EFFECT OF COMPLEMENTARY FOODS ON THE GROWTH PATTERNS OF CHILDREN UNDER THE AGE OF FIVE YEARS IN MAJIRI WARD- MANYONI DISTRICT

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF THE MASTERS OF SCIENCE IN HUMAN NUTRITION OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

2017

ABSTRACT

Proper complementation for children under the age of five years is important for optimal health. More than a quarter of under-five children in Tanzania are malnourished with prevalence rates of stunting (29%), underweight (11.8%) and wasting (4.7%) in Singida region**.** A longitudinal survey was conducted to determine the effect of complementary feeding on the growth patterns of under-five children in Majiri ward, Manyoni District, Singida Region. Three hundred and sixteen mother-child pairs were selected for the baseline survey. Dietary diversity was assessed by using un-quantified validated 24-hour recall method. Anthropometric measurements were taken from children and their respective mothers at baseline, follow-up 1 and follow-up 2 visits. Data were analysed using ENA for Smart program, Excel and IBM Statistical Product for Service Solution (SPSS) program version 20. Results showed that, the mean age of initiation of complementary feeding was 3.81 ± 1.63 months. There was no significant difference *($p > 0.05$)* in the time of initiation of complementary feeding among mothers of different education levels. Most children (84.8% n=190) met the minimum recommended dietary diversity of four food groups per day. Plant based protein was most commonly source of protein in the complementary foods. Marital status ($\beta = 53.92$; $P = 0.044$), maternal age ($\beta = 34.07$; $P = 0.008$) and maternal education levels ($\beta = 89.99$; $P = 0.001$) were significantly associated with time of introduction of complementary foods. Consumption of less than four food groups per day in children was associated ($P < 0.05$) with stunting. Underweight, stunting and wasting prevailed more in children who had complementary foods before six months. Complementing children at earlier life (less than six months) increased the odds of becoming undernourished compared to those who were complemented at latter ages (more than six months). It was concluded from this study that, children who had their complementary feeding earlier than six months were more likely to

become undernourished. It was concluded from this study that, dietary diversity was not only the major factor determining under nutrition, other factors such as maternal age, education level and socio-demographic factors have strong influence on the nutritional status. It was recommended that, mothers should be educated on proper timing of complementing their children and on the importance of dietary diversity for the proper growth of their young children.

DECLARATION

I, Deorinidei Oddo Mng'ong'o do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and that it has never been submitted for a degree award to any other University.

_____ _____

Deorinidei Oddo Mng'ong'o **Date**

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The above declaration is confirmed by

_____ _____

Prof. Theobald C, E. Mosha **Date**

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ACKNOWLEDGEMENTS

I wish to express my sincere appreciations to my supervisor Prof. T. C. E. Mosha of the Department of Food Technology, Nutrition and Consumer Sciences for his effective supervision, guidance and constructive ideas during this study. His support in terms of professional inputs during proposal development and writing of this dissertation – remain a fundamental asset for writing other scientific reports in future. I would like also to recognise assistance of the entire staff of the Department of Food Technology, Nutrition and Consumer Sciences at Sokoine University of Agriculture especially Prof. John Msuya and Prof. Jovin Mugula. I further thank all members of NKUKU 4U project, especially Prof. Robyn Alders, Dr. B. Bagnol, Mrs. Wende Maulaga and Ms. Julia de Bruyn who supported me throughout my study.

I would also like to recognize Edna Ndau and Titus Mihale for their encouragement and assistance during this study. I would also like to thank my family, Mr. Hamidi Shebuge, Mr. and Mrs Simtali Mng'ong'o for being on my side through the many difficulties of this study. I also wish to thank my colleagues in MSc. Human Nutrition (Class of 2014-2016) for their enormous support especially during the early stages of proposal development. It would be impossible to accomplish this study without participation of mothers and children who tirelessly undertook all sessions of this study and making this study the way it is today. May God bless them all.

DEDICATION

To my beautiful daughters, Sophia and Sabrina Shebuge, who in their love, understanding and subtle ways initiated, drove and inspired me to pursue my education.

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LIST OF ABBREVIATIONS, ACRONYMS AND SYMBOLS

AIDS	Acquires Immunodeficiency Syndrome
BMI	Body Mass Index
CI	Confidence Interval
ENA	Emergency Nutrition Assessment
FAO	Food and Agriculture Organization
GPS	Geographical Positioning System
HAZ	Height- for-age-Z- score
HIV	Human Immunodeficiency Virus
IDDS	Individual Dietary Diversity Scores
kg	Kilogram
m	Metre
MoHSW	Ministry of Health and Social Welfare
NBS	National Bureau of Statistics
SMART	Standardized Monitoring and Assessment of Relief and Transitions
SPSS	Statistical Product for Service Solution
TDHS	Tanzania Demographic and Health Survey
UNICEF	United Nations Children's Education Fund
USA	United State of America
WAZ	Weight-for-age Z-score
WHO	World Health Organization
WHZ	Weight-for-height/length Z-score

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Malnutrition can be defined as insufficient, excessive or imbalanced consumption of nutrients like protein, carbohydrates and vitamins (WHO, 2008). Malnutrition is the gravest single threat to global public health. The effects of poor nutrition are mostly observed in infants and young children who bear the brunt of the onset of malnutrition and suffer the highest risk of disability and death associated with it. In 2001, 50-70% of the burden of diarrhea diseases, measles, malaria and lower respiratory tract infections was attributed to under nutrition and due to lack of proper practice of complementary feeding (WHO, 2002).

When breast milk is no longer enough to meet the nutritional needs of the infant, complementary foods should be added to the diet of the child. The transition from exclusive breastfeeding to family foods is referred to as complementary feeding. If appropriate feeding is not conducted at the early life, can lead to poor child growth and some of the effects if acquired at this age are irreversible to change. An effect such as stunting if acquired at this age is irreversible by compensatory feeding at later date. WHO estimates that, two out of five children are stunted in low-income countries (WHO, 2012).

Complementary feeding should be timely such as, start receiving foods in addition to breast milk from 6 months onwards. It should be adequate such as, the complementary foods should be given in amounts as well as frequency and using a variety of foods to cover the nutritional needs of the growing child while maintaining breastfeeding (WHO, 2010). Foods should be prepared and given in a safe manner, meaning that measures should be taken to minimize the risk of contamination with pathogens. The food should

also be given in a way that is appropriate, meaning that foods are of appropriate texture for the age of the child and applying responsive feeding following the principles of psycho-social care. Adequacy of complementary feeding not only depends on the availability of a variety of foods in the household, but also on the feeding practices of caregivers (Pan American Health Organization, 2001).

It has been recommended that, infants receiving complementary foods at six months of age in addition to breast milk, initially two to three times a day between six to eight months should increase to three or four times daily between 9-11 months and 12-24 months with additional nutritious snacks offered one to two times per day, as desired (WHO, 2000).

1.2 Problem Statement and Study Justification

Micronutrient deficiencies such as iron and vitamin A impair growth and development (UNICEF, 2013). The first 1000 days of a child's life are important for the growth and development. The age of five years is used as a marker for changes in nutrition situation (WHO, 2013). This period, however, is characterized by micronutrient deficiencies. A lot of children especially those who were able to practise exclusive breastfeeding for the first 6 months in rural areas usually grow well and healthy until the time when supplementation with complementary foods are given, its soon after the complementary feeding starts that it is when growth faltering begins (Dewey, 2001).

This has been a major problem especially in rural areas where there is little information on nutrition. Children are not given extra care especially in their diet, they consume the basic foods available for the whole family. Therefore, it is important to use a healthy

complementary feeding that covers all the food groups for fast growth and development of the child.

Early complementary feeding is common with 39% of infants below three months already introduced to complementary foods. About 12% of infants are not complemented at the age of 6-7 months. Furthermore, feeding frequency during supplementation is too low (about 2-3 feeds a day), nutrient density is low and the preparation and feeding practices are often unsafe. Children 2 – 5 years old are fed family foods; however, feeding frequency and nutrient density are also inadequate in this age group (MOHSW, 2008-2015).

