NUTRITIONAL STATUS, DIETARY QUALITY AND ASSOCIATED FACTORS AMONG LACTATING MOTHERS FROM SELECTED DISTRICTS OF JIMMA ZONE, SOUTHWEST ETHIOPIA

BY

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October, 2015

Jimma, Ethiopia

NUTRITIONAL STATUS, DIETARY QUALITY AND ASSOCIATED FACTORS AMONG LACTATING MOTHERS FROM SELECTED DISTRICTS OF JIMMA ZONE, SOUTHWEST ETHIOPIA

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I have completed my thesis research work as per the approved proposal and it has been evaluated and accepted by my advisers. Hence, I hereby kindly request the Department to allow me to present the findings of my work and submit the thesis.

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DEDICATION

This thesis is dedicated to my dear Mother Meseret Alemu and my Father Tadesse Birhane, for all their sacrifices and wishes to my success in all my endeavors.

STATEMENT OF THE AUTHOR

I, the undersigned, declare that this is my original work and has not been presented before for an award of a degree/diploma in this or any other university. All sources of materials used for the thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for M.Sc. degree at Jimma University, College of Agriculture and Veterinary Medicine and is deposited at the University Library to be made available to borrowers under the rules of the library.

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BIOGRAPHICAL SKETCH

The author Frehiwot Tadesse Birhane was born to her mother Mrs. Meseret Alemu and her Father Tadesse Birhane at Shashemene town, Arsi zone of Oromia region on November 1987. She attended her elementary and secondary school at Shashemene Biftu secondary school from 1994 to 2004 and high school at Shashemene preparatory school from 2005 to 2006. In 2007 she joined Mekelle University and graduated in 2009 with a BSc degree in dry-land crop and horticultural science with a specialization of horticulture.

After graduation, she had worked in different governmental organizations for three years. From September 2010 to October 2012 worked as horticultural expert in Jarso woreda Harergae zone, environmental protection expert in Addiss Ababa Yeka sub city, and Agricultural College instructor at Agarfa. Then she was joined Jimma University School of graduate studies in November 2012 to pursue her studies for Master of Science in Post Harvest Management.

TABLE OF CONTENTS

Contents **Page**

LIST OF TABLES

Contents **Page**

LIST OF FIGURES

Contents **Page**

LIST OF TABLES IN THE APPENDIX

Contents **Page**

LIST OF FIGURES IN THE APPENDIX

Contents **Page**

LIST OF ABBREVIATIONS AND ACRONYMS

µg/g	Micro gram per gram
µg/ml	Micro gram per milliliter
AED	Academy for Educational Development
AOAC	Association of Analytical Chemists
BDL	Below Detected Level
BMI	Body Mass Index
CED	Chronic Energy Deficiency
Cm	Centimeter
CSA	Central statistics Agency
DDS	Dietary Diversity Score
DHS	Demographic Health Survey
DRI	Dietary Reference Index
EDHS	Ethiopian Demographic Health Survey
EPHNRI	Ethiopian Public Health and Nutrition Research Institute
FAO	Food and Agriculture Organization
FoNSE	Food and Nutrition Society of Ethiopia
g	Gram
GFDRE	Government of Federal Democratic Republic Ethiopia
JUCAVM	Jimma University College of Agriculture and Veterinary Medicine
Km	Kilo meter
MAR	Mean Adequate Ratio
m.a.s.l	Meter above sea level
mg	Milligram
mm	Millimeter
NAR	Nutrient Adequacy Ratio
NCED	Not Chronic Energy Deficiency
PHM	Post Harvest Management
RELOAD	Reduction of Losses and Adding Value in East African Food Value Chains
SD	Standard Deviation

SPSS	Statistical Package for Social Science
UNICEF	United Nations Children's Fund
UNU	United Nation University
USAID	United States Agency for International Development
WHO	World Health Organization
WI	Wealth Index

NUTRITIONAL STATUS, DIETARY QUALITY AND ASSOCIATED FACTORS AMONG LACTATING MOTHERS FROM SELECTED DISTRICTS OF JIMMA ZONE, SOUTHWEST ETHIOPIA

