marasumic-kwashiorkor (6.5%).

The study results also revealed that 80.5% of the households were headed by males while only 19.5% of the households were headed by females. As far as location was concerned, nearly half 44.3% of the households were located in the near major town, 38.3% were from far from major town such as most northeast or southeast districts of Mogadishu, while 17.4% were from IDP camps. Findings also show that most of the houses were of Corrugated iron sheets (72.1%), the *Ticuna* type accounted for only 22.4% while 5.5% of the houses were of other types other than Ticuna and Corrugated iron sheets. The findings further reveal that about two-thirds (66.4%) of the families with malnourished children had house with utmost 2rooms used for sleeping. Only 25.5% and 8.1% of the families had houses with 3 – 4 and more than 4 rooms used for sleeping.

As regards the source of drinking water the findings reveal that only 8.3% of the households use drinking water from protected sources while a large proportion 91.7% of the families with malnourished children drink water from unprotected sources.

As far as the hand washing practice is concerned, the study results indicate that a small number of the caregivers wash their hands after latrine use (8.6%), before food preparation (8.3%), after cleaning the child (8.9%), after lunch (6.2%) and 68.0% were found to wash their hands after all the four activities. This shows that over two-thirds of the caregivers washed their hands. However, as regards the way caregivers wash their hands, the results indicate that only 23.4% always wash their hands with soap, 26.8% wash their hands with only water while 49.7% of the caregivers use soap sometimes to wash their hands.

4.3 Maternal and child factors associated with malnourished children

4.3.1 Maternal factors associated with malnourised children

Maternal/caregiver factors include among others mother/caregiver nutritional status; if the mother still alive and with whom the child lives most of the time; mother/caregiver heath education and counselling on certain topics like breastfeeding,complementary feeding and hygiene; mother/caregiver TB or medical treatment; maternal antenatal care; maternal drugs, alcohol or smoking during pregnancy; place of delivery; regular visits to hospital after birth for child check up; number of live births to the child's mother including this child (birth rate) and birth order of the child (**Table 4.2**).

Table 4.2: Maternal factors associated with malnourished children admitted to SOS hospital

Characteristic	Category	Number	%	Chi-square values	P-Value	Malnutrition category (%)				
						Un-W	**MAR**	**KWA**	**M-KW**	**Un-S**
Mother still alive or not	Yes	376	97.9	3.5498	0.174	34.5	23.6	12.4	11.1	18.4
	No	8	2.1	16.9856	0.856	12.8	34.8	30.0	12.0	10.4
Child is staying with	Parent(s)	346	90.1	34.4597	0.156	18.9	17.3	39.1	17.7	7.0
	Grandparent(s)	18	4.7	4.8954	0.845	25.9	34.9	23.0	12.8	3.4
	Aunt/Uncle	8	2.1	17.7645	0.691	45.0	23.0	12.0	13.1	6.9
	Other	12	3.1	5.6542	0.212	14.3	30.8	35.1	7.7	12.1
Counselling mother	Diarrhea	216	56.3	17.6778	0.173	23.7	26.0	13.7	16.6	20.0
	Healthy eating	201	52.3	34.7686	**0.004**	38.0	40.0	12.0	5.7	4.3
	Breastfeeding	231	60.2	6.8368	0.148	29.2	12.9	11.9	12.8	33.2
	C. feeding	111	28.9	17.2048	0.755	36.7	18.0	19.8	12.9	12.6
	F. fortification	59	15.4	32.7690	0.761	38.0	12.0	35.0	4.5	11.5
	Growth Chart	53	13.8	7.2801	0.812	23.0	45.0	17.7	12.3	2.0
	Hygiene	188	49.0	8.2038	0.615	23.9	18.7	34.9	12.8	9.7
	Other topics	51	13.3	15.8752	0,364	13.8	28.7	34.7	16.9	5.9
TB in the household	Yes	45	11.7	18.8537	0.286	24.5	29.4	40.0	2.7	3.4
	No	339	88.3	12.6785	0.192	18.7	35.9	12.8	17.6	15.0
Treatment of mother (n=384)	Anti TB	43	11.1	2.5546	0.386	15.3	19.5	26.8	24.6	13.8
	Antimalarials	96	25.0	7.5680	0.342	16.9	35.0	18.0	12.6	17.5
	None	230	60	4.7686	0.543	15.8	23.7	13.7	16.7	30.1
	Other (specify)	15	3.9	5.9675	0.248	16.9	34.9	18.9	12.7	16.6
Ante- Natal attendance during pregn.	Yes	200	52.1	4.7680	0.345	14.9	23.6	26.8	23,8	10.9
	No	155	40.4	6.8690	0.984	28.6	12.3	12.8	27.1	19.2
	Don't Know	29	7.6	8.9845	0.879	16.3	19.7	17.9	27.9	18.2
Alcohol/drug consumption during pregnancy (n=384)	Alcohol	4	1.0	5.8765	0.345	27.8	28	17	23.3	3.9
	Cigarette	23	6.0	4.3927	0.134	23.9	45.0	17.7	11.0	2.4
	Khat	73	19.0	6.2987	0.689	33.4	17.0	33.4	6.9	9.3
	Others	52	13.5	3.8752	0.763	16.6	30.9	12.7	38.0	1.8
	Don't know	29	7.6	4.7869	0.465	23.5	20.5	40.0	10.4	5.6
	None	203	52.9	8.9836	0.396	45.0	12.8	14.8	12.8	14.6
Birth place of the child	HealthyFacility	155	40.4	7.1568	0.161	25.5	16.7	18.9	12.8	26.1
	Home	207	53.9	3.9869	0.485	28.4	26.0	12.0	11.0	22.6
	Other	22	5.7	2.6748	0.394	18.3	27.9	18.0	12.0	23,8
Regular hospital visit after birth for check-up of the child	Weekly	13	3.4	6.9627	0.675	25.0	18.0	42.0	12.0	3.0
	Monthly	76	19.8	3.9876	0.546	15.8	18.4	12.9	42.0	10.9
	None	225	58.6	7.4696	0.843	26.8	34.8	12.0	17.9	8.5
	Others	70	18.2	8.3438	0.463	16.8	75.0	2.9	3.8	1.5
Birth rate of the mother	1 – 3	125	32.6	5.2936	0.136	24.8	23.0	18.0	19.9	14.3
	4 – 6	174	45.3	2.9846	0.278	54.8	13.8	12.8	9.6	9.0
	7 – 9	71	18.5	7.3927	0.159	37.9	11.9	17.9	23.8	8.5
	More than 9	14	3.7	5.7392	0.731	11.7	13.8	19.9	40.6	14.0
Birth order of the child	1st child	36	9.4	15.9372	0.156	24.7	27.9	12.9	18.4	16.1
	2nd child	45	11.7	34.9827	0.538	27.9	30.0	20.0	10.5	11.6
	3rd child	55	14.3	2.0397	0.234	12.8	25.7	12.9	19.3	29.3
	4th child	90	23.4	6.3819	0.693	17.0	38.0	27.0	15.0	3.0
	Other	158	41.1	6.2847	0.754	13.0	29.0	18.6	18.5	20.9

From the above table, results show that out of the total children, 97.9% had their mothers still alive while only 2.1% had lost their mothers. However, the results indicate that only 90.1% of the children stayed with their mothers most of the time while 4.7%, 3.1% and 2.1% of the children stayed with grandparents, other family members and aunt/uncle respectively. As regards on whether the child's mother/caregiver received counselling on health topics such as; diarrhea, healthy eating, breast feeding, complementary feeding, food fortification, growth chart monitoring, hygiene and other topics, the study results indicate that majority of mothers/caregivers 60.2% received breastfeeding counselling. This was followed by 56.3% of the mothers/caregivers who received counselling on diarrhea, 52.3% of the mothers/caregivers received counselling on healthy eating and nearly a half (49.0%) of the mothers/caregivers received counselling on hygiene. However, the results further indicate that only 28.9%, 15.4% and 13.8% of the mothers/caregivers received counselling on complementary feeding, food fortification, and growth chart monitoring while only 13.3% received counselling on other health related topics. Only counselling on healthy eating has a significant relationship with malnutrition as shown in the P-value of **0.004.** According to malnutrition category, counseling on healthy eating was found mostly in marasmus and underweight cases of malnutrition in a proportion of 40.0% and 38.0% respectively; this was followed by kwashiorkor (12.0%), marasmic-kwashiorkor (5.7%) and unclassified (4.3%) forms.

As regards the mother/caregiver TB status, the results show that only 11.7% of the caregivers/mothers or any member of the households had TB while 88.3% had no TB. It was also revealed that majority of the mothers/caregivers (60%) were not on any treatment, 25.0% and only 11.1% were on antimalarial and anti TB therapy while 3.9% were on other treatments.

The study also sought information on whether the child mother attended antenatal clinic when she was pregnant with the child under consideration and the study results indicate that only 52.1% of the mothers attended antenatal clinics while pregnant. 40.4% of the mothers did not attend antenatal clinics while 7.6% did not know whether the child mothers attended antenatal clinics during pregnancy.

As regards on whether the mother used drugs during pregnancy, the findings revealed that 52.9% of the respondents did not use any drug/alcohol during pregnancy of the malnourished child. 19%, 6.0%, and 13.5% of the mothers used khat, cigarette, and other drugs while only 1% and 7.6% of the mothers used alcohol and did not know whether the mothers used any drug respectively.

As far as the place where the child was born, the study findings reveals that majority of the children 53.9% were born at home while only 40.4% were born in a healthy facility(Hospital, Clinics or community health centres) while 5.7% were born from other places other than health facilities and homes.

As regards hospital visits after birth, it was revealed that majority of the mothers (58.6%) do not regularly take their children to hospital after birth for checkup while only 3.4% and 19.8% regularly take their children to health facility for checkup weekly and monthly. 18.2% of the mothers followed other patterns other than those mentioned.

As regards the number of live births to the child's mother, 45.3% of the child's mothers had 4 – 6 live births, 32.6% had 1 – 3 live births while 18.5% and 3.7% child mothers had 7 – 9 live births and more than 9 live births respectively. This means that over 67.4% of the child's mothers had more than 4 live births. As far as the child's birth order was concerned, the study findings reveal that only 9.4% and 11.7% of the malnourished children were the first and second child, respectively. 14.3% and 23.4% were of the third and fourth order, respectively while 41.1% of the malnourished children were of other birth orders. This means that the child's malnutrition chances increased as the child's birth order increased.

Table 4.3: Anthropometric information of the mother/caregiver – BMI

BMI of mother/caregiver	Classification	Score	%	Chi-squareValue	P-Value
Less than 18.5kg/m^2	Underweight	1	.3	3.8852	0.467
Between 18.5and 24.9kg/m^2	Normal weight	8	2.1	5.8634	0.864
Between 25 and 29.9kg/m^2	Overweight	29	7.6	7.4574	0.875
Between 30 and 34.9kg/m^2	Obese	77	20.1	5.2840	0.352
Between 35 and 39.9kg/m^2	Morbidly obese	190	49.5	9.3459	0.865
Above 40kg/m^2	Severely obese	79	20.6	4.5785	0.453

As regards the mother/caregivers' anthropometric measurements (**Table 4.3**), only 2.1% of the mothers/caregivers had normal weight while 49.5% of the caregivers/mothers were morbidly obese, 20.6%, 20.1%, 7.6% and 0.3% of the mothers/caregivers were severely obese, obese, overweight and underweight respectively.

4.3.2 Child factors associated with malnourised children

Child factors included the child's age and sex; child's birth weight and whether the child was born prematurely; child's vaccination and vitamin A supplementation; whether the child is breastfed or not; at what age solid foods introduced; twenty-four hours dietary recall; number of meals per day; child's history of current illness, child's history of known chronic diseases and past hospitalization; child's anthropometric measures to assess child's nutritional statu and child's nutritional diagnosis.

