HOUSEHOLD SOCIOECONOMIC DETERMINANTS OF NUTRITIONAL STATUS OF CHILDREN UNDER-FIVE YEARS IN FISHING COMMUNITIES IN PANGANI DISTRICT, TANZANIA

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A THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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EXTENDED ABSTRACT

Undernutrition among children under-five years old is still a public health problem in Tanzania despite the global and national efforts in combating it. The Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC) has initiated a number of projects and programmes in order to curb the problem of undernutrition in Tanzania. Despite the efforts, Tanzania has the highest rate of prevalence of undernutrition in East and Southern Africa. This study was conducted in Pangani District in Tanzania to examine the influence of household socioeconomic determinants of undernutrition among children under-five years old in fishing communities. Data were collected through a household survey of a sample of 340 mothers/care takers child-pairs in which 355 children under-five were involved in anthropometric data collection. Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) were also conducted. Content analysis was used to analyse qualitative data. Quantitative data were analysed using Statistical Package for Social Sciences (SPSS). The analysis employed Emergency Nutrition Assessment (ENA) for SMART to generate indices for weight-for-height, height-for-age and weight-for-age. A Composite Index of Anthropometric Failure (CIAF) was established to measure the rate of undernutrition. Principal Component Analysis was used to compute a wealth index based on household assets as the main indicators of household socioeconomic status (SES). Descriptive statistics and binary logistic regression were performed to estimate the influence of independent variables on the dependent variable. The findings confirm that undernutrition is still a public health problem in Pangani as indicated by higher level of stunting (27.9%) and wasting (5.1%). When CIAF was performed, undernutrition rate was higher 36.7% compared to the rate obtained in the anthropometric analysis. Further analysis based on area of residence indicated that undernutrition was higher in households on the ocean side (20.6%)

compared to those on the river side (16.1%). The difference in the level of undernutrition between the river side and the ocean side was also portrayed in the concentration curve which was then confirmed in the concentration value. Essential antenatal visits of the mother during pregnancy and child immunization status were found to be the most important predictors ($p < 0.05$) of a child wasting and underweight. Even when analysis was performed based on CIAF, immunization status was among the strongest predictors of undernutrition in Pangani. Similarly, education of the mother/child care-taker was one of the most important maternal variables that significantly ($\beta = 2.333$, Wald = 30.356, OR = 10.309, $p = 0.000$) influenced undernutrition as measured by CIAF. The availability of health services near to the communities was linked to undernutrition. The study also found more inclusiveness of undernourished children when CIAF is used in the place of traditional anthropometric analysis. It is concluded that contradictions on the influence of sex of the child on undernutrition still exist. The use of CIAF is more appropriate because it provides a comprehensive analysis of the problem of undernutrition. Despite the sensitivity of PCA in analyzing SES index, it is sufficient enough to differentiate SES quintiles and health inequalities even when the communities are very homogeneous or heterogeneous. Education of the mother is one among the important predictors of nutritional status. Therefore, it is recommended to health and education providers to focus on quality education geared at empowering mothers/caretakers. It is further recommended to use CIAF because it provides the actual nutritional status of children under-five years. Furthermore, it is recommended that the Government through the Ministry of Health, Community Development, Gender, Elderly and Children; should work closely with the service providers at district levels to ensure health services are available close to the communities. Regular follow up visits by Local Government Authorities should be done to the communities.

DECLARATION

I, Edna Harriet Mtoi, do hereby declare to the Senate of Sokoine University of Agriculture that this thesis is my own original work, done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

_____ _____

Edna Harriet Mtoi **Date**

(PhD Candidate)

The above declaration is confirmed by:

_____ _____

Prof. Cornelio N. Nyaruhucha **Date**

(Supervisor)

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DEDICATION

This work is dedicated to my late beloved father Chief Arthur Mtoi who passed away before the dreams of this work could be realized; to my beloved daughters Elaine and Alyah for their love and patience.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

ANC	Ante Natal Clinic
BCG	Bacillus Calmette-Guerin
CI	Concentration Index
CIAF	Composite Index of Anthropometric Failure
CSSH	College of Social Sciences and Humanities
DDS	Department of Development Studies
DMO	District Medical Officer
DPT	Diphtheria Pertussis and Tetanus
ENA	Emergency Nutritional Assessment
FAO	Food and Agriculture Organization of the United Nations
FGDs	Focus Group Discussions
HESLB	Higher Education Students Loans Board
HIV	Human Immunodeficiency Virus
IFPRI	International Food Policy Research Institute
IPRI	International Policy Research Institute
KIIs	Key Informant Interviews
KMO	Kaiser-Meyer- Olkin
MCH	Mother and Child Health
MGDs	Millennium Development Goals
MKUKUTA	*Mkakati wa Kukuza Uchumi na Kupunguza Umaskini* Tanzania
MKUZA	*Mkakati wa Kukuza Uchumi na Kupunguza Umaskini* Zanzibar
MNMA	*Mwalimu* Nyerere Memorial Academy
MoH	Ministry of Health

MoHCDGEC	Ministry of Health, Community Development, Gender, Elderly and Children
NBC	National Bureau of Statistics
NGO	Non-Governmental Organization
NMNAP	National Multi-Sector Nutrition Action Plan
NPERICHI	National Programme for Essential Reproductive and Child Health Initiative
OCGS	Office of the Chief Government Statistician
OPV	Oral Polio Vaccine
OR	Odd Ratio
PCA	Principle Component Analysis
RS/RHMT	Regional Secretary/ Regional Health Management Team
SD	Standard Deviation
SDG	Sustainable Development Goal
SES	Socioeconomic Status
SGDs	Sustainable Development Goals
SMART	Standardized Monitoring and Assessment of Relief and Transitions
SPSS	Statistical Package for Social Sciences
SRI	System of Rice Intensification
SUA	Sokoine University of Agriculture
TBA	Traditional Birth Attendant
TDHS-MIS	Tanzania Demographic and Health Survey – Malaria Indicator Survey
TDV	Tanzania Development Vision
TFNC	Tanzania Food and Nutrition Centre
UN	United Nations
UNFPA	United Nations Population Fund

UNICEF	United Nations Children Education Fund
URT	United Republic of Tanzania
WB	World Bank

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Problem

Nutritional status of children is considered to be a good indicator to measure the overall well-being of society. It reflects the existing socioeconomic status (SES) and environmental conditions, health care system and food security status (Bhutta, 2008). Different age groups can be affected by nutritional disorders differently; children under-five years are more vulnerable to inadequate food intake due to their high growth rate. Therefore, nutritional status of children under-five is generally considered as an indicator of economic status of any particular community (Kuate-Defo, 2001). Nutritional status of under-five is a matter of concern worldwide and undernutrition is one of the most important public health problems. Globally, the burden of malnutrition across the world remains unacceptably high, and progress towards ending it is unacceptably slow.

Malnutrition is responsible for more ill health than any other cause. Children under-five years of age face multiple undernutrition burdens: 150.8 million are stunted, 50.5 million are wasted and 38.3 million are overweight (Development Initiative, 2018). Sub-Saharan Africa and South Asia are the home to the World's stunted children; two out of five stunted children and more than half of wasted children lives in South Asia. Africa is the only region where the number of stunted children rose between 2000 and 2017 (UNICEF/WHO and WB, 2018). Among countries, there are countries with differences between those with high prevalence and those with largest number of children under-five years affected by undernutrition. Tanzania is among the countries with high undernutrition burden in East and Central Africa. According to the 2016 Tanzania Demographic and Health Survey and Malaria Indicator Survey (TDHS-MIS), 34% of children under-five are

stunted; 14% are underweight and 5% are wasted (MoHCDGEC *at al.,* 2016). Although there was a significant reduction of undernutrition in Tanzania between 1996 and 2016 whereby stunting decreased from 48 to 34%, underweight from 24 to 14% and wasting from 7 to 5% (MoHCDGEC *et al.,* 2016), the prevalence is still unacceptably high by the World Health Organization (WHO) standards of reducing wasting to less than 5% and stunting by 40%. Regional prevalence of stunting has remained very high (above 50%), with Rukwa having the highest rate of 56% (MoHCDGEC *et al.,* 2016). The trends show that the prevalence of stunting and underweight have been decreasing in Tanzania since 1999, starting with high and later decreasing (for example in Shinyanga Region). However; in other regions including Arusha, Mbeya, Mwanza, and Singida; prevalence of stunting has been unstable, going up and down all the time with Tanga Region having the highest stunting rate along the coast of the Indian Ocean (MoHCDGEC *et al.,* 2016).

For developing countries like Tanzania, prevalence of undernutrition is one of the indicators of problematic child's health. Knowledge of determinants of nutritional status may lead to policy formulation for the government in the country. Combating the problem of poor nutritional status is an ongoing process and a frequent study on the prevalence of malnutrition and its determinants is a pre-requisite in this process. In recognizing its responsibility towards children's right to adequate nutrition and hence combating malnutrition, the government of Tanzania has signed and ratified the United Nations (UN) Convention on the Rights of the Child, the African Charter on the Rights and Welfare of the Child, and embraced both the 2000 Millennium Declaration which led to Millennium Development Goals (MDGs). At the national level, Tanzania developed Vision 2025 and poverty reduction strategies dubbed MKUKUTA I and II for Mainland Tanzania; and MKUZA I and II for Zanzibar, respectively (World Bank and TFNC, 2007; URT, 2010). These policies foresee a significant commitment in reduction of

malnutrition in Tanzania. In an effort to meet these deliberation policies, a high level and well-co-ordinated research is needed to translate information that will inform interventions to improve child nutrition.

1.1.1 Concept of malnutrition

Malnutrition is explained as a clinical condition that includes several overlapping syndromes, such as growth failure and muscle wasting in adults. These may be a result of an inadequate supply, relative to the body needs, of energy and/or essential nutrients (WHO, 1995, Desai, 2000). Malnutrition in children is a consequence of much of food insecurity, which stems from poor quality and quantity, severe repeated infections or a combination of all three. These conditions are linked to the standards of living and whether basic needs can be met. A lack of nutritional needs in children contributes to childhood malnutrition (UNICEF, 2007). Malnutrition is the main cause of morbidity and mortality among under-five years children. It has impact on physical growth, cognitive development, reproduction, physical work capacity, and risks for several chronic diseases (Solomon and Amare, 2012). These negative impacts of growth and development which are caused by child malnutrition are likely to keep children trapped in the cycle of poverty. Hence, reducing child malnutrition is one of the most important goals in developing countries. According to Torum and Chew (1994), the term malnutrition is usually used to describe Protein Energy Malnutrition (PEM). The comprehensive term for "PEM" is universally accepted, and its severe forms are called "marasmus" "kwashiorkor" and marasmic kwashiorkor".

1.1.2 Measuring nutritional status of children under-five

Several approaches are used in measuring nutritional status of children under-five. However, two approaches are common: calorie/nutrient intake approach as indicated by Seckler (1984) and Gopalan (1992); and anthropometric approach as explained by Trauss and Thomas (1995) and Svedberg (2000). The calories intake or nutrition intake approach mainly considers one nutritional element only in relation to the energy (calories) content of the food. It is based on data collected from households on their consumption of major food items over a certain reference period of 7 or 30 days. However, this approach disregards the specific calorie requirements in terms of age and sex, and also does not consider factors like body weight, nature of work, and state of current health of a person. In calorie intake approach, anybody consuming below the required norm is considered undernourished regardless of variation in calories requirement such as climate change, changing in work pattern, and state of health.

Martorell and Ho (1984) argue that calorie intake is a poor measurement of nutritional status, since it depends not only on the nutrient intake but also on non-nutrient food attributes, which in the end provides inputs to the health status. The non-food factors, which influence biological absorption, are also considered as important for food security as food factors. It is therefore suggested that measuring nutritional status should be based on an outcome measure rather than on inputs measures. The suggested outcome measures include anthropometric measures, clinical signs of malnutrition, biochemical indicators and physical activity. Of the outcome measures, anthropometric measures are considered to have advantage over other indicators because body measurements are very sensitive to even minor levels of malnutrition whereas biochemical and clinical indicators are only useful when the level of malnutrition is extreme (Sen, 1984; Svedberg, 2000). Anthropometric measurement is widely recognized as one of the useful techniques to

assess the growth and nutritional status of an individual or population (Rao *et al.,* 2001). The three combinations of anthropometric (body measure) parameters such as height-for-age (stunting); weight-for-height (wasting) and weight-for-age (underweight) were used to assess nutritional status of children under-five in the study area. These were compared with the recommended reference by WHO standards. The cut-off points used for children under-five years are in terms of standard deviation (SDs) being below or above median measures (WHO, 2006).

1.1.2.1 Stunting

Stunting refers to low growth rate whereby height for age value is less that negative two standard deviations of the WHO child Growth Standard median (WHO, 2014). This reflects a process of failure to reach linear growth potential due to sub-optimal food and/or health conditions in early childhood. In a population, a high level of stunting is associated with poor socioeconomic conditions and increased risks of frequent and early to adverse conditions such as illness or inappropriate feeding practices (WHO, 1998).

1.1.2.2 Wasting

Wasting is defined as low weight for height as an indication of acute malnutrition. A child is wasted when the weight for height is less than negative two standard deviations from the mean (WHO, 2014). Prevalence of wasted children is an indication of deficiency in tissues and fat mass compared with the amount expected in children of the same age (WHO, 1998). Wasting among children is a symptom of acute undernutrition, usually as a consequence of insufficient food intake. Wasting in turn impairs functioning of the immune system and can lead to increased severity and duration of and susceptibility to infectious diseases and an increased risk of death (WHO, 2010; UNICEF, 2013).

1.1.2.3 Underweight

Underweight is defined as weight for age that is less than two standard deviations in comparison to a reference population. It is a combination of low weight for age and low height for age when compared to the reference population (Mushtaq *et al.,* 2012). Underweight captures two dimensions of child growth and is mostly used to approximate the magnitude of malnutrition (Subramanyam *et al.,* 2010). Child underweight is common and an important presentation of malnutrition, which is missed a lot of time. When a diet is insufficient in protein and/or energy there will be a slowing down of linear height, failure to gain weight or weight loss, and this is seen when the child is exposed to an acute food shortage.

1.2 Statement of the Problem

Tanzania has introduced and scaled up a number of cost-effective nutrition related interventions including vitamin A supplementation of children under-five, improving antenatal care and emphasis on vaccination of children less than 2 years (UWAZI, 2010). Nutrition aspects are also anchored in the National Strategy for Growth and Reduction of Poverty (MKUKUTA I and II). Nutrition has also been included as a separate investment priority in the Tanzania Agriculture and Food Security Investment Plan (TAFSIP). At district level, multi-sectoral committees have also been established, and Nutrition Officers have been recruited to support the national strategies. Despite the above efforts, the achievement of these interventions has been undermined by lack of progress in key determinants of child malnutrition at household levels. There are number of studies that have looked into the problem of malnutrition at international, national and regional levels; for example, Nyaruhucha *et al.* (2006) and Kenneth (2006), Niger *et al.* (2010, UWAZI (2010), Solomon and Amare (2012), Zewdie and Abebaw (2013), Kavosi *et al.* (2014). However, what are more common in these studies are baseline surveys of nutrition among

selected populations of children establishing proportions of malnourished children and focusing on micronutrients and supplements for enhancing nutritional value of food.

This study was conducted in Pangani District where fishing and agricultural activities are among the main reliable sources of income. Conversely, food production, which is predominantly carried out by women, is still low, depending on only seasonal rainfall without irrigation. The agricultural activities have also been affected by frequent drought due to climate variation hence reducing food production and income from this sector (URT, 2008). Additionally, fishing which is a man's domain remains a high potential source of income in Pangani District. Therefore, the probability of women to engage in other small activities such as aquaculture, salt processing, harvesting coastal forest and mangrove is high. The increased food insecurity and change in gender roles where women are increasingly engaged in economic activities to complement men's decreasing income is likely to influence undernutrition among children under-five years. Understanding the magnitude of the problem at the district level is among important aspects of coming up with strategies to overcome it.

Although the district has moderate stunting rate (39%) it has the highest stunting level along the coast of the Indian Ocean as compared to Dar es Salaam (14.6%), Lindi (35.2%) and Mtwara (37.7%) (MoHCDGEC *et al.,* 2016). Efforts to reduce this high stunting level continued to be challenged by unknown factors that lead to increased number of children who are at high risk of malnutrition. They also affect the long-term physical growth and development of children, and may lead to high levels of chronic illness and disability in adult life. In addition, high rate of malnutrition jeopardizes future economic growth by reducing intellectual and physical potential of entire population. Therefore, the study on which this thesis is based addressed the underlying determinants of nutritional status in

Pangani District so that Tanzania can achieve nutritional well-being of children under-five hence reach a functional and productive capacity of population.

1.3 Justification for the Study

A number of studies have looked into the problem of malnutrition at international, national and regional levels: these include Nyaruhucha *et al.* (2006) and Kenneth (2006), Niger *et al.* (2010); UWAZI (2010), Solomon and Amare (2012), Zewdie and Abebaw (2013), Kavosi *et al.* (2014). What are more common in these studies are baseline surveys of nutrition among selected populations of children in order to establish the proportion of malnourished children, focusing on micronutrients and supplements for enhancing nutritional value of food. An understanding of the key determinants of nutritional status in a specific context is crucial if the current high rate of malnutrition is to be reduced. The findings presented in this thesis contribute to the new knowledge on the determinants of nutritional status in a specific context which is very crucial in reducing and eventually eliminate malnutrition among under-five children. This will lead to resource savings in health, improve education, enhance productivity and increase income.

Improving under-five nutrition status was also a central issue in the Millennium Development Goals (MGDs), but also in the new set of Sustainable Development Goals (SDGs). Millennium Development Goal (MDG) No. 4 required countries to scale up interventions addressing malnutrition and other immediate determinants of burden of diseases among children to reduce mortality by two-thirds by 2015. However, nutrition was given a minimal attention in the MDGs, with reference to only undernutrition. In the SDGs, there is now a target to end all forms of undernutrition in its all forms by 2030 (Development Initiatives, 2018).

Whereas, globally, some achievements have been made, undernourishment remains a significant problem in some developing countries like Tanzania. In 2013, two years before the final timeline (2015) of the MDG elapsed; a United Nations report revealed that the proportion of undernourishment in developing regions had declined by 35.8% from 1990 to 2012. However, developing countries such as Tanzania had only recorded a reduction of only two per cent in the same period (UNICEF, 2013). This is a developmental issue of concern for Tanzania. As the targeted deadline elapsed with very little progress, determining the reasons for this slow progress is essential to inform strategies for developing remedial measures to address the shortcomings of MGDs but also providing inputs for achieving SDGs targets by 2030. The findings on socioeconomic determinants of undernutrition provide information which contributes to the efforts for achieving the first and the fourth targets of Tanzania Development Vision (TDV) 2025 focusing on high quality of livelihood and strong competitive economy among households (URT, 2016).

1.4 Objectives

1.4.1 General objective

The study establishes the socioeconomic determinants of a household and its influence on undernutrition among children under-five years.

1.4.2 Specific objectives

The specific objectives were to:

i. Determine the nutritional status of children under-five years among fishing communities in Pangani District,
ii. Examine the influence of child care practices on nutritional status of the child,
iii. Determine socioeconomic factors influencing undernutrition of children under-five years,

iv. Establish the association between maternal characteristics and undernutrition among children under-five years.

1.5 Research Questions and Hypotheses

This study was guided by research questions and hypotheses since it used both qualitative and quantitative approaches to collect and analyse data. In that regard, the research questions guided qualitative approach while hypotheses were applied for quantitative and inferential analyses.

1.5.1 Research questions

i. What is the level of undernutrition among children under-five years old in Pangani District?
ii. How do care practices by the mothers/care-takers relate to the level of undernutrition?
iii. How does socioeconomic status of a household include that of the mothers/care-takers and the head of households' influence undernutrition among children under-five years?
iv. Is there any discrepancy in undernutrition status between households in the river side and those in the coast side?
v. In what ways does access to social services by the mother/care-takers at the community level influence health outcomes?

1.5.2 Research hypotheses

i. Maternal factors and child-care practices influence the levels of undernutrition among children under-five years.

ii. The levels of undernutrition differ between households with different socioeconomic statuses in Pangani District.

iii. The levels of undernutrition differ between households on the Riverside and those on the Coast side in Pangani District.

1.6 Theoretical Framework

The theoretical approach of the study was based on macroeconomic models of production and allocation of household resources, and care and support of children as pioneered by Becker (1965 and 1981) and Engle and Ricciut (1995) respectively. Becker (1965) demonstrated, in enlightening the household determinants of nutrition, that a nutrition production function relates to child's nutritional status measured by anthropometric indicators to a set of health "inputs". These inputs could be child nutrients intake, preventive and curative medical care, and the quantity of time of the mother and care givers. In 1981, Becker analysed households' decision on the quantity and quality of children. He argued that households derived utility from conventional goods as well as from the number and quality of children measured by expenditure per child. Engle *et al.* (2000) looked into the behaviour and practices of caregivers that provide food, stimulation and emotional support necessary for children's healthy, growth and development. These practices translate food security and health care into child's well-being. In the context of this study a child's nutritional status reflects the combined effects of many factors including specific characteristics of a child, behaviours and attitude of the mother and care-taker towards the child, and community factors which are governed by parents/caregivers' preferences and access to social services at their disposal.

1.7 Conceptual Framework

A conventional conceptual framework on the study of nutritional status was developed by UNICEF (1997) and extended by Engle *et al.* (2000). The framework is comprehensive; it incorporates both biological and socioeconomic causes, and encompasses causes at both micro and macro levels. This framework recognizes three levels of causality corresponding to immediate, underlying and basic determinants of children's nutritional status. In order to avoid complex inter-relationship between these variables which are risk factors of ill health in children, particularly in developing countries, Victora *et al.* (1997) developed and proposed the uses of frameworks and models for studying and determining the factors of health outcomes (nutritional status) of children under-five. The conceptual framework used categorizes the determinants of nutritional status into three groups of independent variables: Individual characteristics of a child (age, sex, birth order, family size and number of siblings); household socioeconomic characteristics (place of residence, marital status, type of the house, latrine, occupation of the head of household, family size, household food security, source of income, etc.); and community/environmental variables (presence of health facilities, NGOs, market, access to safe water, etc.).

The conceptual framework of this thesis, which is presented in Figure 1.1, is informed by theoretical and empirical literature as depicted by Victora *et al.* (1997). The adapted framework suggests that household socioeconomic characteristics may affect directly or indirectly all other variables with an exception of individual characteristics of a child such as age, sex, childbirth order, etc. These variables, in turn, may affect the nutritional statuses of children under-five as elaborated in figure 1.1. The framework is ideal for this study because it handles complex causes of undernutrition, which range from biological and social to environmental factors as explained by Wamani *et al.* (2007) and Smith and Haddad (1999). The framework, further, illustrates the relationship of some specific

maternal characteristics and child care practices that act directly or indirectly through intervening variables may influence child nutrition status.

In order to recognize the magnitude of undernutrition in Pangani District, it is important to answer the following questions: what is the status of undernutrition in the study areas, and how do care practices by the mothers/care-takers of a child under-five relate to the level of undernutrition in the district. The answers to these questions are given in Manuscript 1. The inspiration around these questions was based on the fact that care practice is among the important underlying factors explaining how well children need to be. The type of care practices as dictated by cultural values at the household level and the available resources provide information required to improve the quality of care by incorporating evidence-based information.