ABSTRACT

Breastfeeding is a natural process, which is well established to provide many health benefits for both mothers and their infants. However the nutrient intake of lactating mothers is one of the most important determinants of mother's health, well-being and the ability for long-term successful breastfeeding. Therefore it is important to determine the dietary quality, nutritional status and nutritional composition of foods consumed by lactating mothers in order to contribute comprehensive baseline information to the country-specified policy makers that can be used in improving maternal nutrition, social and economic wellbeing of the society. This study was aimed to assess nutritional status, dietary quality and associated factors among 558 lactating mothers from purposively selected three districts: Mana, Omo-nada and Dedo of Jimma zone, southwestern Ethiopia. Community based cross-sectional survey design and multistage stratified clustered sampling techniques were used in this study. A scale of seven food groups was used for assessing dietary diversity and food variety within 24- hr recall and The proximate, mineral and anti-nutritional composition of commonly consumed foods were analyzed at EPHNRI. Statistical analyses were carried out using SPSS (version 20).The prevalence of "low DDS" was high ($P<0.05$) in rural mothers, informally educated mothers, mothers who reside in lower HH wealth status, and being in Omo Nada District (cereal crop producing).On the bivariate analysis; husband' occupation, low household wealth status and younger age of the study participants were positively associated with chronic energy deficiency ($p<0.05$). Other predictable variables like DDS, family size and lactating mother's education have no association, ($p>0.05$) with chronic energy deficiency. On multivariable linear regression BMI was positively associated with having additional two meals a day ($\beta=0.529$, $P=0.080$), house hold wealth ($\beta=0.721$, $P=0.004$), age ($\beta=0.72$, $P=0.000$) and husband's occupation ($\beta=0.206$, $P=0.001$) whereas marital status was negatively associated ($\beta=0.412$, $P=0.483$) with BMI. All the commonly consumed foods by lactating mothers were not sufficient to meet the energy requirements, ($NAR<1$). The overall nutrient adequacy MAR was below the cut-off point for all food types. The feeding practices, dietary intakes in relation to diversified diet and nutritional adequacy of common foods were below the national and international recommendation. Unless the risk factors identified and minimized, the lactating mothers stored fat become depleted and have no energy to breast feed their children.

Key words: Breastfeeding, Maternal malnutrition, Dietary quality

1. INTRODUCTION

1.1 Background

Nutrition is a scientific discipline, concerned with the access and utilization of food and nutrients for life, health, growth, development and well-being (FoNSE, 2010). Good nutrition is important for everyone because food gives our bodies the nutrients they need to stay healthy, grow, and work properly. However, the nutrition requirement varies with respect to age, gender and during physiological changes such as lactation, pregnancy (Temesgen et al., 2015).

According to Elodie et al. (2009), nutrient requirements are considerably elevated during lactation than in any other stage of a women's reproductive life. The energy cost of milk production in the first six months of exclusive breastfeeding increases mother's daily energy needs with an additional 500 kilocalories (FAO, 2000).

Malnutrition especially continues to be a major public health problem throughout the developing world, particularly in sub-Saharan Africa, where 1–5 predominant diets deficient in macronutrients (protein, carbohydrates and fat), micronutrients (electrolytes, minerals and vitamins) or both (Olaf and Michael, 2005).

Undernutrition is common in poor populations, since the diets are predominantly based on starchy staples (Wilna et al, 2006) and these plant-based diets are low in micronutrient contents, high in phytate and dietary fiber which inhibits the absorption of micronutrients (Sanusi, 2010). Even in conditions when food availability and purchasing power may be sufficient, poor monotonous diets low in quantity, quality and variety or dietary diversity of foods is often a major contributing factor (FAO, 2010).

Ethiopia is among the poorest countries in Africa with high rates of food insecurity and malnutrition (Jamal and Rebecca, 2009). Although Ethiopia has a wide range of agro-climatic conditions and grows a variety of cereals, root crops and vegetables, some of these are not fully utilized. There appears to be dependency on a predominant food crop by region. The lack of dietary diversity results in a shortage of minerals and vitamins which suggests that the bio-availability of much of the iron, zinc, vitamin A and other micro and macro nutrients in the average will be reduced (Elodie et al., 2009).