Table 4.4: Child characteristics associated with malnourished children admitted to SOS hospital

Characteristic	Category	Number	%	Chi-square Value	P-Value	Malnutrition category (%) Un-W	MAR	KWA	M-KW	Un-S
Child's age (months)	0 – 6 m	44	11.5	2.7639	0.284	12.0	25.6	45.8	10.6	6.0
	7 – 12 m	255	66.4	5.4625	**0.001**	13.8	40.9	32.8	11.0	1.5
	13-24 m	69	18.0	4.7635	0.134	29.9	38.0	13.0	11.0	19.1
	25-59 m	16	4.1	34.8734	0.945	26.9	67.9	1.8	1.3	2.1
Child's gender	Male	170	44.3	12.65423.8764	0.149	24.8	43.8	12.6	2.8	16.0
	Female	214	55.7		0.254	34.8	23.8	12.0	2.9	26.5
Child's birth weight	Very low	29	7.6	5.8985	0.287	32.8	12.9	13.6	28.6	12.1
	Low	90	23.4	7.9863	0.345	43.9	16.4	15.6	14.8	9.3
	Normal	265	69.0	6.7645	0.156	13.4	14.9	28.8	36.4	6.5
Premature delivery	Yes	66	17.2	34.2983	0.928	13.9	15.6	17.8	32	20.7
	No	315	82.0	4.8457	0.274	18.9	36.7	14.9	23.7	5.8
	Unknow	3	0.8	6.9847	0.193	29.6	39.0	12.7	15.0	3.7
Immuniz-ation	Yes	270	70.3	4.9872	0.388	34.8	10.0	17.6	12.0	25.6
	No	114	29.7	7.9257	0.728	12.8	38.6	27.0	10.0	11.6
Vitamin A	Yes	257	66.9	3.9463	0.125	29.8	26.0	12.9	19.0	12.3
	No	127	33.1	34.9826	**0.048**	10.0	45.0	40.0	3.9	5.0
Breastfe-d child	Yes	218	56.8	7.2973	0.668	13.0	25.0	18.0	15.8	28.2
	No	166	43.2	8.9746	0.153	19.0	29.0	17.5	13.9	20.6
Breast-feeding duration (n=218)	1 – 6 m	62	28.4	36.8652	**0.001**	17.9	38.0	1.5	2.6	40.0
	7 – 12 m	144	66.1	2.7648	0.285	28.9	26.0	18.0	21.0	6.1
	13-24 m	12	5.5	5.3527	0.952	19.8	28.9	15.7	27.0	8.6
Type of milk (n=166)	Formula	94	56.6	6.7349	0.276	29.0	18.0	22.0	19.5	11.5
	Cow's	58	35	16.9822	**0.012**	12.0	28.0	32.0	13.0	15.0
	Others	14	8.4	2.6957	0.564	18.0	29.0	17.0	25.0	11.0
Feeding method (n=166)	Bottle	66	40	2.8587	0.784	16.0	29.0	28.0	18.0	9.0
	Cup	100	60	5.8254	0.145	13.0	27.9	21.0	28.0	10.1
Solid food started at	1 – 6 mo	65	29.8	5.9673	0.176	17.0	18.7	27.0	29.0	8.3
(n=218)	7 - 12 mo 13-24 mo	129	59.2	9.3469	0.965	34.7	13.9	28.0	12.0	11.4
		24	11.0	0.8542	0.547	19.4	19.6	18.7	17.9	24.4
Number of meals per day	< 3	102	26.6	0.5634	0.898	24.8	18.7	12.8	11.5	32.2
	3	181	47.1	0.7645	0.245	18.7	12.8	14.7	15.8	38.0
	> 3	101	26.3	0.4325	0.156	29.0	19.5	12.9	18.4	20.2

KEY: Un-W: underweight, MAR: marasmus, KWA: Kwashiorkor, M-KW: marasmic-kwashiorkor, Un-S: unclassified.

The findings in the above table show that majority of children (66.4%) by time of interview were aged between 7 – 12 months and this age group (7 – 12 months) has high risk of malnutrition as shown in the P-value of **0.001** because this is the age of introduction of solid foods, furthermore a high proportion (40.9%) of these children have marasmus; 32.8% have kwashiorkor; 13.8%, 11.0% and 1.5% have underweight, marasmic-kwashiorkor and unclassified forms of malnutrition respectively. This group was followed by those aged between 13 and 24 months while 11.5% and 4.1% of the children were aged between 0 – 6 months and 25 – 59 months respectively. This means that in Mogadishu, malnutrition is more prevalent among the children between 6 months and 24 months of age. Findings also show that more than a half (55.7%) of the malnourished children was females while the males/boys accounted for only 44.3%.

As regards the birth weight of the child, 69.0% of the malnourished children studied had normal birth weight that is between 2500gm – 4000gm, 23.4% had low birth weight between 1500gm – 2500gm while only 7.6% of the children had very low birth weight that is under 1500gm.

The study findings further indicate that majority of the malnourished children 82.0% of all the children were not premature and only 17.2% were premature while only 0.8% of the children's birth status was not known.

About seventy percent (70.3%) of the children under study were immunized up to-date and only 29.7% had their immunization schedules not up to-date. This shows that over two-thirds of the children admitted to the nutrition ward of SOS hospital were immunized. It is further revealed that 66.9% of the malnourished children had their vitamin A supplementation up to-date with only 33.1% who had their vitamin A supplementation not up to-date at the time of interview and lack of Vitamin A supplementation was associated with malnutrition as shown in the slightly significant P-value of **0.048** with marasumus (45.0%) and kwashiorkor (40.0%) being the most

common types of malnutrition among these children who didn't take vitamin A supplementation.

As regards the child's breastfeeding status, results show that a proportion slightly above average (56.8%) of the total children had been breastfed while 43.2% were not breast fed. This shows that a child being malnourished may be attributed to low/lack of breast feeding.

With respect to the age up-to which the child was breastfed, the results show that 66.1% of the children were breastfed between the age of 7 and 12 months, 28.4% were breastfed between the age of 1 and 6 months while only 5.5% were breastfed between the age of 13 and 24 months. The study further revealed that the age up-to which the child was breasted was significantly associated with malnutrition particularly in children with short breast-feeding duration i.e. not more than 6 months as shown in the significant P-value of **0.001**. Furthermore, the study revealed that unclassified (40.0%), marsamus (38.0%) and underweight (17.9%) were most prevelant types of malnutrition among these children with short breast-feeeding duration. Of the total children who were not breastfed, the study thought to establish the type of milk upon which the child was fed and found that majority of the children (56.6%) were fed on formula milk. Thirty five percent (35%) of the children were fed on cow's milk and this type of milk (Cow's milk) was significantly associated with malnutriotion as shown in the P-value of **0.012** with kwashiorkor (32.0%) and marasmus (28.0%) being the most common types of malnutrition associated with Cow's milk. Only 8.4% of the children were fed on other milk types other than formula and cow's milk. As far as the method by which the milk was fed to the child, results indicate that majority of the children (60%) were fed using a cup while only 40% were fed using a feeding bottle.

As far as the age at which solid foods were introduced, results shows that 59.2% of the malnourished children breastfed (n=218), were introduced to solid foods at the age between 7 and 12 months. 29.8% of the breastfed malnourished children were

introduce to solid foods before the age of 6 months while only 11.0% of the children had solid foods introduced at the age between 13 and 24 months.

Among the child factors, the study sought for the number of meals the child had per day and the findings reveal that 47.1% of the children had an average three meals per day, while about the same proportion 26.6% and 26.3% of the children had less than three meals per day and more than three meals per day respectively. This finding shows that, overall, majority of the malnourished children (73.7%) were subjected to not more than three meals per day.

Table 4.5: Medical history of malnourished children admitted to SOS Hospital

Characteristic	Category	Number	Percentage
Child's History of current illness	Fever	275	71.6
	Cough	245	63.8
	Diarrhea	172	44.8
	Failure to gain weight	147	38.3
	Generalized body swelling	10	2.6
	Seizures	11	2.9
	Oral thrush	32	8.3
	Others	33	8.6
Patient's History of known chronic diseases(n=384)	PTB	27	7.0
	Congenital heart disease	29	7.6
	Others	59	15.4
	None	269	70.0
Previous hospital admission	Yes	166	43.5
	No	218	56.5
Child referred by	Nurse	37	9.6
	Doctor	158	41.1
	Dietitian	12	3.1
	Other	177	46.2
Edema in lower limbs	Yes	11	2.9
	No	373	97.1
Nutritional diagnosis of the child at the time of admission	Underweight	165	43.0
	Marasmus	202	52.6
	Kwashiorkor	4	1.0
	Marasmic – kwashiorkor	6	1.6
	Unclassified	7	1.8

As regards the child's medical/health history of current illness, the findings in **Table 4.5** reveal that fever, cough, diarrhea and the child's failure to gain weight were the major illness among the children with proportions of 71.6%, 63.8%, 44.8% and 38.3% respectively. These were followed by oral thrush, seizures and generalized body swelling accounting for 8.3%, 2.9% and 2.6% of the total patient population respectively while 8.6% of the malnourished children were currently suffering from other illnesses other than those mentioned above.

As far as the patient's history of chronic illness was concerned, the study findings revealed that majority of the malnourished children studied had no history of any known chronic disease. Only 7.6% and 7% of the total children studied had history of congenital heart diseases and PTB, respectively while 15.4% of the studied children had history of other chronic diseases other than congenital heart diseases and PTB. The study results also revealed that 43.5% of the total malnourished children studied had been previously admitted to the hospital while 56.5% had not been admitted to the hospital.

As regards to who referred the child to the hospital, the results indicated that only 53.8% of the total malnourished children admitted to SOS hospital were referred by known medical practitioners of which 41.1%, 9.6% and 3.1% were referred by a doctor, nurse and dietitian respectively. Other people other than the nurse, doctor or dietitian referred the remaining proportion of admissions, 46.2%. This finding is as displayed on the following chart.

As regards the condition of edema in the lower limbs of the child, the results indicate that only 2.9% of the malnourished children had the condition while a greater proportion (97.1%) had no edema in their lower limbs.

The results also reveal that among the malnourished children, 43%, 52.6%, 1%, 1.6% and 1.8% were diagnosed with underweight, marasmus, Marasmic-kwashiorkor, and unclassified respectively. This means that the most prevalent/common malnutrition conditions among the children admitted were marasmus and underweight.

Table 4.6: Anthropometric information of the child – weight and height/length

Characteristic	Range	Median
Birth weight of child/baby(kg) (n=384)	1.2 – 4.0	2.5
Current weight of child/baby(kg) (n=384)	1.6 – 15	6.5
Height/length of child/baby (cm) (n=384)	45 – 114	66

The study findings on weight and height/ length of the children presented in **Table 4.6** above show that the birth weight of the malnourished children ranged between 1.2 and 4kg with a median birth weight of 2.5kg. As regards the child's current weight, results shows that the current weight ranged between 1.6 and 15kg with a median current weight of 6.5kg while for height/length, the height of the children ranged between 45 and 114cm with the median height of 66cm.

Table 4.7: Anthropometric information of the child – MUAC and Z - score

Characteristic	Category	Score	Percentage
MUAC of the child(cm)	**Classification**		
12.5 – 13.5cm	Mild malnutrition	11	2.9
11.0 – 12.5cm	Moderate malnutrition	235	61.2
< 11.0cm	Severe malnutrition	99	25.8
MUAC not measured	Unclassified	39	10.2
Z – score	**Classification**		
-1.1 to -2	Mild malnutrition	154	40.1
-2.1 to -3	Moderate malnutrition	100	26.1
< -3	Severe malnutrition	121	31.5
Z – score not measured	Unclassified	9	2.3

As regards the MUAC measurement of the malnourished children considered in this study (**Table 4.7** above), majority of the children (61.2%) had an MUAC ranging between 11.0 – 12.5cm meaning that 61.2% of the children had moderate malnutrition. This was followed by 25.8% of the children who were severely malnourished and only 2.9% of the children had mild malnutrition based on the MUAC. However, 10.2% had their MUAC not measured and thus unclassified. According to weight for height Z – score measurement, majority of children (40.1%) had mild malnutrition (Z-score between -1.1 to -2), followed by 31.5% and 26.1% for severe and moderate malnutrition respectively. However, only 2.3% of the children had their Z-score not measured and thus unclassified.