It was equally important to understand the level undernutrition based on SES of the household in the river side and in the coast side in Pangani District, in order to confirm which area is more prone to child undernutrition. The second manuscript provides this information by first giving a generalized picture of SES of household based on an asset ownership index. Then the rate of undernutrition in the two areas was measured by using a CIAF. The assumption was that the level of undernutrition among households in the river side differs from that of the coast side. This hypothesis was so due to the fact that there are different socioeconomic levels and activities in the two areas of residence. Understanding the nature and magnitude of undernutrition in specific areas is important in order to channel resources and nutrition interventions to the needy ones.

The third manuscript illustrates the association between maternal characteristics that act directly or indirectly through the intervening factors at the community level to influence

child nutrition. Understanding the influence of maternal characteristics is important as most interventions for reducing undernutrition among children under-five are tailored towards women of child bearing age range. A better understanding of channels through which maternal characteristics, such as SES, affect children's nutritional status can contribute to more effective policy response to reduce undernutrition.

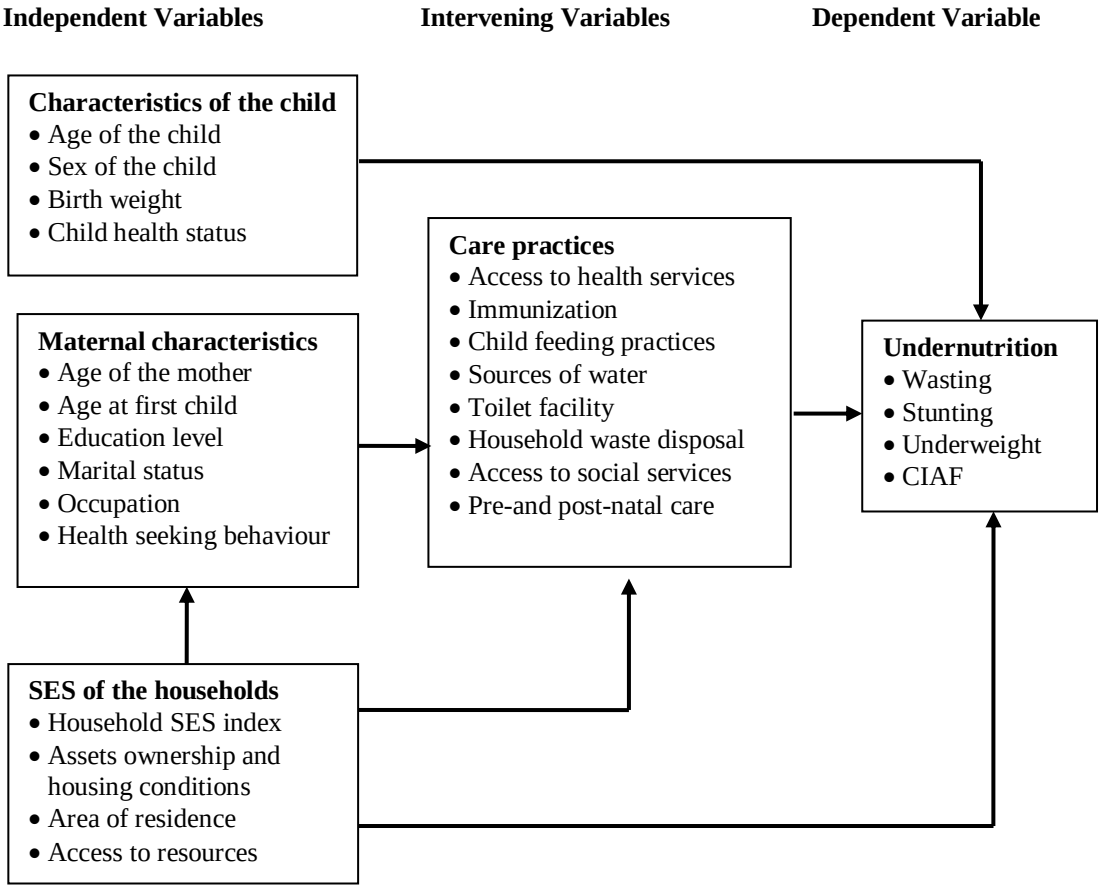

Figure 1.1: Relationship between household SES and undernutrition
Source: Adapted from UNICEF, 1997

1.8 General Methodology

1.8.1 Description of the study area

The study was conducted in Pangani District. The study involved two divisions, Mwera and Pangani. A total of eight villages (two from each ward); Mwera (Ushongo and

Mwera), Tungamaa (Tungamaa and Langoni), Pangani (Pangani East and Funguni), Bweni (Bweni and Mashado) (Fig. 1.2); were involved. Although the district has moderate undernutrition burden in Tanzania, but it has the highest stunting rate among other districts along the coast of Indian Ocean (MoHCDGEC *et al.*, 2016). Pangani District has two main distinct features. One of the features is the riverside that collects its water from Mt. Kilimanjaro and Mt. Meru and empties itself into the coast side which is part of the Indian Ocean. Communities within the river side depend mostly on agriculture activities where the main cash crop is coconut. The other feature is the coastline of the Indian Ocean. As elsewhere along the coastline of the Indian Ocean, fishing is the major occupation of the people living in the coast area, except for a few people; their livelihoods depend directly or indirectly on agriculture, crop and livestock farming, income from petty trade and employment (RS/RHMT, 2013).

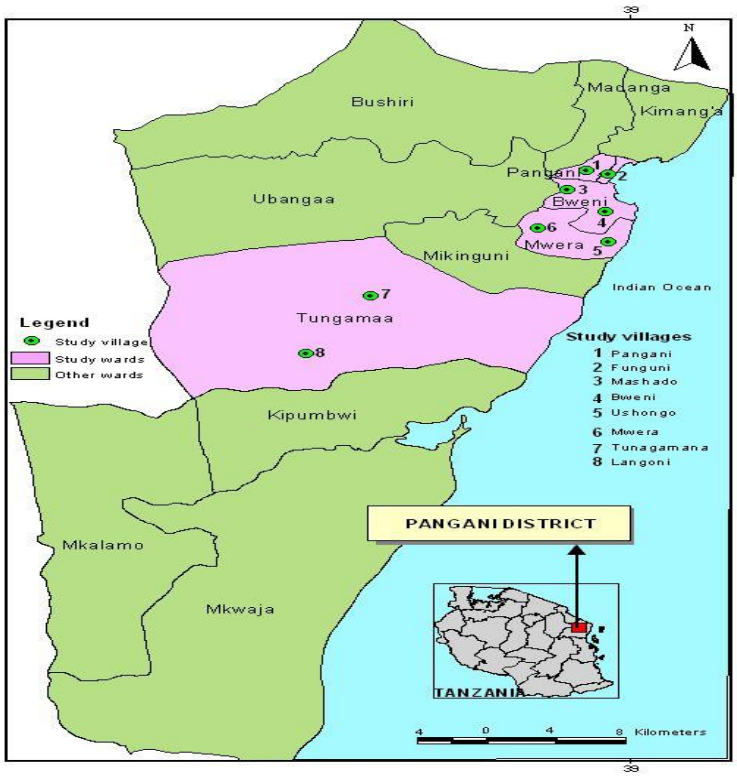

Figure 1.2: Map of Pangani District showing the study villages
Source: District Council Authorities

1.8.2 The study design

The study adopted a cross-sectional research design because it entails the collection of data on a number of cases at a single point in time and is suitable for descriptive analysis and determination of relationships among variables (Bailey, 1994; Walliman, 2006). The design allows more than one method to be used at a time in which larger clusters are divided into smaller clusters (Kothari, 2004). Bryman (2008) argues that cross-sectional design supports a mixed research strategy, whereby qualitative and quantitative data can be collected concurrently. Therefore, it was considered to be suitable to establish how socioeconomic determinants of a household influence undernutrition among children under-five years in Pangani District. A survey design was also adapted to allow the researcher collect information from a large group of people.

1.8.3 Sampling and sample size

Purposive sampling was used to select two divisions: Mwera (representing the river side) and Pangani (representing the ocean side). Two wards from each division including Mwera and Tungamaa on the river side and Pangani East and Bweni on the coast side were randomly selected. Simple random sampling was employed to select eight villages, two from each ward. Purposive sampling was used to select households with children under-five years as a sampling frame, and individual mothers with children under-five years were selected as the sample unit. The sample size was determined based on stunting prevalence in Pangani District (MoHCDGEC *et al.,* 2016) by using Cochran's formula as adopted by Bartlett *et al*. (2001) as detailed in Appendix 6. Based on the adapted formula, a total of 340 households were used in the study. Where a household had two or more children under-five years all were included in the sample. Therefore, a total of 355 children were involved in the study.

1.8.4 Research instruments

The main instruments used in this study were a household questionnaire (for the household surveys), discussion guide (for focus group discussions) and interview guide (for key informant interviews). Variables such as weight, height, birth weight, age and sex of children were taken during home visits. Anthropometric data collected involved the use of a digital weighing machine of the capacity of 100 kg and a two pieces wooden height measuring board, which were all hired from Tanzania Food and Nutrition Centre (TFNC). Other sources of data were key informants from the District Hospital, Village Health Officers, Community Development Officers, District Nursing Officer, Ward Executive Officers and Village Chairpersons. Also, participants of four Focus Group Discussions (FGD) found in the mentioned villages were used to get data.

1.8.5 Data analysis

A series of data analysis methods were employed to analyse quantitative (using SPSS version 25) and content analysis for qualitative data.

Objective one: To determine the nutritional status of children under-five years among fishing communities in Pangani District.

Emergency Nutrition Assessment (ENA) for SMART was used to analyse anthropometric data. Three indices of undernutrition were generated based on Z-scores for child's height-for-age, weight-for-height, and weight-for-age. A Composite Anthropometric Failure (CIAF) was employed in order to consider all undernourished children at a single point as proposed by Svedberg (2000) and modified by Nandy *et al.* (2005).

Objective two: To examine the influence of care practices on nutritional status of the child under-five years.

Descriptive statistical analysis was performed by using Statistical Package for Social Sciences (SPSS), whereby means, standard deviations, frequencies and percentages were generated in order to categorize sociodemographic characteristics, child care and feeding practices for children under-five years old. Binary logistic regression model was employed to determine the relationship between the categorical outcome variable (0 = well nourished; 1 = undernourished) and predictor variables. Content analysis was used to analyse views of the respondents during FGDs.

Objective three: To ascertain socioeconomic factors influencing undernutrition of children under-five years.

PCA was used to develop indicators of SES based on a set of household assets and living conditions or household service and dwelling conditions into categories or interval variables. Descriptive statistics were computed for all the variables including means, frequencies and standard deviations. A bivariate analysis was performed to measure the level and trend of undernutrition across the households' wealth quintiles. A concentration index (CI) was applied to measure socioeconomic inequality in childhood undernutrition in Pangani. The CI ranges between -1 to +1; a zero value implies the problem of undernutrition is equally distributed across the socioeconomic groups.

Objective four: To establish the association between maternal characteristics and undernutrition among children under-years.

Descriptive statistical analysis was performed by using the Statistical Package of Social Sciences (SPSS), whereby means, standard deviations, frequencies and percentages were generated in order to categorize maternal sociodemographic characteristics, child

characteristics and care practices by mothers for children under-five years old. Binary logistic regression model was employed to determine the relationship between the categorical outcome variable and predictor variables. Content analysis was used to analyse views of the respondents during FGDs.

1.9 Ethical Considerations

Before getting on into data collection, the researcher obtained a research clearance permit from the Vice Chancellor of Sokoine University of Agriculture introducing the researcher to the District Medical Officer of Pangani District Council. This permit had all the important information including the research title, purpose and duration for which the research was to be conducted. Likewise, a legal permit to carry out the research in the study area was given by the District Medical Officer who introduced the researcher to the Ward Executive Officers in the selected wards. These officials introduced the researcher to leaders of the places where data collection were collected through household surveys, key informant interviews and focus group discussions. During the actual data collection, the purpose of the survey was introduced to the respective leaders and to the informants (heads of the households) in the study area. Consent was sought from the respondents to participate in the survey. During data analysis, care was taken to ensure that appropriate statistical analysis techniques were used. This included proper weight and height measurements of children under-five years. During report writing, effort was made to avoid reporting errors such as intentional misrepresentation and deception of the findings. Only the findings obtained were reported.

1.10 Validity and Reliability

The researcher strove to ensure that validity of the research tools, mainly the household questionnaire, was achieved. This was done first through pre-testing the tools. A

questionnaire was developed after doing rigorous literature review. It was further polished to ensure that it was accurate and could elicit the intended information. After incorporating the comments raised during pre-testing, the revised version was resubmitted to supervisors who provided comments on likely problems and proposed the ways of dealing with them. Incorporation of the final comments resulted into the final draft ready to be used in the pilot testing. A pilot test was done to 20 respondents randomly selected in Kunduchi Mtongani Ward, which was not sampled for the study. Therefore, the respondents who were involved in the pilot test were not included in the actual household surveys. To ensure reliability of the responses, the questionnaire was made simple and strait forward.

1.11 Organization of the Thesis

This thesis presents three publishable manuscripts organized in three chapters. The whole thesis is organised in five chapters and begins by presenting the introduction in Chapter One. This sets background information to the thesis, including methodology used in data collection and analysis. Chapter Two presents manuscript number one that combines objectives one and two which provide information on the status of undernutrition in the study area, and how care practices by the mothers/care-takers of a child under-five relate to the level of undernutrition in study area. This is followed by Chapter Three, which addresses objective three focusing on the determinants of household's social economic status (SES) on undernutrition. Chapter Four presents manuscript number three, which focuses on the influence of sociodemographic characteristics of a mother on undernutrition of children under-five years. Chapter Five presents a summary of the results and discussion from all the manuscripts and finally draws conclusions and recommendations.

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CHAPTER TWO

Child Care Practices and Nutritional Status of Under-five Children in Tanzania: Evidence from Fishing Communities in Pangani District

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Abstract

Undernutrition is still a public health problem in Tanzania despite national and global efforts in combating it. However, little availability of suitable data limits understanding of why the problem still persists. This manuscript aimed at finding out the determinants of undernutrition among under-five children in Tanzania. Specifically, this manuscript assessed the influence of child care practices on nutritional status of under-five children focusing on local fishing communities in Pangani District. A sample of 355 under-five children was selected from households using systematic sampling method. Cross-sectional research design was employed to collect both anthropometric quantitative and qualitative

data. ENA for SMART software version 2011 was used to generate indices for weight-for-height, height-for-age and weight-for-age. The findings confirm that under-nutrition is still a public health problem in Pangani as indicated by higher level of stunting (27.9%) and wasting (5.1%). Binary Logistic Regression was employed to assess the influence of individual characteristics of a child and care practices by mothers/care-takers on under-nutrition in children under-five. The study findings revealed that malnutrition is still a health problem in terms of high stunting rate which is above the acceptable level by WHO. Stunting and underweight were more profound in girls than boys. It was also found that undernutrition is age sensitive because children between one and two years are mostly affected. In binary logistics regression analysis, place of delivery, delivery assistance, sex of a child, having siblings' under-five, immunization status, essential ANC visits and exclusive breast feeding were the most important factors associated with under-nutrition. The findings call for collaborative action between Government, NGOs and the District Nutrition Officer on how to curb malnutrition in Pangani.

Key Words: Undernutrition, children under-five years, child care practices, Pangani District.

2.1 Introduction

Despite global and national efforts for improving child health and availability of nutrition interventions, malnutrition remains a significant burden in developing countries. It continues to be the foremost cause of morbidity and mortality worldwide, particularly in developing countries (Black *et al.,* 2008). Fifty per cent of child deaths in the developing countries are related to the consequences of malnutrition. Victora *et al.* (2008) ascertained that malnutrition is a significant contributing factor for infant and child mortality, poor nutritional status during childhood and also an important implication for adult economic

activities. World Health Organization (WHO) in (1995) defines malnutrition as a clinical condition that includes several overlapping syndromes, such as growth failure and muscle wasting in adults. Malnutrition literally means imperfect nutrition that technically includes both over and undernutrition, and this paper focuses more on the latter. Undernutrition places children at an increased risk of impaired physical and mental growth, poor socio-emotional development due to deficiencies of nutrients like protein, iron, iodine and vitamin A. Undernourished children are more likely to become short adults, have lower educational development, and give birth to smaller children (Victora *et al*., 2008). Therefore, nutritional status of under-five children is important because it can serve as a proxy indicator for assessing the entire health status of any population and also as a major predictor of child survival.

Tanzania has one of the highest undernutrition burdens in East and Southern Africa, threatening not only individual lives but also the next generation's economic advancement, and loss of income and opportunities. Nationwide, 34% of children under-five are stunted or short for their age, which is a sign of chronic malnutrition. Five per cent of children under-five are wasted or too short for their height, a sign of acute malnutrition. Fourteen per cent of children are underweight or too thin for their age as reported in the TDHS-MIS, 2015-2016 (MoHCDGEC *et al.*, 2016). The regional prevalence indicates that Rukwa (56%), Njombe (49%) and Ruvuma (44%) regions have the highest prevalence of stunting. Even though Tanga is among the regions with moderate prevalence of stunting (39%) it has the highest stunting level along the coast of the Indian Ocean as compared to Dar es Salaam (14.6%), Lindi (35.2%) and Mtwara (37.7%) (MoHCDGEC *et al.*, 2016). The study was conducted in Pangani District, which is part of Pangani River that empties its water into the Indian Ocean.

The theoretical approach of this paper is based on macroeconomic models of production and allocation of household resources, and care and support of children as pioneered by Becker (1965 and 1981) and Engle and Ricciut (1995) respectively. Becker (1965) has demonstrated, in enlightening the household determinants of nutrition that a nutrition production function relates to child's nutritional status measured by anthropometric indicators to a set of health "inputs". These inputs could be child nutrients intake, preventive and curative medical care, and the quantity of time of the mother and care givers. In 1981, Becker analysed households' decision on the quantity and quality of children. He argued that households derive utility from conventional goods as well as from the number and quality of children measured by expenditure per child. Engle *et al.* (2000) looked into the behaviour and practices of caregivers that provide food, stimulation and emotional support necessary for children's healthy, growth and development. These practices translate food security and health care into child's well-being.

Prevalence and determinants of nutritional status among under-five children in other developing countries have been widely documented by a number of researchers (for example Rayan and Khan, 2006; Nguyen and Nguyen, 2009; Solomon and Amare, 2012; and Ziwdie and Abebaw, 2013). In Tanzania, similar information has widely been documented. For example, Abubakar *et al.* (2012) reported the prevalence and socioeconomic risk factors of stunting among children aged 1-35 months in Same District, Kilimanjaro Region and found that chronic malnutrition was associated with child's sex and age, mother education, family size and number of ante natal visits. In Jibondo and Chole Islands, Moshy *et al*. (2013) revealed that underweight was attributed to substantial reduction in breastfeeding. A cross-sectional study by Safari *et al.* (2015) in Nzega, Tanzania, assessed the prevalence of malnutrition among children aged 6 to 59 months

and showed that the factors associated with a high stunting rate are sex, age, family size, age of the mother and number of antenatal visits.

Despite the enormous literature that details the causes of undernutrition, little is known about the linkage between under-five nutritional status and care practices, especially along the coast of the Indian Ocean in Tanzania where the population is characterized by multiple economic activities including agriculture, non-agricultural and fishing activities. An understanding of the connection of these multiple economic activities and care practices and their influence on under-five nutritional status, especially in fishing communities is essential in designing appropriate response interventions for addressing undernutrition. To fill this knowledge gap, this paper assessed the nutritional status of children under-five focusing on undernutrition. Specifically, the paper (i) examined the sociodemographic characteristics of the children under-five years, (ii) determined the levels of undernutrition among under-five children, (iii) analyzed child care practices among the households with children under-five old, and (iv) assessed the influence of individual characteristics and child care practices on nutritional status of under-five children.

The United Nations' Millennium Development Goal No. 4 (MGD 4) requires countries to scale up interventions for addressing malnutrition and other burden of diseases among children (Semali *et al.*, 2015). Although there is global improvement in child health, but undernutrition remains a significant problem in some developing countries including Tanzania. This paper is therefore noteworthy to provide feedback for the shortcomings of failure in reaching the target for reaching MDGs' targets in 2015. The findings for this paper serve as a road map to the post MDGs dubbed Sustainable Development Goals (SDGs), specifically goal No. 2 which is about ending all forms of malnutrition for all

people by 2030, including achieving the internationally agreed targets of 40% reduction in stunted children and maintain wasting to less than 5% (IFPRI, 2016). As part of the commitment to addressing undernutrition, the government of Tanzania has launched a comprehensive five years National Multi-Sectoral Nutrition Action Plan (NMNAP 2016-2021) intended to address the burden of child undernutrition (URT, 2016). The findings from this paper contribute to translate these commitments into action by providing information that guide stakeholders, nutritionists, academicians, researchers and programmes aimed at addressing undernutrition among children under-five years in Tanzania.

2.2 Methodology

2.2.1 Description of the study area

Pangani District is the smallest in size and the least populated among the eight districts in Tanga Region but is strategically situated with good access to the Northern highlands and the coastal belt of Tanzania. Administratively, the District is divided into four divisions, 13 wards, 33 villages and 94 hamlets (RS/RHMT, 2013). As elsewhere along the coast of the Indian Ocean in Tanzania, fishing is the major occupation of the people living in the study area. Except for a few, their livelihood depends directly or indirectly on agriculture, crop and livestock farming, income from business and employment (RS/RHMT, 2013). These diverse socioeconomic activities are likely to influence nutritional status of children under-five years in different ways. Thus, understanding the nature of care practices by the mothers on this population group is important so that nutrition interventions can be more focused.

2.2.2 Research design

A cross-sectional research design was used because it was considered to be suitable to assess the existing influence of child's characteristics and care practices on nutritional status of under-five children in Pangani District. The design allows more than one method to be used at a time, but also allows data to be collected at a one point in time and is suitable for descriptive analysis and determination of relationship among variables (Bailey, 1994; Kothari, 2004, and Walliman, 2006).

2.2.3 Sampling frame and sample size

Purposive sampling was used to select two divisions, Mwera (representing the river side) and Pangani (representing the ocean side). Two wards from each division and two villages from each ward were randomly selected making a total of eight villages. Purposive sampling was conducted to select households with children under-five years as a sample. The main sampling unit in this paper was an individual mother or care taker of children under-five years. A sample size of 340 households was determined by using Cochran's formula as adopted by Bartlett *et al.* (2001).

Where a household had two or more children under-five years all were included in the sample, therefore a total of 355 children were involved in the study.

A total of 18 Key Informants (KIs), (two Health Officers from the District Hospital, two MCH coordinators, four Wards Community Development Officers, two NGO representatives from each ward, and eight Village Officers) were selected. Participants in the Focus Group Discussions (FGD) were purposively selected from among mothers or caregivers within the households with children under-five years.

2.2.4 Data collection

Variables such as weight, height, birth weight, age and sex of children were taken during home visits. Length of the children less than 24 months was measured in a recumbent position to the nearest 0.1 cm using a board with an upright wooden base and a movable head piece. Height of children aged 24 and above 24 months was measures in a standing position to the nearest 0.1 cm using a vertical board with a detachable sliding piece (Assaf *et al.*, 2015). An electronic SECA weighing machine with a scale graduation of 100 grams and a capacity of 100 kilograms was utilized for measuring weight of children with minimum clothing and without shoes to the nearest 0.1 kg. A household survey questionnaire which consisted of both open ended and close ended questions was used to collect information on individual characteristics of children that were not captured in anthropometric measurement. The household survey questionnaire was used to collect information on child health care practices in the study area. In-depth interviews with KIs at the district hospital, village health centres, community development officer and district nutritionist were purposively conducted for the purpose of supplementing information collected using the questionnaire on the status and causes of malnutrition in Pangani. Data such as place of birth, number of siblings under-five, vaccination status, child care and feeding practices were obtained from clinic cards and mothers' recalls.