Tanzania's huge investments in primary and secondary education yield less because children are not getting the basic nutrition they need during the critical first two years of life to enable healthy brain development (Uwazi, 2010). Prevalence of stunting in Tanzania among under-five children is 42%, with the highest prevalence (55%) among the children aged 18-23 months. The lowest prevalence of stunting was (18%) among children less than six months of age. Singida region is one of the regions which are prone to under nutrition due to geographical location (NBS, 2010). It has areas which are prone to drought and few other areas that receive unimodal rainfall per year. Manyoni district is among the areas in the region with unstable climate where, food insecurity and poor nutrition are common in households especially among children under the age of five years. Despite the government efforts to eliminate under nutrition in the country, Singida still faces this problem. Prevalence rate of stunting in Singida is 29%, wasting is 11.8% while underweight is 4.7% (NBS, 2015/2016).

Proper complementation of children under the age of five years is important for optimal health, mental well-being and growth. Tanzania has made conspicuous progress in many health indicators over the past decade, but not on children nutritional status. High levels of stunting in the country, which affect more than three million children, constitute a silent emergency (UNICEF, 2013). The study was designed to determine the effect of complementary feeding on the growth patterns of children under the age of five years in Manyoni district.

1.3 Objective of the Study

1.3.1 Main objective

To assess the effect of complementary feeding on the growth patterns of under five children in Manyoni district

1.3.2 Specific objectives

The specific objectives of the study are to:

i. Determine the timing of introduction of complementary foods in children
ii. Identify the composition of complementary foods
iii. Determine the socio-economic and demographic factors that influence the time of initiation of complementary feeding
iv. Determine the growth patterns of children aged 6 – 60 months

1.4 Hypothesis

The following null and alternative hypotheses were tested for this study:

1.4.1 Null hypothesis

There is no significant effect of complementary feeding on the growth pattern of under five children in Manyoni District

1.4.2 Alternative hypothesis

There is significant effect of complementary feeding on the growth pattern of under-five children in Manyoni District.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Nutrition and Child Growth

Adequate nutrition during infancy and early childhood is fundamental to the development of each child's full human potential (WHO, 2012). It is well recognized that, the period from birth to two years of age is a "critical window" for the promotion of optimal growth, health and behavioural development. Longitudinal studies have consistently shown that, this is the peak age for growth faltering, deficiencies of certain micronutrients, and common childhood illnesses such as diarrhoea. After a child reaches two years of age, it is very difficult to reverse stunting that has occurred earlier (Martorell *et al*., 1994).

The immediate consequences of poor nutrition during these formative years include significant morbidity and mortality and delayed mental and motor development. In the long-term, early nutritional deficits are linked to impairments in intellectual performance; work capacity, reproductive outcomes and overall health during adolescence and adulthood. Thus, the cycle of malnutrition continues (Pan American Health Organization, 2001).

2.2 Timing of Introduction of Complementary Foods

Complementary feeding is defined as the process starting when breast milk alone is no longer sufficient to meet the nutritional requirements of infants, and therefore other foods and liquids are needed, along with breast milk. Appropriate complementary foods should be introduced in a timely fashion, beginning when the infant is six months old. In developing countries, early or inappropriate complementary feeding may lead to malnutrition and poor growth (Pearce *et al.*, 2013). After six months of age, it becomes increasingly difficult for breastfed infants to meet their nutrient needs from human milk

alone (WHO/UNICEF, 1998). Furthermore, most infants develop mentally ready for other foods at about six months (Naylor and Morrow, 2001). The new foods are intended to 'complement' ongoing breastfeeding with those dietary items whose intake has become marginal or insufficient. Both breastfeeding and complementary feeding can have direct or later consequences on health (Przyrembel, 2012).

2.3 Amount of Complementary Food Needed

Starting at six months of age, small amounts of food is needed and increase the quantity as the child gets older, while maintaining frequent breastfeeding. The energy needed from complementary foods for infants in developing countries is approximately 200 kcal per day at 6 – 8 months of age, 300 kcal per day at 9 – 11 months of age, and 550 kcal per day at 12 – 23 months of age. This guideline is based on children receiving average amounts of breast milk at each age. If an infant is consuming more or less breast milk than the average, the amount of energy needed from complementary foods will differ accordingly (WHO, 2000). In practice, caregivers will not know the precise amount of breast milk consumed, nor will they be measuring the energy content of complementary foods to be offered. Thus, the amount of food to be offered should be based on the principles of responsive feeding while assuring that energy density and meal frequency are adequate to meet the child's needs (WHO, 2000).

2.4 Recommended Meal Frequency

According to WHO (2000), there should be an increase in the frequency of feeding as the child gets older. The guideline shows that, the appropriate number of feedings depends on the energy density of the local foods and the usual amounts consumed at each feeding. For the average healthy breastfed infant, the number of meals of complementary foods that should be provided should be 2 - 3 times per day at 6-8 months of child age. It should be 3

- 4 times per day at 9 - 11 months and 4 - 5 times per day at 12 - 24 months of age. The frequency of feeding should also be associated with additional nutritious snacks offered 1 - 2 times per day, as desired. The guideline, however, indicates that, if energy density or amount of food per meal is low, or the child is no longer breastfed, more frequent meals would be required.

2.5 Food Varieties Included in Complementary Feeding

Achieving a diet that is nutritionally adequate and safe is difficult among 6 – 24 month-old children who have a predominantly plant-based diet. Many complementary diets are mainly based on plants, cereals or roots and a large amount of starches in these plant sources result in a thick, gelatinous porridge, which often has low nutrients density. In addition, mineral bioavailability is poor in many plant-based foods (WHO/UNICEF, 1998).

Some of the common foods used for complementation includes, potatoes, rice, maize meal, cooked bananas and porridge that is made by combination of maize, wheat, groundnuts, millet and/or soybean flour. At six months old, the child's digestive system is mature enough to digest the starch, protein and fat in a non-milk diet. Very young infants push foods out with their tongue, but by 6 - 9 months, they can receive and hold semi-solid foods in their mouths more readily (WHO, 2008)

Optimal complementary feeding depends not only on what is fed but also on how, when, where and by whom a child is fed (Engle *et al.,* 2000. Pelto *et al.,* 2003). Behavioural studies have revealed that, a casual style of feeding predominates in some populations. Young children are left to feed themselves, and encouragement to eat is rarely observed. In such settings, a more active style of feeding can improve dietary intake. Microbial

contamination of complementary foods is a major cause of diarrhoeal diseases, which are particularly common in children 6 - 12 months old (Bern, 1992). Safe preparation and storage of complementary foods can prevent contamination and reduce the risk of diarrhoea.

2.6 Nutrient Composition of Foods

Complementary foods for children in developing countries are based on local staple diets made from cereals, roots and tubers. These foods are usually prepared as liquid gruels in order to be suitable for feeding of young children. These cereals are prepared in liquid form by dilution with a large quantity of water, thereby resulting in more volume but with a low energy and nutrient density (Sanni *et al.,* 1999). A list of various foods which are commonly consumed and their composition per 100 g is shown in Table 1 below.

Table 1: Nutrient composition of common foods used as complementary foods

Energy and nutrient	Name of the food							
	Spinach	**Banana**	**Onion**	**Rice**	**Maize**	**Tomato**	**Sweet potato**	**Wheat**
Energy (kcal)	22	92	38	360	86	21	105	331
Protein (g)	2.86	1.03	1,16	6.61	3.22	0.85	1.65	10.4
Carbohydrates (g)	0.8	21	6.83	79.3	16.3	3.54	21.3	12.5
Fibre (g)	2.7	2.4	1.8	-	2.7	1.1	3	-
Vit A (µg ER)	672	8	-	-	28	62	2006	0.39
Vit B1 (mg)	0.08	0.05	0.04	0.07	0.2	0.06	0.07	0.09
Vit B2 (mg)	0.19	0.1	0.02	0.05	0.06	0.05	0.15	4.8
Niacin (mg)	1.37	0.74	0.43	2.88	2.08	0.73	1.1	0.27
Vit B6 (mg)	0.19	0.58	0.12	0.15	0.06	0.08	0.26	41
Folate (µg)	194	19.1	19	9	45.8	15	13.8	-
Vit C (mg)	28.1	9.1	6.4	-	6.8	19.1	22.7	-
Vit E (mg)	1.89	0.27	0.13	-	0.09	0.38	0.28	1.44

Source: Pamplona- Roger (2007)

2.7 Factors Associated with Early Introduction of Complementary Foods

Even though the World Health Organization (2013) shows comprehensible evidence of numerous undesirable outcomes associated with early introduction of complementary foods, initiation of complementary feeding in early life remains a common problem, not only in developing countries but also in developed countries (Alzaheb, 2016). A study in five European countries namely; Belgium, Germany, Italy, Poland, and Spain, revealed that, about a quarter of infants were complemented before reaching the age of four months and by the age of six months, at least ninety percent of them had consumed solid foods (Alvisi *et al.*, 2015). A study on complementary feeding in the Middle East had also found that, complementary feeding practices do not follow the worldwide recommendations set out by the World Health Organization. For example, in Iraq, the United Arab Emirates and Lebanon, more than half of the infants were complemented between ages 4 -6 months (Nasreddine *et al.*, 2012).