4.4 Comorbidities associated with malnourished children

Table 4.8: Comorbidities associated with malnourished children admitted to SOS Hospital

Comorbidity	Number	%	Chi-Square Value	P-value	Malnutrition category				
					Un-W	MAR	KWA	M-KW	Un-S
UTI	46	12.0	10.594	0.032*	14.6	36.9	34.2	11.0	3.3
Otitis media	52	13.5	8.249	0.083	24.6	18.5	17.0	12.0	27.9
Bronchopn.	239	62.2	14.262	0.007*	11.8	32.0	28.0	12.0	16.2
Sepsis	17	4.4	4.617	0.329	12.8	12.0	19.0	35.0	21.2
TB	18	4.7	1.078	0.898	23.0	19.6	26.8	16.0	14.6
Measles	93	24.2	14.623	0.006*	14.9	29.0	34.0	13.0	9.1
Malaria	127	33.1	14.765	0.005*	18.4	32.0	29.0	17.0	3.6
Diarrhea	213	55.5	3.257	0.516	27.0	19.0	18.0	26.0	10.0
Anaemia	65	16.9	5.691	0.223	19.7	18.5	23.0	30.0	8.8
HIV	3	0.8	0.742	0.946	28,0	24.0	34.0	12.9	1.1
Others	47	12.2	3.245	0.356	18.0	30.0	23.0	22.0	7.0

KEY: Un-W: underweight, MAR: marasmus, KWA: Kwashiorkor, M-KW: marasmic-kwashiorkor, Un-S: unclassified. ***Indicates significant association at 5% level of confidence.*

Results in Table **4.8** above showed that bronchopneumonia and diarrhea were the most prevalent comorbidity among the malnourished children studied with a proportion of 62.2% and 55.5% respectively**.** This was followed by malaria, measles, severe anaemia, otitis media, urinary tract infection, TB, sepsis and HIV with proportions 33.1%, 24.2%, 16.9%, 13.5%, 12%, 4.7%, 4.4% and 0.8% respectively. However, 12.2% of the malnourished children had different conditions other than those mentioned. The study also revealed that urinary tract infection (P-value = 0.032, which was significant at 5% level of confidence), bronchopneumonia (P-value = 0.007, which was significant at 5% level of confidence), measles (P-value = 0.006, which was significant at 5% level of confidence) and malaria (P-value = 0.005, which was significant at 5% level of confidence) were significantly associated with the malnourished children admitted to SOS hospital. Furthermore the study revealed that UTI was associated mostly with marasmus (36.9%), kwashiorkor (34.2%) and underweight (14.6%); bronchopneumonia with marasmus (32.0%), kwashiorkor (28.0%) and unclassified (16.2%); measles with kwashiorkor (34.0%), marasmus (29.0%) and underweight (14.9%); malaria with marasmus (32.0%), kwashiorkor (29.0%), underweight (18.4%) and marasmic-kwashiorkor (17.0%).

The study also revealed that over 90% (90.6%) of the malnourished children who had comorbidities were on treatment while only 9.4% were not under treatment as portrayed on the following chart (Figure **4.1*)***.

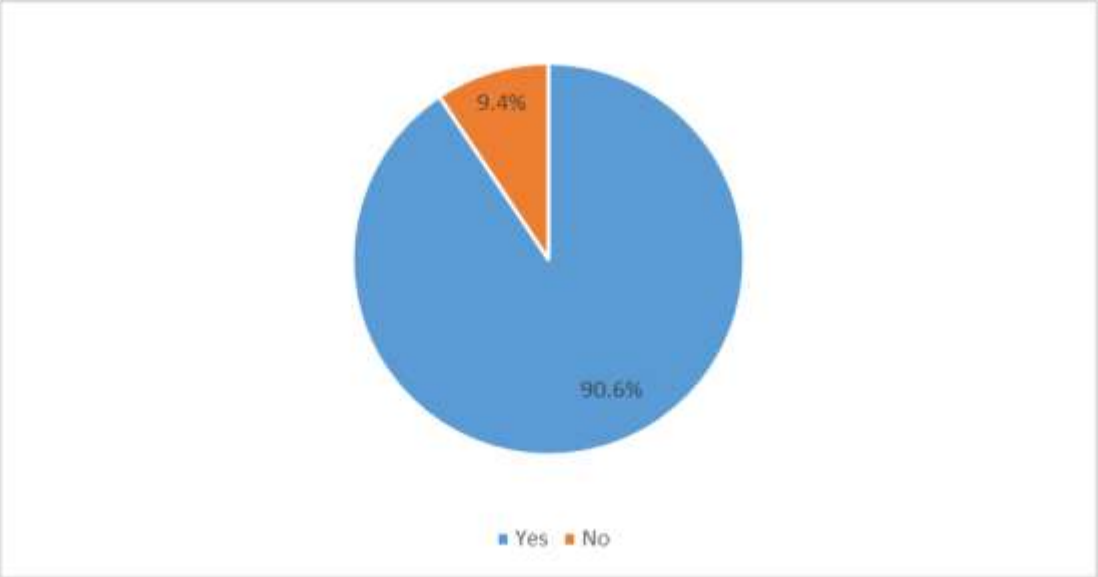

Figure 4.1: Whether the child receive treatment for any comorbidity

Table 4.9: Type of the treatment the malnourished child received for comorbidity

Characteristic	Category	Number	Percentage
Type of treatment	Antibiotics	322	83.9
	Anti TB therapy	18	4.7
	Antimalarial therapy	70	18.2
	Antiretroviral therapy	4	1.0
	IVF therapy	1	0.3
	Blood transfusion	11	3.1
	Others	91	25.2

As regards the type of treatment received, results (**Table 4.9** above) indicate that about 84% of the patients were receiving Antibiotics, followed by 18.2%, 4.7% and 3.1% of the children who were on antimalarial therapy, anti TB therapy and blood transfusion respectively. Only 1% and 0.3% of the patients were on antiretroviral therapy and IVF therapy respectively. However, 25.2% of the patients were on other treatments other than those mentioned.

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Introduction

In this section, the results of the study were discussed and where possible compared to the results of relevant studies of the same nature. Conclusions and recommendations were also addressed.

5.1 Discussion of the findings

In this section, the results of the study will be discussed and where possible compared to the results of relevant studies of the same nature.

5.1.1 Socio-demographic factors

Rahman et al. (2016) determined the prevalence of malnutrition was markedly higher in children with LBW than those with normal birth-weights (stunting: 51% vs 39%; wasting: 25% vs 14% and underweight: 52% vs 33%). While controlling for the known risk factors, children with LBW had significantly increased risk of becoming malnourished compared to their counter part with RR 1.23 (95% CI:1.16–1.30), 1.71 (95% CI:1.53–1.92) and 1.47 (95% CI: 1.38–1.56) for stunting, wasting and underweight, respectively. (Rahman, *et al.,* 2016). Studies done in the Mulago Hospital in Kampala, Uganda and the Moi Teaching and Referral Hospital in Eldoret, Kenya looked at children zero to 60 months and three to 35 months respectively and found an association between PEM and young (15-25 years), single mothers (Owor *et al.*, 2000; Ayaya *et al.,* 2004). There may be a true biological effect of very young age at first pregnancy (<15 years or so) on infant health, through the increased risk of preterm birth and LBW. The evidence that young maternal age increases the risk of maternal anaemia is also fairly strong (Gibbs *et al.,* 2012). In this study (**Table 4.1**) the majority of mothers (43.5%) were between 26-34 years of age and 43% of mothers were younger (19-25 years old), which showed that majority

of the children caregivers (86.5%) were below the age of 35 years and only 13.5% of the caregivers were 35 years and above.

Malnutrition affects poor people who also have poor health seeking behavior. Studies had shown that in women who didn't attend school and ones with primary level of education, their children had high chance of getting malnutrition compared to educated mothers who are more cautious about their children's health, have a tendency of health seeking behavior and taking care in a better ways (USAID, 2004; Rayhan and Khan, 2006; Kandala *et al.,* 2011). In this study, the illiteracy status (inability to read and write) of the parents of the child was slightly high among the mothers (77.9%) as compared to fathers (63.1%). Only 22.1% and 36.9% of the child mothers and fathers respectively could read and write (**Table 4.1)**. Similar findings were found in a study in Machakel Woreda, Northwest Ethiopia where illiteracy was high among mothers (84.3%) compared to fathers (63.20%) (Bantamen *et al.,* 2014). Saito et al. (1997) found an association between nutrition related knowledge and mild mixed malnutrition in children younger than four years old in India. There was, however no significant difference in the mother's attitudes regarding seeking health care for their children. When the mothers were questioned about their traditional beliefs, they did not believe that medical care was needed to manage childhood illnesses such as malnutrition and measles (Saito *et al.*, 1997).

The study revealed that (**Table 4.1**), 79.4% of the caregivers were married, 15.6% of the caregivers had divorced while only 2.9%, 1.8% and 0.3% of the caregivers were widowed, single and others respectively. This was in contrast to a study by Mahgoub *et al.* (2006) undertaken in Botswana amongst children zero to three years old, where 76.4% of the mothers with malnourished children were single and 22.1% of the mothers were married (Mahgoub *et al.,* 2006). Maternal marital status also has an effect on child malnutrition, with the married mother being economically sounder than a single, divorced or separated mother. If the mother is married and still living with the child's father, the family can be considered economically stronger (Gibbs *et al.,* 2012)**.**

This study's findings correlate well with the findings of a study by Bantamen *et al.* (2014) undertaken in Machakel Woreda, Northwest Ethiopia among under five year children, where 88.2% of the mothers with malnourished children were housewife and 2% of the mothers were employed (Bantamen *et al.,* 2014). In this study, 89.8% of the mothers with malnourished children were housewife, 8.1% were merchants while only 2.1% of them were employed.

Socio-economic status is linked to income and malnutrition (Pierecchi-Marti *et al.*, 2006). Households that cannot attain nutritious foods due to income poverty are most associated with the inadequate diet and disease that leads to malnutrition (Horton *et al*., 2008). In this study (**Table 4.1**), majority of the families (89.1%) with the malnourished children who participated in this study had a daily income of not more than $5. This study further showed that there is a strong relationship between malnutrition and poor household income (P –value = 0.000) (**Table 4.1)**.

Household size and composition can have different effects. Anthropologists writing of different continents have documented how parents reluctantly practice triage, neglecting the care of certain children who die as a result (Turnbull, 1973; Scheper-Hughes, 1992), or even actively intervene to bring about death usually of daughters (Croll, 2000; Venkatramani, 1992). In South Africa, stunted children often live in households that are bigger or have more people (Kleynhans *et al.*, 2006) and therefore the risk for stunting has been found to be highest in households with nine or more people in the household (Mamabola *et al.,* 2005). In South Africa about 56% of households have a size of five to nine people (Kleynhans *et al.,* 2006). The risk of children from a household in Zimbabwe and Ethiopia being stunted increased from 7% when it was only one child to 38% when the household had seven children younger than ten. In Ethiopian communities, 24% of households with more than four children were malnourished (Bantamen *et al.,* 2014) found that most of malnutrition case (62.5%) in Machakel Woreda, Northwest Ethiopia had household size greater than three. The above data was consistent with this study's findings (**Table 4.1**) where most of the malnutrition cases (81.3%) came from large households (more than three persons) with only 18.7% of the households had three persons. There was

a significant relationship between malnutrition status in children under five admitted to SOS Hospital and the household/family size (P –value = 0.002) (**Table 4.1**).

This study revealed that males headed 80.5% of the households, while females headed only 19.5% of the households. Bantamen et al. (2014) reported similar findings where males headed 93.13% of the households.

This study showed no significant association between the nutritional diagnosis (underweight, marasmus, kwashiorkor, marasmic-kwashiorkor and unclassified) and location of the residence where children from families in IDPs had lower cases of malnutrition diagnosis across all the categories of malnutrition while there was no meaningful difference between the children from near and far major towns regarding their malnutrition diagnosis.

This study revealed that about two-thirds (66.4%) of the families with malnourished children had house with utmost 2 rooms used for sleeping. Only 25.5% and 8.1% of the families had houses with 3 – 4 and more than 4 rooms used for sleeping respectively (**Table 4.1**). Most of the houses were of Corrugated iron sheets (72.1%). In this study, a large proportion (91.7%) of the families with malnourished children drinks water from unprotected sources (**Table 4.1**). The above findings were in line with Bantamen et al. (2014) findings where most of the houses were of Corrugated iron sheet (81.38%) and the households used unprotected drinking water source accounts 58%.