1.2 Statement of the Problem

Mothers in developing countries generally enter lactation with low bodily energy reserves, which makes them to be at risk of adverse nutritional consequences (Anita, 2010). Even though there is very limited information available outside of developed countries, it is clear that poor nutritional status among women is a global problem, and is most severe for poor women (Woldemariam and Timotiows, 2002).

Comparing the nutritional status of Ethiopian women with that of women in 29 other sub-Saharan African countries, the prevalence of under nutrition in Ethiopia is higher than in any other country which results from inadequate intake of nutrients (Fikrewold and Daniel, 2010).

In Ethiopia, people are eating enjera with stew or "wot". Enjera is Ethiopian traditional cereal-based pancake, prepared from fermented cereal sour dough that is diluted in hot water to form a batter that is then cooked (baked) (Kaleab et al., 2013). Stew or "Wot" is prepared from a mix of pulses, vegetables, animal products and spices (Todd, 2005). Kita is unfermented thinly baked bread type prepared from dough of wheat, maize, barley, sorghum or other grain types.

Poor households usually enjera with wot prepared from pulse crops. Usually diets are very limited in many Ethiopian households with a majority of plant source protein and basic starches and a lack of vitamins (Todd, 2005).

Poor nutrition perpetuates the life cycle of poverty and malnutrition through direct losses in productivity from poor physical status and losses of mothers caused by disease linked with malnutrition and indirectly losses from poor cognitive development and losses in schooling of their child (FoNSE, 2010), causing repercussions for herself, her family, her community, and the broader society (The Manoff Group, 2011).

The present study covered wide nutritional perspectives and presented research based information on the feeding practice, nutritional status, and nutritional composition of foods consumed by lactating mothers. Therefore, this study contribute significant, comprehensive baseline and new findings to the country-specified policy makers which will enable them give attention to improving maternal nutrition, social and economic wellbeing of the society.

Moreover, it will help the scientific community to start dealing with nutritional status from their respective country wise perspective especially for those who do not develop cut off for nutritional status, so can evaluate the progress being made by countries globally.

1.3 Research questions

1. What is the nutritional status of the lactating mothers in the study area?
2. Are there any contributing factors to the nutritional status of the mother?
3. What is the nutritional quality of foods consumed by mothers during the lactation period?
4. Is the nutrient profiles of the consumed foods be able to fulfill the recommendations set by the World Health Organization (WHO)/ Food and Nutrition Board Institute of Medicine of the National Academies

1.4 Objectives

1.4.1 General objective

The general objective of the study was to assess the dietary quality and associated factors with lactating mother's nutritional status in Jimma Zone, Southwestern Ethiopia.

1.4.2 Specific objectives

- To determine the nutritional status of lactating mothers in the study area.
- To measure the dietary quality of foods consumed during lactation period
- To identify factors associated with nutritional status and dietary diversity score (DDS)

2. LITERATURE REVIEW

2.1. Overview of malnutrition in lactating mothers

Malnutrition in all its forms either directly or indirectly is responsible for approximately half of all deaths worldwide (WHO, 2011). In the worst-affected countries, individual productivity losses due to malnutrition are equivalent to 10% of lifetime earnings, resulting in gross domestic product (GDP) losses of up to 3% (FAO, 2010).

The proportion of women who are malnourished in selected sub Saharan African countries for which a Demographic Health Survey (DHS) was recently conducted ranged from 7 to 37 percent. Ethiopia has one of the highest proportions of undernourished women (FoNSE, 2010). Chronic energy deficiency appears to be a more serious concern than overweight among women in Ethiopia.