Four FGDs, one from each ward comprising eight participants, were conducted for the purpose of supplementing the information of the influence of child care practice on nutritional status of under-five children. Bryman (2004) and Barbour (2011) suggest that six to 12 participants are enough for effective participation and good quality data in FGDs. There were separate groups of men and women alone because Pangani District is characterized by Islamic culture in which girls after puberty and married women do not mix with men.

2.2.5 Data analysis

Emergency Nutrition Assessment (ENA) for SMART software version 2011 was used to generate measurement indices of height-for-age, weight-for-age, and weight-for-height. The indices generated were compared with standard reference values for WHO growth standard (2006) to obtain Z-scores. Z-score of -2 standard deviations is the most commonly adopted cut-off point for all nutrition indicators (Zewdie and Ababaw, 2013). In this study, a child with Z-scores below -2 SD in respective nutritional status indicator was considered malnourished i.e. stunted, wasted or underweight (WHO, 2006).

Descriptive statistical analysis was performed by using the Statistical Package for Social Sciences (SPSS) Version 16.0, whereby means, standard deviations, percentages and frequencies were generated in order to categorize sociodemographic characteristics, care and feeding practices for children under-five years old. Prevalence of malnutrition was estimated by computing percentages of malnutrition cases among children under-five from the entire sample. Binary logistic regression model was employed to determine the relationship between the outcome categorical variable (Pallant, 2007) (height-for-age, weight-for-height, and weight-for-age) and predictor variables (health facility, delivery assistance, sex of a child, age of a child, born premature, number of siblings, given pre-lacteal foods, immunization status, breast feeding after birth, exclusive breast feeding, duration of breastfeeding, number of meals per day, and essential ANC visits). Those predictor variables were a mixture of categorical and continuous variables. Therefore, this model allows testing to predict categorical outcomes with two or more outcomes. Furthermore, the model combined the predictor variables to estimate the probability that a particular event would occur i.e. a subject will be a member of one of the groups defined by a dichotomous outcome variable. Analysis of the results from the model focused on interpretation of β-coefficients for measuring the directions of the relationship, p-values

for testing significance of the relationship, and odds ratios (Exp (B) values) for predicting the number of times various predictor variables have chances to occur relative to one another regarding the relationship between individual characteristics and care practices on undernutrition of children under-five years.

The binary logistic regression model used is shown in the following equation:

$\text{Log}\ (P_i/1\text{-}P_i) = \beta_0 + \beta_1 X_1 + \beta_2 X_{2\,+} \ldots + \beta_{13} X_{13} + e$

Where: Log $(P_i/1\text{-}P_i)$ = is the natural logarithm of the status of a child being malnourished (underweight/wasted/stunted) or not, Pi = Probability of the i^{th} child being malnourished

$1\text{-}P_i$ = probability of the i^{th} child not being malnourished

β_0 = Constant (Y- interception)

$\beta_1 - \beta_{13}$ = Logarithm of regression coefficient of independent (predictors) variables, X_1= place of child delivery (1= health facility, 0 = home delivery); X_2 = delivery assistance (1 = health professionals, 0 = Tradition Birth Attendants (TBA) and relatives); X_3 = sex of a child (1 = Male, 0 = Female) , X_4 = born premature (1 = Yes, 0 = No); X_5 = have sibling under-five years (1 = Yes, 0 = No); X_6 = pre lacteal feeding (1 = Yes, 0 = No); X_7 = immunization status (1 = Yes, 0 = No); X_8 = breastfeeding soon after birth (1=Yes, 0 = No); X_9 = exclusive breastfeeding (1 = Yes, 0 = No); X_{10} = breastfeeding duration continuous); X_{11} = number of meals per day (continuous); X_{12} = essential ANC (continuous); X_{13} = age of a child (continuous). Finally, content analysis was then used to analyse qualitative information collected through FGDs and interviews with KIs. In content analysis, the recorded discussions and interviews were broken down into units of information and ideas to supplement quantitative data analysis and discussion.

2.3 Results and Discussion

2.3.1 Socio - demographic characteristics of children under-five years

The sociodemographic characteristics of the under-five children sampled are summarized in Table 2.1. The results show that out of 355 children in the sampled households, 47.9% were male while 52.1% were female. The distribution of children based on age groups indicated that 76% of the children were between 13 and 36 months, implying that the majority of the children in the study area were at weaning age. The overall mean (± SD) age of the children was 28.93 months (±14.44). The results from this study showed that the majority of the children (93.2%) had birth weight of greater than or equal to 2500 g while only 6.8% had low birth weight of less than 2500 g. These results project that the chances of children to have higher incidence of morbidity are low as only 6.8% were born with low birth weight hence this decreases the chance of being undernourished due to low birth weight.

Table 2.1: Sociodemographic profile of children under-five years (n = 355)

Variable	n	%
Sex of the children		
Male	170	47.9
Female	185	52.1
Age (months) of the children		
01 -06	19	5.4
07- 12	27	7.6
13 -24	96	27.0
25 - 36	174	49.0
37 - 48	35	9.9
49 – 60	4	1.1
Birth weight		
Greater than or equal to2500g	331	93.2
Less than 2500g	24	6.8
Child born prematurely		
Yes	15	4.2
No	340	95.8
Bilateral Pitting Oedema		
Yes	44	12.4
No	311	87.6
Have Sibling Under-five years		
Yes	90	25.4
No	265	74.6

Note: n = number of respondents, % = per cent

Birth weight of a child is usually linked to the chances of child's morbidity and mortality. Children with low birth weight or weight below 2500 g, as defined by WHO, are at high risk 20 times of morbidity and mortality at birth and during early days of life time than healthier babies (Suman and Rajani, 2016). Further analysis indicated that 4.2% of the surveyed children were born prematurely with 12.4% children having oedema and 25.4% having siblings under-five years of age.

2.3.2 Nutritional status of children under-five years

Anthropometric analysis of children under-five years indicated that the prevalence rates of stunting, wasting and underweight were 27.9, 5.1 and 13.9% respectively as detailed in Fig. 2.1. Although the current level of stunting in Pangani is lower than the stunting rate in Tanga Region (49%) and in Tanzania (42%) in general, but it is still higher than the acceptable level by the WHO of less than 20%. Similar results were reported by Safari *et al.* (2015) that few children are thin for their age (wasting) but many are stunted. These findings indicate that stunting is still recognized as a serious health problem in the study area. It is evident that children who are deprived of healthy growth (stunted children) are also deprived of healthy brain development and immune system development. Studies conducted in Ghana, Tanzania and Nepal (Beasley *et al.,* 2000) concluded that stunted children are less likely to be enrolled in school, are more likely to enrol late and have poorer cognitive ability than non-stunted children.

The level of wasting was not only higher than the national level of 5% (TDHS-MIS, 2015-2016), but also exceeded the acceptable level of 5%. Wasting is usually due to recent illness and/or insufficient dietary intake caused by food shortages, feeding practices, or other events (Safari *et al.,* 2015). Wasting leads to significant weight loss; it indicates deficits in tissue and fat mass compared with amount expected in a child of the

same height or length and may result either from failure to gain weight or from actual weight loss (WHO, 2000).

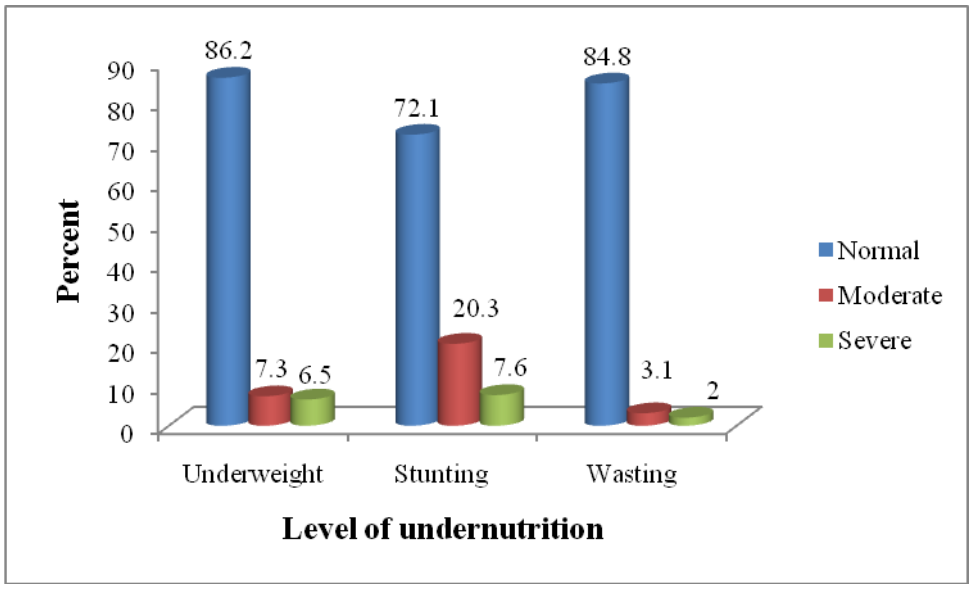

Figure 2.1: Anthropometric analysis of children under-five (n = 355)

The descriptive analysis of nutritional status of children under-five years based on demographic characteristics of a child is summarized in Table 2.2. On gender aspects, the study findings reveal that girls (24.9%) were more prone to malnutrition than boys (21.6%). A comparison of stunting between male and female showed that more female (14.6%) were stunted compared to 13.2% of male. Male children had also better height-for-age and weight-for-age than female children but had slightly higher percentage of weight-for-height. This result contradicts results of study by Wamani *et al.* (2007) who found that male children are more stunted than female children. The findings from this chapter concur with findings by Gibson (2005) who reported that female children are often deprived of resources due to socio-cultural settings. The relationship between sex of a child and nutritional status has been reported as favourable for male children, with discriminatory breastfeeding and supplementary practice for female children. Infant girls are breastfed less frequently, for shorter durations, and over short periods than boys.

Table 2.2: Nutritional status of children under-five years in Pangani Districts (n =355)

Age groups (in months)	Normal		Stunted		Wasted		Underweight		Overweight		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
1 - 6	11	3.1	4	1.1	1	0.3	3	0.8	5	1.4	19	5.4
7 - 12	17	4.7	3	0.8	3	0.8	4	1.1	6	1.7	27	7.6
13 - 24	55	15.4	26	**7.3**	3	0.8	12	**3.4**	13	3.7	99	27.0
25 - 36	77	21.6	58	**16.3**	11	**3.1**	28	**7.8**	07	1.9	174	49.9
37 - 48	25	7.0	08	2.3	0	0	2	0.5	0	0	35	9.9
49 - 60	04	1.1	0	0	0	0	0	0	0	0	04	1.1
Birth Weight												
≥ 250 g	173	48.6	95	26.7	16	4.5	47	13.2			311	87.61
< 250 g	16	4.5	4	1.1	2	0.5	2	0.5			24	6.8
Sex of a child												
Male	93	26.2	47	13.2	11	3.1	19	5.3			170	47.9
Female	96	27.0	52	**14.6**	7	**1.9**	30	**8.4**			185	52.1

Note: ***:** Age range with highest level of undernutrition

Further analysis showed that the highest rate of malnutrition as indicated by stunting, wasting and underweight increased with age and decreased as the children got older (Fig. 2.2). The increase was especially rapid during the second to the third years of life, as evidenced in the highest percentage of stunting rate of 23.6% from 13 to 36 months and underweight rate of 11.2% in the same age group. Nyaruhucha *et al.* (2006) reported similar results that children with age between 24 and 36 had high rate of malnutrition. Similar findings have also been reported in different countries for example in Nigeria, Kenya and rural India (Sarmistha, 1999; Kabubo-Mariara *et al.*, 2006; Babatunde, 2011). This trend may be explained by the fact that in some instances parents tend to give less attention to older children, especially when they give birth to a new child who needs more attention and care. Similarly, the time mothers introduce complementary foods, types of food used for complementary feeding; feeding practices by mothers or care-takers including number of meals given in a day and the feeding frequencies may also contribute to the problem.

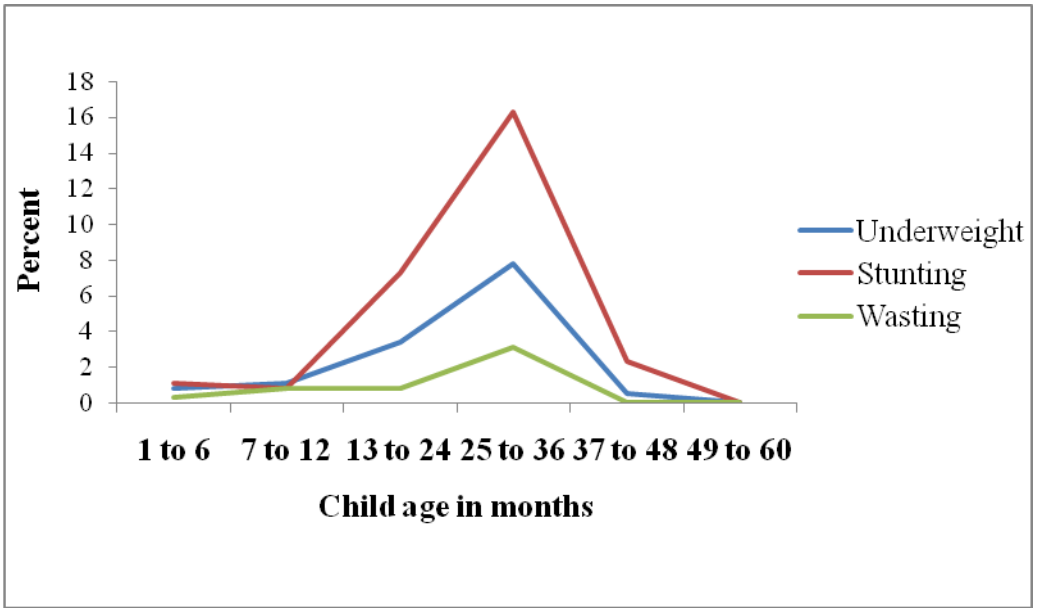

Figure 2.2: Trend of malnutrition (%) with age for children under-five

It is also worth noting that in some studies it has also been concluded that the problem of malnutrition is age sensitive, that younger children are less likely to be malnourished than older ones. This may be due to the fact that after weaning the children begin to get adequate nutrition when they get used to complementary feeding (Shrimpton *et al.,* 2001).

2.3.3 Under-five child care practices by the mothers/caregivers in Pangani District

Child care involves all measures and behaviours which are necessary to translate available resources (food and health) into good child growth and development. Improved under-five child care practices which start when the mother is pregnant and go all the way to proper feeding practices, immunization status and health care behaviour can have impact on child health (Ramji, 2009). In this paper child care practices focused on health seeking behaviour by the mothers during pregnancy, child vaccination status and feeding practices among children under-five years.

2.3.3.1 Health seeking behaviour by the mothers

Antenatal Care (ANC) coverage indicated good findings in the study areas since more than 90% of pregnant women had attended ANC (Table 2.3). The results also showed that 69.9% of the mothers had attended a minimum of four times; 19% had attended 2 to 3 times during pregnancy while only 6.2% did not remember the number of times they had attended to ANC. The majority of the children (80.6%) were born at health facilities including the district hospital, village/community health centres or dispensaries compared to 19.4% who were born at home with assistance of either TBA or assisted by relatives. Of all under-five children, 71.5% were fully immunized while 28.5% were partially immunized. Antenatal care links the mothers/care-takers with the formal health system, thus increase the chance of using skilled medical attendants at birth. This may guarantee the child with better care; educating mothers on feeding practices and care during illness as a result reduce the chances of undernutrition.

According to RS/RHMT (2013), Pangani District has 22 health facilities, one of them being the district hospital, 1 health centre and 20 dispensaries. The availability of these health facilities apparently guarantees accessibility of immunization facilities. In order for children to be fully immunized, they have to get the six required vaccines: BCG for tuberculosis, OPV for polio, DPT for diphtheria-tetanus- pertussis and measles.

Table 2.3: Utilization of health services and child care practices (n = 355)

Variable	n	%
Antenatal clinic visits		
None	22	6.2
1-3	69	19.4
4+	248	69.9
Place of delivery		
Home	69	19.4
Healthy facility	286	80.6
Type of delivery assistance		
Health professionals	266	74.9
Traditional Birth Attendant (TBA)	51	14.4
Relatives	38	10.7
Child immunization coverage is up to date		
Partially immunized	101	28.5
Fully immunized	254	71.5

Note: n = number of respondents, % = per cent

2.3.3.2 Infant feeding practices

The findings on infant feeding practices are presented in Table 2.4. The findings show that the majority of children 61.1% were breastfed within 30 minutes after birth. Although the prevalence of breastfeeding was higher compared to the nationwide status of 51% (TDHS-MIS, 2015-2016), the appropriate exclusive breast feeding was not practised. This was evidenced by the status of pre-lacteal feeding which shows that 27.6% of children were given plain water; 5.1% were fed with glucose or sugary water and 9.6% were given cow milk, baby formula and soft cassava porridge. This finding is supported by the FGDs. For example, during an FGD, one participant said: *"We give breast milk 2 to 3 days after delivery to allow mothers time to recover. In the meantime, we give warm sugary water, cow milk or cassava porridge to the baby to stop the child crying..."* (A woman participant in FGD, Mwera Village).

Inappropriate feeding practices and their consequences were also observed in a study by Safari *et al.* (2015). They ascertained that delayed initiation of breast milk deprives infants of the nutritional benefits of colostrum and is likely to increase risks of neonatal mortality

and impede nutritional status. Sub-optimal breastfeeding results in more than 800 000 under-five deaths annually worldwide. Of these, 22.3% of the neonatal deaths could be prevented if all children were breastfed in the first hour of their life (Liben *et al.,* 2016). WHO also recommends that an infant should be introduced to breast milk immediately after birth between 30 minutes to 1 hour (Black *et al*., 2013; WHO and UNICEF, 2013).

More than two-fifths (43.1%) of children were provided with complementary food at the age below 6 months, while 9.6% started being given such food after 6 months. The findings also showed that the majority of the children (72.1%) were fed 3 to 4 times a day, but that 20.6% of children who were fed once or twice a day. Although the findings indicated that the frequency of feeding was reasonably satisfactory, there was early introduction of complementary food. This implies that exclusive breast feeding is not well practised in the study area to the extent of threatening health of under-five children. This consequently triggers a risk of infection due to early introduction of other solid foodstuffs. During FGDs participant stated that "*I had to give my grandchild soft porridge because her mother breastfed her in the morning and went to the shore to work and returned late in the evening" ……* (A grandmother caring for a four-month old infant in Bweni Village). This result suggests a need for a further study to realize the impact of women's gender roles on child health focusing on undernutrition. Similar results were reported in a study done by Moshy *et al.* (2013) which covered Chole and Jibondo Island. They revealed that women resume sea weed farming after 40 days to sustain family income; as a result, they reduce breast feeding frequencies and opt for early introduction of complementary foods. According to WHO (2008), breast milk alone is the right food for children until the age of six months. After six months, a child needs a variety of foods in addition to breast milk to meet the additional requirements for energy and nutrients.

Table 2.4: Breastfeeding practices for children under-five years in Pangani District (n=355)

Variable	n	%
Breastfeeding immediately after birth (in hours)		
Within 30 minutes to 1 hour	217	61.1
After 2 hours to 24 hours	97	27.3
After 2 to 3 days	41	11.6
Child was given anything to eat/drink in the first 3 days		
None	205	57.7
Plain or sugary water	116	32.7
Cow or baby formula	34	9.6
Age at introduction of complimentary food (in months)		
Below 6 months	153	43.1
At 6 months	168	47.3
After 6 months	34	9.6
Duration of breastfeeding (in months)		
Still breastfeeding	120	33.8
Below 24 months	111	31.3
Within 24 months	108	30.4
After 24 months	16	4.5
Number of meals (per day)		
1- 2 times/day	73	20.6
3 - 4 times/day	256	72.1
5 – 6 times/day	26	7.3

Note: n = number of respondents, % = per cent

2.3.3.3 Dietary diversity

Dietary diversity among children under-five years in a week as described by parents and care givers is summarized in Fig. 2.3. The findings indicate that 85.6% of the parents and care givers reported that cereals and tubers are consumed on a daily basis; 3.1% mentioned beef and 3.1% mentioned that eggs are less consumed. Although the study was conducted among fishing communities, the findings revealed that the consumption of fish and fish products was less than 50%. This is partly due to low catch resulting from climate change. Paricipants in an FGD in Ushongo village said. "..*we don't get big and enough fish due to climate variability; we only eat sardines (called dagaa in Kiswahili). If at all we manage to get big fish we sell them all to sustain our income"*. This implies that a good catch is only meant for business, and families rely on sardines which are considered

as inferior. Although beef as well as chicken meat is not consumed on a daily basis but at least they are consumed two to three days in a week (55.8%), and dark green vegetables are consumed daily (31%) and two to three times in a week (40.3%). These results suggest that, apart from fish and fish products, beans and legumes are the most important sources of protein and dark green vegetables for minerals.

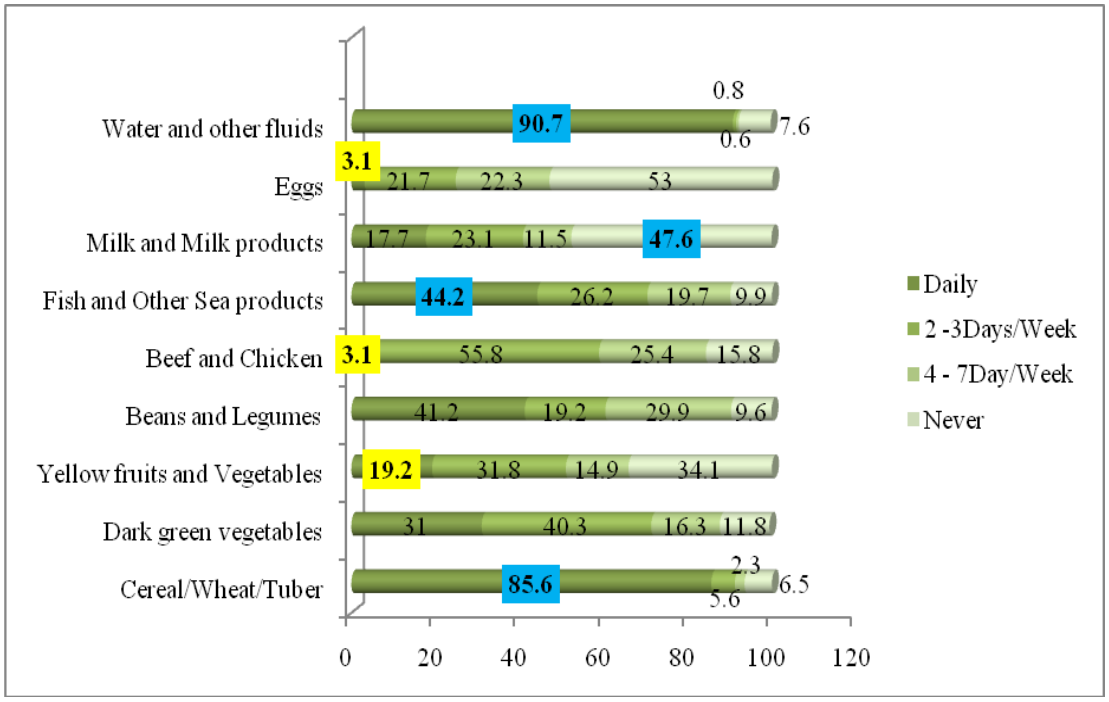

Figure 2.3: Dietary diversity and feeding frequency for children under-five in Pangani

One of the key informant interviewees (KIIs) confirmed that, "…*there is a problem of balancing diet; the majority of the community memebres depend on only stapple foods like cassava, maize, yams, and food made from wheat and rice. The main source of protein is beans; green vegetables are only consumed to supplement protein foods, but not as part of diet. Although Pangani District is leading in milk production in Tanga Region, but milk is only meant for business purposes and not for family consumption…"*(Acting District Nutritional Officer). These findings suggest that there is a need for a nutritional education

programme, especially for pregnant and nursing mothers on how to balance diet using locally available food items.