The provision of sanitation and drinking water is seen as an essential complement to the availability of food in preventing child malnutrition. The study showed that (**Table 4.1**) as regards the hand washing practice of the child's mother/caregiver, As far as the hand washing practice is concerned, the study results indicate that about 68.0% were found to wash their hands after all the four activities (after latrine use, before food preparation, after cleaning the child and after lunch). This means that 32.0% were not wash their hands after the above four activities. Caregiver's poor hand washing practices was also found by Bantamen et al. (2014) where only 5.88% of mothers/caregivers reported always washed their hands with soap.

5.1.2 Maternal and child factors associated with malnourished children

In this study (**Table 4.2**), almost all the mothers were alive (97.9%) while only 2.1% had lost their mothers i.e their mothers died. Kleynhans *et al.* (2006) found that children that lived in households where grandparents were caregivers had the highest rate of stunting. This study found that marasmus was most common among children lived with grandparents as caregivers in a proportion of 34.9% followed by underweight (stunting) in a proportion of 25.9% (**Table 4..2**). In rural areas it is usually the grandmothers that caregivers, but evidence from a study in Limpopo, South Africa amongst children twelve to 24 months of age showed that children had a lower risk of stunting if the mother was the caregiver (Kleynhans *et al.*, 2006). In Nigeria 450 mothers were interviewed and 77% of mothers cared for their own children, while 23% of mothers had somebody that cared for their children (Ogunba, 2008). In this study, 90.1% of the children (**Table 4.2)** stayed with their mothers most of the time and therefore cared for by their parents while 4.7%, 3.1% and 2.1% of the children stayed with grandparents, other family members and aunt/uncle respectively. In a study done in Kenya amongst children three to 36 months old, the caretaker of the malnourished children was most often not married to the child's parent and children with malnutrition had not been staying with both parents during the previous six months (Ayaya *et al.*, 2004).

In this study (**Table 4.2)**, majority of mothers/caregivers (60.2%) received breastfeeding counselling, this was followed by 56.3% of the mothers/caregivers who received counselling on diarrhea, 52.3% of the mothers/caregivers received counselling on healthy eating and nearly a half (49.0%) of the mothers/caregivers received counselling on hygiene. However, only 28.9%, 15.4% and 13.8% of the mothers/caregivers received counselling on complementary feeding, food fortification, and growth chart monitoring while only 13.3% received counselling on other health related topics. This study further revealed that there was a significant association between malnutrition and counselling on healthy eating with a P-value = 0.004 (**Table 4.2**). A study in Ethiopia amongst children three to 36 months old showed no significant difference between the health practices of mothers with

malnourished children (38.5%) that withheld food during episodes of diarrhoea and those of well-nourished children (40.1%). The mothers in the Ethiopian study, which withheld food from their children during episodes of diarrhoea, did not give fruit, vegetables and milk. In malnourished children, the foods that were withheld during diarrhoea included porridge and potatoes (Abate *et al.*, 2001).

In this study, only 11.7% of the caregivers/mothers or any member of the households had TB while 88.3% had no TB (**Table 4.2)**. It was also revealed that majority of the mothers/caregivers (62.8%) were not on any treatment, 25.0% and 11.2% were on antimalarial and anti TB therapy while 3.9% were on other treatments **(Table 4.2**). Studies reported by the United States Agency for International Development (2009) and Chatterjee et al., (2007) showed the importance of mothers receiving treatment for illnesses (USAID, 2009) and (Chatterjee *et al.*, 2007).

Clinic attendance of mothers during pregnancy was relatively low, with only 52.1% accessing antenatal care during pregnancy. 40.4% of the mothers did not attend antenatal clinics while 7.6% did not know whether the child mothers attended antenatal clinics during pregnancy (**Table 4.2)**. In a study by Teller and Yimar (2000) in Ethiopia aimed at determining the nutritional status of women and children younger than five years of age, antenatal visits were related to stunting in a child, with the prevalence of stunting decreasing as the number of antenatal visits of the mother increased.

Of the 384 mothers participating in the study, the findings (**Table 4.2)** revealed that 52.9% of the respondents did not use any drug/alcohol during pregnancy of the malnourished child. Only 19%, 6.0%, and 13.5% of the mothers used khat, cigarette, and other drugs while only 1% and 7.6% of the mothers used alcohol and did not know whether the mothers used any drug respectively. A study undertaken by Setswe (1994) in Bophuthatswana (South Africa) amongst children younger than five years of age, showed an association between child malnutrition and the consumption of alcohol (Setswe, 1994). Environmental tobacco smoke (ETS), or secondhand smoke, is increasingly recognized as the direct cause of lung disease in adults and

children. In children, ETS is associated with an increased risk of lower respiratory tract infections (LRTIs), such as bronchitis and pneumonia. An estimated 150,000-300,000 cases of LRTIs in children younger than 18 months are attributed to ETS annually. Finally, ETS is a risk factor for the development of asthma in children (Timothy, 2016).

Most of the children (53.9%) included in this study (**Table 4.2)** were born at home and majority of the mothers (58.6%) did not regularly take their children to hospital after birth for checkup while only 3.4% and 19.8% regularly take their children to health facility for checkup weekly and monthly respectively. This was in contrast with a study undertaken by Abate et al. (2001) amongst children three to 36 months old, 76% of mothers took their children to hospital or clinics for the treatment of diarrhoea.

This study showed significant association between the nutritional diagnosis and number of live births, where 45.3% of the child's mothers had 4 – 6 live births, 32.6% had 1 – 3 live births while 18.5% and 3.7% child mothers had 7 – 9 live births and more than 9 live births respectively (**Table 4.2)**. This means that over 67.4% of the child's mothers had more than 4 live births. This study also indicated the child's malnutrition chances increased as the child's birth order increased (**Table 4.2)** where only 9.4% were the first child, 11.7% were the second child, 14.3% were of the third order and 23.4% and 41.1% of the children were of the fourth and other birth orders respectively. This was in line with a study undertaken by Jeyaseelan and Lakshman (1997) in India amongst children five to seven years old, found that the high birth order of a child was associated with the child being malnourished (Jeyaseelan & Lakshman, 1997). Similarly, a study undertaken by Teller and Yimar (2000) in Ethiopia amongst mothers 15 to 49 years old and children younger than five years old, showed the highest rate of stunting in children with a birth order of four or five (54%) and then a birth order of six or more (53%).

In this study (**Table 4.3**), only 2.1% of the mothers/caregivers had BMI in the normal range of 18.5 and 24.9kg/m2 while 49.5% of the caregivers/mothers were morbidly

obese, 20.6%, 20.1%, 7.6% and 0.3% of the mothers/caregivers were severely obese, obese, overweight and underweight respectively. In contrast, James et al. (1999) analysed data from Ethiopia, India and Zimbabwe and found that 56.3% of households had women with an average BMI of less than 18.5 kg/m2. In only 29.9% of the Indian households, children had a normal weight-for-height and the adults had an average BMI of more than 18.5 kg/m2 (James *et al.,* 1999).

In a study by Saito et al. (1997) in Tamil Nadu, India amongst children younger than four years old, poor nutritional status was directly associated with the gender of the child (Saito *et al.,* 1997). However, this study showed that (**Table 4.4)** more than a half (55.7%) of the malnourished children were females while the males/boys accounted for only 44.3%. This was in contrast with a study in Machakel Woreda, Northwest Ethiopia where malnutrition was high among males (52.94%) compared to females (47.06) %) (Bantamen *et al.,* 2014). In most studies more males are malnourished. A study in Nairobi, Kenya, found that in the malnourished group of children three to 36 months old, 51.2% were males and 48.8% were female (Abate *et al*., 2001).

This study specifically looked at children 0 to 59 months old and found that 66.4% of the malnourished children had an average age of 6-12 months followed by those aged between 13 and 24 months (18.0%) (**Table 4.4**). This study also revealed that there there was as a significant association between nutritional diagnosis and age of the child with P-value = 0.001 (**Table 4.4**). Cartmell et al. (2005) looked at children (six months to five years old) admitted to the malnutrition ward in the Central Hospital of Maputo in 1983 and again in 2001 and found an average age of 23.8 months in 1983 and 21.7 months in 2001 (Cartmell *et al.,* 2005)**.** Kleynhans et al. (2006) investigated the nutritional status of children 12 to 24 months old in Limpopo in rural villages and urban informal settlement areas and found a mean age of 18.63 months in malnourished children. A study conducted in Nigeria showed that the most common age groups with PEM were 6 to 12 months (55.7%) followed by 13 to 24 months (36.8%) and the lower household socio-economic class was found to be significantly associated with mortality of child malnutrition (Ubesie *et al*., 2012). A study done in

Kenya, the mean age was 29.5 months in 1993, 28.3 months in 1998 months, 27.8 months in 2003, and 28.7 months in 2008-09. (Masibo, 2013). If these children are not given special care in diet and are not treated for severe infections, they have a higher chance to develop malnutrition compared to children of other age group.

In this study, the findings indicate that only 17.2% of the malnourished children were born prematurely (**Table 4.4)**. This is in agreement with a similar study undertaken by Enweronu-Laryea et al., (2012) amongst infants younger than six months old, which reported that only 36.4% of the malnourished children were born prematurely.

More than 30 million children are unimmunized either because vaccines are unavailable, because health services are poorly provided or inaccessible, or because families are uninformed or misinformed about when and why to bring their children for immunization. Pneumonia, diarrhoea, malaria, measles, HIV/AIDS and malnutrition are the primary killers of children in the developing world. These children die because they are poor, they do not have access to routine immunization or health services, their diets lack sufficient vitamin A and other essential micronutrients, and they live in circumstances that allow pathogens (disease-causing organisms) to thrive (UNICEF, 2015b**)**. In this study (**Table 4.4**), 70.3% of the children under study were immunized up to-date and only 29.7% had their immunization schedules not up to-date. This shows that over two-thirds of the children admitted to the nutrition ward of SOS hospital were immunized. In Ethiopia 80.2% of children three to 36 months old were fully immunized and the proportion of malnourished children that were fully immunized for age was not significantly different from that of well-nourished children (77.6%) (Abate *et al.,* 2001).

Vitamin A is necessary for a well functioning immune system and a deficiency can cause high risk of mortality. In 2008, 71% of 6-59 month old children were protected against a deficiency because of the two doses they received twice per year through the vitamin A supplementation programme. In 2008, 22 of the 34 least developed countries passed the 80% coverage rate. The coverage doubled from 41% in 2000 to 88% in 2008 (UNICEF, 2009a). In this study, 66.9% of the malnourished children

had their vitamin A supplementation up to-date with only 33.1% who had their vitamin A supplementation not up to-date at the time of interview (**Table 4.4**). This study further revealed that there is a significant asscociation between malnutrition and vitamin A supplementation with P-value = 0.048 (**Table 4.4**). In a study undertaken in an informal settlement in Durban, South Africa by Coutsoudis et al. (1993) amongst children three months to six years, the preschool children presented with low vitamin A status in 44% of the group. Five percent 5% had a vitamin A deficiency (Coutsoudis *et al.*, 1993). A study undertaken by Ferraz et al. (2005) in Brazil amongst children older than 24 months and younger than 72 months found that 75% of this age group were still deficient in vitamin A (Ferraz *et al.*, 2005).

According to UNICEF (2009), less than 40% of infants in the developing world receive immediate breastfeeding after birth. Only 39% of babies are put to the breast one hour after birth despite the fact that early initiation of breastfeeding can contribute to reduced neonatal mortality through skin-to-skin contact that can prevent hypothermia (UNICEF, 2009a). In study in Ethiopia, researchers found that 57.84% of mother's cases were squeeze out their first breast milk whereas 42.16% of mothers cases were not squeeze out their first breast milk (Bantamen *et al.*, 2014). Similarly, this study showed that a proportion slightly above average (56.8%) of the total children had been breastfed while 43.2% were not breastfed (**Table 4.4**).

It is evident that breastfeeding reduces the risk of a child suffering from all the malnutrition conditions as only 5.5% of the admitted children were breastfed up to 13 – 24 months and the age up-to which the child was breastfed was significantly associated with malnutrition with P-value = 0.001 (**Table 4.4)**. According to a study undertaken in Brazil on children admitted to hospital, 19.2% of mothers never breastfed and 49.5% of children were breastfed for less than two months (Falbo and Alves, 2002). Over the last ten to fifteen years exclusive breastfeeding increased in Africa from 33% in 1995 to 38% in 2008 (UNICEF, 2009a). In a study undertaken in Malawi, infants were followed up from birth to twelve months and only 13.3% of mothers exclusively breastfed their children (Kalanda, 2006). A study in Ethiopia amongst children younger than five years old showed a positive association between

malnutrition and prolonged breastfeeding (Getaneh *et al.,* 1998) and a study undertaken in Kampala amongst children zero to 60 months showed a positive association between malnutrition and lack of breastfeeding (Owor *et al.,* 2000).