There are a number of factors that are associated with such early introduction of complementary feeding. Some of these are due to maternal characteristics, such as age, education, occupations, marital status, socioeconomic status and pre-pregnancy body mass index (BMI) (Nasreddine *et al.*, 2012). Other factors are those related to child characteristics such as birth weight, delivery method and order of birth (Caroli *et al.*, 2012) and those related to tradition and customs of a particular society (Nasreddine *et al.*, 2012).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

Manyoni is one of the four districts in Singida Region, Tanzania. Its capital is Manyoni. The district is bordered to the North by Singida Rural and Singida Urban Districts, to the East by Dodoma Region, to the South by Iringa Region, to the Southwest by Mbeya Region and to the West by Tabora Region. The district is located at 5° 45' 0" South and 34° 50' 0" East. It has a population of 296,763 with 146,030 males and 150,733 females (NBS, 2013). Manyoni has 32 admnistrative wards namely Manyoni town, Mkwese, Muhalala, Aghondi, Chikola, Chikuyu, Heka, Idodyandole, Ipande, Isseke, Itigi Majengo, ItigiMjini, Kalangali, Kintinku, Kitaraka, Majiri, Makanda, Makuru, Makutupora, Maweni, Mgandu, Mitundu, Mwamagembe, Nkonko, Rungwa, Sanjaranda, Sanza, Saranda, Sasajila, Sasilo, Solya and Tambukareli (PMORALG, 2014). The district has 3 hospitals, 3 health centres and 50 dispensaries, it has 34 medical personnel including the Medical Officers, Clinical Officers and Assistant Medical Officers. Manyoni town can be reached through the Central Railway and by roadway through the Dar es Salaam – Mwanza highway. The main ethnic group are Wanyiramba, Waluguru, Wagogo and Wasukuma. The main economic activity is farming.

Majiri is one of the administrative ward in Manyoni district where this study was conducted. Majiri ward was chosen because of its long distance from the main road hence, there is less interference of the population in the area with other areas.

3.2 Study Design

The study was a longitudinal design that took place for one year (with three surveys, conducted in November 2014, May 2015 and November, 2015) in order to monitor the growth pattern of the under-five children.

3.3 Sampling Frame/Population

The study population included all mothers living in Majiri ward with children under the age of five years. The sampling frame comprised of all mothers-child pairs residing in Majiri Ward.

Inclusion criteria: Inclusion criteria were children underfive years living in Majiri ward permanently.

Exclusion criteria: All children with physical and mental problems example, those with chronic diseases like diabetes, sickle cell and HIV/AIDS and handicaps shall be excluded from the study. Mothers who also declined to participate in the study shall be excluded.

3.4 Sampling Procedure and Sample Size

Purposive sampling was used to identify those households with mothers with children under the age of five years who had started complementary feeding. From the identified mother-child pairs, a representative sample was randomly selected for the study using a formula adopted by Fisher *et al*., (1991). A total of 316 mother-child pairs were selected for the baseline study (See Appendix 1).

3.6 Data Collection

3.6.1 Construction of a questionnaire

A structured questionnaire was constructed which consisted of five sections. Section I was for the household and participant identification. Section II solicited information on households and women characteristics. Section III collected information on breastfeeding history and the health status after birth of the under-five children. Section IV collected information about food intake using a 24-hour recall method. Section V solicited information about anthropometric measurements of the mothers and their children.

3.6.2 Pretesting of the questionnaire

Before data collection, the questionnaire and other equipment were pre-tested in Sanza Ward in Manyoni District. Necessary changes were incorporated into the questionnaire before its final administration. Ten enumerators were trained on how to administer the questionnaire, proper use of the equipment and recording the information.

3.6.3 Administration of the questionnaire

The pre-tested questionnaire was administered to the subjects by face- to- face interview through home visits during the morning and evening hours of the day. The questionnaire was administered three times during the study at baseline, follow-up1 and follow-up2 at intervals of three months.

3.6.4 Measurements taken and tools

Anthropometric measurements of both mothers and their children were taken at baseline and thereafter during follow-ups. The measurements taken were height and weight.

3.6.4.1 Height

In each visit, height measurement was taken for those who had an age above 24 months. Children who were less than two years of age, a recumbent length was measured with a height board positioned flat on a hard surface. The child was placed on the board while facing upward with the feet touching the immovable fixed end of the board. The movable head board was then carefully fitted at the top of the head, pressing the hair slightly. The height was read on the stadiometer and recorded to the nearest 0.1 cm.

For children above 24 months, a stadiometer was placed against a wall firmly. Then, subjects (mothers and children aged 24 months) were asked to stand straight with the

head positioned such that the Frankfurt plane was horizontal, feet placed together, knees straight and heels, buttocks and shoulder blades in contact with the vertical surface of the stadiometer. Hands hanged loosely with palms facing the thighs. The movable headboard was then lowered slowly until it touched the crown of the head. Measurement was read and recorded to the nearest 0.1 cm.

3.6.4.2 Weight

SECA weighing scale was used for both children and their mothers. The scale was placed on a hard flat surface. The scale was then turned on and adjusted to zero. Children with age above two years were asked to step on the scale bare feet and stand still to allow their weights to be displayed. Then the measurement was read and recorded to the nearest 0.1 kg. For those children with age below two years, their respective mothers would stand on the scale without the baby and her weight was recorded to the nearest 0.1 kg. Thereafter, the scale was zeroed with the mother on it. The mother was then given the child to carry him/her while standing on the scale. The weight of a child was then read and recorded to the nearest 0.1 kg.

3.7 Ethical Consideration

Objectives of this study were explained to the mothers before enrolment into the study. For those who accepted to participate in the study, they signed a consent form to affirm their willingness to participate. Subjects were identified by their real names and residences to enable follow-up surveys. However, confidentiality of the data from the participants was ensured. Subjects had freedom to drop out from the study at any stage without fear of retribution. Permission to conduct the study was obtained from Sokoine University of Agriculture and the Manyoni District Authority.

3.8 Data Analysis

Data were coded, cleaned and organized to facilitate analysis. Analysis was conducted using the Emergency Nutrition Assessment (ENA) for SMART software (2010 version) for the anthropometric data, and reported using WHO (2006) growth reference values. Statistical Package for Social Sciences - version 21 (SPSS, Inc, Chicago, IL, USA) was used to analyse descriptive data such as frequencies, percentage for categorical data, example age, sex and marital status; level of education; occupation and income. Continuous data such as anthropometrics indices (BMI, Weight for Age Z - Scores, Weight for Height Z - Scores and Height for Age Z – Scores), maternal and child age were exported from ENA into SPSS for furthers statistical analysis in order to determine whether the patterns drawn from the sample were likely to represent the whole population in which the sample was drawn.

Individual diversity scores in children were assessed based on seven food groups recommended by FAO (2011). Dietary diversity score therefore ranged from 0 – 7 with minimum of 0 if none of the food groups was consumed to 7 if all the food groups were consumed. Consumption of less than four food groups was regarded as low dietary diversity – as was below the minimum dietary diversity recommended by WHO (2008). For correlation analysis, logistic regression was performed with 95 % confidence intervals (CI).