2.4 Influence of Individual Characteristics of a Child and Child Care Practices on Nutritional Status of Children Under-five

The influence of child's individual characteristics and care practices by mothers or care givers was subjected to binary logistic regression model in order to single out specific factors that have influence on a child being malnourished (stunted, underweight or wasted) or otherwise. In order to ensure the credibility of the results multi-collinearity was performed. The term refers to a relationship among independent variables in multiple regressions. Multi-collinearity exists when some pairs of independent variables are highly correlated i.e. $r \geq 0.9$ (Pallant, 2007). A goodness of fit test using the Omnibus Test Model of Coefficients showed the Chi-square of 60.221, p-value of 0.000 indicating that the model fitted well with the data. This was supported by the Hosmer and Lameshow test result of 8.356 with p-value of 0.401. The amount of variation in the variable gave a Cox and Snell R Square of 0.172 and a Nagelkerke of R Square of 0.473 implying that 17.2 to 47.3% of the variance in the outcome variable was explained by the variables that were entered in the model. ß-coefficient with positive or negative signs indicate the direction of the relationship between dependent and independent variables; either ß increases (positive sign) or decreases (negative sign) the likelihood of the problem of malnutrition to occur. Wald test measures the magnitude of the problem and p-value is for testing the significance of influence of the predictors.

The results in Table 2.5 show that sex of a child had the highest influence (Wald 15.99; $p \leq 0.001$) on the likelihood of a child being stunted. The negative coefficient ($ß = -1.08$) indicates that male children were less likely to be stunted than female children. These

findings confirmed the results of cross-tabulation (Table 3.5), which indicated that more female children were stunted than male children and therefore support the conclusion by Gibson (2002) that male children are more favoured in nutritional care than female children, something which puts female children at a higher risk of being malnourished compared to male children.

Table 2.5: Results of logistic regression on the influence of child individual characteristics and care practice by mothers on nutritional status of children under-five years (n=355)

Variables entered in the model	Stunting					Wasting					Underweight				
	ß	S.E	Wald	p-value	OR	ß	S.E	Wald	p-value	OR	ß	S.E	Wald	p-value	OR
Place of delivery	-0.683	0.405	**2.839**	**0.092**	0.505	-1.99	0.802	**6.210**	**0.013**	0.135	1.370	1.094	1.569	0.210	3.936
Delivery assistance	-0.840	0.380	**4.898**	**0.027**	0.432	-0.432	0.730	0.351	0.554	0.649	0.543	1.192	0.207	0.649	1.721
Sex of a child	-1.08	.272	**15.99**	**0.000**	0.337	-1.90	0.794	**5.756**	**0.016**	0.149	-0.002	0.933	0.000	0.998	0.998
Age of a child	0.112	0.153	0.538	0.463	1.119	-0.301	0.385	0.610	0.435	0.740	0.668	0.496	1.812	0.178	1.950
Have sibling U5	-0.153	0.328	0.218	.641	0.858	2.271	0.782	**8.435**	**0.004**	**9.689**	-4.12	1.120	**13.54**	**0.000**	.016
Immunization status	-0.312	0.318	.962	0.510	1.237	1.187	0.716	**2.744**	**0.098**	**3.276**	4.699	1.335	**12.38**	**0.000**	**59.82**
Essential ANC	-0.312	0.318	.962	0.327	0.732	-1.48	0.759	**3.840**	**0.050**	0.226	3.154	1.119	**7.949**	**0.005**	**23.43**
Breast fed after birth	0.108	0.332	.106	0.745	1.114	-.555	0.877	0.400	0.527	0.574	1.902	1.074	**3.135**	**0.077**	**6.696**
Exclusive breast feeding	0.241	0.272	.782	**0.027**	0.432	1.385	0.733	**3.564**	**0.059**	**3.994**	-1.09	1.027	1.142	0.285	0.334
Number of meals	-0.940	0.293	**10.29**	**0.001**	0.391	-0.817	0.754	1.173	0.279	0.442	-3.46	0.880	**15.46**	**0.000**	0.031
Constant	1.797	1.040	2.984	0.084	6.033	-0.778	2.14	0.131	0.717	0.459	0.508	3.094	0.027	0.870	1.662

Model fitting information: Omnibus test Chi-square = 60.221 (p = 0.000), Hosmer and Lameshow test = 8.356 (p = 0.401), -2 log likelihoods 83.81[a], Cox and Snell R^2 = 0.172, Nagelkerke R^2 = 0.473.

The findings indicated that appropriate exclusive breastfeeding has significant influence on undernutrition as shown by its association with stunting and wasting levels. Although the findings indicated a significant association with stunting but the influence was not that severe as the odds ratio was less than 1, meaning that for every child who was not exclusively breastfed the chances of being stunted were only by 0.432. However, exclusive breastfeeding indicated a significant influence on the child being wasted (ß = 3.564, Wald 3.994, p = 0.059). The Wald positive coefficient indicates that exclusive breastfeeding increases the chances of a child being not wasted. Similarly, number of meals given to a child per day had negative influence on a child being underweight (ß = -

3.46, Wald 15.46, p = 0.000). The negative coefficient of the number of meals given to a child in a day indicates that children who are fed more frequently in a day are less likely to be underweight.

During a FGD, participants said: "*children are fed with what is available and the feeding is done on demand and availability of the food…*" (A participant from Ushongo village). Children fed frequently with balanced meals are protected from malnutrition while infrequent child feeding contributes to child malnutrition. This is due to the fact that the child's stomach cannot accommodate a large amount of food at once (Smith and Haddad, 2000); during complementary feeding the food given to a child should be rich in nutrients or (balanced food) to promote developmental growth of a child. Feeding frequency has been found to protect children against malnutrition.

Empirical findings of this study suggest that there is a strong relationship between sib-ship size and the health outcomes. This is evidenced by the Wald statistics values, which showed that having siblings under-five in the same household had the highest negative impact (ß = -1.08, Wald = 8.435, p = 0.004) and (ß = 0.16, Wald = 13.54, p = 0.00) on the likelihood of children being wasted and underweight respectively. The odds ratio for number of sibling was 9.689, suggesting that having a sibling under-five years increases the chances of children being wasted by 9.689. The influence of number of siblings under-five years and health outcomes has also been explained by other researchers. For instance, Blake (1989) uses "Resource Dilution Model" to explain the relationship between sib-ship size and health outcome. The model posits that parental resources are finite and that as the number of children increases, the resources accrued by anyone child also decreases. This implies that the presence of more than one child in the household not only brings resource constraints but may also bring competition among siblings over resources as a result of

unequal health outcomes such as undernutrition.

Despite successful immunization coverage in the study area, the regression analysis showed that immunization status has significant influence on wasting and underweight as indicated by the odds ratio for wasting and for underweight, which were 3.2 and 59.82 respectively. This implies that poor immunization coverage has over 3 and 59 times likelihood of causing malnutrition (wasting and underweight respectively) than any other variable. Immunization status is one among the most important care practices which have significant influence on under-five nutritional status. Non-immunized children are at a high risk of increase or reoccurrence of infectious diseases and subsequently at risk of malnutrition or early death than fully immunized ones. The results also showed that Ante Natal Clinic (ANC) visits had the highest impact (Wald = 7.9, OR = 23.43) on the likelihood of children being underweight. This can be interpreted that ANC visits reduce the chances of having undernourished children. Ozor and Omuemu (2014) reported similar results that women who do not utilize pre-natal care are six times more likely to have low birth weight infants, which may lead to undernutrition.

In order to achieve the full life-serving potentials that ANC promises for women when pregnant and during delivery, at least four ANC visits providing essential evidence based interventions are required. Essential interventions on ANC include identification and management of obstetric complications, tetanus immunization, intermittent preventive treatment for malaria during pregnancy, and identification and management of infections including HIV, syphilis and other sexually transmitted diseases. Ante Natal Clinic is also an opportunity to promote the use of skilled attendants at birth and health behaviours such as breastfeeding. These findings coincide with the theoretical approach proposed by Becker 1965 and 1981 that a child's nutritional status reflects the combined effects of

many factors including dietary diversity, health, individual characteristics of a child and health behavioural factors governed by parents or caregivers.

2.5 Conclusions and Recommendations

This paper assessed the influence of child care practices on nutritional status of under-five children in Pangani District, Tanzania. Specifically, the chapter determined the level of undernutrition and analysed the child care practices among the households with children under-five years old. The study findings revealed that malnutrition is still a public health problem because of higher level of stunting which is above national level with wasting, which is also beyond the acceptable level. Although descriptive analysis indicated that malnutrition is age sensitive, but its influence on undernutrition was not statistically confirmed. Stunting and underweight was more profound in girls than in boys, meaning that malnutrition is more likely to affect girls than boys. Having another sibling under-five in the same household also showed a significant contribution to a child being wasted and underweight. Although overweight was not part of the study it pictured out in the results; therefore, specific attention is needed to determine its magnitude, causes and effects among under-five children in Pangani.

Descriptive analysis showed that nearly half of the children were given pre-lacteal feeding within three days after birth, and exclusive breastfeeding was not appropriately practised. These contributed to the status of malnutrition because children who were not exclusively breast fed were either underweight or wasted. Likewise, duration of breast feeding and number of meals given to the child in a day have impact on stunting and underweight. This implies that apt feeding practices play a major role in improving nutritional status of children under-five. This calls for emphasis on nutritional education and awareness on the importance of care practices on child health and development.

The influence of child care practices and nutritional status of under-five were well demonstrated in this chapter. It was observed that place of birth, kind of assistance mother received during delivery, ANC visits and immunization status were significantly associated with stunting, wasting and underweight. Children of mothers who delivered at health facilities under the assistance of health officers had lower chances of being malnourished. These results suggest that mothers who deliver at health facilities have opportunities of being served by health professionals and at the same time their new-borns have more access to vaccinations than otherwise. Therefore, delivery at health facilities guarantees the mothers opportunity to be served by health professionals and receive the entire required immunization for their child protection from infections which may lead to undernourished children.

Based on the above findings, this paper conclude that the problem of undernutrition observed in the study area was due to inappropriate feeding behaviours and child care practices by the mothers or care providers. The study therefore recommends that the Government and other relevant stakeholders dealing with child's health and nutrition should upscale educational interventions at household level on positive behavioural change communication strategies on child care and feeding practices, ANC, immunization and proper feeding behaviours. Along with this, it is high time for Nutritional Officers at the District level to conduct education programmes among the communities in their localities.

Finally, the paper recommends the following further studies: first that the contradiction of influence of sex and nutritional status needs to be explored in order to understand if the influence is based on social aspects or there is scientific explanation. Second, a further study should be done on the influence of maternal factors on under-five

nutritional status; and third a study should be done on how access to health services relates to health outcomes in order to rule out the influence of hospital delivery versus home delivery on the nutritional status of a child. The current chapter focused on the individual characteristics of a child rather than on household characteristics in general. Therefore, a follow up research should be directed towards understanding the influence of household socioeconomic characteristics on under-five nutritional status in order to devise appropriate measures which will assist directly the local communities.

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CHAPTER THREE

Household Socioeconomic Status and Undernutrition among Under-Five Children in Pangani District, Tanzania

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Abstract

Child malnutrition is among the major public health concerns worldwide, leading to higher morbidity and mortality among children under-five years old. Various studies have highlighted the factors associated with it, but limited researches have looked into the association between socioeconomic status (SES) and undernutrition at community and household levels. This manuscript quantifies the magnitude and examines the pattern of inequalities in undernutrition among children under-five years of age. Principal Component Analysis (PCA) was used to compute household wealth scores based on household assets and dwelling conditions as the main indicator of socioeconomic status.

Forty-seven items were used; of the 47 items entered for analysis, only 40 variables qualified for further analysis due to their low variances and standard deviations. A sample of 340 households with 355 children under-five years were used. The sample came from two geographical locations, the coastal (170 households and 181 children) and river side (170 households and 174 children). A concentration curve and an index were used to quantify inequality in undernutrition. Similarly, Emergency Nutrition Assessment (ENA) for SMART Software Version 2011 was used to generate nutrition indices for weight-for-height, height-for-age, and weight-for-age. The composite index of anthropometric failure (CIAF) was then used to measure undernutrition among children under-five years. The CIAF for the ocean side (20.2%) was higher than that for the River side (16.3%) for children under-five years. The concentration curves and index revealed unequally distribution of CIAF within the two areas of residence, thus confirming CIAF results. Finally, it was found that socioeconomic inequality in undernutrition exists in the study area with different scenarios, based on area of residence. Undernutrition is more affecting children on the ocean side as compared to those on the riverside. On the ocean side, undernutrition increases with increase in socioeconomic status while on the ocean side it decreases with increase in socioeconomic status. Thus, efforts to reduce undermatron in communities should be area focused and not generalized interventions.

Key words: Socioeconomic status, undernutrition inequality, children under-five, Pangani, Tanzania

3.1 Introduction

The Global Nutrition Report of 2016 indicates that the world has made a significant progress in combating malnutrition that many nations are in line to meet 2025 global nutrition targets of reducing undernutrition (IPRI, 2016). Despite this progress,

undernutrition remains the most significant challenge, causing about 45% of all deaths reported for children under-five in developing countries (Akombi *et al.*, 2017). Evidence shows that undernutrition and its consequences are not equally distributed throughout the world (UNICEF, 2013). According to the 2015 Millennium Development Goals report (MDG), the problem is more pronounced in sub-Saharan Africa and South Asia, mainly in poor communities within these regions (United Nations, 2015). Tanzania is among the countries with high undernutrition burden in East and Central Africa. According to the 2016 Tanzania Demographic Health Survey and Malaria Indicator Survey (TDHS-MIS), 34 % of children under-five are stunted; 14% are underweight and 5% are wasted (MoHCDGEC *et al.*, 2016). Although there was a significant reduction of undernutrition in Tanzania between 1996 and 2016 whereby stunting decreased from 48 to 34%, underweight from 24 to 14% and wasting from 7 to 5% (MoHCDGEC *et al.*, 2016), but the prevalence is still unacceptably high by the World Health Organization (WHO) standards. Therefore, efforts to reduce undernutrition among children under-five years in Tanzania are needed.

Undernutrition is a consequence of either acute or chronic nutrient deficiencies ensuing from low food and/or nutrient intake over a short or long period of time (Black *et al.*, 2008). The causes of undernutrition can be broadly categorized into immediate causes (insufficient diet, poor breastfeeding practices, early weaning, food taboos and personal choices related diet), underlying causes (household food insecurity, inadequate child care, low women's status, unhealthy environments, social and religious norms, gender equity and maternal access to education), and basic causes (poor availability and control of resources i.e. political, ideological and economic, and household socioeconomic status) (UNICEF, 1990). However, these causes differ from one area to another. Evidence reveals that undernutrition is correlated with poor health outcomes in adulthood, affects

cognitive as well as motor development and limits education attainment, ultimately perpetuating poverty (Black *et al.,* 2008). In order to formulate effective and efficient interventions for addressing undernutrition in a specific area, it is necessary to examine the factors contributing to it. Socioeconomic factors such as poverty, education and access to safe water and sanitation are among the important determinants of undernutrition among children under-five in many low-income countries (Silveira *et al.,* 2010). Available literature documenting socioeconomic inequality[1] in malnutrition focuses mainly on individual countries or regions. At the global level; Wagstaff and Watanabe (2003) and Van de Poel *et al*. (2008) provide evidence on socioeconomic inequalities in undernutrition across 20 and 40 developing countries respectively. Other relevant studies include those by Black *et al.* (2013) who estimated undernutrition for the top-bottom and wealth quintiles in a large set of data from 36 developing countries and that of Smith *et al.* (2005).

Studies conducted in Tanzania shed some light on the role of socioeconomic factors in influencing ill-health. Gwatkin *et al*. (2000) using data from developing countries observed inequalities between the poor and the least poor in mortality, nutrition and treatment of illness in Tanzania. Armstrong *et al*. (2003) made similar observation of poor/least poor inequities of childhood illness and health interventions using principal component analysis (PCA)[2] of household data in rural Tanzania. Abubakar *et al*. (2012) reported the prevalence and socioeconomic risk factors of stunting among children aged 1–13 months in Same Kilimanjaro whereby the stunting level was closely associated with sociodemographic factors such as maternal education and child characteristics. Chirande

[1] Socioeconomic inequality in malnutrition means the degree to which childhood malnutrition rates differ between more and less socially and economically advantaged groups.
[2] Principal Component Analysis (PCA) is a statistical technique which involves breaking down assets or household services into categorical or interval variables to obtain weight and principal components (Filmer and Pritchett, 1998).

et al. (2015) also conducted a population-based study to investigate the risk factors of stunting in Tanzania and noted that children from poorest households with no portable water were at more risks of undernutrition than their counterparts. Despite the available empirical evidence, the undernutrition of children under-fives within various population groups in Tanzania is still poorly understood. Data on nutritional statuses are mainly based on periodic demographic and health surveys; and hospital attendances as reported by Safari *et al*. (2015). There is thus a need to understand prevalence of undernutrition and related risk factors related to undernutrition and how they vary within and between various socioeconomic groups. This manuscript addresses the gap by examining the linkage between household socioeconomic status and undernutrition among children under-five years of age in fishing communities.

This manuscript is guided by a prominent conceptual framework on the study of nutritional status developed by UNICEF in 1997, and extended by Engle *et al.* (2000). The framework considers the causes of undernutrition in three groups: intermediate socioeconomic variables (household economic variables, economic status and family size), proximal factors including environment variables (type of house, house structure, type of latrines, and source of water) and distant factors (area of residence) which in turn influences health outcomes. The conceptual framework for this manuscript (Fig. 3.1) is based on the review of some of these variables with emphasis on the linkage between household socioeconomic status and area of residence as key descriptive independent variables. The framework further considers interaction of these variables that may directly or indirectly affect all sociodemographic variables of the head of household, which in turn may affect health outcomes.

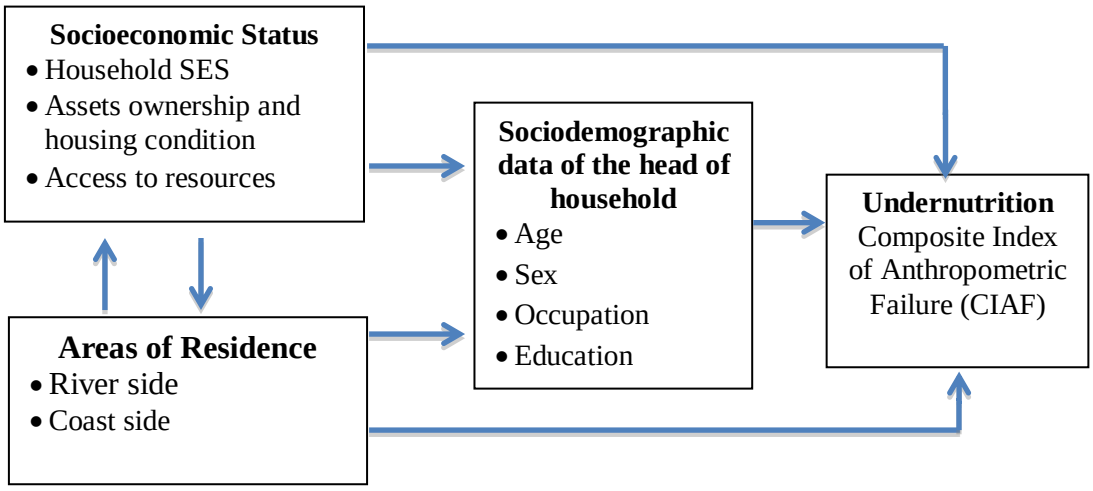

Figure 3.1: Conceptual framework adapted from UNICEF (1997) and Victoria *et al.* (1997)

Specifically, this manuscript: (i) establishes levels of undernutrition, (ii) examines how proxies for socioeconomic status (assets ownership, housing quality and sanitation) relate to undernutrition, and (iii) determines the pattern of undernutrition inequalities employing a concentration curves and index.

The findings for this manuscript contribute to the implementation of Sustainable Development Goal (SGD) Number 1, which emphasizes on ending poverty in all its forms, which is manifested in hunger, malnutrition, limited access to education and other basic needs. Furthermore, the manuscript intended to contribute to the implementation of SDG Number 2, which is about ending all forms of malnutrition for all people by 2030, including achieving the internationally agreed targets of 40% reduction in stunted children and maintaining wasting at less than 5% (IPRI, 2016). Additionally, the paper is in line with Goal Number 8, which promotes inclusive and sustainable economic growth. Thus, the benefit of sustainable economic growth will support and improve nutrition on a large scale targeting nutritionally vulnerable households (Alberman *et al.*, 2006). The

information from this manuscript thus provides a feedback on the progress for achieving these goals and provides insights to inform planning interventions for addressing undernutrition at local, regional and national levels. The information is also intended to inform programmes, projects and policy makers within the health system to recognize the existing inequalities between and within sub-groups so that health interventions can target the responsible population.

3.2 Materials and Methods

3.2.1 Description of the study area

The study was conducted in Pangani District, Tanga Region Tanzania. The District has the smallest area and population size than the other eight districts of the region. The District has two main distinct features, the riverside that collect its water from Mt Kilimanjaro and Mt Meru and empties itself into the coast side which is part of Indian Ocean. The Pangani River passes through the northern side of the town, separating the old buildings and the present-day market from the farms and small houses on the southern side. The river itself requires a ferry to cross, its dark brown waters filled heavily with silt as it meanders slowly into the ocean. Communities within the river side depend mostly on agriculture activities where the main cash crop is coconut. As elsewhere along the coastline of the Indian Ocean fishing is the major occupation of the people living in the coast area except for a few people; their livelihood depends directly or indirectly on agriculture, crop and livestock farming, income from petty trade and employment (RS/RHMT, 2013).

3.2.2 Research design and study population

A cross-sectional research design was used. The study population involved heads of households and mother/care takers of children under-five years old residing in the study

area. The residency of mother/care takers consider all mother/care taker who were residing in the study area at least three months prior to the survey. All mothers/care takers with children above five years who were not residing in the study areas were excluded from the study.