Mothers that were not breastfeeding at the time of the interview, majority of their children (**56.6%)** were fed on formula milk, followed by **35%** of the children were fed on cow's milk while the remaining **8.4%** were fed on other milk types other than formula and cow's milk such as Goat's milk, camel's milk and Nido. This study also revealed a significant association between malnutrition and the type of milk the baby is fed particularly Cow's milk with P-value = 0.012 (**Table 4.4**). In this study, majority of the children (60%) were fed using a cup while only 40.0% were fed using a feeding bottle (**Table 4.4)**. According to a study in Bangladesh amongst babies six to 60 months old, 48.3 % of babies received milk via a bottle and only 7% were breastfed (Iqbal *et al.,* 1999).

In this study**,** 59.2% of the breastfed malnourished children (n=218), were introduced to solid foods at the age between 7 and 12 months. 29.8% of the breastfed malnourished children were introduce to solid foods before the age of 6 months while only 11.0% of the children had solid foods introduced at the age between 13 and 24 months (**Table 4.4**).

According to the number of meals the child had per day, this study revealed that (**Table 4.4)** majority of the malnourished children (73.7%) were subjected to not more than three meals per day.

Because of low immunity, malnourished children suffer from many symptoms; in this study **(Table 4.5**), fever, cough, diarrhea and the child's failure to gain weight were the major history of current illnesses among the children with proportions of 71.6%, 63.8%, 44.8% and 38.3% respectively. Majority (70.0%) of the malnourished children studied had no history of any known chronic disease. Only 7.6% and 7% of the total children studied had history of congenital heart diseases and PTB, respectively with previous hospital admissions of 43.5% of the total malnourished children. According to who referred the child to the hospital, the study revealed that

only 53.8% of the total malnourished children admitted to SOS hospital were referred by known medical practitioners of which 41.1%, 9.6% and 3.1% were referred by a doctor, nurse and dietitian respectively. However, other people other than the nurse, doctor or dietitian referred the remaining proportion of admissions, 46.2%.

Birth weight is a predictor of malnutrition (Kleynhans *et al.,* 2006) and there is a direct link between maternal and child nutrition (Teller and Yimar, 2000). In a study done by Falbo and Alves (2002), the median birth weight of children was 2.80kg. The study was done in Brazil between 1999 and 2000, 88.9% of the children with severe malnutrition were younger than six months, and 42.4% had low birth weights **(**Falbo and Alves, 2002). A study done by Ramakrishnan (2004) found that the prevalence of low birth weight babies was 10% for Sub-Saharan Africa, but this is not very reliable, as two thirds of births in Africa are never reported. In India, low birth weight is related to maternal nutritional factors such as energy and protein intake during pregnancy and the weight of the mother before she got pregnant (Ramakrishnan, 2004). Gupta (2008) found that low birth weight babies had a higher risk of developing feeding problems and malnutrition (Gupta, 2008). In a study done in Limpopo, South Africa most children twelve to 24 months old that had a birth weight of less than 2.5kg, were more likely to develop stunting. About 25% of the stunted children weighed less than 2.5kg at birth (Kleynhans *et al.,* 2006).

In this study, the birth weight of the malnourished children ranged between 1.2 and 4kg with a median birth weight of 2.5kg. Thirty one percent (31%) of the children had a birth weight of less or equal to 2.5kg (**Table 4.6)**. The results of this study further revealed that the current weight ranged between 1.6 and 15kg with a median current weight of 6.5kg (**Table 4.6**) while the height/length of the children ranged between 45 and 114cm, with the median height of 66 cm (**Table 4.6**). In a study done in Limpopo, South Africa, children were followed from birth up to three years of age and results showed that when a child has a greater height at one year it protects the child against stunting. Normal length and weight at one year are very important as

this can predict the nutritional status of the child at three years of age (Mamabola *et al.,* 2005).

With the interpretation of the MUAC in this study (**Table 4.7**), majority of the children (61.2%) had an MUAC ranging between 11.0 –12.5cm meaning that 61.2% of the children had moderate malnutrition. This was followed by 25.8% of the children who were severely malnourished (MUAC less than 11cm) and only 2.9% of the children had mild malnutrition based on the MUAC.

In a study done in Kenya on children twelve to 59 months, the clinical features associated with malnutrition were significantly more common in children that had a MUAC of less or equal to 11.5cm (Berkley *et al.,* 2005). Kikafunda et al. (1998) found that 21.6% of Ugandan children zero to 30 months old had a MUAC lower than 13.5 cm. The risk factors for low MUAC were poor health, lack of meat and cow's milk consumption, low energy through fat, mothers with low educational levels and older mothers (Kikafunda *et al.,* 1998).

5.1.3 Comorbidities associated with malnourished children

Malnutrition weakens immunity thus child becomes susceptible to many infectious agents; in this study (**Table 4.8**), bronchopneumonia, diarrhea, malaria and measles were the most prevalent comorbidities (diseases/conditions) among the malnourished children admitted to SOS hospital with a proportion of 62.2%, 55.5%, 33.1% and 24.2% respectively. This is followed by severe anaemia, chronic suppurative otitis media and urinary tract infection with a proportion of 16.9%, 13.5% and 12% respectively, while TB, Sepsis and HIV were the least prevalent with proportions of 4.7%, 4.4% and 0.8% respectively. However, 12.2% of the malnourished children had different conditions other than those mentioned.

Urinary tract infection was diagnosed in 12.0% of malnourished children and there was a significant relationship between UTI and malnutrition as exhibited by the P-value of of 0.032 which was significant at 5% level of confidence (**Table 4.8**).

A study done in Dhaka, Bangladesh reported the prevalence of pneumonia in children with hypoxia and severe malnutrition to be 11% , which was lower compared with our study which reported all cases of pneumonia and not considering whether the child had hypoxia or not (Christi *et al.,* 2013). In this study, a high proportion of malnourished children **(**62.2%) had bronchopneumonia with a P-value of 0.007 which was significant at 5% level of confidence indicating a significant and positive relationship between malnutrition and bronchopneumonia (**Table 4.8**).

Children who are malnourished, or have impaired immunity as well as people living with HIV are most at risk of life-threatening diarrhea. Children who die from diarrhea often suffer from underlying malnutrition, which makes them more vulnerable to diarrhea. Each diarrheal episode, in turn, makes their malnutrition even worse. Diarrhea is a leading cause of malnutrition in children under five years old (WHO, 2013a). In this study, diarrhea was found in 55.5% of malnourished children (**Table 4.8**).

A study done in Kenya on malaria and nutritional status in children living on the coast of Kenya concluded that the effect of malaria on nutritional status appears to be greatest during the first 2 y of life (Nyakeriga *et al*., 2004). In Enungu, Nigeria they reported a higher rate of 40.0% (Ubesie *et al.,* 2012). In this study, malaria was diagnosed in 33.1% of malnutrition cases and it was significantly associated with malnutrition with a P-value of 0.005 which was significant at 5% level of confidence (**Table 4.8**).

Measles is one of the leading causes of death among young children even though a safe and cost-effective vaccine is available. In 2014, there were 114 900 measles deaths globally – about 314 deaths every day or 13 deaths every hour. Measles vaccination resulted in a 79% drop in measles deaths between 2000 and 2014 worldwide. In 2014, about 85% of the world's children received one dose of measles vaccine by their first birthday through routine health services – up from 73% in 2000. During 2000-2014, measles vaccination prevented an estimated 17.1 million deaths making measles vaccine one of the best buys in public health (WHO, 2016).

Measles is an important acute childhood viral infection having severe consequences on the nutritional status. The adverse nutritional effects of measles are experienced by both the well-nourished and the malnourished children. However, the severe nutritional deficiencies like kwashiorkor/marasmus are precipitated only in children who are already malnourished. As high as 3-4 per cent of children with measles suffered from these clinical nutritional syndromes in their post-measles period (Bhaskaram, 1995). In this study**,** 24.2% of cases were reported with measles infection at the time of interview and there was a significant association between measles and malnutrition with a P-value of 0.006 which was significant at 5% level of confidence (**Table 4.8**).

In this study, over 90% (90.6%) of the malnourished children who had comorbidities were on treatment while only 9.4% were not under treatment (**Figure 4.1)**. As regards the type of treatment received, results indicate that about 84% of the patients were receiving antibiotics, followed by 18.2%, 4.7% and 3.1% of the children who were on antimalarial therapy, anti TB therapy and blood transfusion respectively (**Table 4.9**).

5.2 Conclusions

5.2.1 Socio-demographic factors associated with malnourished children

Majority of the children caregivers were female and below the age of 35 years. The illiteracy status was high among caregivers with low household income. Household size was directly linked to a child becoming malnourished with a household of more than three people being at higher risk and males headed most households.

5.2.2 Maternal and child factors associated with malnourished children

Counselling of the mother on healthy eating was significantly associated/related to malnutrition diagnosis of the children under five years in our setting. Over two-thirds of the children's mothers had more than 4 live births. The child's malnutrition

chances increased as the child's birth order increased with most children included in this study coming from homes with a high birth order (fourth or more).

In our setting, malnutrition is more prevalent in children between six to 12 months of age and significantly, more boys than girls in this study presented with malnutrition. Vitamin A supplementation schedule up-to date reduced the risk of child malnutrition.

There was a strong and significant relationship between breastfeeding particularly the age up-to when a child was breastfed and the malnutrition diagnosis. Even if the child was not breastfed, the type of milk the baby is fed on particularly cow's milk was significantly linked with malnutrition. Marasmus and underweight were the most prevalent nutritional diagonsis among the children admitted to our setting. Obese, overweight or underweight mothers have a higher chance of having malnourished children.

5.2.3 Comorbidities associated with malnourished children

Urinary tract infection, bronchopneumonia, measles and malaria were the most prevalent comorbidities among the malnourished children admitted to SOS hospital. Of those with comorbidities, majority were on treatment in the form of antibiotics, antimalarial therapy, anti TB therapy and blood transfusion.

5.3 Recommendations

(a) Caregivers need to improve their poor household income through creating a good daily income source for them.

(b) Encouraging mothers to practice birth control methods to regulate their birth rates and thus large household size.

(c) Community-based counseling of the mother/caregiver on healthy eating and food fortification should be established and implemented at all community levels.

(d) Supplementation of vitamins particularly vitamin A and other essential vitamins should be offered to all under five children.

(e) Encouraging mothers to breastfed their children particularly first 6 months and avoiding Cow's milk supplementation to their babies in the first year.

(f) Early detection and treatment of infections in under five children like urinary tract infection, bronchopneumonia, measles and malaria.