There were limited studies conducted regarding women's nutritional status in Ethiopia, malnutrition is often wide spread throughout the country. For example, according to Woldemariam and Timotiows (2002), the mean height of Ethiopian women was 156 centimeters, and about 4 percent of the women were shorter than 145 centimeters. The percentage of women whose height was below 145 centimeters was highest in Tigray (4.8%). Findings by Kiday et al., in Samre woreda, south eastern zone of Tigray also reported that the prevalence of chronic energy deficiency (BMI <18.5 Kg/m2) among the lactating mothers was 25% (Kiday et al., 2013). Recently, Temesgen et al., studied an institutional based cross- sectional study on nutritional status, and associated factors among lactating mothers in Nekemte Hospital and Health Centers; reported that the nutritional statuses of the lactating mothers were short of the national and international recommendations (Temesgen et al., 2015).

2.2. Causes of maternal malnutrition

Research have been identified that the process of becoming malnourished often starts in uterus and may last, throughout the life cycle and also spans generations particularly for women (Priyanka, 2014). A mother who was malnourished as a fetus, young child, or adolescent is more likely to enter pregnancy stunted and malnourished. Her compromised nutritional status affects the health and nutrition of her own children (USAID/AED, 2004).

There are three major groups of causes of maternal malnutrition. First, inadequate dietary intake and disease are considered the most significant immediate causes of malnutrition of women. Secondly, the underlying causes for inadequate dietary intake and diseases fall within the three interrelated groupings of insufficient food availability and access, inadequate care for mothers, and insufficient health services and inadequate provision of a healthy environment (e.g. clean water and sanitation). Finally, the major basic or structural causes of malnutrition in the hierarchy include economic, technological, political, cultural, and institutional structures and processes, the means of control of physical resources, and the level of human development (Todd, 2005).

The causes of malnutrition are complex, multidimensional and interrelated (Priyanka, 2014). There are different determinants of malnutrition among reproductive age group of women. The limited study conducted in Ethiopia showed the association between residence area and the nutritional status women. Fikrewold and Daniel (2010) reported a study on under-nutrition among women in Ethiopia; rural women were more likely to be affected by under-nutrition than their urban counterparts (Fikrewold and Daniel, 2010; Woldemariam and Timotiows, 2002). Greater access to health care, safe water and sanitation facilities may be the causal factors for better nutritional status among urban women. Moreover, better infrastructure, which has a direct influence on food security, is relatively poor in the rural parts. Moreover, slow expansion of education and social services and roads in rural part may contribute to lower nutritional status among women in rural areas (Woldemariam and Timotiows, 2002).

Another important determinant of the nutritional status of women is household wealth in which it indicates a direct association with household food security. Household food security in turn is a precondition for daily dietary intake for all household members (Fikrewold and Daniel, 2010). A study done in Ethiopia found that compared with women residing in medium/high economic status households, the risk of being undernourished for women in very poor or poor households was significant (Woldemariam and Timotiows, 2002; Temesgen et al., 2015). A recent study done in Nigeria also reported that the purchasing power of a family dictates the level of household food security and types of diets that are ultimately consumed by household members (Ukegbu et al., 2014). However, in this study nutritional status of the women was not assessed. Educational levels and income usually interact to have a positive effect on food intake, because higher educational attainment in households is likely to be associated with higher income and increased income is linked to more expenditure on food (Sanusi, 2010). Still lack of education may affect mothers' knowledge regarding healthy food habits and sanitation practices (Alemtsehay et al., 2013). Increasing maternal education has been shown to be effective in addressing the problem of malnutrition Based on UNICEF's conceptual frame work of determinants of malnutrition, maternal illiteracy and unhealthy environment were classified as underlying causes of malnutrition (UNICEF 1998) (Figure 1).