3.2.3 Sampling and sample size

Purposive sampling was used to select two divisions, Mwera (representing river side) and Pangani (representing ocean side). Finally, two wards from each division and two villages from each ward were randomly selected making a total of eight (8) villages. Purposive sampling was conducted to select households with children under-five years. The main sampling unit in this manuscript was head of household with mother(s) or care taker(s) of children under-five years. Eventually, a sample size of 340 households was determined by using Cochran's formula as adopted by Bartlett *et al*. (2001). Where a household had two or more children under-five years all were included in the sample, consequently a total of 355 children were involved in the study.

3.2.4 Data collection

A household survey questionnaire consisting of both open ended and close ended questions was used to collect information on assets and housing conditions for the purpose of building a household socioeconomic status as a proxy of household income. Chalasani (2012) suggests that, in the absence of income or expenditure data, proxies such as the assets-based wealth index can be used to assess household socioeconomic status.

Variables including weight, height, and birth weight were taken during household survey. An electronic SECA weighing machine with a scale graduation of 100 grams and a capacity of 26 kilograms was utilized for measuring weight of children with minimum

clothing and without shoes to the nearest 0.1 kg. Height of the children less than 24 months was measured in a recumbent position to the nearest 0.1 cm using a two pieces wooden base and a movable headpiece. Height of children above 24 months was measured in a standing position to the nearest 0.1 cm using a vertical board with a detachable sliding piece as recommended by Assaf *et al.* (2015). Additionally, socioeconomic inequality in undernutrition is measured by using concentration index that, takes into consideration the magnitude and direction of health inequalities across the entire socioeconomic distribution. The manuscript uses a composite index of anthropometry failure (CIAF)[3] initiated by Svedberg (2000) later modified by Nandy *et al.* (2006) as an alternative means to present data on child undernutrition at population level. This methodology combines data related to underweight, stunting and wasting to a single CIAF index in order to give a clearer picture of undernutrition.

3.2.5 Data analysis

Principal Component Analysis (PCA) was used to develop indicators of socioeconomic status (SES) based on a set of household assets and housing conditions. PCA is method that extracts few data that capture common information from a large set of variables. PCA, recommended by Filmer & Pritchett (1998), proved to yield good results in studies conducted in coastal and other areas of Tanzania as well as several developing countries (INDEPTH Network, 2005; Mwageni *et al.*, 2005). Using PCA, 47 variables were entered for analysis, but only 40 qualified for further analysis as the rest of the variables had low variances and zero standard deviations. McKenzie (2003) contends that variables with low standard deviations carry low weight for PCA and exhibit no variation between households therefore would be of little use in differentiating SES among households.

[3] Composite Index of Anthropometry Failure is a model that counts all children with wasting and/or stunting and/or underweight in six different groups and excludes all children with no anthropometric failure (Nandy *et al.*, 2006).

In order to establish if the PCA would produce reliable results, Bartlett test of sphericity and Kaiser-Meyer-Olkin (KMO) measures of sampling adequacy were performed. According to Pallant (2007), Bartlett test of sphericity should be significant ($p < 0.05$) for factor analysis to be considered appropriate. The KMO index ranges from 0 to 1, with 0.6 being suggested as the minimum value for a good factor analysis (Tabachnick and Fidell, 2007). The probability value for Bartlett's test was $p \leq 0.001$, and the overall the KMO test for household SES was 0.6. This means the data qualified for further analysis. Descriptive statistical analysis was performed to obtain principal components, scoring weights, means and standard deviations of the entered variables.

The results obtained were used to develop a socioeconomic status index based on the formula:

$Aj = f_1 \, x \, (a_{ji} - a_1)/ (S_1) + \ldots + f_N \, x \, (fa_{jN}\_a_N)/ (S_N)$ (Filmer and Pritchett, 1998).

Where: f_1 is the scoring weight for the first asset, x is the variable (asset or service) and aj is the value of the asset, $a_1$is the mean and S_1 standard deviation.

Based on this equation, socioeconomic statuses of the households surveyed were divided into quintiles to represent proxies for socioeconomic status. The 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 5^{th} quintiles were developed to assign households from poorest and least poor respectively. A bivariate analysis was performed to measure the level and trend of undernutrition across the households' wealth quintiles. A concentration index (CI) was applied to measure socioeconomic inequality in childhood undernutrition. The CI ranges between -1 to +1; a zero value implies the undernutrition is equally distributed across the socioeconomic groups. A negative value indicates that undernutrition is concentrated among the poorer or disadvantaged, while a positive value denotes undernutrition is concentrated among least poor or advantaged group.

Emergency Nutrition Assessment (ENA) for SMART Software Version 2011 was used to generate measurement indices of height-for-age, weight-for-age and weight-for-height. The indices generated were compared with standard reference values for WHO growth standard (WHO, 2006) to obtain Z-scores[4]. Specifically, the height-for-age Z-score, for example is obtained by: $Z = X- \mu/\sigma$ where X is the child's height-for-age; μ is the median height-for-age of the reference population of children of the same age and sex group; and σ is the standard deviation of the reference population.

In order to consider all undernourished children at a single point, this manuscript adopted an aggregate composite index of anthropometry failure (CIAF). Svedberg (2000) proposed six groups and later Nandy *et al*. (2005) modified the method by adding the seventh group. Based on this method, CIAF categorizes children into seven nutritional status groups. The first group includes children without anthropometric failure i.e. children with normal weight and height according to their weight and height. The second group includes only wasted children; the third group is of wasted and underweight children; the fourth group is of stunted, underweight and wasted children. The fifth group comprises stunted and underweight children; the sixth group is of only stunted children; and the final group is of only underweight children. The final CIAF, therefore, excludes the first group and is calculated by summing up the rest of the groups.

3.3 Results and Discussion

3.3.1 Sociodemographic characteristics of the respondents

Sociodemographic characteristics of the household heads are analysed in order to describe the sample population. Data on the household heads characteristics are summarized in

[5] A Z-score of -2 standard deviations is the most commonly adopted cut-off point for all nutrition indicators (Zewdie and Ababaw, 2013). In this study a child with Z-scores below -2 SD in respective nutritional status indicator was considered malnourished i.e. stunted, wasted or underweight (WHO, 2006).

Table 3.1. In terms of age, the majority of the respondents were in the age band 30-44 years; implying that a greater proportion of the heads of household were in their active reproductive age and were mature enough to take responsibilities of caring for children. The findings indicate that the majority of households in the study area were male headed (73.8%). The majority of the households (53%) had between four to six members. Education wise, the findings revealed that the majority of heads of household had primary education (71.2%), with 11.5% having completed secondary education. Very few heads of household had post-secondary education in the study area. Occupation wise, about a third (30%) reported that fishing was their main activity, followed by agriculture (23%) and formal employment (19%).

Table 3.1: Distribution of respondents by household sociodemographic characteristics (n = 340)

Variable	River side		Ocean side		All	
	n	%	n	%	n	%
Age (Yrs)						
15-29	39	11.4	15	4.4	54	15.9
30-44	77	22.6	84	24.7	161	47.4
45+	54	15.9	71	20.9	125	36.8
Sex						
Male	106	31.2	145	42.6	251	73.8
Female	64	18.8	25	7.3	89	26.2
Household size						
1 - 3	33	9.7	23	6.7	56	16.5
4 - 6	92	27.0	90	26.4	182	53.5
7 - 9	33	9.7	48	14.1	81	23.8
10+	12	3.5	9	2.6	21	6.2
Education level						
Not attended school	26	7.6	26	7.6	52	15.3
Primary education	122	35.9	120	35.3	242	71.2
Secondary education	18	5.3	21	6.2	39	11.5
Diploma education	4	1.2	3	0.8	7	2.1
Occupation						
Employment	50	14.7	15	4.4	65	19.1
Agriculture	41	12.1	36	10.6	77	22.6
Fishing	29	8.5	73	21.5	102	30.0
Livestock keeping	3	0.8	14	4.1	17	5.1
Others	47	13.8	32	9.4	79	23.2

Note: n=number of respondents, %=percentage

3.3.2 Analysis of undernutrition in Pangani district

The prevalence of undernutrition among children under-five is high in the study area. Based on ENA, the prevalence of wasting, underweight and stunting among under-five children were established at 27.9%, 13.9% and 5.1% respectively. Although the proportion of stunting (Table 3.2) is considerably lower than the per cent reported for Tanga Region (39.4%) as reported by MoHCDGEC *et al.* (2016), it is still higher than the acceptable WHO standard level of 20%. However, other researchers in Tanzania (Kejo *et al.,* 2018; Safari *et al.,* 2015; Black *et al.,* 2013) have reported an even higher prevalence of child undernutrition. The prevalence of stunting and wasting reported in this study is lower compared to one reported by the TDHS-MIS (2016), but it is still higher than the acceptable WHO standards level of reducing stunting to 20% and keeping wasting to below 5% (MoHCDGEC *et al.,* 2016).

Stunting has been reported by other researchers to be a common health problem in Tanzania (Chirande *et al.,* 2015, Mgongo *et al.,* 2017). The TDHS-MIS (2016) shows that, for of the past 10 years, there has been slow progress in reducing stunting rate among children under-five in Tanzania. According to Sustainable Development Goal (SDG) Number 2, the global stunting rate should be reduced by 20% by the year 2025. If we fail to reduce the stunting condition, children will be exposed to long term effects of stunting and may not reach their full growth potential (Black *et al.,* 2013). Specific interventions to target local factors influencing stunting among children under-five in fishing communities may help to reach the SDG goal by 2025. Furthermore, children were assessed for anthropometric failure based on CIAF, which permits disaggregation of undernutrition into five sub-groups. Individually, anthropometric indicators cannot measure the overall prevalence of undernutrition because they overlap; that is a child may have underweighted along with stunting and/or wasting, but the CIAF depicts an inclusive rate of

undernutrition. The CIAF results are presented in Table 3.2. Based on the data, 36.6% of children in the study population had multiple anthropometric failures. This implies that children under-five had more than one form of undernutrition problem.

Further analysis showed that children along the Ocean side were more vulnerable (20.6%) to undernutrition than those residing on the River side (16.1%). This may be due to the nature of activities performed by mothers on both sides which may favour or deny the opportunity to cater for under-five nutritional needs. The cultural behaviour may relate to gender-based role and responsibilities in child care, where in the ocean side the nature of activities performed by women do not allow mothers to care for children as they work on the shore. This could be due to the fact that in developing countries, mothers who leave home to undertake other economic activities often leave their young children in the care of older siblings, neighbours or relatives who often do not provide optimal care which might be the case in the ocean side of Pangani District. These may increase the chances of undernutrition as reported by other researchers such as Kejo *et al.* (2018). Therefore, assessing the level of undernutrition based on area of residence gives a clearer picture of which area is more prone to undernutrition than the other areas, hence in turn makes nutritional interventions more focused.

Although the CIAF result obtained (36.7%) was a bit lower than the national level (45.9%) as reported by Gupta (2017), but it demonstrated that a large number of undernourished children were included in CIAF. The results were not identified by using the normal method. Therefore, it is evident that using CIAF to assess nutritional status is more appropriate because CIAF offers a comprehensive measurement of undernutrition among children under-five years of age. This is in line with a study done by Shit *et al.*

(2012), which ascertained that, despite certain conceptual limitations, CIAF gives a near complete picture of undernutrition and helps prioritizing undernourished children.

Table 3.2: Nutrition status in Tanzania (TDHS-MIS 2016) compared to study area

Variable	Undernutrition in Tanzania (TDHS-MIS 2016) (%)	Undernutrition in Tanga (TDHS-MIS 2016) (%)	Undernutrition in Pangani (Survey data 2018) (%)
Undernutrition by anthropometric analysis			
Stunting	34	39.4	27.9
Underweight	14	13	13.9
Wasting	5	3.4	5.1
Undernutrition by CIAF			**36.9**
CIAF by sex of a child			
Male			22.8
Female			14.1
CIAF by area of residence			
Riverside			16.3
Coast side			20.2

Note: Nutrition indices of stunting, wasting and underweight only were calculated by ENA.

3.3.3 Status of undernutrition by sociodemographic characteristics of head of household

The level of undernutrition by sociodemographic characteristics of the head of household is summarized in Table 3.3. Analysis in the level of CIAF was based on sex of head of house and revealed that the majority of children with anthropometric failure were found in male-headed households compared to female-headed households. The possible reason is that women are more likely than men to spend their incomes on food and child welfare while men tend to spend more on personal consumption. In support of this, Donkon *et al.* (2014) showed that more female headed households spent greater percentages of their income on food than male headed households. Thus, where women are heads of households they are more autonomous and may exercise their power for the welfare of the

children. Surprisingly, majority of the children with anthropometric failure were found in households headed by people with primary education while those with no primary education were less affected. Parental education is expected to affect care-giving practices through the ability to model childcare behaviour for positive results. However, Glick and Sahn (1998) explain that, as a result of high education levels, women tend to join the working population, an activity that makes them not to have adequate time for breastfeeding and preparing nutritious food and making use of health services that would enhance the nutrition status of their children.

Table 3.3: Level of undernutrition of children under-five years based on CIAF by sociodemographic characteristics of the head of household (n=355)

Variable	Normal		Undernutrition	
	n	%	n	%
Sex of the head of household				
Male headed household	160	45.1	99	27.9
Female headed household	65	18.3	31	8.7
Education of the HH				
No Formal education	39	10.9	19	5.4
Primary education	158	44.5	92	25.9
Secondary education	23	6.5	17	4.8
Diploma	4	1.1	1	0.3
University	1	0.3	1	0.3
Occupation of the HH				
Employment	45	12.7	21	5.9
Agriculture	47	13.2	30	8.5
Fishing	67	18.9	46	12.9
Agriculture/Livestock/Fishing/ Business	22	6.2	**7**	1.9
Business only	44	12.4	26	7.3

Note: Nutrition was only calculated by CIAF

Analysis of CIAF based on occupation of the head of household was intended to establish whether certain economic activities offer opportunity for a better health over the others. Although this study was conducted in a fishing community, but fishing activities might not offer chances for better health because 12.9% of children with CIAF were found in the

households whose members were mainly engaged in fishing activities, followed by households whose members were mainly engaged in agriculture (8.5%).

3.3.4 Socioeconomic status index of households in Pangani District

An index of socioeconomic status was formulated by combining information on a set of household assets and dwelling conditions to obtain the index. The results of complete PCA are given in the screen plot (Figure 3.2). The Eigen value of the first component was used as scoring weight for each asset and service item. Based on PCA variance, the first component was explained by asset ownership (65.5%). Source of energy and sanitation explained almost similar variance at 15.7% and 15.2% respectively, while housing and living conditions explained the least variance at 3.6%. PCA results were used based on the formula proposed by Filmer and Pritchett (1998). The values obtained were used to assign each household to a wealth index value. These values were finally used to assign households into quintiles.

The assets ownership status, according to the socioeconomic status of the household, is summarized in Appendix 8. Certain types of assets owned and services accrued by members of households were almost similar in all five quintiles. For example, there was nearly equal ownership of some items in all the five quintiles thus making difficult to differentiate them. For example, there was even distribution between the poorer and the least poor in owning agricultural land, a house, livestock and bicycles.

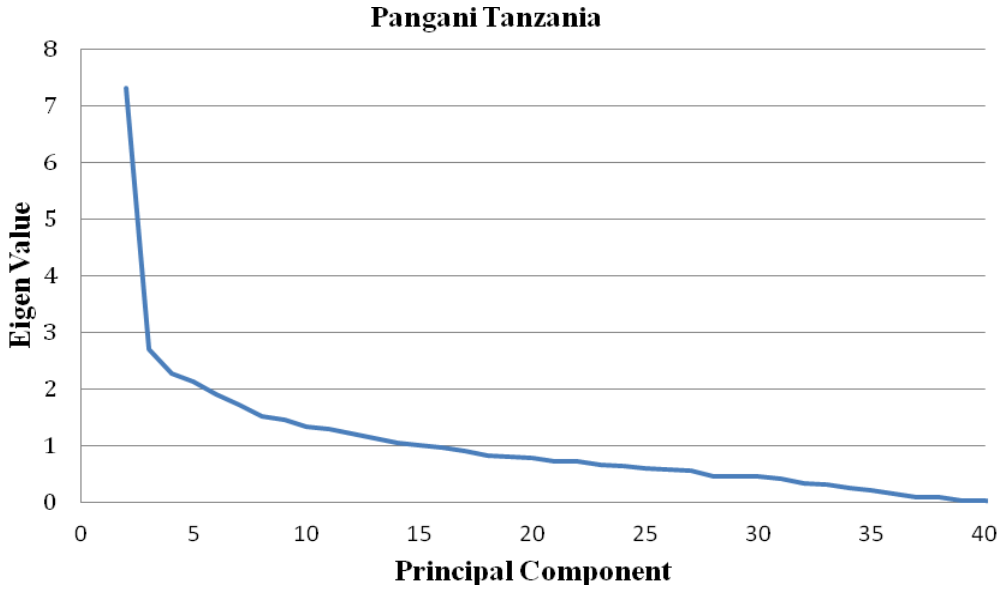

Figure 3.2: Screen plot of principal components and Eigen values

Vyas and Kumaranayake (2006) term this condition as a '*truncation*' problem, meaning that there is more even distribution of SES but spreading over a narrow range making the differentiation between the poorest and least poor difficult. Similarly, McKenzie (2003) explained another challenge of '*clumping*', that households are grouped together in a small number of distinct clusters. Despite all these, a general proportion of households possessing certain items based on socioeconomic status of that household reveals that the better off had more access to certain items and the poorest were below the average on most of the items. For example, the least poor were better off in using electricity as a source of light while the poorer depended more on kerosene and paraffin lamp. An interesting result was revealed in housing conditions where the households which were ranked lower on socioeconomic conditions were more likely to have their houses constructed with poles and mud while the better off were using cements and iron roofing. These observations indicate that assets ownership and living conditions tend to reflect socioeconomic status of the households as reported by Mwageni *et al*. (2005).

3.5 Undernutrition by wealth quintiles with inequality measures in Pangani District

The level of undernutrition as presented by CIAF shows the relationship between household socioeconomic status and health outcomes for the children under-five in the study area. Table 3.4 indicates how CIAF is distributed across different socioeconomic quintiles based on the area of residence. The findings show that the majority of children with CIAF were residing in the coast area (20.6%) as compared to those in the river side area (16.1%). These findings also portray interesting information that CIAF on the riverside decreases with increase in socioeconomic status while those on the coast side increase with increase in socioeconomic status. The data presented show that CIAF on the riverside was higher in the poorest quintile and lower in the rest of quintiles with discrepancy on the third quintile. For example, the proportions of undernutrition were high in the first and second (5.6%) socioeconomic quintiles in the riverside area, but decreased in the third quintile (1.4%) and increased again in the fourth socioeconomic quintile (2.25%). The discrepancy between socioeconomic quintiles and health outcomes has also been reported by Gwatkin *et al.* (2000). The homogeneity of scores within quintiles in Pangani district can confirm that when a community is too homogeneous or too heterogeneous there will be inconsistency relationship between health outcomes and socioeconomic quintiles.

Table 3.4: Undernutrition of children under-five years by wealth quintiles

Quintiles	Total number of children in quintile	Undernutrition in quintile	Undernutrition in the Coast side		Undernutrition in the River side	
			n	**%**	**n**	**%**
1st (Poorest)	69	27	07	1.97	20	5.6
2nd	76	32	12	3.4	20	5.6
3rd	68	18	13	3.7	05	1.4
4th	72	26	18	5.1	08	2.25
5th (Least Poor)	70	27	23 (	6.5	04	1.12
Total	**355**	**130**	**73**	**20.6**	**57**	**16.1**
Poorest – Least Poor Ratio				**0.304**		**5**

Note: Nutrition was only calculated by CIAF.

The concentration curves, along with concentration index, are widely used to measure inequality in health, its determinants and inequity in health utilization and ill health (Wagstaff *et al.,* 1991; Kakwani *et al.,* 1997; Wagastaff and Watanabe, 2003). Concentration curve is used to identify whether socioeconomic inequality in health variables exists and whether it is more pronounced at one point in time than at other points. It indicates the extent to which health indicators are concentrated among the disadvantaged or the advantaged. However, concentration curve does not give the magnitude of inequality for further comparison. Arriving at the components of concentration curve, this manuscript used wealth-disaggregated data from Pangani in Table 3.4. A cumulative fraction of children under-five ranked by wealth quintile is plotted on the x-axis against the cumulative fraction of children with CIAF on the River side and the Coast side respectively on the y-axis. The line of perfect equality (straight line in the middle) demonstrates how the curved line for each area of residence deviates from the line of perfect equality (Fig. 3.3).

It is clear that the households on the Coast side (the curve below the line of perfect equality) had more health-based relative inequality than households on the River side

because the line falls farther from the line of perfect equality. The CIAF on the River side (the curve above the line of perfect equality) is closer to the line of perfect equality indicating that there was more even distribution of ill health (undernutrition) within that particular community. Similarly, there was unequal distribution of CIAF on the Coast side as the curve deviates further from the line of equality. The result implies that undernutrition is unequally distributed among the poorer socioeconomic groups on the river side, while on the coast side undernutrition is concentrated in the least poor socioeconomic group.

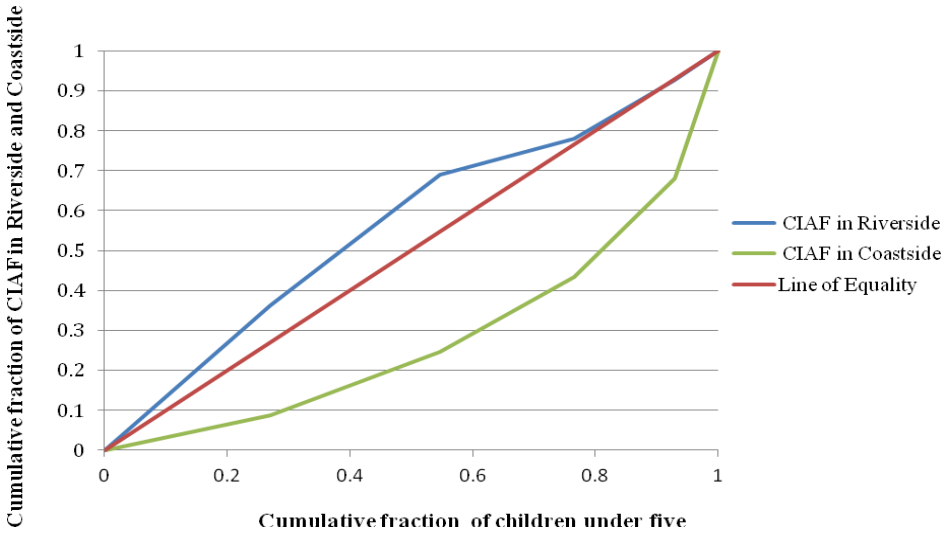

Figure 3.3: Relative wealth based inequality in CIAF represented using concentration curves

In order to ascertain the magnitude and nature of these inequalities, this manuscript computed CI to illustrate the pattern of undernutrition distribution across socioeconomic groups. The CI, which is directly related to concentration curve (Kakwani *et al.*, 1980, 1997), measures and compares the magnitude of socioeconomic inequality in health variables (Kakwani *et al.*, 1997) such as child child immunization (Gwatakin *et al.*, 2003), malnutrition (Wagstaff and Watanabe, 2003) and mortality (Wagastaff, 1991) and other

health related variables. Extending the information contained in each concentration curve and line of equality, we calculated the CI which is basically the area between concentration curve and the line of equality. The value of CI ranges between -1 and + 1 and the magnitude of the CI provides information about the strength of the relationship and the degree of variability in health outcomes. The closer the absolute value of the CI to one, the higher the degree of ineqaulity. Using the information in Table 3.5, CI for the River side and Coast side is summerzied based on the calculations indicated below.