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APPENDICES

Appendix I: Map of Study Area

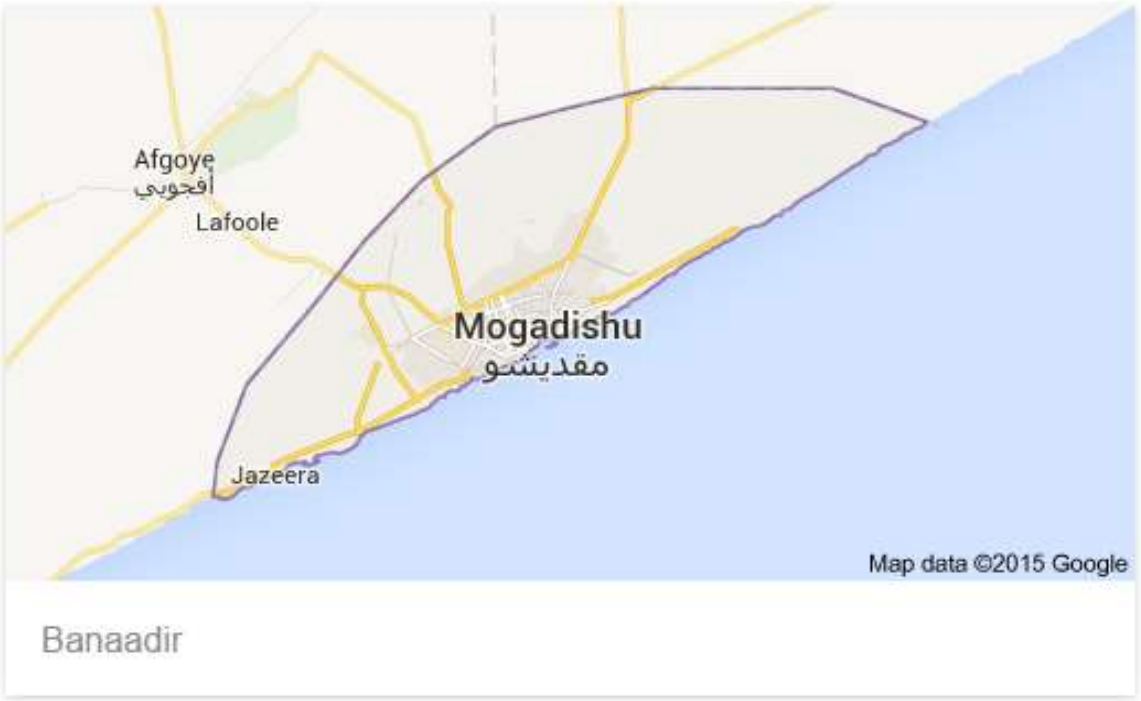


Figure 5. Map of study area

Appendix II: Child's Medical History and Physical Examination

Checklist of points for taking the child's medical history and conducting the physical examination (WHO, 2019)

Medical history:

• Usual diet before current episode of illness
• Breastfeeding history
• Food and fluids taken in past few days
• Recent sinking of eyes
• Duration and frequency of vomiting or diarrhoea, appearance of vomit or diarrhoeal stools
• Time when urine was last passed
• Contact with people with measles or tuberculosis
• Any deaths of siblings
• Birth weight
• Milestones reached (sitting up, standing, etc.)
• Immunizations

Physical examination:

• Weight and length or height
• Oedema
• Enlargement or tenderness of liver, jaundice
• Abdominal distension, bowel sounds, "abdominal splash" (a splashing sound in the abdomen)
• Severe pallor
• Signs of circulatory collapse: cold hands and feet, weak radial pulse, diminished consciousness
• Temperature: hypothermia or fever
• Thirst
• Eyes: corneal lesions indicative of vitamin A deficiency
• Ears, mouth, throat: evidence of infection
• Skin: evidence of infection or purpura
• Respiratory rate and type of respiration: signs of pneumonia or heart failure
• Appearance of faeces

Appendix III: Laboratory Tests in Malnutrition

Table 5 Laboratory Tests in Malnutrition

Test	Result and significance
Tests that may be useful	
Blood glucose	Glucose concentration <54 mg/dl (3 mmol/l) is indicative of hypoglycaemia
Examination of blood smear by microscopy	Presence of malaria parasites is indicative of infection
Haemoglobin or packed-cell volume	Haemoglobin <40g/l or packed-cell volume <12% is indicative of very severe anaemia
Examination and culture of urine specimen	Presence of bacteria on microscopy (or >10 leukocytes per high-power field) is indicative of infection
Examination of faeces by microscopy	Presence of blood is indicative of dysentery Presence of Giardia cysts or trophozoites is indicativeof infection
Chest X-ray	Pneumonia causes less shadowing of the lungs in malnourished children than in well-nourished children Vascular engorgement is indicative of heart failure Bones may show rickets or fractures of the ribs
Skin test for tuberculosis	Often negative in children with tuberculosis or thosepreviously vaccinated with BCG vaccine
Tests that are of little or no value	
Serum proteins	Not useful in management, but may guide prognosis
Test for human immunodeficiency virus (HIV)	Should not be done routinely; if done, should be accompanied by counselling of the child's parents and result should be confidential
Electrolytes	Rarely helpful and may lead to inappropriate therapy

Source: (WHO, 2019**)**

Appendix IV: WHO guidelines for treatment of moderate and severe acute malnutrition

(the '10 Steps')

There are ten essential steps:

1. Treat/prevent hypoglycaemia

2. Treat/prevent hypothermia

3. Treat/prevent dehydration

4. Correct electrolyte imbalance

5. Treat/prevent infection

6. Correct micronutrient deficiencies

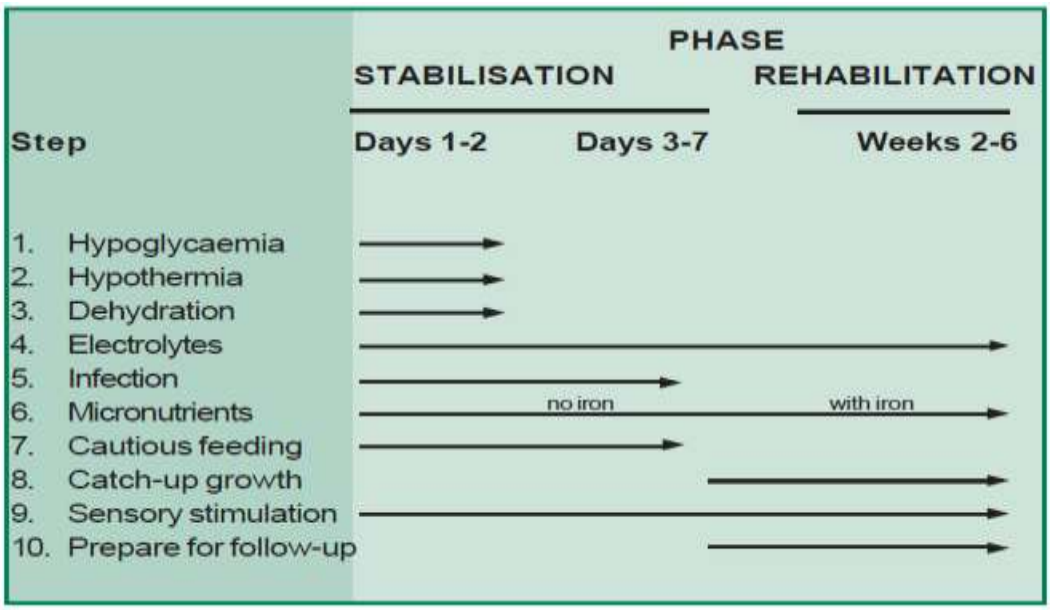
7. Start cautious feeding

8. Achieve catch-up growth

9. Provide sensory stimulation and emotional support

10. Prepare for follow-up after recovery

These steps are accomplished in two phases: an initial **stabilisation phase** where the acute medical conditions are managed; and a longer **rehabilitation phase**. Note that treatment procedures are similar for marasmus and kwashiorkor. The approximate time-scale is given in the box below:


PHASE
STABILISATION
REHABILITATION
Step
Days 1-2
Days 3-7
Weeks 2-6
1. Hypoglycaemia
2. Hypothermia
3. Dehydration
4. Electrolytes
5. Infection
6. Micronutrients
no iron
with iron
7. Cautious feeding
8. Catch-up growth
9. Sensory stimulation
10. Prepare for follow-up

Appendix V: Consent to Participate in the Study

This is an academic research being conducted by a student from Jomo Kenyatta University of Agriculture & Technology.You are requested to participate in the research by answering the questionnaire through the research assistants. Your participation is voluntary and you have free to withdraw at any time if you may feel so and there is no victimization for any withdrawal. All information you have provided will be handled with security and confidentiality and feedback will be given to the institution for communication of study findings.

Research participant information

1. Explanation of Research

Research is done to carry out a study on malnutrition amd comorbidities among children under five years in SOS Hospital in Mogadishu. You are being asked to participate in the study. You must be a mother/caregiver to take part in the study. You need to answer the questionnaire with the help of research assistant to enable the placing of a tick on the right choices according to your understanding.

2. Right to participation

Participation in the research study is voluntary, and you have a right not to take part in the study by saying No. In case you opt to say yes in taking part in the study, you have a right to withdraw at any stage of the study if you wish to do so, and refusal to participate will involve no penalty. Efforts will be made to keep personal information confidential.

3. No cost except your time on answering the questionnaire. No compensation of whatever kind will be given to study respondents.
4. Contact information for questions and concerns in relation to study you are free to do so through research assistants.
5. Research assistants will help you when necessary.

6. There are no risks or hazards involved in taking part in this research study. The measurements that are going to be taken are not harmful in any way to you or your child and will only be done once. The measurements that are going to be taken are height, weight and mid-upper arm circumference.

Declaration of consent to participate in the research

You have been asked for your child to participate in a research study.

You have been informed about the study by research assistant.

You may contact research assistant at any time if you have questions about the research.

Your child's participation in this research is confidential, voluntary, and you will not be penalized if you refuse for your child to participate or decide to terminate participation.

The research study, including the above information has been verbally described to me. I understand what my child's involvement in the study means and I voluntarily agree for my child to participate.

_____ _____

Signature of Mother / Caregiver Date

Appendix VI : Questionnaire

Dear Respondent,

This is a research being carried out by S**aid Mohamed Nor,** a student pursuing degree of Masters in Public Health, Jomo Kenyatta University. The research is being carried out on: **MALNUTRITION AND COMORBIDITIES AMONG CHILDREN UNDER FIVE YEARS IN SOS HOSPITAL, MOGADISHU.**

Your responses are kindly required and needed to complete these questions. I do therefore declare you that the information you give will be treated with highest confidentiality.

Questionnaire number (leave open) _____

Date of admission _____

Name of interviewer _____

SECTIONA: SOCIO-DEMOGRAPHIC CHARACTERISTICS FOR THE CAREGIVERS

1. Mother's / caregivers Age (years)

   19-25yr ☐ 26 – 34 yr ☐ 35 – 44 yr ☐ More than 44yr ☐

2. What is gender of the caregiver?
   Male ☐ Female ☐
3. What is the marital status of the mother?
   Single ☐ Married ☐ Divorced ☐ Widowed ☐ others (specify) ☐ ___
4. What is the level of education of the mother?
   Cannot read and write ☐ Literate ☐
5. What is the level of education of the father?
   Cannot read and write ☐ Literate ☐
6. What is the occupation of the mother?
   Merchant ☐ Housewife ☐ Employ ☐
7. What are the sources of income in the household?

i.	Salary/ Wage	Yes ☐	No ☐
ii.	Old Age Pension	Yes ☐	No ☐
iii.	Disability Grant	Yes ☐	No ☐

iv. Child Support Grant Yes ☐ No ☐
v. Other (please state) Yes ☐ No ☐

8. What is the level of income per day in the household?
0-5 $ per day ☐ 6-10$ per day ☐ More than 10$ per day ☐
9. What is the household size?

Less than three ☐ Greater than three ☐
10. Who is the head of the household?