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio - economic and Demographic Characteristics of the Respondents

4.1.1 Women marital status

Table 2 presents the socio-economic and demographic characteristics of the subjects. Results showed that, about 72% (n = 161) of the females in the studied households were married while 17% (n = 38) and 11% (n = 25) were cohabitating and singles, respectively. Percent of married women found in this study was higher than that reported by NBS (2012). These women were the ones who were responsible for childcare, especially in child feeding. One study in Ethiopia reported that, mother's and children's nutritional status was significantly associated with marital status, and prevalence of maternal and child under nutrition was higher among unmarried rural and divorced or separated rural women compared to married women (Teller and Yimar, 2000).

4.1.2 Maternal age

The mean ± SD age of mothers during baseline survey was 27.73 ± 7.84 years with majority (80.4%; n = 180) in between 18 – 35 years. Only 6.7% (n = 15) of the mothers involved in the study had age below 18 years. Result showed also that, 12.5% (n = 28) of the women were aged 36 – 44 years while only 0.4% (n = 1) of the women had age above fifty years.

Table 2: Socio – economic and demographic characteristics of the households and respondents

Variable	Categories	N	Percent (N = 224))	Mean ± SD
Marital status	Married	161	71.9	
	Single	25	11.2	
	Cohabitating	38	17	
Maternal age (years) at baseline survey	14 – 17	15	6.7	27.73 ± 7.84
	18 – 26	109	48.7	
	27 – 35	71	31.7	
	36 – 44	28	12.5	
	45 – 53	0	0.0	
	54 – 62	1	0.4	
Age (months) of children during baseline	0 - 5	35	15.6	10.94 ± 4.49
	6 – 11	103	46	
	12 – 17	79	35.3	
	18 – 23	5	2.2	
	24 – 29	2	0.9	
Sex of children	Female	114	50.9	
	Male	110	49.1	
Education level of maternal	Informal	86	38.4	
	Primary	136	60.7	
	Secondary	1	0.4	
	College	1	0.4	
Source of drinking water used by the household	Water tap	2	0.9	
	Unprotected well	196	87.5	
	Protected well	3	1.3	
	Spring/dam	23	10.3	
Occupation	Crop production / sale	60	26.8	
	Cattle or goat production / sale	12	5.4	
	Skilled trade / artisan	7	3.1	
	Casual labor	1	0.4	
	Mining / mineral sales	19	8.5	
	Beer brewing	7	3.1	
	Gathering natural products for sale	1	0.4	

4.1.3 Sex and age of children during baseline survey

Findings show that 50.9% (n =114) and 49.1% (n = 110) of the children were females and males, respectively. The mean age of the studied children during baseline survey was 10.94 ± 4.49 months while at first and second follow-up survey the mean ages were 13.50

± 4.19 and 19.72 ± 4.19 months, respectively. During baseline survey, analyses showed, 15.6% of the studied children had age below five months while 46% (n = 103) were in age category 6 – 11 months (Table 1). About 38% (n = 84) of the children were 12 and 23 months old. Results also showed that, only 0.9% of the studied children during baseline survey were aged above two years (Table 2).

4.1.4 Maternal education level

Study findings show that, about 38% (n = 86) of the women had informal education while 49% (n = 138) had undergone formal education. Primary graduate mothers were many (60.7%, n = 136) compared to 0.4% (n = 1) and 0.4% (n = 1) who had secondary and college level education, respectively (Table 2). Education is one of the most important resources that enable women to provide suitable care for their children, which enhance optimal growth and development. Many studies in different countries have shown decreased incidence of malnutrition among young children with an increase in the level of mothers' level of education (Yimer, 2000).

4.1.5 Main sources of drinking water used by households

Many households 98% (n = 222) do not have access to clean and safe water for household consumption. These households obtained water from unprotected sources, including wells and springs or dams, which were either nearby or away from their residences. The findings indicated that, only 0.9% of the households had access to clean and safe water obtained from water taps (Table 2).

According to NBS (2012), the percent of rural households in Singida Region that used water from unprotected sources was 60.4%, which was lower than the proportion observed in this study. In many areas, one study found that, households could directly use unclean

and unprotected water for consumption without further treatment or boiling (Samson and Lakech, 2000). This could increase the possibility of infectious diseases which directly perpetuate the disease-malnutrition vicious cycle (WHO, 2010). A comparative study done by Samson and Lakech (2000), showed that, unprotected water sources were associated with low child survival.

4.1.6 Occupation

Twenty seven percent (n = 60) of the women were engaged in crop production or sale. Results showed that, 5.4% (n = 12), 3.1% (n = 7) and 8.5% (n = 19) of the women were engaged in cattle production or sale, skilled trade and mineral trade, respectively. Women's employment increases household income, with consequent benefit to their Own nutritional status, their children's and all other households' members. Joshi *et al., (2006)* argued that, "employment may increase women's status and power, and may bolster a woman's preference to spend their earnings on children's health and the whole family.

4.2 Initiation of Breastfeeding and Child Weight at Birth

Results of this study show that, most (84.6%, n = 187) mothers initiated breastfeeding within the first hour after delivery, which was higher proportion than that reported by Rao *et al.,* (2011) and Kátia *et al.*, (2010). Finding of the present study showed also that, 5% (n = 3) of mothers began to breastfeed their children after three hours. Results of this study also showed that, 12.6% (n= 18) of children were born with low weight (less than 2.5 kg) compared to the recommended weight of 2.5 kg by the WHO/UNICEF (2008) (Table 3). According to Kátia *et al., (*2010) children who were born with average of weight below the recommended birth weight had increased risk of childhood mortality because of increased complications at childhood.

Table 3: Child weight at birth and initiation of breastfeeding

Variable	Kg at birth	N	Percent
Child birth weight (recorded from RCH 1 card)	<2.5	18	12.6
	2.5 – 3.5	90	62.9
	3.6 - 5	35	24.5
Time of initiation of breast feeding	hours	N	percent
	≤ 1	187	84.6
	1 -2	24	10.9
	3 -6	3	1.4
	>6	7	3.2

4.3 Maternal Nutrition Status

This study has revealed that, the mean prevalence rate of underweight (BMI < 18) among women of the studied children was 5.8 $kg/m^{2.}$ · Analysis showed higher prevalence of underweight mothers (8.2%; n = 18) during the first follow-up (May 2015) than at the second follow-up (4.5%; n = 10; November 2015) and baseline (2.7% n = 6; November 2014) surveys. Existence of intergenerational link between maternal and child nutrition implied a malnourished mother will likely have a malnourished baby who in turn will grow to become a malnourished mother. Studies show that, under-nourished women have greater incidences of having under-nourished children as well (Kátia *et al.*, 2010). As Teller and Yimer (2000) reported that, there are high proportion of low-birth-weight and stunted children among malnourished mothers compared to their well-nourished peers.

Presence of higher proportion of malnourished mothers in the first follow-up (May 2015) compared to the preceding surveys conducted in November 2015 could be due to many of the mothers engaging in heavy farm activities since may is the middle of the cropping season in which there are a lot of farm work such as weeding that women are engaged with.

Table 4: Maternal nutritional status at baseline and follow-up surveys

Indicator	Survey					
BMI kg/m^2	Baseline (N =221)		First follow-up (N = 219)		Second follow-up (N = 220)	
	n	%	n	%	n	%
16 - 17.9	6	2.7	18	8.2	10	4.5
18 - 24.9	184	83.3	175	79.9	179	81.4
25 - 29.9	27	12.2	23	10.5	28	12.7
30 - 35.9	4	1.8	3	1.4	3	1.4

4.4 Timing of Introduction of Complementary Feeding

Table 5 shows that, 78.4% (n = 145) of mothers introduced solid, semi-solid or soft foods to their children within five months of child survival. It was also revealed that, 10.3% (n=19) of the mothers begun to feed their children within the first month after delivery, which was higher than 8.2% reported by NBS (2010). Results showed further that, 33% (n = 61) of children were fed complementary foods at the age of two to three months which was also higher than 22% reported by NBS (2010).