Table 3.5: Wealth-based relative inequality in CIAF based on area of residence

Area of Residence	Household Wealth	Fraction of U5 with CIAF	Fraction of Under-five children	% of population with CIAF	Score	Concentration Index
Riverside	Quintile 1	0.344	0.271	0.729	0.5882	
	Quintile 2	0.310	0.276	0.453	0.3627	
	Quintile 3	0.120	0.218	0.235	0.0804	
	Quintile 4	0.137	0.164	0.071	0.0390	
	Quintile 5	0.086	0.071	0	0.0056	**-0.4269**
			Total score		**1.4269**	
Coast side	Quintile 1	0.083	0.11	0.88	0.1496	
	Quintile 2	0.152	0.14	0.74	0.2430	
	Quintile 3	0.194	0.18	0.56	0.2470	
	Quintile 4	0.259	0.25	0.31	0.2175	
	Quintile 5	0.319	0.31	0	0.0961	**0.0468**
			Total score		**0.9532**	

Note:
1. % of Popn U5 with CAIF: Adding up all fraction of population terms below that row
2. Score: Fraction of U5 with CIAF * (Faction of population + 2 * % of population with CIAF)
3. CI = 1- Total Score

The results reported in this manuscript show that household wealth again is the most important indicator in explaining health inequality. The CI on Riverside areas was -0.4269 while that in the ocean side was 0.0468. The negative sign of CI on the Riverside areas indicates that the problem of undernutrition in under-five children is more concentrated in low SES group while the positive sign indicates that undernutrition is more concentrated in the least poor quintile. Although the CI mirrored what was presented in the concentration curve in Figure 3.3, but it gives the magnitude and the direction of those inequalities. Wagstaff *et al.* (1991) mentioned that CI is the most appropriate measure of

health inequality, since it reflects the socioeconomic dimension to inequalities in health and the experience of the entire population. Furthermore, it is sensitive to changes in the distribution of population across socioeconomic groups. Therefore, this manuscript ephasizes on the use of CI in measuring health inequality in order to understand the magnitude of inequality for policy manner.

3.6 Conclusion and Recommendations

CIAF provides a comprehensive picture of the overall number of undernourished children in a population, which are not included in the traditional anthropometric analysis. This confirmed the importance of using CIAF in the place of traditional anthropometric analysis. Despite the sensitivity of PCA in differentiating SES, it is concluded that the use of PCA in differentiating socioeconomic index is sufficient enough to predict health outcomes; even where the communities are too homogeneous or heterogeneous using PCA makes it more appropriate for planning and informing policy.

Finally, this manuscript illustrates that socioeconomic inequality in undernutrition is present in the study area with different scenarios, based on area of residence. Predominantly, these two communities differ in economic activities, implying that assessing undernutrition based on areas of residence which are differentiated by economic activities is more important for policy action to be more focused. Therefore, it is concluded that not only does the degree of socioeconomic undernutrition matter, but also the pattern of inequality should be the concern of health policies. Basing on this study, efforts to reduce undernutrition in the riverside areas should focus on the poorer while in the ocean side areas more focus should be on the least poor. A follow up research on the influence of maternal socioeconomic status and undernutrition is important.

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CHAPTER FOUR

Maternal and Child Characteristics as Protective Factors for Child Nutritional Status in Pangani District, Tanzania

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Abstract

Undernutrition is attributed to various causes, including characteristics of the mother. Maternal health and height of the mothers have been identified several times in the literature as critical factors influencing child growth. However, the influence of maternal sociodemographic characteristics on undernutrition, especially among those population residing in rural settings has scantily been explored. This paper examined the influence of maternal variables on undernutrition among children under-five years in Pangani District. Data were collected from 340 mothers/caregivers-child pairs using a structured questionnaire, child hospital cards, and anthropometric measurements which were taken

from 355 children under-five years of age. Emergency Nutrition Assessment (ENA) for SMART (2011) software was used to generate indices for weight-for-height, height-for-age and weight-for-age. Thereafter, a composite index of anthropometric failure (CIAF) was used to measure undernutrition. Binary logistic regression analysis was used to measure the relationship between a categorical dependent variable and independent variables. The CIAF results indicated that undernutrition is still a health problem in Pangani District whereby male children were more undernourished (22.5%) compared to female children (14.1%). Ten variables were entered for analysis; of the 10 variables subjected to binary logistic analysis, four variables (education of the mother or caretaker, sex of the child, immunization status and marital status) significantly influenced undernutrition. Education of the mother was the strongest predictor of undernutrition of children under- five years ($\beta = 2.333$, Wald = 30.356, OR = 10.309, $p = 0.000$). It is concluded that undernutrition is still a problem in the study area. Education of the mother was found to be among the important factor influencing child undernutrition in Pangani district. It is recommended that the government, through the Ministry of Health, should ensure availability of health services and facilities close to the communities. Provision of quality education to transfer knowledge geared at empowering women to take actions regarding their health and the health of their children is also recommended.

Key words: Maternal characteristics, undernutrition, children under-five**,** Pangani, Tanzania

4.1 Introduction

Undernutrition remains a significant public health problem in many developing countries. According to WHO (2018), 52 million children under-five years of age are wasted; 17 million are severely wasted and 155 million are stunted. Although the Global Nutrition

Report of 2017 details the world's progress in reducing number of children under-five years who are chronically or acutely malnourished, the progress is not rapid enough to reduce these forms of malnutrition by 2030 (Development Initiative, 2017). In an effort to achieve this, the United Nations (UN) Sustainable Development Goals (SDGs) included incredible challenges to the world, which comprise an end to hunger and improving nutrition for all people by 2030 (Development Initiative, 2017). Despite the significant steps the world has taken towards achieving the set targets through the inclusion of SDGs targets in national policies and programmes, undernutrition remains a major considerable drawback to the success of the efforts (Akombi *et al.,* 2017). This particularly remains as an alarming public health concern in South Asian countries (Tariq *et al., 2*018) and in sub-Saharan Africa, especially in East and Central Africa (UN, 2015).

Tanzania is among the countries with the highest undernutrition burden in East and Central Africa. In order to overcome this, a number of programmes have been put in place and implemented in order to reduce child undernutrition. Such programmes include infants and young child feeding, sanitation, de-worming, Vitamin A supplementation and health education (MoHSW, 2008). As a way of understanding the progress and outcomes of these efforts, the Tanzania Demographic Health Survey and Malaria Indicator Survey (TDHS-MIS, 2015 - 2016) has been following up changes and reported a significant reduction of undernutrition between 1996 and 2016, that stunting decreased from 48 to 34%, wasting from 7 to 5% and underweight from 24 to 16% (MoHCDGEC *et al.*, 2016). Even with this reduction, the prevalence of undernutrition among children under-five in Tanzania is still disappointingly too high by the World Health organization (WHO) standards of reducing wasting to less than 5% and achieving 40% reduction of stunting by 2025 (FAO and WHO, 2018). In this regard, scholars need to carry out studies that could highlight factors leading to a slow pace in achieving the set standards and suggesting

effective measures that policy makers could devise in order to reduce undernutrition and achieve related SDGs.

Several studies carried out on the nutritional status of children under-five suggest that undernutrition is caused by many factors. Whereas some these studies have tried to focus on the general contributions of the maternal characteristics (Nyaruhucha *et al.,* 2006; Semali *et al.*, 2015; Safari *et al.,* 2015), many of these studies are area specific and have not fully explored the influence of maternal characteristics in relation to household variables on undernutrition among children under-five years. Additionally, like in many other developing countries, the empirical evidence on the cause of undernutrition is based on periodic demographic data and health surveys (Safari *et al.,* 2015). Consequently, little is understood on how these causes differ at the community level. Moreover, available statistics from TDHS-MIS, 2015 - 2016 have been hardly analysed to see the extent to which maternal characteristics influence undernutrition. Understanding the status of undernutrition and the prevailing determinants of it is an important stepping-stone to the strategies of overcoming the problem at the district level. Similarly, an accurate understanding of the causes of undernutrition and how they relate to each other is important for designing programmes and interventions aiming at reducing undernutrition at district, regional and national levels. Pangani District is of no exceptional as communities differ in terms of availability of health facilities, cultural backgrounds and economic activities.

The conceptual framework of this manuscript is informed by empirical literature review, which is based on traditional conceptual framework developed by UNICEF (1990), which was later modified by Victoria *et al*. (1997). The framework mainly explains the causes of undernutrition in view of three variables: intermediate (socioeconomic variables),

underlying factors (environmental variables at the household level) and the basic factors, which influence health outcomes. The conceptual framework adapted in this manuscript (Fig. 4.1) illustrates the relationship of child specific characteristics and maternal characteristics that act directly or indirectly through intervening variables to influence child nutrition status. The framework put forward role of these variables that act at a household level to influence nutritional outcomes. It provides a broader understanding of factors impacting on the nutrition status, emphasize the need to look beyond food needs of a population and address other underlying factors that directly or indirectly influence health as explained by UNICEF (2013). The likelihood of a child being undernourished is based on non-maximization of quality child care practices that the child receives which are essential for child health, growth and development. The quality of these child care practices in turn is determined by the sociodemographic characteristics of the mother and household status at which the child is born.

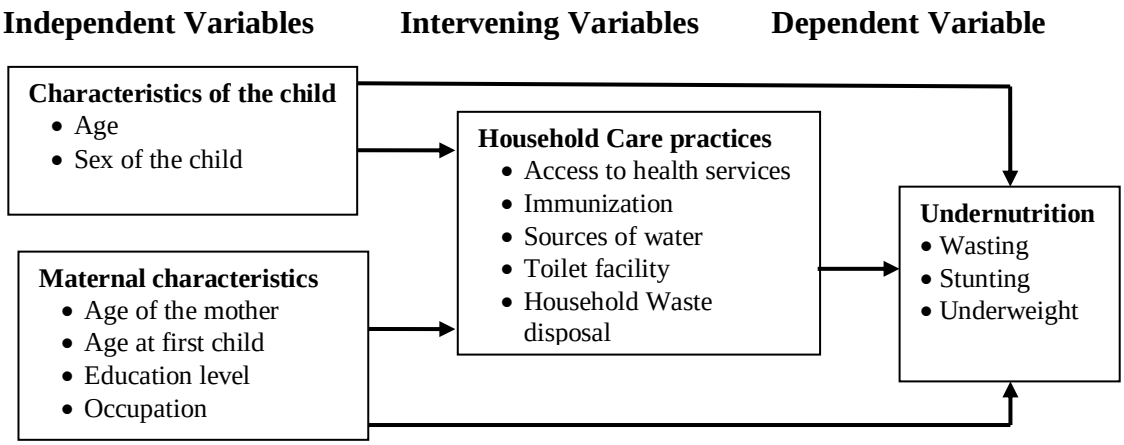

Figure 4.1: Relationship between maternal sociodemographic characteristics and undernutrition

Source: Adapted from UNICEF (1990) and Victoria *et al.* (1997)

Based on the review of these variables explained in the conceptual framework, this manuscript aims to see how these characteristics of the mother/caretaker relate to the health outcomes of children under-five years. Specifically, this manuscript (i) determined the sociodemographic characteristics of the mothers with children under-five years, (ii) assessed child care practices by the mothers/caretakers of children under-five years, and (iii) examined the influence of maternal characteristics and community variables on undernutrition among children under-five years in Pangani District.

4.2 Methodology

4.2.1 Description of the study district

The study was conducted in Pangani District. The District occupies the smallest area and population of the eight districts of Tanga region. It bordered by Handeni district to the West, the Indian Ocean with the islands of Zanzibar and Pemba to the East, Muheza district to the North and Bagamoyo district of the Coast Region to the South. Administratively, the District is divided into four divisions, 13 wards, 33 villages and 94 hamlets (RS/RHMT, 2013). The district has 22 health facilities, among which are one district hospital, one health centre and 20 dispensaries (RS/RHMT, 2013). The district was selected purposively because it has highest stunting rate among other districts along the coast of Indian Ocean (MoHCDGEC *et al.*, 2016). Choosing this area with highest stunting rate was aimed at understanding the magnitude of undernutrition and its determinants as well as understanding child care practices and socioeconomic well-being in the study area.

4.2.2 Research design

A cross–sectional research design was suitable for this manuscript because it entails the collection of data on a number of cases at single point in time and is suitable for

descriptive analysis and determination of relationship among variables (Bailey, 1994; Walliman, 2006). The design allows more than one method to be used at a time in which larger clusters are divided into smaller clusters (Kothari, 2004). Therefore, it was considered that this design was suitable to assess the influence of maternal characteristics on nutritional status of under-five children in Pangani District. The study population involved mother/care takers of children under-five years of age residing in Pangani and those who were willing to participate in the study. All mothers/care takers with children above five years, and those who were not willing to participate in the study and those who were not residing in the study areas were excluded from the study.

4.2.3 Sampling and sample size

Purposive sampling was used to select two divisions, Mwera (representing river side) and Pangani (representing ocean side). Two wards from each division and two villages from each ward were randomly selected, making a total of eight villages. Simple random sampling was then used to select households with children under-five years as a sample. The sample size was determined based on stunting prevalence in Pangani district of 49% (MoHCDGEC *et al.,* 2016) by using Cochran's formula as adopted by Bartlett *et al.* (2001). Based on the above formula, a total of 340 households were used in the study. Where a household had two or more children under-five years all were included in the sample, therefore a total of 355 children were involved in the study.

4.2.4 Data collection

Variables including weight, height, birth weight, age and sex of children were taken during home visits. Length of the children less than 24 months was measured in a recumbent position to the nearest 0.1 cm using a wooden base and a movable head piece. Height of children above 24 months was measured in a standing position to the nearest 0.1

cm using a vertical board with a detachable sliding piece (Assaf *et al.*, 2015). A household survey questionnaire which consisted of both open ended and close ended questions was used to obtain information on children. Four FGDs, one from each ward comprising 8 participants, were conducted in order to understand the depth of the qualitative information on care practices, access to community services and health related factors. Bryman (2004) and Barbour (2011) suggest that 6 to 12 participants are enough for effective participation and good quality data in FGDs for the reasons that if participants are too many some of them may just remain silent, and if they are too few they may not be able to discuss difficult topics effectively.

4.2.5 Data analysis

Emergency Nutrition Assessment (ENA) for SMART was used to generate measurement indices of height-for-age, weight-for-age, and weight-for-height. The indices generated were compared with standard reference values for WHO growth standard (2006) to obtain Z-scores[5]. In order to consider all undernourished children at a single point, this manuscript adopted an aggregate composite index of anthropometry failure (CIAF) as proposed by Svedberg (2000) later modified by Nandy *et al*. (2005). Binary logistic regression model was employed to determine the relationship between the dependent categorical variable and explanatory independent variables. Analysis of the results from the model focused on interpretation of β-coefficients for measuring the directions of the relationship; p-values for testing significance of the relationship, and odds ratios (EXP (B) values) for predicting the number of times various predictor variables have chances to occur relative to one another regarding the relationship between variables as explained in

[2] Z-score of -2 standard deviations is the most commonly adopted cut-off point for all nutrition indicators (Zewdie and Abebaw, 2013). In this study, a child with Z-scores below -2 SD in respective nutritional status indicator was considered malnourished i.e. stunted, wasted or underweight (WHO, 2006).

Pallant (2007) and undernutrition of children under-five years. The binary logistic regression model used is shown in the following equation.

$\text{Log } (P_i/1\text{-}P_i) = \beta_0 + \beta_1 X_1 + \beta_2 X_{2+} \ldots + \beta_{10} X_{10} + e$…… Equation

Where: $\text{Log } (P_i/1\text{-}P_i)$ = is the natural logarithm of the status of a child being malnourished (Undernutrition) or not, Pi = Probability of the i^{th} child being malnourished

$1\text{-}P_i$ = probability of the i^{th} child not being malnourished measure by CIAF

β_0 = Constant (Y- interception)

$\beta_1 - \beta_{15}$ = Logarithm of regression coefficient of independent (predictors) variables:

X_1= age of the mother/caretaker (years)

X_2 = Marital status of the mother/caretaker (1 = married; 0 = otherwise)

X_3 = Education of the mother/caretaker (years of schooling)

X_4 = Occupation of the mother/caretaker (1 = engaged with work outside home; 0 = otherwise)

X_5 = Access to nearby health facility (1 = Yes; 0 = No)

X_6 = Sex of the child (1 = Male; 0 = Female)

X_7 = Child Immunization status (1 = fully immunized; 0 = partially immunized)

X_8 = If child was sick or admitted two weeks before survey (1 = Yes; 0 = No)

X_9 = If a child received Vitamin A supplement (1 =Yes; 0 = No)

X_{10} = If a child received de worming tablets (1 = Yes; 0 = No)

4.3 Results and Discussion

4.3.1 Demographic characteristics of the mothers

A total of 340 mothers/care takers and child pairs were studied, consisting of 355 children under-five years because some of the mothers had more than one child under-five years. The sociodemographic characteristics of the mothers are summarized in Table 4.1. The findings revealed that the minimum and maximum ages of the mothers ranged between 18

and 48 years with the mean age of 28.48 years. Nearly half of the mothers (48.5%) were in the age group which ranged from 25 to 34 years, suggesting that a greater proportion of the mothers were at their active reproductive age, while 30.6% were young mothers with the age range from 14 to 24 years.

In analysing mothers' age at the time of delivering the first child, more than half (57.2 %) of the mothers had their first child at the age range from 15 to 18 years, indicating a high rate of early childbearing in Pangani District. Similar findings have also been reported by UNFPA (2013) that Tanzania is among the countries with highest adolescent pregnancy rate, with an estimated of 23% of girls between 15 and 19 years compared to the global adolescent pregnancy estimate of 19%. Early childbearing is reported to place girls at high health risks, and they are likely to die in childbirth (UNFPA, 2013).

Premature childbearing in Pangani District could be attributed to the culture of most coastal areas in which a girl is married soon after puberty. This may imply that the community in the study area violates a number of local and international legal instruments which define a child as a person below 18 years as explained in Nyange *et al*. (2016). Infants born to a mother below 18 years are likely to be undernourished due to nutrient competition between mother and unborn child. Thus, this manuscript may emphasize the value of delaying child bearing in the study population in order to adhere to the rights of the girl child but also reduce the chances of increasing undernutrition among children under-five years. The findings on occupation of the mothers show that the biggest proportion of the mothers (43.2%) were engaged in small businesses such as food vendors, selling vegetables and fruits, while 30.9% of the mothers were involved in fishing activities. Further analysis shows that 20% of the mothers were engaged in agricultural activities with only 5.9% being employed in different sectors. Although the

results indicate diverse income generating activities among the mothers, but the types of activities performed by the majority of the mothers provided an opportunity for the mothers to be with a child while working. Women's economic statuses in the household are likely to increase status power and may likely to reinforce their preference in spending their earnings on health and nutrition of their families.

Table 4.1: Sociodemographic characteristics of the mothers (n = 340)

Variable	n	%
Age of the Mothers (Yrs)		
14 - 24	104	30.6
25 - 34	165	48.5
35 - 44	70	20.6
45+	01	0.3
Age of the Mothers at First Child		
Below 14	133	37.5
15 - 18	203	57.2
19 - 30	04	1.1
Marital Status		
Single	42	12.4
Married	213	62.6
Divorced/Separated	46	13.5
Cohabitating	33	9.7
Widow	06	1.8
Education level		
Not attended school	61	12.9
Primary education	223	62.8
Secondary education	54	15.3
Post-Secondary Education	04	1.1
Occupation		
Employment	20	5.9
Agriculture	68	20
Fishing	105	30.9
Business	147	43.2

Note: n=number of respondents, %=percentage

4.3.2 Level of undernutrition among children under-five years

Out of 355 total of children under-five years, 47.9% were male and 52.9% were female (Table 4.2). The results for anthropometric analysis of children under-five years indicated the prevalence of stunting, underweight and wasting among children under-five years was 27.9, 13.8 and 5.1% respectively. Stunting is still recognized as a health problem; it was found to be higher (27.9%) than the acceptable WHO standard level of 20%. Similarly,

the level of wasting surpassed the national and acceptable level of 5% (MoHCDGEC *et al.,* 2016).

Table 4.2: Anthropometric analysis of children under-five years (n=355)

Age groups (in months)	Normal		Stunted		Wasted		Underweight		Overweight		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
1 - 6	06	1.7	4	1.1	1	0.3	3	0.8	5	1.4	**19**	5.4
7 - 12	11	3.1	3	0.8	3	0.8	4	1.1	6	1.7	**27**	7.6
13 - 24	42	11.8	26	**7.3**	3	0.8	12	**3.4**	13	3.7	**99**	27.0
25 - 36	71	20	57	**16.2**	12	**3.4**	28	**7.9**	07	1.9	**174**	49.9
37 - 48	23	6.5	9	2.5	0	0	2	0.6	0	0	**35**	9.9
49 - 60	04	1.1	0	0	0	0	0	0	0	0	**04**	1.1
Sex of a child												
Male	93	26.2	47	13.2	11	3.1	19	5.3			170	47.9
Female	96	27.0	52	**14.6**	7	**1.9**	30	**8.4**			185	52.1

Note: n = number of respondents, % = per cent

Further analysis was performed to measure the level of undernutrition based on CIAF, which permits disaggregation of undernutrition into six sub-groups as explained by Nandy *et al.* (2005). The CIAF results (Table 4.3) show a high prevalence of undernutrition (36.6%) in comparison with three other anthropometric indicators (stunting, underweight and wasting). Analysis of CIAF based on sex of a child indicated that more male children were undernourished compared to female children. This is contrary to what has been reported by Gibson (2005) that female children are often deprived of resources due to socio-cultural settings which favour male children in child care practices.

The relationship between sex of a child and nutritional status has been reported as favourable for male children, with discriminatory breastfeeding and supplementary practice for female children. Infant girls are breastfed less frequently, for short duration, and over short periods than boys. However, this is contradictory to what Wagstaff *et al*. (2003) and Chirwa and Ngalawa (2008) have reported that boys are generally prone to malnutrition than girls. This contradiction may suggest that the influence of child sex over

undernutrition is area specific and therefore any generalization of the findings from one area to another is unjust.

Table 4.3: Status of under-nutrition of children under-five years based on CIAF (n = 355)

Variables	n	%
No Failure		
Male	88	24.7
Female	137	38.6
CIAF (Wasting + Stunting + Underweight)		
Male	80	22.5
Female	50	14.1
Total	**355**	**100**

Note: n = number of respondents, % = per cent

The present manuscript shows a lower CIAF (36.6%) than the national level of 45.9% as reported by Gupta (2017), but indicates that large number of undernourished children is incorporated in the CIAF analysis as compared to anthropometric analysis. These findings, therefore, propose that using CIAF to assess nutritional status is more appropriate because CIAF offers a comprehensive measurement of undernutrition among children under-five. This is in line with a study done by Shits *et al*. (2012) which ascertained that, despite certain conceptual limitations, CIAF gives a near complete picture of undernutrition and helps prioritize undernourished children.

4.3.3 Child health care practices

Analysis of child care practices for this manuscript focuses on immunization status, incidences of illness and care for children during illness. The findings in Fig. 4.2 show that the majority of children (71.8%) were fully immunized while 28.1% were partially immunized. Further analysis indicated that 62.8 % of children above 2 years of aged had received all the basic vaccinations required for their age. Additional analysis indicated

that vitamin A supplementation for children aged 6 to 12 months was 69%, and de worming for children aged between 12 and 59 months was 64.2%.