Male ☐ Female ☐

11. Where is the location of residence of the family?
IDPs ☐ Far major towns ☐ Near major towns ☐
12. What is the type of the house?
Ticuna ☐ Corrugated iron sheet ☐ other (specify) ☐_____
13. How many rooms (except the bathroom) in the house are used for sleeping?
1-2 rooms ☐ 3-4 rooms ☐ more than 4 rooms ☐
14. What is the source of drinking water?
Unprotected ☐ Protected ☐
15. What about hand-washing practice of the caregiver?

i. After use latrine Yes ☐ No ☐
ii. Before food preparation Yes ☐ No ☐
iii. After cleaning child Yes ☐ No ☐
iv. Mostly after lunch Yes ☐ No ☐
v. All Yes ☐ No ☐

16. How does the caregiver wash his/her hands?

Only with water ☐ sometimes with soap ☐ always with soap ☐

SECTION B: MATERNAL AND CHILD FACTORS ASSOCIATED WITH MALNUTRITION

17. a. Mother's / caregivers Weight (kg)

Less than 40 ☐ 40-60 ☐ More than 60 ☐

b. Mother's / caregivers Height (m)

Less than 1.40 m ☐ 1.40-1.60 m ☐ More than 1.60 m ☐

18. Is the mother still alive?

Yes ☐ No ☐

19. With whom is the child staying most of the time?

Parent /parents ☐ Grandparent / grandparents ☐ Aunt / uncle ☐
Other family ☐ Other (specify) ☐ _____

20. Has the mother/ caregiver received counselling on the following topics? (More than one option can be marked)

i.	Diarrhea	Yes ☐	No ☐
ii.	Healthy eating	Yes ☐	No ☐
iii.	Breastfeeding	Yes ☐	No ☐
iv.	Complementary feeding	Yes ☐	No ☐
v.	Food fortification	Yes ☐	No ☐
vi.	Growth Chart	Yes ☐	No ☐
vii.	Hygiene	Yes ☐	No ☐
viii.	Other	Yes ☐	No ☐

21. Does the mother/ caregiver or any other person in the household has TB?

Yes ☐ No ☐

22. Is / was the mother / caregiver on any of the following treatment?

i.	Anti TB therapy	Yes ☐	No ☐
ii.	Antimalarial therapy	Yes ☐	No ☐
iii.	None	Yes ☐	No ☐
iv.	Other (specify)	Yes ☐	No ☐

23. Did the mother attend the Ante- Natal Clinic when she was pregnant with this child?

Yes ☐ No ☐ Do not know ☐

24. Did the mother consume the following during pregnancy?

i.	Alcohol	Yes ☐	No ☐
ii.	Cigarette smoking	Yes ☐	No ☐
iii.	Khat	Yes ☐	No ☐
iv.	None	Yes ☐	No ☐
v.	Other (specify)	Yes ☐	No ☐

25. Where was the child born?

Hospital ☐ Clinic ☐ Community Health Centre ☐ Home ☐

Other, please specify ☐ _____

26. How regularly is the child taken to the hospital after birth?

Weekly ☐ Monthly ☐ None ☐ other, please specify ☐ _____

27. Number of live births to the child's mother including this child

1-3 ☐ 4-6 ☐ 7-9 ☐ More than 9 ☐

28. Is this child the

1st child ☐ 2nd child ☐ 3rd child ☐ 4th child ☐

Other (specify) ☐ _____

29. Age of child

0- 6 months ☐ 6-12 months ☐ 13-24 months ☐ 24-59 months ☐

30. Gender of child

Male ☐ Female ☐

31. Birth weight of the child (grams):

Very low birth weight (< 1500g) ☐ Low birth weight (1500-2500g) ☐

Normal birth weight (2500-4000g) ☐

32. Was the child born prematurely?

Yes ☐ No ☐

33. Has your child been immunized up to date?

Yes ☐ No ☐

34. Is the child's Vitamin A supplementation up to date?

Yes ☐ No ☐

35. Has the child been breastfed?

Yes ☐ No ☐

If NO, skip to Part (B) or if YES, only do Part (A) and continue at Q 36.

35.1 (A) To what age?

1-6 months ☐ 7-12 months ☐ 13-24 months ☐

35.4 (B) What milk did the child drink, if not breastfed?

Formula Milk ☐ Cow's Milk ☐ Other please specify ☐ _____

35.5 How was the milk fed to the baby?

Bottle ☐ Cup ☐ Spoon ☐

36. At what age did the mother introduce solid foods?

1-6 months ☐ 7-12 months ☐ 13-24 months ☐

37. Number of meals per day

< Three ☐ Three ☐ > Three ☐

38. Patient's History of current illness (More than one option can be marked)

i. Fever Yes ☐ No ☐

ii.	Cough	Yes ☐	No ☐
iii.	Diarrhroea	Yes ☐	No ☐
iv.	Failure to gain weight	Yes ☐	No ☐
v.	Generalized body swelling	Yes ☐	No ☐
vi.	Seizures	Yes ☐	No ☐
vii.	Oral thrush	Yes ☐	No ☐
viii.	Other (specify)	Yes ☐	No ☐

39. Patient's History of known chronic diseases (More than one option can be marked)

i.	PTB	Yes ☐	No ☐
ii.	Congenital heart disease	Yes ☐	No ☐
iii.	None	Yes ☐	No ☐
iv.	Others (specify)	Yes ☐	No ☐

40. Was this child previously admitted to hospital?
Yes ☐ No ☐

41. Who referred child to the hospital?
Nurse ☐ Doctor ☐ Dietitian ☐ Other (specify) ☐ _____

42. Current Weight (kg) Measured ( ) ☐ Not measured ☐

43. Length/Height (cm) Measured ( ) ☐ Not measured ☐

44. MUAC (mm)
12.5-13.5 ☐ 11.0-12.5 ☐ < 11 ☐ MUAC not measured ☐

45. Z score
-1.1 to -2 ☐ -2.1 to -3 ☐ < -3 ☐ Z score not measured ☐

46. Edema in lower limbs
Yes ☐ No ☐

47. What is the nutritional diagnosis of the child at time of admission (as indicated in patient's file)?
Underweight ☐ Marasmus ☐ Kwashiorkor ☐ Marasmic-Kwashiorkor ☐
Unclassified ☐

SECTION C: COMORBIDITIES ASSOCIATED WITH MALNUTRITION

48. Does this child has currently the following conditions? (As indicated in patient's file. More than one option can be marked)

i.	Urinary tract infection	Yes ☐	No ☐
ii.	Chronic suppurative otitis media	Yes ☐	No ☐
iii.	Bronchopneumonia	Yes ☐	No ☐

iv.	Sepsis	Yes ☐	No ☐
v.	TB	Yes ☐	No ☐
vi.	Measles	Yes ☐	No ☐
vii.	Malaria	Yes ☐	No ☐
viii.	Diarrhea	Yes ☐	No ☐
ix.	Severe anaemia	Yes ☐	No ☐
x.	HIV	Yes ☐	No ☐
xi.	Other (specify)	Yes ☐	No ☐

49. Does the child receive treatment for comorbidity?

Yes ☐ No ☐

50. If yes, what treatment does the child receive for comorbidity?

i.	Antibiotics	Yes ☐	No ☐
ii.	Anti TB therapy	Yes ☐	No ☐
iii.	Antimalarial therapy	Yes ☐	No ☐
iv.	Antiretroviral therapy	Yes ☐	No ☐
v.	IVF therapy	Yes ☐	No ☐
vi.	Blood transfusion	Yes ☐	No ☐
vii.	Other(specify)	Yes ☐	No ☐

Appendix VII: Application for Proposal Approval by Ethics Review committee

SAID MOHAMED NOR

TM310-C005-4675/2013

PUBLIC HEALTH DEPARTMENT

COLLEGE OF HEALTH SCIENCE

JKUAT MOMBASA CBD CAMPUS

REF: APPLICATION FOR PROPOSAL APPROVAL BY ETHICS REVIEW COMMITTEE

I, SAID NOR, a Master of Science in Public Health student in JKUAT, Mombasa CBD campus do hereby submit my research proposal for approval by Ethics Committee on the study topic "Determinants of malnutrition among children under five years in SOS Hospital, Mogadishu".

....

Signature Date

Appendix VIII: Certificate of ethical approval

NACOSTI ACCREDITED

ERC/MSc/009/2016

Pwani UNIVERSITY

ETHICS REVIEW COMMITTEE

ACCREDITTED BY THE NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION (NACOSTI, KENYA)

CERTIFICATE OF ETHICAL APPROVAL

THIS IS TO CERTIFY THAT THE PROPOSAL SUBMITTED BY:

SAID M. NOR

REFERENCE NO:
ERC/MSc/009/2016

ENTITLED:
Determinants of malnutrition among children under five years in SOS Hospital, Mogadishu

TO BE UNDERTAKEN AT:
MOGADISHU, SOMALIA

FOR THE PROPOSED PERIOD OF RESEARCH

HAS BEEN **APPROVED** BY THE ETHICS REVIEW COMMITTEE

AT ITS SITTING HELD AT PWANI UNIVERSITY, KENYA

ON THE **8th DAY OF APRIL 2016**

CHAIRMAN SECRETARY LAY MEMBER

PTO

NOTICE:

This decision is subject to the information available at the time of APPROVAL. The Committee may on its own motion and/or by application by a Party, review its decision on the grounds of discovery of new and important information which was not reasonably within its knowledge at the time of decision or on account of mistake or error apparent on the face of the record, or for any other sufficient reason, provided the researcher shall be given prior opportunity to be heard.

Appendix IX: Permission request to conduct a pilot study at Banadir Hospital

TO: Dr. LUL MOHAMOUD MOHAMED, Head of Pediatric Department at Banadir Hospital

CC: Prof. Dr. ABDIRAZAK HASSAN ALI, Banadir Hospital Director

SUBJECT: Permission request to conduct a pilot study at Banadir Hospital

I, SAID NOR, a Master of Science in Public Health student in JKUAT, Mombasa CBD campus do hereby request permission to conduct a pilot study at your institution, Banadir Hospital. The study is entitled "Determinants of malnutrition among children under five years in SOS Hospital, Mogadishu". Please see the enclosed copy of the ethical approval certificate from the ethics review committee (ERC). I hope that the hospital administration will allow me to take a sample of 20 malnourished children under five years from the Hospital to complete a 6-page questionnaire (copy enclosed) after taking consent from their parents/caregivers.

If you need any more information, you can contact Said M. Nor, the researcher, at:

Cellphone: 0617002627

E-mail: tashte@gmail.com

COMPILED BY: SAID NOR

_____ _____

Signature Date

Appendix X: Approval Letter for conducting a pilot study at Banadir Hospital

Banadir Hospital
Ministry of Health
Mogadishu-Somalia

مستشفى بنادر
وزارة الصحة
مقديشو- صوماليه

Ref: BH/0022/06/16

Date: April 10, 2016

TO: Dr. Said Mohamed Nor, Researcher
Cc: Dr Abdirizak H. Ali, Director
Re: Request for Conducting Research

The management of the hospital hereby grants Dr Said Mohamed Nor to conduct a research titled

DETERMINANTS OF MAL-NUTRITION AMONG CHILDREN UNDER 5 YEARS IN SOS HOSPITAL.

The doctor would conduct a pilot study in the Banadir Hospital Pediatrics Department. We therefore accepted the doctor's request to conduct the research in our department.

Regards

Dr Lul Mohamud Mohamed
Pediatrics Head
Banadir Hospital

JAMHURIYADDA SOMALIA WASAARADDA CAAFIMAADKA BANADIR HOSPITAL

Website: www.banadirhospital.com E-mail: ADMIN@banadirhospital.com
Contacts: +252-612253333 Or +252-618035555

Appendix XI: Permission request to conduct a study at SOS Hospital

TO: Dr. MOHAMED DAKANE, SOS Hospital Manager

SUBJECT: Permission request to conduct a study at SOS Hospital

I am writing to request permission to conduct a research study at your institution, SOS Hospital. I am currently enrolled in MSc. in Public Health at Jomo Kenyatta University of Agriculture and

Technology, and am in the process of writing my Master's Thesis. The study is entitled "Determinants of malnutrition among children under five years in SOS Hospital in Mogadishu". Here, a copy of the ethical approval certificate from the ethics review committee (ERC) is enclosed.

I hope that the hospital administration will allow me to recruit 384 malnourished children under five years from the Hospital to complete a 6-page questionnaire (copy enclosed) after taking a consent from their parents/caregivers.

If you need any more information, you can contact Said M. Nor, the researcher, at:

Cellphone: 0617002627

E-mail: tashte@gmail.com

COMPILED BY: SAID NOR

_____ _____

Signature Date…….

Appendix XII: Approval Letter for Data Collection from SOS Mother and Child Hospital

SOS CHILDREN'S VILLAGES SOMALIA

MOGADISHU
SOS Mother Child Hospital
Wabare-ade Estate Mogadishu
+252616968685
+254720413962
Mohamed.dakane@sossomalia.org
www.sos-sk.org

REF: EPU/1/16

DR SAID NOOR,

MOGADISHU,

15th April, 2016

Dear Dr. Said;

RE: PERMISSION TO CONDUCT RESEARCH IN SOS MOTHER AND CHILD HOSPITAL.

Your letter dated 25th May 29, 2016 on the subject matter above refers.

Am delighted to inform you that your request to conduct research titled " **determinants of malnutrition among children under five years in SOS Hospital in Mogadishu"** involving 384 under five children has been approved. While undertaking the study ensure that ALL applicable ethical principles are observed to protect the rights of patients and the Hospital.

Upon completion of your research you are also expected to make presentation of your findings to SOS Hospital management since the problem under study is a common problem in our setup and also make available a copy of the final report to SOS Hospital.