Table 5: Time of introduction of complementary feeding

Age of child (months)	Number of children	Percent (%)
0 – 1	19	10.3
2 – 3	61	33.0
4 – 5	65	35.1
6 – 8	40	21.6

About 21.6% (n = 40) of mothers introduced complementary feeding to their children at the age of 6 – 8 months (Table 5). The proportions of mothers who introduced complementary foods to their children at age 6 – 8 months in this study was lower than that reported from Nepal which revealed that, 70% of children aged 6-8 months were introduced to complementary feeding (Joshi *et al.*, 2006), while in Ethiopia 35% of

mothers introduced complementary foods to their children at 6-8 months (Haile *et al*., 2015). According to this study, the most common drink given to children in the first three days after birth was water mixed with sugar. Other types of drink given to the child were water-sugar-salt solution.

Akawire *et al*., (2012) in their study on child feeding patterns during the first seven days in Northern Ghana, revealed that, children were either given food, drinks or some local herbs and each of these was given for a certain reasons. For example, researchers reported that, "*warm water was usually given to the child to create 'appetite and make the baby able to suck the mother's breast milk*" and overcome thirsty. Introduction of some drinks in this study was also similar to the existing literature in sub-Saharan Africa which states that, children are given other foods other than breast milk in the first few days of life (Tawiah *et al.,* 2008).

4.5 Maternal Education and Time of Initiation of Complementary Feeding

The average age for introduction of complementary foods was 3.81 ± 1.63 months. The study found that, 74.1% and 65.4% of the informal and primary educated mothers, respectively, introduced complementary foods to their children within five months after delivery. However, there were no significant differences ($p > 0.05$) in the average age of introducing complementary foods (Table 5).

Table 6: Maternal education level and time of introduction of complementary foods

Time (months)	Education level						P - value
	Informal (N= 85)		Primary (N= 78)		Secondary (N= 1)		
	N	%	N	%	N	%	
0 – 1	9	10.6	6	7.7	0	0	0.764
2 – 3	28	32.9	20	25.6	0	0	0.646
4 – 5	26	30.6	25	32.1	0	0	0.773
6 – 8	22	25.9	27	34.6	1	100	0.692

4.6 Diet Diversity for Children Aged 6 – 28 Months

Results showed that, most of the children (97.8%; n = 219) aged 6 – 28 months were mostly consuming legume and nuts with the mean score of 1.62 ± 0.60. This was followed by milk and milk products, which were consumed by 97.8% of the children (Table 7). Other foods that were frequently consumed were vitamin A rich fruits, vegetables and tubers.

Table 7: Frequency per day of food groups consumption among children aged 6 – 60 months

Food group	N	Means ± SD	Percent
Grain roots and tubers	188	0.92 ± 0.48	83.9
Vitamin A rich fruits and vegetables	219	1.07 ± 0.25	97.8
Other fruits and vegetables	109	0.54 ± 0.61	48.7
Flesh foods (meat, fish, chicken, meat organ)	208	0.97 ± 0.34	92.9
Eggs	0	0.00 ± 0.00	0.0
Legume and nuts	221	1.62 ± 0.60	98.7
Dairy products	219	2.27 ± 0.75	97.8

4.7 Dietary Diversity in Children Aged 12 – 35 months

The mean consumption of food group was 6.40 ± 0.59 times/day. about 15% (n = 34) of the studied children were found to have consumed less than four food groups, which is less than the minimum dietary diversity score for food groups recommended by the World Health Organisation (2006). More than three quarters 82.1%; (n = 184) of the children were found to have consumed five to seven food groups. Only 2.7 %;(n = 6) of the children were found to have consumed more than seven food groups in the preceding 24 hours (Table 8).

In this study, most children (84.8%; n=190) met the minimum recommended dietary diversity (≥4 food groups per day), contrary to that of Mahama *et al.,* (2015) who found

that, only 34.8 % of the children aged 6 – 23 months met the recommended minimum dietary diversity per day.

Table 8: Dietary diversity scores in children aged 12 – 35 months

Food group	N	Percent	Mean score	SD
< 4	34	15.2		
5 – 7	184	82.1	6.41	0.59
≥ 7	6	2.7		

4.8 Consumption Patterns of Food Groups in Children Aged 12 – 35 Months

Results of this study have revealed some variations in consumption of food groups among children aged 12 – 35 months. Children who habitually consumed foods rich in carbohydrates (cereals, white roots and tubers) were significantly ($p < 0.01$) associated with higher consumption of legume, nuts, milk and milk products, but had lower consumption of flesh foods (meat, fish poultry, organ meats) (Table 7). According to the guideline suggested by Cohen (1988), the value of 'r = 0.10 to 0.29'; 'r = 0.30 to 0.49' and 'r = 0.50 to 1.0' ignoring their direction, were classified as "small, medium and large correlated". Thus, consumption of carbohydrate rich foods, legume and nuts among children was medium correlated with the other food groups (Table 9). Consumption of vitamin A rich fruits was marginally associated with low consumption of both plant and animal proteins. It was, however, positively associated with consumption of carbohydrate rich foods and other fruits and vegetables.

Table 9: Correlation of consumption of various food groups

Value	Correlation (N = 224)					
	Starchy staples	**Vitamin A rich fruits and vegetables**	**Legume and nuts**	**Other fruits and vegetables**	**Meat and fish**	**Milk and milk products**
Grain, roots and tubers	1.000	0.050	0.431**	-0.132*	-0.124	0.202**
Vitamin A rich fruits and vegetables	0.050	1.000	-0.193**	0.229**	-0.047	-0.170*
Legume and nuts	0.431**	-0.193**	1.000	-0.569**	-0.05	0.288**
Other fruits and vegetables	-0.132*	0.229**	-0.569**	1.000	-0.274**	-0.016
Fresh foods (meat, fish)	-0.124	-0.047	-0.050	-0.274**	1.000	-0.360**
Dairy products	0.202**	-0.170*	0.288**	-0.016	-0.360**	1.000

** Correlation is significant at 0.01 level (2-tailed);
*correlation is significant at 0.05 level (2-tailed).

4.9 Factors Influencing Initiation of Complementary Feeding

To determine contribution of socio-demographic characteristics on the initiation of complementary feeding, bivalent and multiple logistic regressions were computed (Table 10). Two factors were noted to be significantly (p=0.05) associated with timing of introduction of complementary feeding. These were maternal age (β = 34.07; P = 0.008) and maternal education levels (β = 89.99; P = 0.001). Maternal marital status and occupation were not significantly associated with the timing of introduction of complementary foods (Table 10). Maternal education level was highly (65.1%) associated with the initiation of complementary feeding compared to marital status (42.9%) and maternal age (52.1%).

Table 10: Factors that were associated with timing of complementary feeding

Variable	Coefficient					Change in statistics	
	Un-standardized		Standardised				
	β	SE	β	SE	R^2	R^2 change	*P*- Value
Marital status	53.92	3.78	0.147	0.499	0.498	0.429	0.064
Maternal age	34.07	2.007	0.567	0.897	56.09	52.08	0.008
Maternal education level	89.99	6.076	4.088	0.00	78.09	65.08	0.001
Occupation	89.08	67.07	8.90	56.90	23.08	69.81	0.870

Results of this study were comparable with those of Rao *et al*., (2011) who reported that, maternal education level in India was significantly ($P<0.05$) associated with initiation of complementary feeding. In their study, it was found that, maternal age was not significantly associated with initiation of complementary feeding. Other retrospective studies involving 200 mothers showed also that, maternal education level was significantly correlated with the age of initiation of complementary feeding (Aggarwal *et al.*, 2008).

4.10 Complementary foods consumed by children during the 24-hour recall

The results below (Table 11) shows that, most of the children consumed maize porridge 98.7% (n = 219) as complementary foods, followed by milk 97.8%; (n= 219) and ugali (maize) 92.8% (n= 208). Foods like rice and mashed potatoes/ banana 48.7% and 83.9% respectively were less likely to be consumed as complementary foods.

The findings in this study were similar to those found by Faber (2004) and that of Gardner (2002) who reported that, infants to be most fed by maize porridge. Faber (2004) reported that more than half infants in South Africa to be fed with maize porridge. Whereas, Gardner (2002) reported 80% of children were fed maize porridge in Jamaica.