The immunization status reported in this manuscript is lower than the immunization coverage reported by MoHCDGEC (2018) that Vitamin A supplementation and deworming were 78% and 79% respectively. The low status observed in this manuscript may be due to the fact that data collected are based on household surveys which include those children who may not be attending health facilities regularly. This is contrary to the MoHCDGEC (2018) report which is hospital-based and therefore includes all children who receive hospital services frequently including the possibility of receiving Vitamin A supplementation and de-worming. This manuscript may suggest the use of household survey data in reporting health status of children under-five in order to get the actual health situation rather depending on hospital visits which may not include those who do not have access to health services.

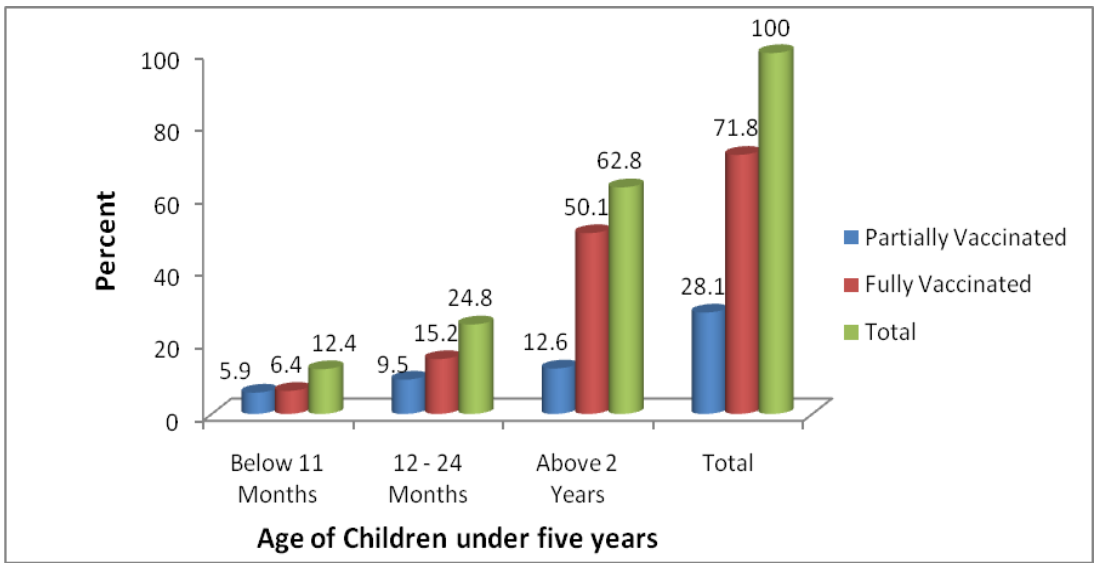

Figure 4.2: Immunization status for children under-five years (n = 355)

Health status of children shows that 47% of children under-five had suffered an illness two weeks prior to the study while 53% had not been sick. Of these, 21.7% suffered from diarrhoea; 19.7% suffered from fever; 9.6% were vomiting; 7.9% suffered from abdominal pain and 8.5% had other illnesses including respiratory infections and coughing. It was found that the majority of the respondents (72.4%) sought health care facilities for their sick children while 15.5% bought drugs from local drug stores, and 5.9% relied on self-medication. When asked how they fed their children during illness, the greatest proportion of the respondents (46.8%) forced them to eat, while 28.8% increased solid and soft foods; 20.3% gave them small amounts of food more frequently and 4.5% stopped solid food and continued breast feeding. Results from focus group discussions (FGD) reported mixed responses when asked what they gave to their children when they had diarrhoea, for example, participants reported that:

> "…. *we reduce breast feeding and give the children more water with little salt and sugar because if we continue breastfeeding them the problem of diarrhoea increases…"* (FGD Participants, Mwera Village, 4th November, 2016).

Similarly, the participants also agreed that:

> "…. *We usually feed our children more frequently and small amounts with more water and other fluids such as fruit juice whenever they are available …"* (FGD participants, Tungamaa Village, 6th November, 2016).

This result portrays minimum knowledge and information about care practices for children during illness in the study area. According to the adapted UNICEF conceptual framework, child care practice is among the immediate factors influencing undernutrition among children under-five years. Similarly, Raamji (2009) explained care practices including all actions and behaviors by the mothers or care taker related to feeding children, hygiene practices, home health practices and food preparation. Findings from

FGDs indicate that there was lack of proper knowledge and information on child care during illness which might endanger the health of children eventually increasing chances of undernutrition.

4.3.4 Proximate variables related to undernutrition

This manuscript assessed household characteristics including access to health services, water availability, toilet facilities and sanitation, which may directly or indirectly intervene the child health status. The results (Table 4.4) show that the majority (89.3%) had access to health facilities while 10.3% had no access to nearby health facilities. Among these respondents, 32.1% had access to the District hospital; 31.5% had access to village health posts; 14.4% had access to dispensaries and 11.8% had access to health centres. When asked if they were satisfied with the available services at the health centres, 35.6% of the respondents said that they were not satisfied. Participants in an FGD at Bweni village said:

> "…. *We have to pay for MCH cards in order to register for MCH clinic. Luckily, we had money to pay but those who didn't have money opted for not attending clinic …"* (FGD participants, Bweni Village, 8th November, 2016).

Although the district has an adequate number of health facilities including the district hospital, health centres and dispensaries (RS/RHMT, 2013), but these findings may suggest that the availability of health services may not guarantee the accessibility and quality of services to the community. This challenge has also been mentioned by Neke *et al.* (2018) that the availability of medicines, medical supplies, and equipment continue to affect the provision of quality services in many areas in Tanzania. While child care is one of the key components of the National Package for Essential Reproductive and Child Health Interventions (NPERCHI) which focus on improving the quality of live for women

and children, not all components of services are of good quality and provided to the scale. This is very much in agreement with the adapted UNICEF conceptual framework which shows that if access to health services is limited, the vulnerability to undernutrition among children under-five increases. The main source of household water supply was water taps (45.3%) and water wells in the residence and public areas (36.8%), while only 17.9% depended on other sources including rain water and seasonal ponds. Although the findings indicated that the majority of the respondents depended on public taps, but the availability of water from the public tap was unreliable. This was also mentioned in a FGD that:

> *"…. We have pipe water, but it's just a name; you can stay for a week without getting a single drop from the pipe…. then we have to go back to the well water which is too salty and unsafe…"* (FGD participants, Bweni Village, 8th November, 2016).

Table 4.4: Households' access to community health services (n = 340)

Variables	n	%
Access to nearby Health Facility		
District Hospital	109	32.1
Health Centre	40	11.8
Dispensary	49	14.4
Village Health Posts	107	31.5
No nearby health facility	35	10.3
Source of Water		
Public Piped water	154	45.3
Public well	125	36.8
Other sources	61	17.9
Type of Toilet Facility		
Bush or No Toilet Facility	36	10.6
Pit Latrine	217	63.8
Flush Toilet	87	25.6
Household waste disposal		
Public Dump	66	19.4
Household Damp	230	67.6
No proper place for waste disposal	44	12.9

Note: n=number of respondents, %=percentage

When asked if they were treating water to make it safe for drinking, the majority (60.3%) of the respondents said that they were treating it and mentioned that they were doing so by

boiling (29.4%), filtration (5.6%), use of chloride or water guard (1.8%) and other methods (2.1%). However, some people in the research areas were not treating water; in a FGD mothers said:

> *"... No need to treat water; it is safe to drink it since we get it from a deep well..."* (FGD participants, Tungamaa Village, 8th November, 2016). In another FGD, participants said *".... if you drink boiled water you get diarrhoea*…" (FGD, Langoni village 7th November, 2016).

Large outbreaks of acute watery diarrhoea and death usually affected most vulnerable groups in the research areas. Children were particularly affected by lack of access to safe water, and poor sanitations made them vulnerable to diarrhoea diseases. With limited access to safe water, no proper information on water treatment and lack of proper waste disposal place may promote water-borne diseases. This finding suggests that outbreaks of diseases and illnesses associated with shortage of water and unhygienic environment are likely to occur in the study communities thereby affecting vulnerable groups, including children under-five years. UNICEF (2010) cautions that poor sanitation and hygiene have many other serious repercussions which are health related problems caused by poor hygiene and consumption of contaminated water. Wagstaff *et al.* (2003) shares a similar concern that places for defecation, hand washing after using toilet and before touching any food, and safe drinking water influence occurrence of diarrhoea and other infectious diseases.

4.3.5 Maternal characteristics and child care practices influencing undernutrition among children under-five years

Binary logistic regression was used to single out specific maternal characteristics and care practices that have influence on undernutrition of children under-five years, which was

measured based on the level of CIAF. In order to ensure the credibility of the results, multi-collinearity analysis was performed. The term refers to a relationship among independent variables in multiple regressions. It exists when some pairs of independent variables are highly correlated i.e. $r \geq 0.9$ (Pallant, 2007). The findings indicated a Hosmer and Lameshow Goodness of fit result of 14.458 ($p = 0.071$) which is larger than 0.05 indicating that the overall model well predicted the outcome because Hosmer and Lameshow test Chi-square was not significant (Pallant, 2007; Field, 2013). The amount of variation in the variables gave a Cox and Snell R Square of 0.356 and a Nagelkerke of R Square of 0.488 meaning that 33.9 to 48.8% of the variance in the dependent variable was explained by the variables entered in the model. The Omnibus Chi-square was significant ($p = 0.000$) indicating that the overall model predicted the outcome well (Pallant, 2007; Field, 2013).

Analysis of the findings based on interpretation of; a ß-coefficient with a positive or negative sign indicates the direction of the relationship between dependent and independent variables; either ß increases (positive sign) or decreases (negative sign) the likelihood of the problem of malnutrition to occur. Wald test measures the magnitude of the problem and p-value is for testing the significance of influence of the predictors. A greater Wald statistic implies that the independent predictor variable associated with it has a higher contribution to the occurrence of the outcome variable.

The results of the binary logistic regression in Table 4.5 reveal that, among the ten (10) variables entered for analysis, four variables were found to be important determinants of undernutrition in the study area. Education of the mother was the strongest predictor of undernutrition; the Wald statistic was 30.356, demonstrating that education of the mother contributed significantly to predicting the chances of the child being undernourished. The

findings indicated further that the odds ratio for education of the mother was 10.309, implying that not having basic education for the mothers increased the chances of children being undernourished by about than 10 times. Based on the adapted UNICEF conceptual framework, household characteristics can exacerbate the problem of undernutrition through immediate factors such as education of the mother. Numerous studies have associated undernutrition with low parental educations, particularly mother's education. For example, Gwatkin *et al*. (2000) found that the prevalence of malnutrition is lower among children of educated mothers. Similarly, Safari *et al*. (2015) reported that, in Tanzania, stunting level declines with increase in education status of the mothers. The findings from this manuscript indicate that maternal education is among the important demographic determinants influencing undernutrition in the study area. Mother's education has a large positive influence on the nutrition status of the children (Dancer and Rammohan, 2009). At the household level, greater education for mothers contributes to acquisition of new skills, beliefs, and choices about sound health and nutritional practices that directly influence the proximate determinants of child health.

Children immunization status was another strangest predictor ($p = 0.005$) of undernutrition; it recorded an odds ratio of 5.372, implying that children who were not fully immunized were 5.372 times more likely to be undernourished than those children who were fully immunized.

Table 4.5: Maternal characteristics and care practices influencing undernutrition of children under-five years (n = 340)

Variables	Coefficient (B)	S.E.	Wald	Sig.	Exp(B)
Age of the mother	-0.190	0.306	0.385	0.535	0.827
Marital status of mother	0.961	0.330	**8.495**	**0.004**	2.615
Education of the mother	**2.333**	0.423	**30.356**	**0.000**	10.309
Occupation of the mother	-0.086	0.674	0.016	0.898	0.917
Access to nearby health facility	0.709	0.493	2.067	0.151	2.031
Access to safe water	-0.102	0.372	0.075	0.785	0.903
Sex of the child	0.989	0.301	**10.796**	**0.001**	2.688
Child immunization status	**1.681**	0.595	**7.983**	**0.005**	5.372
Vitamin A supplementation	0.046	0.641	0.005	0.942	1.048
De worming tablets	0.282	0.404	0.488	0.485	1.326

Model fitting information: Omnibus Tests of Model Coefficients (Chi-square = 139.065; sig. = 0.000), Hosmer and Lameshow test = 14.458 (p = 0.071), Cox and Snell R^2 = 0.337, Nagelkerke R^2 = 0.462.

Immunization status is among the important child care practices which had significant influence on nutritional status among children under-five years old. Non-immunized children are at higher risks of increasing or reoccurrence of illnesses; as a result, they end up being undernourished compared to fully immunized children. Undernutrition and incidence of illness have synergistic relationship that illness can suppress appetite, leading to nutrition deficiency which ends up with vulnerability to diseases and a vicious circle of undernutrition among children under-five years.

4.4 Conclusions and Recommendations

Although Tanzania has initiated a number of programmes and initiatives, undernutrition among under-five children is still unbridled in the study area. Stunting and wasting were above the WHO standards. Even when undernutrition was measured using CIAF, it was higher than regional levels. The use of CIAF provides a comprehensive picture of the level of undernutrition which is not seen in the individual anthropometric analysis.

Some maternal variables such as education of the mother, influence significantly undernutrition among children under-five years. Children from mothers who have basic

education are less likely to be undernourished than their counterparts. Therefore, health interventions explicitly targeted at educating mothers are likely to reduce undernutrition.

The immunization status is an important child care practice and the strongest predictor of child undernutrition. When a child receives all essential immunization based on the age, the chances of becoming undernourished are minimal.

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CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Major Results

5.1.1 Child care practices and undernutrition among children under-five years

The influence of care practices on the three indices of undernutrition is assessed in Chapter two. This covers the first and second objectives of this study. The objectives were guided by Becker's theoretical approach on macroeconomic model of production and allocation of resources. The findings show that the problem of undernutrition is still one of the health challenges among fishing communities as denoted by higher rates of stunting and wasting, which are higher than the acceptable levels by WHO. A comparison of stunting between male and female showed that more female children were stunted compared to male children. This finding contributes to gender aspects when analysing child undernutrition so that interventions can be more focused. Further analysis showed that undernutrition is age sensitive that increased with age increase and decreased as children got older.

Moreover, health seeking behaviours of the mothers as part of care practices is exhibited by successful ante natal visits (ANC) by the mothers during pregnancy. Although the incidence of pre-lacteal feeding was observed, successful exclusive breastfeeding behaviours and early initiation of breast milk soon after delivery were reported. The influence of child care practices on nutritional status of children under-five is well demonstrated. Immunization status, ANC visits and kind of assistance mother received during delivery were clearly associated with stunting, wasting and underweight. This concurs with the theoretical approach mentioned earlier (Sections 1.6) which emphasizes on the behaviours and practices of the mothers and care takers in providing quality care

for child's wellbeing and development. This is the case because the study findings on care and support of children were positively adhered to as per suggested model and theory. These findings have a policy allusion that calls for concerted efforts of development actors into the health sector that health services and quality health environment are maintained during pre- and post-natal times in order to get assured positive health results.

5.1.2 Household SES and undernutrition among children under-five years

Comparison results of SES among households between the river side and the coast side as well as comparison results of undernutrition between these two communities are discussed in Chapter three to address the third objective. In using household assets and dwelling conditions certain discrepancy occurred due to heterogeneity of the respondents in access to services. Despite the discrepancy, the use of PCA is sufficient enough to differentiate households into SES quintiles.

As hypothesized earlier (Section 1.5.2), levels of undernutrition differ between households with different SES in Pangani District. This is due to the fact that majority of the children with CIAF were residing in households on the Coast side compared to those who were residing on the River side. Furthermore, CIAF on the River side decreased with increase in SES while that on the Coast side increased with increase in SES. This means that the problem of undernutrition is not equally distributed within SES quintiles in the river side and in the coast side. In the river side, undernutrition was more distributed among the poorer; while in the coast side it was concentrated in the least poor socioeconomic group. This result is complemented by the values of concentration index and the nature of the concentration curve as it deviated from the line of perfect equality. Therefore, it is important not only to understand the degree of health inequality, but also the nature of inequality should matter for health interventions to be more focused.

In analysing undernutrition based on CIAF, majority of undernourished children were included in CIAF analysis as compared to traditional anthropometric analysis. Based on this, it is apparent that the use of CIAF remains a comprehensive measurement of undernutrition in the community where the research was done. In using PCA to analyse SES, discrepancies within quintiles occurred and made differentiating the poorer from the least poor a bit challenging. However, in this study it was found that the use of PCA was sufficient enough to predict SES inequalities within the quintiles.

5.1.3 Maternal sociodemographic characteristics and undernutrition among children under-five years

Maternal sociodemographic data and their influence on undernutrition are discussed in Chapter four addressing the fourth objective of the study. As hypothesized earlier (Section 1.5.2), some maternal factors and child-care practices were likely to influence the levels of undernutrition among children under-five years. The adapted conceptual framework in (Section 1.6) explicitly explains that household characteristics can exacerbate the problem of undernutrition through immediate factors such as sociodemographic characteristics of a mother. Early child bearing was revealed in Pangani District as majority of the mothers had their first child at the age range from 15 to 18 years. The premature child bearing revealed in the study area is largely attributed to the culture of most coast areas in which a girl is married soon after puberty.

The theoretical approach based on macroeconomic model of production and allocation of resources, care and support was used to explain the role of households' health inputs, nutrient intake, preventive and curative measures, and care givers have on health outcome of a child. Using binary logistic regression, education of the mother (Wald statistic = 30.356) significantly influenced undernutrition (well-nourished = 0, undernourished =1).

Similarly, immunization status was among the strongest predictors ($p = 0.005$) of undernutrition; it had an odds ratio of 5.372. These complement the importance of immunization status as part of care practice for positive health outcomes, and therefore concur with the hypothesis and support the adapted conceptual framework. The theory emphasizes on the behaviours and practices of the mothers or care takers in providing quality care for child's wellbeing and development. As such, the availability of health services and a healthy environment and the quality of care the woman receives during pre- and post-natal were maintained for positive health results. While minimum knowledge on care for children during illness with dissatisfaction of health services was realized, that calls for further research and policy actions.

5.2 Conclusions

As revealed in the findings, the prevalence of undernutrition in Pangani District is still high as indicated by higher levels of stunting and wasting. Immunization status, number of ANC visits by the mothers during pre-and post-natal are taking a more important role in child care practices. Despite being important, child care variables are still constrained by lack of nearby health facilities close to the communities in the study area. There is more inclusiveness of undernourished children when CIAF is used in the place of traditional anthropometric analysis, which means that when CIAF is used more it provides a comprehensive analysis of the problem of undernutrition. Although undernutrition is gender sensitive, when anthropometry analysis is performed more female children are found to be undernourished compared to male children. However when analysis is performed by using CIAF the results are oppposite. Therefore, any generalization on the influence of sex of a child on undernutrition is unjust.

Whilst using assets to obtain wealth index, internal consistency in ownership of some items occurred which made it difficult to differentiate the socioeconomic groups. Despite the sensitivity of PCA in differentiating the SES index, it is sufficient enough to differentiate SES quintiles even when the communities are very homogeneous or heterogeneous, making it more appropriate for planning and policy purposes and therefore contributing to the new body of knowledge. The use of concentration curve along with concentration index is very important because it makes the direction and the magnitude of health inequality to be realized. Although the household wealth is an important indicator in explaining health inequality, it is not always that the poorer are more disadvantaged.

Of the ten maternal variables analyzed, education of the mother was found to be the most important predictor of nutrition status of children under-five. It is well established that education is key in empowering women by giving them a sense of self-confidence in making decisions affecting their health and the health of their children. Although the findings did not show any significant association of undernutrition and community variables such as access to community services such as health facilities, water and sanitation; these variables are likely to increase the risk of infectious disease occurrence, which in turn contribute to undernutrition and creating a vicious cycle.

5.3 Recommendations

Apart from using anthropometric analysis in health survey, it is important to use CIAF because it provides a comprehensive and actual nutritional status which is not captured in the anthropometric analysis. Thus, this study recommends to the TDHS-MIS and other researchers to include CIAF in the analysis of nutritional status of children under-five, so that the actual nutritional status can be realized.

It is important to go beyond the socioeconomic status by looking into the nature of activities performed by the poorer and the least poor within socioeconomic groups. This will inform how these activities affect the health of their children and what opportunities are available to address the problem.

On the basis of conclusion that education of the mother is the most important predictor of nutrition status; universal basic education alone as emphasized by MGD 2 and SDG 4 is not sufficient to protect children against undernutrition. Thus, it is recommended that health and education providers to focus on quality education geared at empowering mothers/caretakers to take actions of matters affecting their health and health of their children.

The Government of Tanzania; through the Ministry of Health, Community Development, Gender, Elderly and Children; should work closely with the service providers at district levels to ensure health services are available close to the communities. Regular follow up visits to the service providers should be initiated by Local Government Authorities in order to ensure that free services offered by the government are not taken for granted by corrupt people who make others not to access the services based on financial constraints.

5.4 Contribution of the Study

5.4.1 Contribution to the Body of Knowledge

This study contributes to the existing literature that the determinants of nutritional status of children under-five years are area specific and vary across different socioeconomic groups. The study contributed towards the knowledge gap that children immunization status and education of the mother are empirically proved to influence undernutrition of children under-five years. In addition, this study contributes to the existing literature that

households' socioeconomic characteristics have an influence on health outcomes. The influence of sex of a child on undernutrition is still debatable in the sense that when anthropometric analysis was performed, more girls were undernourished, while in using CIAF more boys were undernourished**.** Chirwa and Ngalawa (2008) reported similar contradicting results. This suggests that more empirical information is required to contribute to the on-going debate on the influence of child sex on undernutrition so as to inform pertinent interventions. Therefore, the contribution of this study to the on-going debate is relevant in order to increase the scope of understanding of this relationship if it is biological, methodological or is based on scope of the study.

The study contributes to the existing literature that, despite heterogeneity or homogeneity of a community, the use of PCA in analysing SES of the community is sufficient enough to predict health outcomes inequalities within households' quintiles as long as additional analysis is performed.

5.4.2 Theoretical Reflections

The study employed a theoretical approach based on a macroeconomic model of production and allocation of resources, care and support. The theory suggests that a child's nutritional status measured by anthropometric indicators is related to a set of health inputs that could be child nutrients intake, preventive and curative medical care, and the quantity of time of the mother and care givers (Becker, 1965). The theory concurs with the findings in the sense that the immunization status was found to be among the important care practices for child health and development. Children who are immunized are protected from diseases which lead to disability or death. The role of parents and care givers on why, when, where and how many times the child should be immunized was well demonstrated in supporting the theory used. Basing on the theoretical framework for this

study, some of individual characteristics of a child such as sex of the child do not reflect the health outcomes, hence they did not concur with the theory.

The theory emphasizes on the behaviours and practices of the mothers or care takers in providing quality care for child's wellbeing and development (Engle *et al.,* 2000). The theory concurs with the study findings due to the fact that care and support of children by the mothers were positively adhered to as per suggested model and theory. As such, the availability of health services and a healthy environment and the quality of care the woman receives during pre- and post-natal were maintained for positive health results. While minimum knowledge on care for children during illness with dissatisfaction of health services was realized, that calls for further research and policy actions.