Conceptual frame work

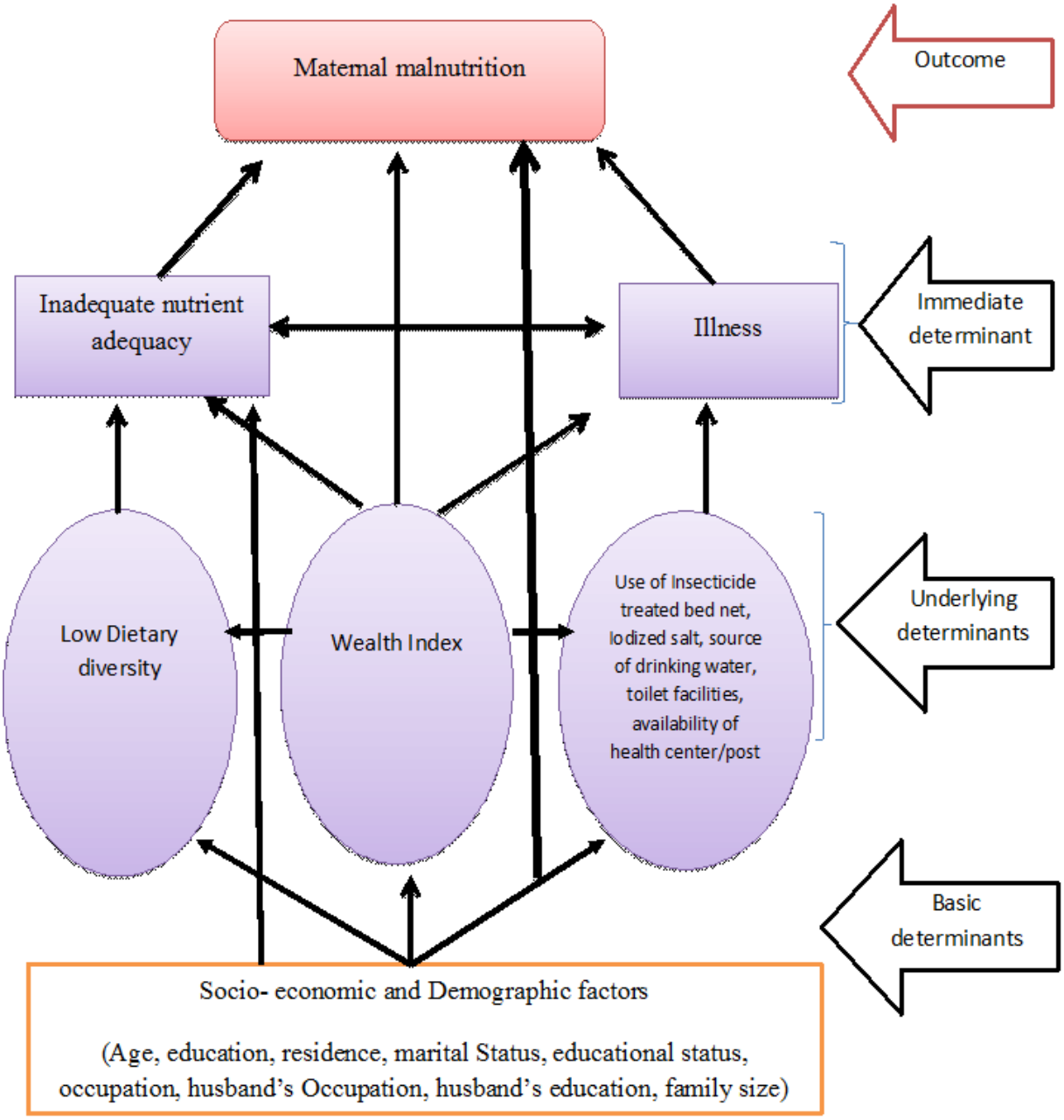

Figure 1: Conceptual framework developed based on UNICEF, 1998

2.3. Specific nutritional requirements during lactation

All foods are made up of a combination of energy (fat, carbohydrate), body building (protein) and micronutrients (vitamins and minerals). Together with water, these nutrients are essential for life (WFP, 2000).

2.3.1. Energy

Energy is needed for the essential body functions (such as breathing), growth (especially during childhood), and physical activities (working and playing). The total amount of energy and protein needed by different individuals varies a great deal, depending primarily on the amount of physical activity but also on age, sex, body size and, to some extent, climate. Extra energy is needed during lactation (WFP, 2000).

Lactation is the most energy demanding phase of human reproduction. The energy cost of milk in the first six months of exclusive breastfeeding increases women's daily energy needs by 30% or 1260 kJ/day above the pregnancy energy requirement. This is worldwide accepted since the energy cost of lactation is presumed to be similar in well and poorly nourished women. However women in developing countries generally inter lactation with low bodily energy reserves, which puts them at risk of adverse nutritional consequences (Anita, 2010).