Table 11: Complementary foods consumed by children during the 24- hour recall period

Food (dish)	Number of children	Percent	Portion size
Ugali (maize)	208	92.8	92
Maize porridge	219	98.7	121
Mashed potatoes/banana	188	83.9	60
Rice	109	48.7	35
milk	219	97.8	130

4.11 Growth Patterns of Children Aged 6 – 59 Months

Prevalence of stunting was higher during the first follow-p survey (85.5%; n = 146) than at baseline (83.5%; n = 189) and the second follow-up survey (50.9%; n =114). Results showed that, prevalence rate of severe stunting (< -3 SD) decreased with age, in the descending order of 58.9%; 57.9% and 15.6%, at baseline, first follow –up and second follow – up surveys, respectively (Table 12).

Nevertheless, prevalence of moderate stunting (-3 SD to -2 SD) increased with child age. Result showed that, at baseline survey only 25.6% of children were moderately stunted whereas at first and second follows-up surveys, prevalence rates were 27.6% and 34.3%, respectively (Table 12). Other longitudinal studies revealed that, prevalence of stunting decreases with the increase of child age (Sah, 2004; Apkota and Gurung, 2009) because at young age breast milk is adequate to meet the nutritional requirements of a growing child (Mahama *et al.*, 2015).

Table 12: Growth patterns of children during baseline and follow-up surveys

Survey	Z – score	Indicator					
		HAZ		WAZ		WHZ	
		n	%	n	%	n	%
Baseline	> -2	29	16.6	145	81.5	181	97.8
	-3 – -2	43	24.6	24	13.5	4	2.2
	< -3	103	58.9	9	5.1	0	0.0
First follow-up	> -2	32	14.5	167	75.6	217	97.7
	-3 – -2	61	27.6	36	16.3	5	2.3
	< -3	128	57.9	18	8.1	0	0.0
Second follow-up	> -2	109	48.7	179	79.9	212	94.6
	-3 – -2	79	35.3	36	16.1	11	4.9
	< -3	35	15.6	9	4.0	1	0.4

Like height – for – age, prevalence of underweight was found to be higher during the second follow-up survey than at baseline or at final follow-up survey. Results showed that, about 16.3% of children were underweight during first follow –up survey whereas only 16.1% and 13.5% of the children had low weight for their age at final and baseline surveys, respectively. Prevalence of severe underweight decreased at the second follow – up (4.0%) than at baseline survey (5.1%) (Table 12).

The prevalence of wasting among children increased with child age. Result showed that, only 2.2% of children had low weight – for their height at baseline surveys, of which, during first and second follow –up surveys, their proportion increased to 2.3% and 4.9% at first and second follow –up survey, respectively. Prevalence of stunting, under-weight and wasting among children aged 6 – 28 months observed in this study were higher than to those reported by Mahama *et al.,* (2015) in Ghana. Prevalence of stunting among these children was also higher than the national average NBS (2010).

4.12 Association Between Dietary Diversity and Growth Patterns of Children

Table 13 presents the association between HAZ, WAZ and WHZ scores and dietary diversity among children aged 6 – 60 months. Multivariate logistic regression showed that, consumption of more than four food groups per day was not significantly associated with default growth in children. Nonetheless, consumption of less than four food groups per day in children with the mean age of (10.92 ± 4.48) months was significantly ($P < 0.05$) associated with low height for age (stunting). The result showed, however that, low height for – age did not significantly ($P > 0.05$) associate with consumption of less than four food groups per day in children with the mean age of (28.7 ± 6.6) months.

Unlike low weight – for height and low height for – age in children with mean age (28.7 ± 6.6) months, finding of this study showed that, low weight for – age was significantly ($P < 0.05$) associated with consumption of less than four food groups per day.

Table 13: Association between low HAZ, WAZ and WHZ Scores and dietary diversity among children aged 6 - 59 months

Survey	Status	Consumption of food groups					
		< 4		5 – 7		≥ 7	
		Exp. (β)	*P*	*Exp. (β)*	*P*	*Exp. (β)*	*P*
Baseline	Stunted	8.371	0.042	6.478	0.682	6.956	0.163
	Wasted	14.365	0.345	12.417	0.067	13.783	0.564
	Under-weight	45.411	0.788	17.276	3.67	12.673	3.957
First follow-up	Stunted	44.947	0.067	33.695	0.876	5.678	0.902
	Wasted	11.893	0.086	18.099	0.893	45.001	0.234
	Under-weight	24.682	0.019	9.001	0.087	89.012	0.672

1- Multivariate logistic regression outputs

Studies in Ethiopia and Zambia reported that, higher dietary diversity score was related with decreased prevalence of malnutrition and the vice versa was also true (Disha, 2014; Arimond and Ruel, 2014). With the use of evidences from a meta-analysis of eleven

demographic and health surveys, Arimondand and Ruel (2014), also found a positive correlation between child dietary diversity and nutritional status. A study in rural Bangladesh by Rah *et al.,* (2010) confirmed that, reduced dietary diversity was a strong predictor of stunting among children under the age of five years.

With no doubt, dietary diversity indicators are associated with child nutrition outcomes such as stunting, underweight and wasting according to Mahama *et al., (*2015). However, this was not the case elsewhere. In the present study, some indicators of poor nutrition status (wasting and underweight) were not significantly related to minimum dietary diversity. Nevertheless, diet is only one aspect of what makes children grow and dietary diversity may not be the most serious control in some areas, particularly in areas with higher prevalence of infections. For that reason, contextual deprived health might be more central determinant of nutritional status than dietary diversity (Mahama *et al.,* 2015).

4.13 The effects of Initiation of Complementary Feeding on the Growth Patterns of Children

About three quarters (75%) of the children who had complementary feeding before six months had low weight for their age during baseline survey. For those children who started complementary feeding at 6 months or above, only 7.8% of these children had low WAZ score at the baseline (Table 10). The findings showed further that, children who were fed with complementary foods at 4-5 months, 17.6% and 6.9% of them, respectively, had low weight for their age. Results showed, however, that, there were no significance ($p < 0.05$) differences in the prevalence of low weight for age among children who were given complementary foods at these ages (Table 10).

Low height for age (stunting) prevailed more (72.2%) in children who had complementary foods before six months than those who received their complementary foods at or after six months (10.2%). Findings of this study were similar with those reported by Mahama *et al.*, (2015) and Masresha *et al.,* (2013). Low weight for age was higher among children who received complementary foods at the age of four months than those who received complementary foods at the age of five months (Table 12). In the present study, the association between initiation of complementary feeding either before or at six months and the prevalence of malnutrition in children have revealed no significant ($P > 0.05$) differences. This was contrary to a study by Mahama *et al.,* (2015) who found a significant ($P < 0.05$) association between the time of initiation of complementary feeding and the prevalence of low HAZ, WAZ and/or WHZ- scores.

At first follow-up survey, findings showed that, all of the underweight (low WAZ) children were those who were complemented before six months of age while 73% and 80% of the children had low HAZ and WHZ scores, respectively. Like during baseline survey and first follow-up surveys, prevalence of wasting, underweight and stunting during second follow-up was higher among children who were supplemented with other foods before the age of six months compared to those who were supplemented at/or above six months. Likewise, during the second follow-up survey the nutritional status of those who were complemented earlier in life was worse of compared to those who were complemented at an older age (Table 14).

Table 14: Effects of initiation of complementary feeding on growth patterns of children

Survey	Indicator	Initiation age (month)			
		Non-specific age		Specific age	
		<6	≥6	5	4
		%	%	%	%
Baseline	Underweighted	74.5	7.8	6.9	17.6
	Stunted	72.2	10.2	9.7	21.0
	Wasted	60.0	0.0	0.0	0.0
First follow-up	Underweighted	100.0	0.0	0.0	0.0
	Stunted	72.6	12.6	7.4	20.0
	Wasted	80.0	0.0	0.0	40.0
Second follow-up	Underweighted	75.4	8.8	8.8	19.3
	Stunted	53.8	7.7	7.7	21.7
	Wasted	53.8	7.7	7.7	0.0

Generally, this study revealed that, underweight, stunting and wasting prevailed more in children who had complementary foods before six months than those who were initiated at and after six months. This study also revealed that, complementing children at earlier life (before six months) increases the odd of becoming malnourished than those who were complemented at latter ages (after six months).