5.5 Areas for Further Research

The following areas for further research are recommended:

i. The study demonstrated that some individual characteristics of a child influence undernutrition. However, the influence of sex of a child needs further research in order to rule out who is more at undernutrition risks between male and female children so that health interventions can target the more disadvantaged group.

ii. This study exhibited that care practices by the mothers and/or care givers such as feeding practices are important aspects for child health outcomes. Thus, the thesis recommends that formative research should be conducted to study the actual practices of the mothers in order to learn their basic skills which can assist child-care education programmes suitable to local communities. This is in line with the need to understand their feeding behaviours in order to strengthen and improve child feeding practices.

iii. The study revealed that socioeconomic determinants of undernutrition are area specific. This leads to a recommendation on more studies on socioeconomic determinants of undernutrition in other communities such as among agriculturists, pastoralists, and other communities.

APPENDICES

Appendix 1: A copy of household questionnaire used in the research

SOKOINE UNIVERSITY OF AGRICULTURE

COLLEGE OF SOCIAL SCIENCES AND HUMANITIES

DEPARTMENT OF DEVELOPMENT STUDIES, P. O. BOX 3024, MOROGORO

A Household Questionnaire for a PhD Research on

Household Socioeconomic determinants of nutritional status of children under-five years in fishing communities in Pangani, Tanzania

By

Edna Harriet Mtoi, PhD Student

My name is Edna Harriet Mtoi, a PhD student at Sokoine University of Agriculture, Morogoro, Tanzania. This interview is part of a study on **"Household Socioeconomic determinants of nutritional status of children under-five years in fishing communities in Pangani, Tanzania".** I would like to ask you some questions related to household's economic activities, child care practices by the mothers and care taker of children and its effects on nutritional status of children under-five years. The study survey will involve measuring weight and height of children under-five years, getting information from head of households and mothers or caretakers of children under-five years. The interview will take about 30 to 40 minutes. The information you give will be confidential and only used for the purpose of this PhD research study. Therefore, please be free to give me your views and opinions truthfully.

A. PRELIMINARY INFORMATION

S/No.	Item	Details / Responses
	Date of Interview	
	Interviewer Serial Number	
1.	Division	
2.	Ward	
3.	Village	
4	Area of Residence	

B. HOUSEHOLD CHARACTERISTICS

1. Household profile

Member	Sex	Age in Years	Marital status	Education level	Occupation
B1 Household head					
B2					
B3					
B4					
B5					
B6					
B7					
B8					
B9					
B10					

Key Household Profile

Sex: 1= Male, 2= Female

Marital status: 1= Single, 2= Married, 3= Divorced, 4= Separated, 5= Widow/Widower

Formal education level: 1= No formal education, 2= Primary, 3= Secondary, 4= Diploma, 5= University degree

Occupation: 1=Employed, 2= Crop Farming, 3= Fishing, 4= Livestock Keeping 5= Self-employed, 6= Other (Specify) ----------

2. Household size……
3. Total number of children under-five years old in the household……..
4. What is the ownership status of the house you are living in? 1. Rented 2. Family house, 3. Government free house, 4. Inherited house, 5. Others (specify)

C. SOCIOECONOMIC STATUS OF THE HOUSEHOLD

5. What is the main source of income for the household? 1=Employed, 2= Crop Farming, 3= Fishing, 4= Livestock Keeping 5= Self-employed, 6= Other (Specify) ----------
6. Does your household involved in fishing activities? If yes, how is the fishing condition? ----------If no, skip the follow up question.
7. What kind of fishing activities does the family involved with? 1=Boat owner, 2=Fishermen, 3=Crew member, 4=Maintenance work; 5= harvesting fish products, 6=Others (Specify) ----------

In question 8 to 13 I am going to ask you (or rather observe) materials used for construction of household and assets ownership among members of your household. Record observation), mark only one.

8. What kind of toilet facility do the members of your household usually use?

Variable	**Response (Yes =1, No = 0**	
Bush or no toilet facility		
Pit latrine on the compound		
Neighbour pit latrine		
Flush toilet in the compound		
Other (specify)		

9. What is the main source of energy for cooking in this household?

Variable	**Response (Yes =1, No = 0**	
Electricity		
Kerosene/Paraffin		
Gas		
Charcoal		
Firewood		
Other (specify)		

10. What is the main source of lighting for this household?

Variable	**Response (Yes =1, No = 0**	
Electricity		
Kerosene/Paraffin		
Solar		
Candle		
Other (specify)		

11. What are the walls of this household made of?

Variable	**Response (Yes =1, No = 0**	
Grass		
Pole and mud		
Bricks (Mud)		
Bricks (Cement)		
Stones		
Other (specify)		

12. What is the roof of this household made of?

Variable	**Response (Yes =1, No = 0**	
Grass		
Iron sheet		
Concrete		
Asbestos		
Other (specify)		

13. What is the main material for the floor?

Variable	**Response (Yes =1, No = 0**	
Earth/Sand		
Wood/Palm		
Polished wood		
Cement		
Tiles/Terrazzo		
Carpet		
Other (specify)		

14. How Many rooms are used for sleeping in this household…….?.

15. Does anyone in this household own any of the following items?

Variable	**Response (Yes=1, No =0**	
A house		
A watch/clock		
A paraffin lamp		
Agriculture land		
A mobile telephone		
Water pump		
A bicycle		
Equipment for livelihood (axe, hoe, etc.)		
Refrigerator/deep freezer		
A radio		
A satellite dish		
An iron (charcoal/electricity)		
Fishing equipment (canoe/fishing net, etc)		
Motor bike		
Sofa set/Timber chair		
Television set		
Solar power		
Car		
Livestock (cow/goat/poultry)		
Sewing machine		

D. CHARACTERISTICS OF A MOTHER (In the absence of a mother, a caretaker can provide the required information)

Please use additional space (in the same questionnaire) if more than one mother or caretaker of children under-five is residing in the same household.

16. Age of the mother ---------- Number of live birth ----------
17. How old were you when you had your first child? 1=below 18 years, 2=19 – 30 years, 3=31 – 40 years, 4=above 40 years.
18. What is the marital status of the mother or caretaker? 1= Single, 2= Married, 3= Divorced, 4= Separated, 5= Widow/Widower
19. What is formal education level of the mother or caretaker?1= No formal education, 2= Primary, 3= Secondary, 4= Diploma, 5= University degree
20. Main occupation of the mother or caretaker: 1=Employed, 2= Crop Farming, 3= Fishing, 4= Livestock Keeping 5= Self-employed, 6= Other (Specify) ---------
21. If working outside the house, who is taking care of the child in your absence? 1=Mother, 2=older sibling, 3=neighbour, 4=caretaker (specify)----------, 5=other (specify)----------
22. Did the mother received ante natal clinic for this pregnancy? 1=Yes (How many visits) ----------2=No (reasons for not attending the clinic) ----------
23. Where was this chi born? 1=Home, 2=health facility
24. Who assisted you with the delivery of this child? 1=Health professional (Doctor/Nurse/Midwife), 2=village/community health worker, 3=Traditional Birth Attendants (TBA), 4=Relative/family member, 5=other (explain)----------
25. If home delivery, what are the reasons for not using health facility? ----------

E. AVAILAIBILITY AND ACCESS TO COMMUNITY SERVICES

26. What is the type of health services which is available near to your household? 1=Hospital, 2=Dispensary, 3=Community health centre, 4=Village health centre, 5=Other (specify)----------
27. How far is the nearest hospital facility? ----------
28. If you had to go to the nearest health facility, how would you get there? 1=Motorcycle, 2=Walking, 3= Public transport, 4= other (specify)
29. Are you satisfied with the services offered at the health facilities? 1=yes, 2=no. If no, what are the reasons for dissatisfaction? ----------
30. What is the main source of drinking water for this household? 1=Piped water in the dwelling, 2=piped water in public, 3=well in dwelling, 4=well in public, 5=surface water, 6=rain water harvesting, 7=other (specify) ----------

31. How you treat household waste products? 1=Throw away to the public dump, 2=burn in private pit, 3= throw away to the household dump, 4= no proper place for dumping waste products.

D. GENERAL INFORMATION OF CHILDREN UNDER-YEARS OLD.

32. Anthropometric information of a child (**Pease use additional space if more one children under-five years is residing in the same household**)

Anthropometric Data	
A child has MCH card (1=Yes, 2=No)	
Date of birth	
Birth weight (in kilogram)	
Sex (1=Male, 2=Female)	
Current child weight (in kilogram)	
Current child height (in centimetre)	
Bilateral pitting oedema (1=Yes, 2=No)	
A child was born prematurely (1=Yes, 2=No)	
A child has a sibling under-five years (1=Yes, 2=No)	

33. How soon after birth a child was put on mother's breast?1=Within 3 hours, 2=4 – 24 hours, 3=After 24 hours, 4=No not remember, 5=Never put on the mother's breast

34. Was the child given anything to eat or drink other than mother's milk during the first three days after delivery? 1=Yes, 2=No. If yes, please specify.1=Plain water, 2=sugary water or glucose, 3= powdered or fresh animal milk, 4=other (specify) ----------

35. Is the child immunization status up to date (based on his/her age)?

Type of vaccine or service received based on child age	**Response (Yes =1, No = 0**	
BGC		
DPT		
Polio vaccine		
Measles vaccines		
Vitamin A		
De-worming		
Other (specify)		

36. Vaccination status 1=appropriately vaccinated, 2=partially vaccinated, never received any vaccination.

37. If not or partially vaccinated, what are the reasons for not receiving or completing the required vaccination? 1=do not know the importance of vaccination, 2=health facility if far from the community, 3=other reasons (specify) ----------
38. Was the child undergoing treatment or being sick or admitted to hospital in the past three weeks? 1=Yes, 2=no

39. What were the common illnesses during those three weeks?

Common illness	**Response (Yes =1, No = 0**	
Diarrhoea		
Vomiting		
Abdominal pain		
Fever (malaria)		
Respiratory infections		
Urinary truck infection		
Other (specify)		

40. In case of illness, where do you normally seeking treatment? 1=Health facility, 2=drug store, 3= self-medication, 4= traditional medicine, 5=faith leaders, 6=other (specify).

D. BREAST FEEDING AND COMPLEMENTARY FEEDING

41. Are you currently breastfeeding the child? 1. Yes 2. No
42. I not breastfeeding, how old was the child when you completely stopped breastfeeding? ----------Months, ----------years.
43. Why did you stop breastfeeding the child? 1=childe was old enough, 2=child did not want breast milk, 3=child did not have enough breast milk, 4=other reasons (specify) ----------
44. How old was the child when you start to give other solid foods? ----------Months, ----------years.
45. How many meals does the child eat per day? ---------- Meals.
46. How do you feed the child when is sick? 1=increase fluid and soft food, 2=stop solid food and breast fed only, 3=give small amount of food more frequently, 4=force the child to eat, 5=other (specify) ----------

47. What type of food was the child introduces to in the past 7 days (Tick all that are relevant)?

Food Items	**Daily**	**1 – 3 days**	**4 – 7 days**	**Never**
Food made from cereals, wheat flour, roots, tubers and plantain				
Dark green leafy vegetables				
Yellow /orange fruits & vegetables such as carrots, pumpkin, sweet potatoes, papaya				
Beans, lentils and legumes				
Meat (beef/goat/chicken) any other type of meat				
Fish & other sea foods and products				
Milk and milk products				
Water and other fruit juices				
Eggs				
Other food (specify)				

Thank you for your cooperation

Appendix 2: A copy of Focus Group Discussion Interview Guide

Household socioeconomic determinants of nutritional status of children under-five years in fishing communities in Pangani, Tanzania

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Step 1: Introduction.

I wish to thank you all for your willingness to participant in this group discussion. My name is Edna Harriet Mtoi and my colleagues are Habiba, Mohamed and David. The household socioeconomic determinants of nutritional status of children under-five years in fishing communities in Pangani, is part of PhD research study as per Sokoine University of Agriculture post-graduate's guideline. The purpose is this session is to learn more how household socioeconomic factors influence undernutrition in your community. As children's parents/caretakers, you have a lot of experience in child care practices and the importance of nutrition for growth and development. The knowledge you share with will help us inform service delivery institution and the Government to make guidelines for children nutritional care. All information provided here will be confidential and will only be shared with relevant people at different levels. We would like, with your permission, to record this discussion so that no information is missed. This session is expected to last for 30 minutes to 1 hour.

Note time discussion starts .....hr.....minutes

Step2: Questions guide for FGD

1. What do you understand with the term malnutrition and what does it involve?
2. When children nutritional status is inadequate, what can happen to the child? (Types of malnutrition, signs and symptoms, treatment of malnutrition).
3. What do we require to provide good nutrition to our children? (Try to identify factors that influence children nutritional status directly such as feeding practices, environmental factors, health care, economic status, cultural and traditional practices).
    - ✓ Feeding practices (breastfeeding practices, types of complementary feeding, what are some introductory foods given to children)
    - ✓ Health care (Pre-and Post-natal ANC, management of childhood diseases, vaccination, food supplementation, de-worming).
    - ✓ Environmental factors (food hygiene, waste disposal, water sources).

- ✓ Socio economic (source of income for household, occupation, level of education)

4. How do cultural and traditional practices influence children nutritional status (food limitation, taboos, feeding practices, health seeking behaviour, etc).
5. When children nutritional status is inadequate, what can happen to the child? Types of malnutrition, signs and symptoms, treatment of malnutrition).
6. What are the major challenges experienced children care givers in their bid to provide appropriate nutrition for the children. (Try to understand underlying and basic factors that influence nutrition).
7. How can we reduce malnutrition in children?
8. Is there any benefit for pregnant women to check for her HIV/AIDS status and that of the child after delivery?

Step 3: Dismissing the participants.

Thank you for your participation and contribution to this discussion. The information you have given us will help us inform the health service delivery accordingly.

Thank you for your cooperation

Appendix 3: A copy of key Informant Interview Guide Questions for Village Leaders

Household socioeconomic determinants of nutritional status of children under-five years in fishing communities in Pangani, Tanzania

Key Informants Interview Guide

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1. What in your opinion on the current nutritional status of children under
2. What are the contributing factors to the current nutritional status?
3. Explain the existing efforts which work best in this area for improving child nutrition and reducing undernutrition of children under-five years.
4. What are culture or traditional believes and/or practices which have impact on health of the mothers and children in the community.
5. How do men and women cope with cultural or traditional believes which have impact on undernutrition of children under-five years.

Thank you for your cooperation

Appendix 4: A copy of key Informant Interview Guide Questions for Health Officer

Household socioeconomic determinants of nutritional status of children under-five years in fishing communities in Pangani, Tanzania

Key Informants Interview Guide

1. What is your general observation on the current nutritional status of children under-five years in the community?
2. What are the contributing factors to the current nutritional status?
3. Mention the existing effort that work best in the community for improving child nutritional status and reducing malnutrition in the community.
4. What are cultural or traditional believes which constraint the government and local efforts of reducing undernutrition in the community?

Appendix 5: Definition of variables used in the binary logistic regression model

Variable	Definition	Level of measurement
Age of a person	Age of the household head	Ratio (years)
Sex of a person	Biological sex of a person	Nominal (1=male, 2=female
Household headship	Household headship type	Nominal (1=Male-headed household, 0=Female-headed household)
Education of a person	Household head education level	Ratio (Years of schooling)
Occupation of a person	A person usual work or business	Dummy (list of activities)
Marital Status	Household marital status	Nominal (1= Married, 0=otherwise
Family size	Household composition by gender	Ratio (Number of people in the household)
Asset ownership	Valuable materials for wealth creation	Nominal (List of items for SES determination)
Water supply	Source of safe drinking water by members of household	Nominal (List of different types of sources of drinking water)
Access to toilet facility	Type of toilet used by members of household	Nominal (List of types of latrines)
Health services	Availability of nearby health services	Nominal dichotomous (1=yes, 2=no)
Professional health care	Availability of professional health care and birth attendants	Nominal dichotomous (1=yes, 2=no)
Place of delivery	A place where a child was born	Dummy (0=home delivery, 1=hospital delivery
Delivery assistance	A person helped mother during delivery	Dummy (0=TBA and others, 1=professional assistance)
Number of sibling	Number of older children under-five in similar household	Ratio (number of children under-five years)
Immunization status	Child immunization coverage	Ratio (number)
Exclusive breastfeeding	Feeding the child with mother's milk only	Nominal dichotomous (1=yes, 2=no).
Weaning	Introduction of solid food/complementary food other than mother's milk	Nominal dichotomous (1=yes, 2=no)
Child malnutrition	Current nutritional status based on anthropometric analysis	Nominal (1=normal, 2=underweight, 3=wasted, 4=stunted, 5=overweight)
Child undernutrition	Current nutritional status based on composite index of anthropometric failure (CIAF)	Dummy (1=CIAF, 0=No failure)

Appendix 6: Sample size calculation

The sample size was determined based on stunting prevalence in Pangani district of 49% (MoHCDGEC *et al.*, 2016) by using Cochran's formula as adopted by Bartlett *et al.* (2001) as follows:

$$n = \frac{Z^2 p (1-p)}{d^2}$$

Where Z^2 = standard normal distribution at 95% equal to 1.96

p = estimate of stunting prevalence in Pangani district (49%)

d = absolute error of 5% which is equal to 0.05

Hence, $n = 1.96^2 \times 0.49 (1-0.49)/0.05^2$

$n = 3.38416 \times 0.49 \times 0.51/0.0025$

$n = 0.845701584/0.0025$

$n = 338.280$

$n \sim 340$

Based on the above formula, a total of 340 households were used in the study. Where a household had two or more children under-five years all were included in the sample, therefore a total of 355 children were involved in the study.

Appendix 7: Value of the principal component with their corresponding initial Eigen value and % of variance

	Initial Eigen values				
Component	**Total**	**% of Variance**	**Cumulative %**	**% of Variance**	**Cumulative %**
1	7.299	18.247	18.247	10.556	10.556
2	2.699	6.748	24.995	7.633	18.189
3	2.275	5.688	30.683	6.200	24.389
4	2.118	5.295	35.978	5.371	29.759
5	1.904	4.761	40.739	4.789	34.549
6	1.712	4.281	45.020	4.773	39.322
7	1.524	3.810	48.830	4.552	43.874
8	1.463	3.657	52.487	4.408	48.283
9	1.330	3.325	55.812	4.185	52.468
10	1.286	3.214	59.026	4.145	56.613
11	1.206	3.016	62.042	3.955	60.568
12	1.128	2.819	64.861	3.351	63.919
13	1.052	2.629	67.490	3.242	67.161
14	1.007	2.517	70.007	2.846	70.007
15	.961	2.402	72.409		
16	.907	2.268	74.676		
17	.813	2.032	76.708		
18	.804	2.010	78.719		
19	.775	1.938	80.657		
20	.718	1.796	82.453		
21	.713	1.783	84.236		
22	.664	1.660	85.896		
23	.631	1.577	87.473		
24	.600	1.500	88.973		
25	.586	1.466	90.439		
26	.548	1.369	91.808		
27	.465	1.161	92.970		
28	.459	1.147	94.117		
29	.451	1.126	95.243		
30	.409	1.024	96.267		
31	.341	.853	97.120		
32	.306	.764	97.884		
33	.255	.639	98.523		
34	.207	.517	99.040		
35	.151	.378	99.418		
36	.098	.244	99.662		
37	.084	.211	99.872		
38	.020	.049	99.922		
39	.019	.047	99.969		
40	.012	.031	100.000		

Extraction Method: Principal Component Analysis.

Appendix 8: Distribution of assets and housing condition by quintiles (%) Quintile

(Per cent of a population)

Variable	Poorest 1st	2nd	3rd	4th	Least Poor 5th	Average	Poorest/Least poor ratio
If a household has….							
A house	15.3	17.9	11.7	12.1	13.5	14.1	**1.13**
Three sleeping rooms	19.4	18.5	18.2	17.5	15	17.78	**1.29**
Four seeping rooms	0.8	1.4	1.4	3.8	4.1	2.3	**0.19**
A watch	1.7	3.2	2.6	2.3	5.0	2.96	**0.34**
A paraffin Lamp	16.1	5.2	12.9	6.1	3.8	8.82	**4.23**
Agriculture Land	7.9	8.8	7.3	9.7	7.9	8.32	**1.00**
Water pump	0.0	0.0	0.0	0.8	1.7	0.5	**0.00**
A mobile telephone	15.2	16.7	18.2	20.2	18.2	14.06	**0.83**
A bicycle	8.2	6.7	7.0	10.2	7.6	7.9	**1.07**
Livelihood equips.	17.0	17.9	14.4	15.5	15.5	16.06	**1.09**
A refrigerator	0.0	0.8	1.4	2.9	10.0	3.02	**0.00**
A radio	6.4	7.9	9.1	11.1	12.6	9.42	**0.50**
A satellite dish	0.0	0.2	1.4	2.9	10.0	2.9	**0.00**
An iron	2.9	3.8	6.1	7.3	13.2	11.88	**0.21**
Fishing equipment	0.8	2.2	2.9	5.2	2.9	2.8	**0.27**
Motorbike	0.2	1.7	2.9	3.5	8.2	3.3	**0.02**
A sofa set	1.1	2.6	7.3	10.0	11.4	6.48	**0.09**
Television set	0.2	0.5	1.2	6.1	11.4	3.88	**0.01**
Solar power	1.7	4.7	5.0	5.0	2.9	3.72	**0.58**
Car	0.0	0.5	0.0	0.0	0.5	0.5	**0.00**
Livestock	10.8	14.1	8.2	7.9	7.0	9.6	**1.54**
Sewing machine	0.5	2.0	1.1	2.6	4.1	2.06	**0.12**
If household toilets facility is….							
Bush or no toilet	2.05	1.76	1.47	2.05	0.29	1.52	**7.06**
Pit latrine in compound	14.1	18.2	12.9	14.1	10.0	13.86	**1.41**
Pit latrine in neighbour	2.05	1.76	3.8	2.9	0.29	2.16	**7.06**
Flush toilet	3.2	1.7	2.9	3.8	9.7	4.26	**0.32**
If source of energy is….							
Electricity	0.8	1.4	1.7	1.7	2.3	1.58	**0.34**
Kerosene	2.3	3.5	2.6	2.6	2.6	3.44	**0.88**
Charcoal	1.7	1.7	3.2	5.8	10.5	4.48	**0.16**
Firewood	16.7	18.8	14.4	12.9	8.2	14.2	**2.03**
Source of light is ……							
Electricity	0.0	0.2	1.7	14.7	17.3	6.78	**0.00**
Kerosene	17.3	11.4	8.8	1.7	0.5	7.94	**34.60**
Solar (M-Power)	2.9	5.0	4.7	4.7	1.7	3.8	**1.70**
Floor of the house is …….							
Earth/ Mad floor	19.1	16.4	4.1	0.5	0.0	8.02	**0.00**
Cement	0.0	4.1	15.2	20.2	19.1	11.72	**0.00**
Wall and roofing of the house							
Pole and mad wall	17.9	17.7	5.8	2.0	0.0	8.68	**0.00**
Brick/ cement wall	1.1	1.4	9.4	16.1	19.1	9.42	**0.05**
Grass roofing	17.3	7.6	2.3	0.8	0.5	7.24	**34.6**
Iron sheet	0.5	12.3	14.7	18.2	18.2	12.8	**0.02**
asbestos	18.2	19.4	18.5	17.0	15	17.62	**1.21**