As the staple food in most food aid contexts, cereals provide the largest proportion of energy in the diet, a large part of the protein, and significant amounts of micronutrients. Animal and plant source of oil also contributes to fat. The levels of micronutrients present depend on the type of cereal and the extraction rate during milling or other processing. The higher the extraction rate, the less whole cereal grain remains and, in general, the lower the level of micronutrients. Pulses (peas, beans, and lentils) are rich sources of protein (WFP, 2000).

In lactation, carbohydrate intake is slightly increased by 80g/day from 130g/day recommended for pregnancy. Human milk has a very high lactose content (the principal carbohydrate in milk), about 7g/day and provides about 40% energy to the infant. In most studies, breast milk concentration appears to be insensitive to changes in diet and nutritional status. However, carbohydrates are essential to provide the lactating mother with energy for the nursing period (Anita, 2010).

Foods providing carbohydrates are the cheapest sources of energy in the world. For many small farmers in developing countries, they provide not only the main food, but also a source of income for the family. In terms of the world commodity trade, carbohydrate-containing foods, predominantly cereals represent a major part. It is clear that carbohydrates are an important source of energy for the body, providing glucose for immediate use and glycogen reserves (Mary, 2003).

2.3.2. Proteins (body building)

The word ‘protein’ is derived from the Greek and means ‘holding first place’. Proteins are essential in the structure and function of all living things; without them no life can exist (Mary, 2003).

During lactation a further increase of 15g/day to 20g/day above pre-pregnancy requirements is needed since protein is responsible for various function, i.e. cell growth, tissue repair, energy source, maintenance of fluid and electrolyte balance, acid-base balance, and a strong immune system (Anita, 2010).

The major sources of protein are meat, milk, bread and cereals. However, protein can also be provided by other animal products, such as eggs, dairy produce (cheese and milk based desserts) and fish. Plant foods that are useful sources of protein include all cereals and their products (including pasta and breakfast cereals), legumes, nuts and seeds. For many people of the world who follow vegetarian diets, the plant foods are the only sources of protein; clearly they can provide an adequate supply of protein. Roots and tubers do not have high protein content but, if they constitute a substantial proportion of the diet, this protein can make an important contribution (Mary, 2003).

2.3.3. Vitamin A and minerals

2.3.3.1. Vitamin A

There are two forms of vitamin A in foods: preformed retinol as retinyl esters and pro-vitamin A carotenoids. The three major pro-vitamin A carotenoids are β-carotene, which consists of two molecules of retinol joined together, and α-carotene and β-cryptoxanthin, which consist of one retinol molecule joined to another retinoid with no vitamin A activity (Sonja et al.,2005). Vitamin A, a fat-soluble, and beta carotene which can be used in the body as either an anti-oxidant or a precursor to vitamin A, are critical during fetal development because of their involvement in growth, vision, protein synthesis and cell differentiation (Judith and Sari, 2011).

Infant liver stores vitamin A at birth is very small even in well-nourished population. They greatly depend on dietary intake of the mother. On the other hand, although vitamin A in human milk decreases over the course of lactation, breast milk is a good source of vitamin A and clinical vitamin A deficiency is rare in breastfeed infants during their first year of life, even in poor population. Therefore, mother does not consume vitamin A in her diet; she will be depleted with her child and the recommended dietary allowance for lactation is 850µg/day (Anita, 2010).

Good sources for vitamin A are eggs, butter, milk and milk products, liver and fish or fish oils. Plant foods contain carotenoids, which are red or yellow pigments found in many fruit and vegetables (Mary, 2003). In most tropical countries, where consumption of animal products is often low, the main sources of vitamin A activity in the diet are the carotenes, particularly β-carotene. Red palm oil is rich in β- and α-carotenes, as are carrots. Papayas are rich in β-carotene and β-cryptoxanthin (Jim and Stewart, 2002).