4.14 Growth Pattern of Children in relation to WHO (2006) standards

The patterns in Figure 1-3 show comparison of the growth patterns of children with the WHO (2006) references. The growth patterns of the children did not all follow the standard normal growth patterns.

4.14.1 Relationship between weight-for-height z-scores with WHO (2006) standards

Growth curve (Figure 1) indicates that, the growth of children was normally distributed in relation to WHO (2006) growth curve, as the WHZ score of the children lied between -2

to +3 standard deviation (Z-scores) as shown in the belly shaped curve. This means that the weight of the children continued to change in line with their height. Dewey *et al*, (2005) found that weight change was significantly correlated with height gain in children during their first year of life.

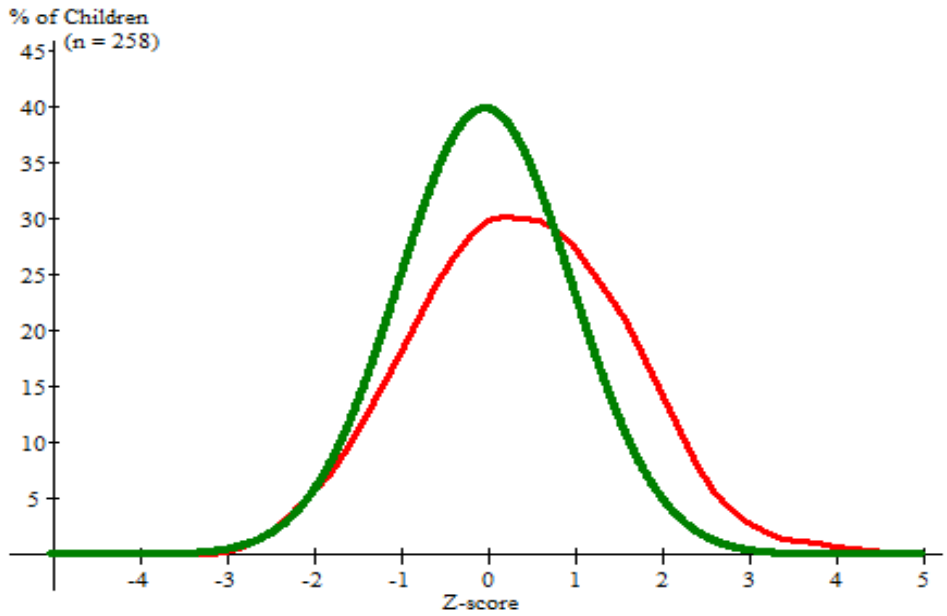

Figure 1: Relationship between WAZ-scores of study children with WHO (2006) reference children

4.14.2 Relationship between Weight-for-Age Z-scores with WHO (2006) standards

Figure 2 showed that the mean Z-score of the study children was -0.5 standard deviation below the mean Z-score of the reference children. This implied that, there was abnormal distribution of the growth pattern with WAZ scores of the children being positively skewed relative to WHO (2006) reference growth.

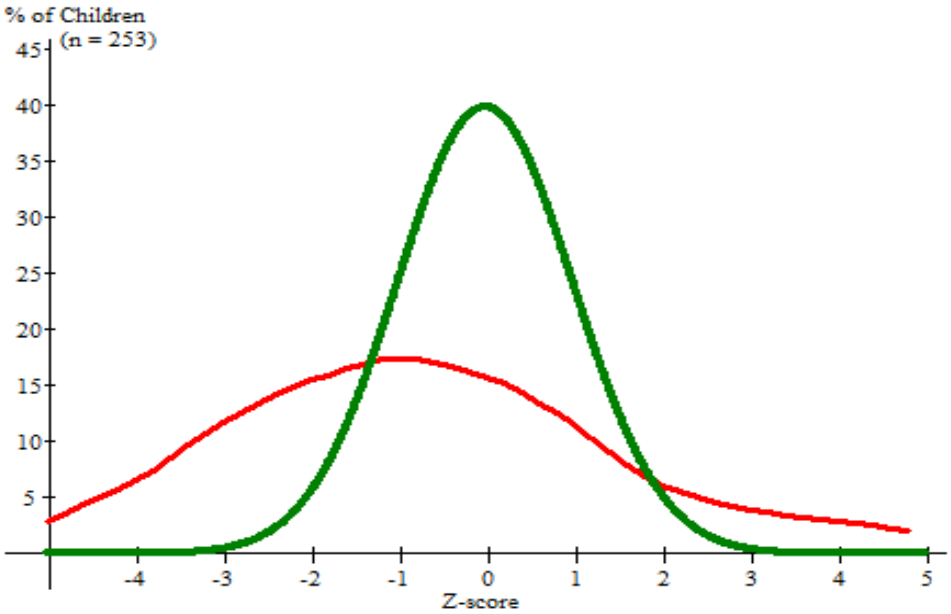

Figure 2: Relationship between WAZ-z-scores of study children with WHO (2006) reference children

4.14.3 Relationship between height-for-age z-scores

Figure 3 showed that the mean Z-scores of the study children were -1.8 standard deviation below the mean Z-score of the reference children. This indicated that the HAZ-scores of most children were positively skewed relative to the WHO (2006) standard growth.

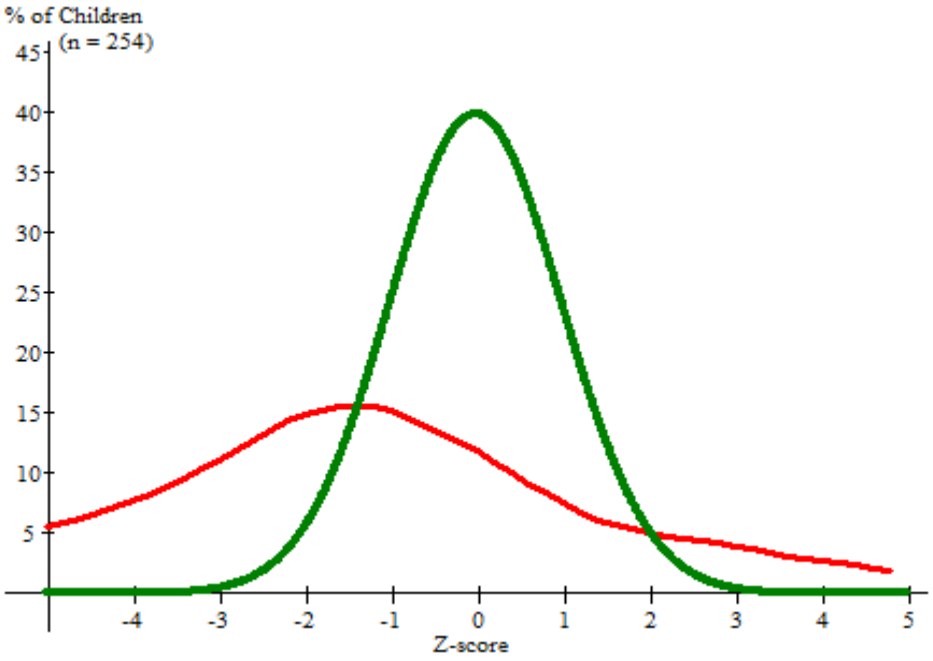

Figure 3: Relationship between HAZ- z-scores of study children with WHO (2006) reference children.

4.13 Limitations of the Study

i. Availability of consistent information from the participants was a problem especially on the pattern of meal consumption. As a result, it became difficult to know exactly their meal patterns due to inability to recall.

ii. The data were collected by recall method hence the study has a component of recall bias

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Most mothers had introduced complementary feeding earlier before the standard recommended period. This study found children who received their complementary feeding earlier before the recommended period of six months, were more likely to be undernourished compared to their peers, who did not receive early complementation. Complementary foods mostly fed to children were maize porridge, which was dense in energy (kcal) and less in other nutrients such as, vitamins and minerals that are essential for child growth. In this study, marital status, occupation and lack or low level of education were among the factors that influenced the timing of introduction of complementary feeding. Prevalence of under nutrition among the children remained high despite the fact that, most of them met the minimum recommended dietary diversity of four food groups per day. Due to the poor timing of introduction of complementary feeding it was found that, most children (72%) were stunted compared to those who were given complementary food after first six months of age. Growth patterns were therefore affected much by timing of introduction of complementary feeding. It was concluded based on this study that, dietary diversity was not the only factor that was central for existence of under nutrition. Other factors including maternal age, education levels and socio-demographics factors were also strong determinants of nutritional status apart from dietary diversity.