Thank you

SOS CHILDREN'S VILLAGES SOMALIA
Mother and Child Clinic
Mogadishu

MOHAMED MAALIM DAKANE,

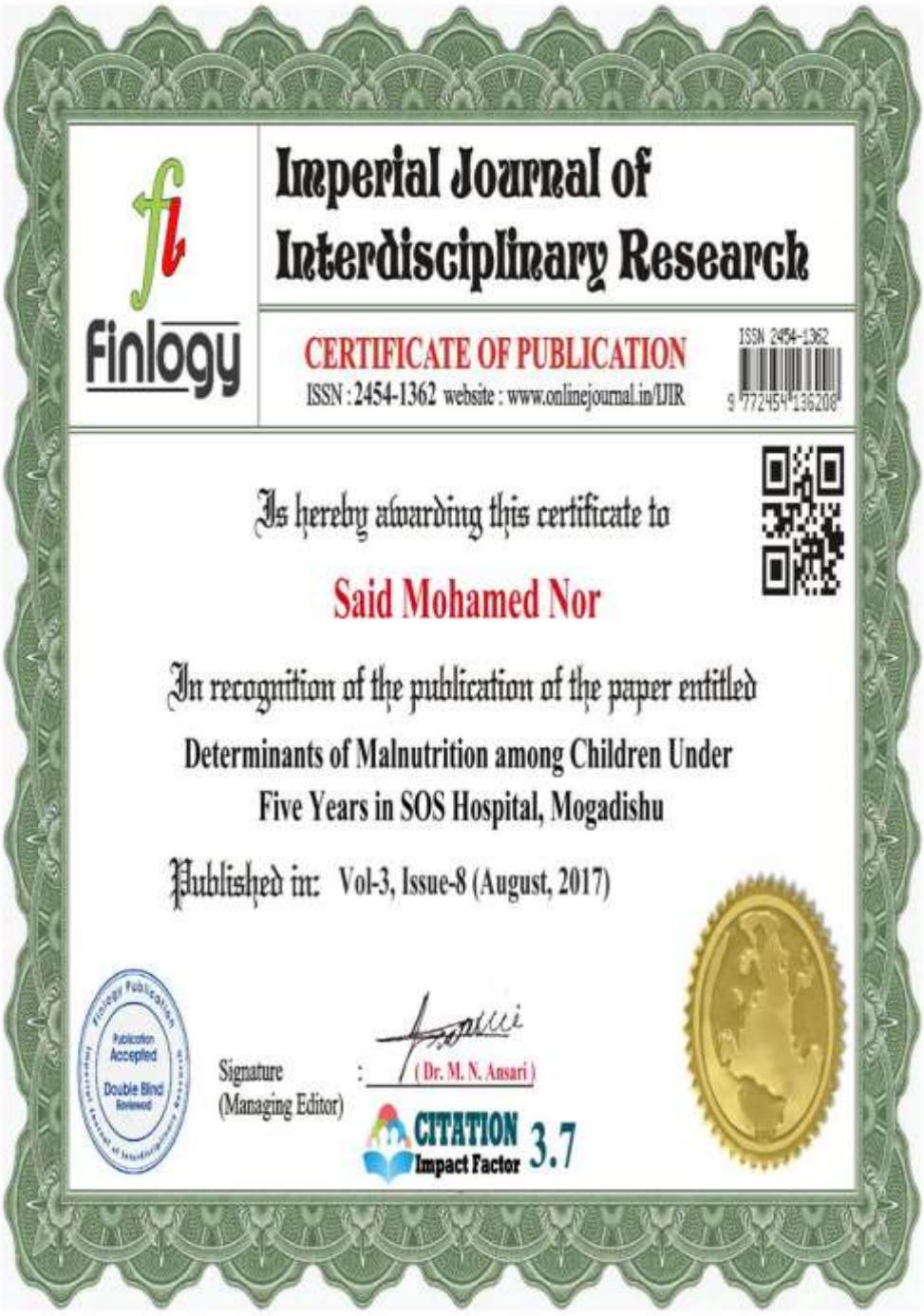
MEDICAL DIRECTOR,

SOS MOTHER AND CHILD HODPITAL

Outer Ring Road
Kenya

A loving home for every child

Appendix XIII: Approval Letter for Publication



Imperial Journal of Interdisciplinary Research

CERTIFICATE OF PUBLICATION

ISSN : 2454-1362 website : www.onlinejournal.in/IJIR

ISSN 2454-1362

Is hereby awarding this certificate to

Said Mohamed Nor

In recognition of the publication of the paper entitled

Determinants of Malnutrition among Children Under Five Years in SOS Hospital, Mogadishu

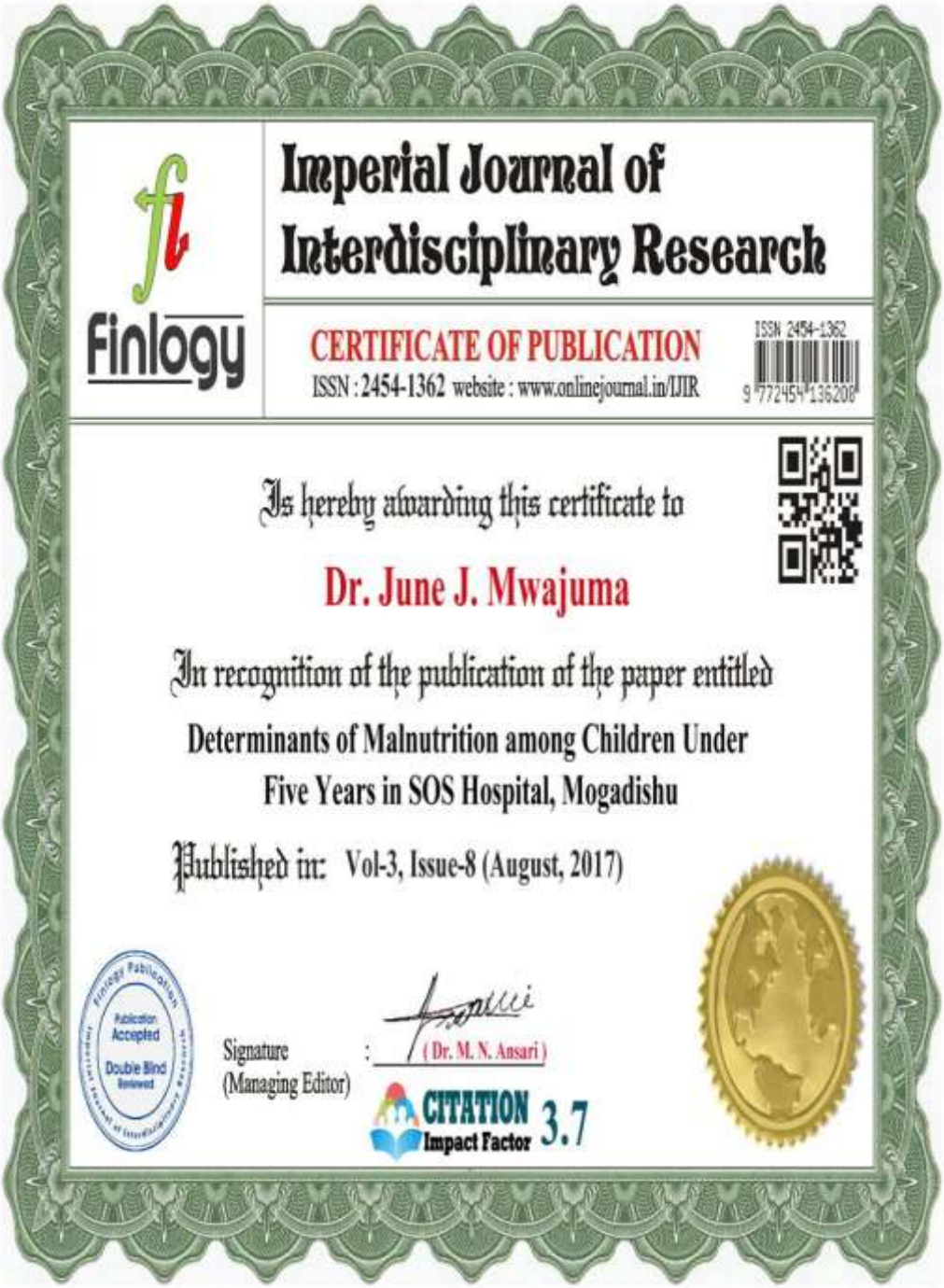
Published in: Vol-3, Issue-8 (August, 2017)

Publication Accepted Double Blind Reviewed

Signature : (Dr. M. N. Ansari)

(Managing Editor)

CITATION Impact Factor 3.7



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Is hereby awarding this certificate to

Dr. June J. Mwajuma

In recognition of the publication of the paper entitled

Determinants of Malnutrition among Children Under Five Years in SOS Hospital, Mogadishu

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(Managing Editor)

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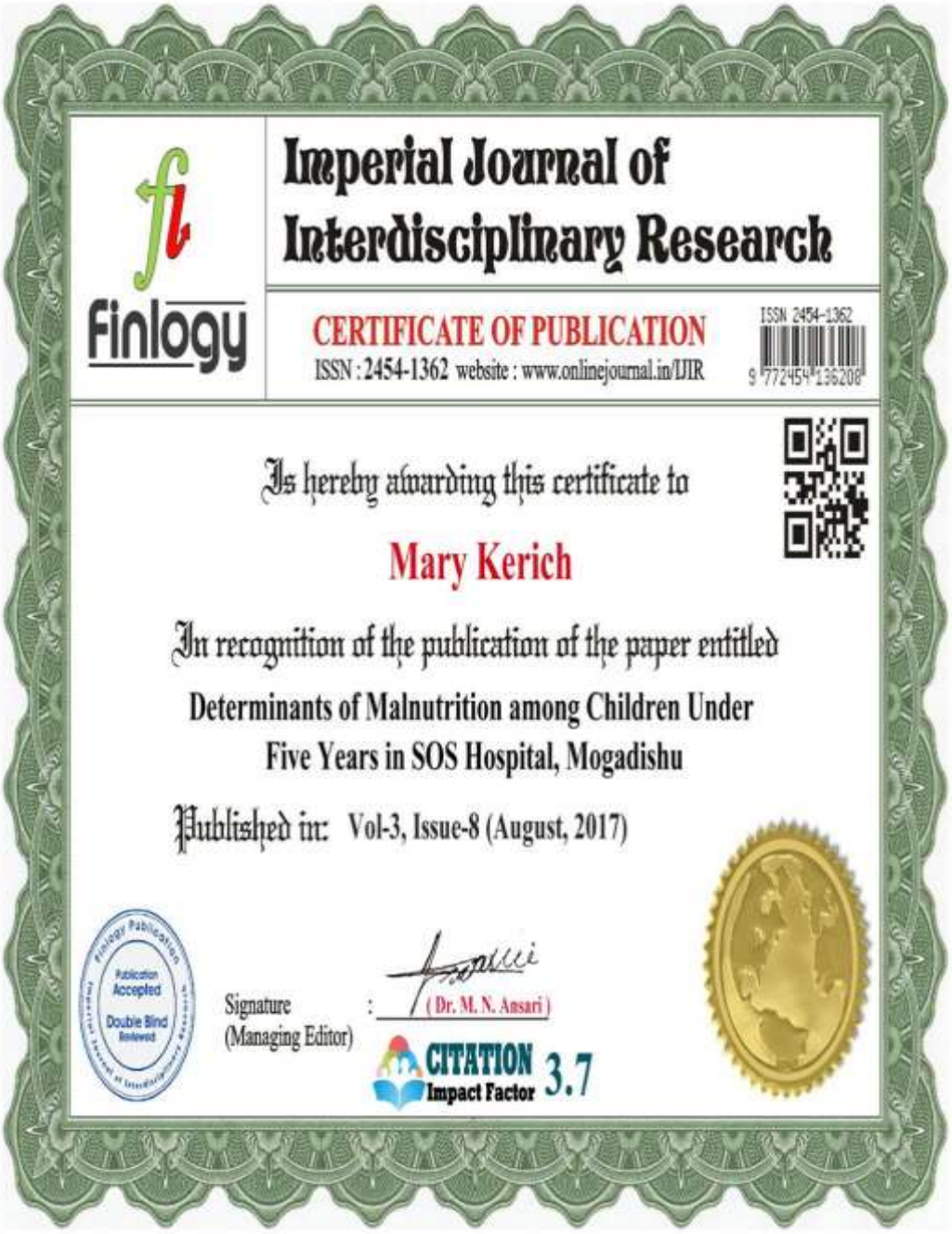

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Is hereby awarding this certificate to

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