2.3.3.2. Iron

Iron is a trace mineral that is vital for fetal growth and development as it plays a key role as a co-factor for enzymes involved in oxidation-reduction reactions, which occur in all cells during metabolism. Iron is also necessary as the component of hemoglobin that allows red blood cell to carry oxygen needed throughout the body (Judith and Sari, 2011).

Iron supply is greatly influenced by the composition of the diet. Two broad categories of iron are present in food. Heme iron, derived mainly from hemoglobin and myoglobin in meat, and non-haem iron in the form of iron salts, iron in other proteins and iron derived from processing or storage methods. Heme iron enters the mucosal cells by a different mechanism and is better absorbed than non-heme iron. It is also less influenced by the body iron status, and, because the iron is protected by the heme molecule it is not affected by other constituents in the diet. The most important promoters of non-heme iron absorption are ascorbic acid (vitamin C) and meat. Other organic acids (e.g. citric acid) and some spices have also been shown to enhance iron absorption (Jim and Stewart, 2002).

Both mother and baby need iron for their developing blood supplies. A developing baby also stores iron for use after birth. This increases the mother's iron needs. All pregnant women need around 27 milligrams per day. The need for iron declines after birth but women who are breastfeeding still require about 10 milligrams a day (Anett, 2013).

The main iron sources are oysters, liver lean, red meat (especially beef) poultry, dark red meat, tuna, salmon, iron-fortified, cereals, dried beans, whole grains, eggs (especially egg yolks), dried fruits, dark leafy and green vegetables (Maria et al., 2010).

2.3.3.3. Zinc

Zinc is one of the essential trace elements and vital micronutrients with diverse physiologic and metabolic functions. It participates in all major biochemical pathways and plays multiple roles in the cellular proliferation and differentiation. It affects physical growth, immunity, reproductive function and neuron-behavioral development (Samson et al., 2011).

The recommended amount of zinc during lactation is 12mg/day for women over 19 years and slightly higher than for pregnancy, which is 11mg/day (Jun and Nancy, 2000).

Rich sources of dietary zinc include meat, fish, shellfish, nuts, seeds, legumes, and whole-grain cereals. However, plant sources are considered to be less bioavailable because of the presence of phytic acid that binds to zinc-forming insoluble complexes, which thus inhibits zinc's absorption. Pulses and whole grains are a moderate source, but are of importance in vegetarian diets. Low levels of zinc occur in leafy vegetables, fruit, fats, alcohol (Nicola et al., 2009).

2.3.3.4. Calcium

Calcium (Ca) is a remarkable and fascinating mineral. It is an essential constituent of all forms of life and is critically important for good health and human nutrition. The skeleton contains 99% of the body calcium and human beings need adequate dietary calcium and vitamin D to grow and keep healthy bones and teeth (Jim and Stewart, 2002).

Calcium is a significant component of breast milk. As in pregnancy, calcium absorption is enhanced during lactation and urinary loss is decreased. The recommended intake for calcium for lactating women is unchanged from pregnancy; that is 1000mg/day. Because of their continual growth, teenage mothers should consume 1300mg/day. Typically if calcium is adequate, a women's bone density returns to normal shortly after lactation ends (Anita, 2010).

Milk and dairy products are the major sources of calcium in many diets. In countries such as the UK where addition of calcium to flour is required by law, bread and other cereal products also make an important contribution to intake. Sardines and other small fish, which are eaten whole, are also good sources of calcium. In countries where dairy products are not used in quantity and where fortification of flour is not required, requirements may be met by green leafy vegetables, roots, nuts and pulses (Henry and Chapman, 2002).

3. MATERIALS AND METHODS

3.1. Study site

The study was conducted in Jimma Zone, South West Ethiopia, in three agro-ecologically selected districts namely Mana, Dedo and Omo-Nada.

The table-1 below summarizes the demographic characteristics of the study area.