5.2 Recommendations

From the discussion and conclusion the study recommends the following:

i. Findings in this study revealed that, mothers who frequently fed their children with foods rich in Vitamin A had lower consumption of both animal and plant proteins. Mothers should ensure that, their children receive all the necessary foods groups in the recommended proportions and amounts to support optimal growth.

ii. Mothers should be given more education on the importance of proper timing of initiation of complementary feeding and the importance of exclusive breastfeeding and breastfeeding on demand. This would help reduce early initiation of complementary foods to children.

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APPENDICES

Appendix 1: Sample Size

Using the formula $n=Z^2*P\ (1-p) / d^2$

Where; n- sample size

D - Degree of accuracy desired (accepted error 0.05)

P – Prevalence of stunting children in Singida region (NBS, 2015)

Z – Confidence Interval (1.96)

$n = 1.96^2 * 0.29\ (1- 0.29) / 0.05^2$ = 316 households.

Therefore the estimated sample size is 316 households.

Appendix 2: Questionnaire used in data collection

SECTION I

HOUSEHOLD AND PARTICIPANT IDENTIFICATION

101	Household Name		Name of a selected child	
102	Village name		Code of a selected child	
103	Sub village name		Name of selected mother	
104	Household code		Code of a selected mother	
105			When were your borne? *(Age of the involved mothers)* *(Record DD / MM / YYYY*)	
106	GPS Codinates:			

Measure	Degree	Minutes	Second
Latitude (S)			
Longitude (E)			

(Record first the location reading at start of interview)

SECTION II

HOUSEHOLD AND WOMEN CHARACTERISTICS

201	What is the main source of drinking water for members of your household? (*Circle the most appropriate answer one option only).*	Piped water into house .....1 Piped water into yard / plot .....2 Public tap .....3 Open well in yard / plot .....4 Open public well .....5 Neighboring public well .....6 Protected well / borehole in yard / plot .....7 Spring / river / stream / pond / lake / dam ....8 Other (specify)..... 96
202	In the last seven days, have you been involved in any activity for which you are paid in cash or in kind?	Yes..... 1 No 2
203	What kind of work do you mainly do? (*Circle as many responses as apply).*	Crop production / sale ..... 1 Cattle or goat production / sale .... 2 Chicken production / sale ..... 3 Skilled trade / artisan..... 4 Casual labor ..... 5 Mining / mineral sales ..... 6 Beer brewing ..... 7 Gathering natural products for sale.. 8 Collecting scrap / waste materials for re-sale ..... 9 Other (specify)..... 96
204	Are you currently married or living together with a man as if married?	Yes, currently married..... 1 Yes, living with a man ..... 2 No, not in union..... 3

SECTION III

BREASTFEEDING HISTORY AND THE HEALTH STATUS AFTER BIRTH OF THE UNDER-FIVE CHILDREN

No.	Questions	Selected child	Skip to
301	What is (NAME)'s birth?	***(Record DD / MM / YYYY)*** ☐☐ ☐☐ ☐☐☐☐ I don't know 98	
302	Was (NAME) weighed at birth that is within one hour of being born?	Yes.....1(ask to 303) No.....2 Don't know 98	→304
303	How much did (NAME) weigh at birth? (Record the weight in kilograms from clinic card if available, If records are not available, circle code 98.	Weight from card ☐ ☐☐ Kg Record not available 98	
304	How long after birth did you first put (NAME) to the breast? *(If less than 1 hour, circle code "000". If less than 24 hours, record the number of hours; if more than 24 hours, record in days).*	Immediately .....000 Number of hours or number of days Hours ☐☐ Days ☐☐	
305	In the first 3 days after delivery, before you were producing enough milk, was (NAME) given anything	Yes .....1 No 2	→306

No.	Questions	Selected child	Skip to
	else to drink?		
306	What was (NAME) given to drink? *(Record all liquids mentioned. Circle as many answers as appropriate).*	Milk (other than breast milk) .....1 Plain water .....2 Sugar or glucose water ....3 Sugar-salt-water .....4 Fruit juice .....5 Infant formula .....6 Tea / infusions .....7 Other (specify)..... 96	
307	Are you still breast-feeding (NAME)?	Yes .....1 No..... 2	→ 308
308	For how many months did you breastfeed (NAME)? *Record the number of months (if less than one month, enter "00"). If unknown, circle code "98".*	Months ☐☐ Don't know 98	
309	How old was (NAME) when he / she was first fed something other than breast milk to drink?	Months ☐☐	

No.	Questions	Selected child	Skip to
	(Probe with common drinks, including juice, cow's milk, water, sugar water, infant formula, or anything else. Record age in months, or circle the appropriate code).	Not started giving anything .....99 Don't know 98	
310	If (NAME) was fed semi-solid or solid foods before the age of 6 months, what was the most common food given? *Circle the most appropriate response (one option only).*	Cereal-based porridge .....1 Root / tuber-based porridge.2 Plantain-based porridge...3 Other (specify).....96 ☐ No semi-solid or solid foods given before the age of 6 months 99	
311	If (NAME) was fed semi-solid or solid foods before the age of 6 months, what was added to the common food given? *Select all options which apply.*	Chicken .....1 Other meat product .....2 Egg .....3 Cow or goat's milk .....4 Vegetables / leaves .....5 Groundnuts / beans .....6 Fats or oil .....7 Sugar .....8 Other (specify).....96 ☐ No semi-solid or solid foods	

No.	Questions	Selected child	Skip to
		given before the age of 6 months 99	
312	If (NAME) was fed something other than breast milk before the age of 6 months, what was the reason? *Circle the most appropriate response (one option only).*	Another pregnancy .....1 Child refused .....2 Mother fell sick .....3 Mother had insufficient milk .....4 Mother and child separated ..... Other (specify) .....96 [ ] Nothing other than breast milk given before the age of 6 months 99	

SECTION IV

ASSESSMENT OF THE MEAL COMPOSITION BASED ON A PREVIOUS 24-HOUR RECALL

(*Ask the mother to describe all foods that were consumed by the child during the previous 24 hours. These included foods that were eaten outside from home. Circle the food against the number besides each)*

FOOD GROUP AND CODE		SELECTED CHILD	
401	**Grain roots and tubers**	Maize (/porridge)	1
		Millet (/porridge)	2
		Cassava	4
		Potatoes	5
		Rice	6
		Wheat	7
		Other (specify)	96
		None	99
402	**Other fruits and vegetables**	Guava	1
		Lemon	2
		Berry	3
		Other (specify)	96
		None	99
403	**Legumes and nuts**	Beans	1
		Mung beans	2
		Groundnuts	3
		Cashew nuts	4
		Bambara nuts	5
		Cowpeas	6
		Other (specify)	96
		None	99

404	**Vitamin A rich fruits and vegetables**	Pumpkin	1
		Carrot	2
		Squash	3
		Sweet potatoes that are orange inside & other locally available vitamin A rich vegetable	4
		Other (specify)	96
405	**Fresh foods**	Rabbit	1
		Goat	2
		Pork	3
		Chicken	4
		Duck	5
		Sardine	6
		Liver	7
		Fish	8
		None	99
406	**Eggs**	Chicken eggs	1
		Duck eggs	2
		Other (specify)	96
		None	99
407	**Dairy products**	Cheese	1
		Milk	2
		Yogurt	3
		Others Specify)	
		None	99

SECTION V

ANTHROPOMETRIC MEASUREMENTS

(Measure weight and height of both mother and the child, thereafter, record respective measurement against appropriate survey)

501	Survey (tick **v**)			Mother	Child
502	1st	2nd	3rd	Height (cm)	Height/length (m)
205	1st	2nd	3rd	Weight kg	Weight kg

Thank you for your continued cooperation. Would you like to participate in the next six months for the survey like this? **Yes (1) (0)**