Table 1: Geographical description of the study area

Descriptions	Jimma Zone	Dedo	Mana	Omo-Nada
Location	Oromia region 356 Km southwest Ethiopia	Jimma Zone,	Jimma Zone,	Jimma Zone,
Coordinates	7^{o}13'N and 8^{o}56' and 35^{o}49' and 38^{o}38'	713'-739'N and 36.443'-3712'E	7^{o}38-7^{o}54'N and 36.38'-3653'E	7^{o}17-7^{o}49'N and 3700'-3728'E
Elevation (m)	900-3360	200-1500	1470-2610	880-3344
Average rainfall (mm)	1060	1300-1700	1467	900-1600
Temperature (^{o}C)	9.5-28	18-22	13 -24.8	11.8 -26.8
Crop production	-	Vegetables and fruits	Cash crops (e.g. Coffee)	Cereal crops

Source: Jimma Zonal Finance Planning Department (2009).

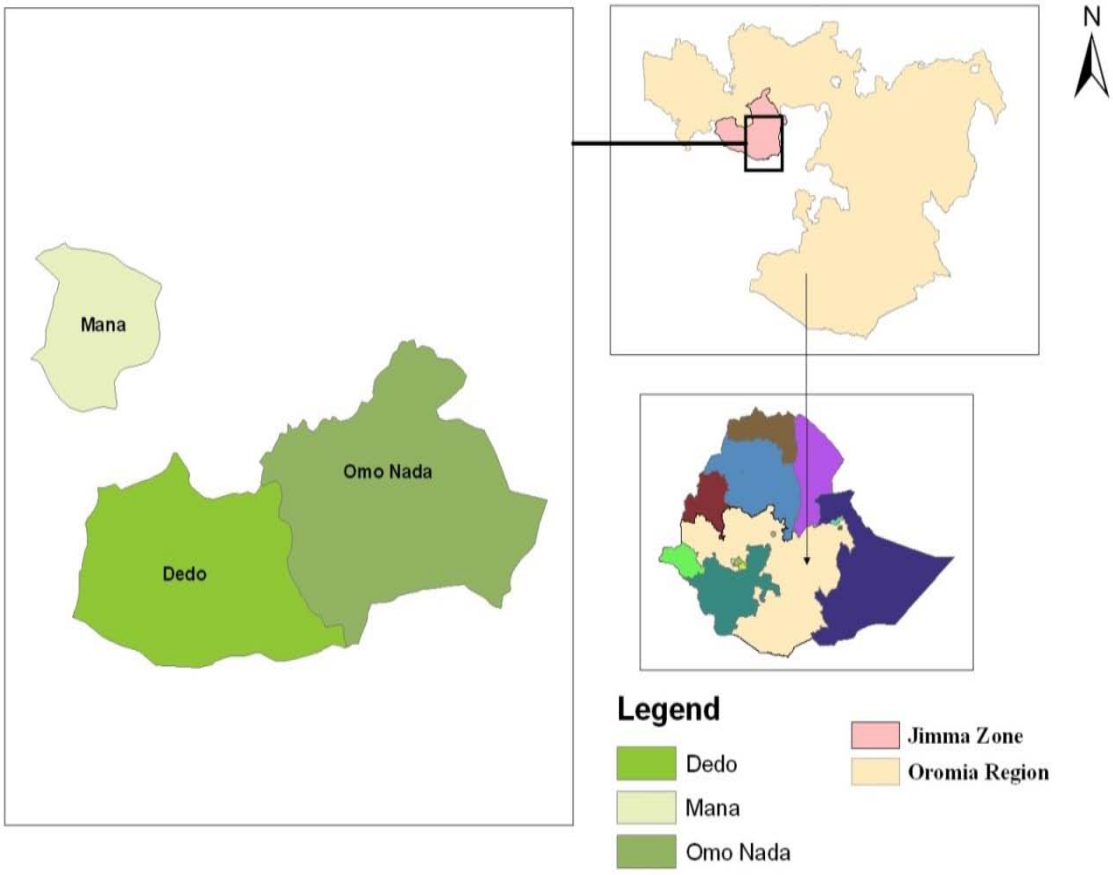

Figure 2: Map of the Study area: Source (Ethiopian Mapping Agency, developed in 2015)

3.2. Study design and sampling

The study used a cross-sectional survey design and data were collected from 558 lactating mothers of reproductive age group 15-49 years (EDHS, 2011). As shown in figure 3, Multi stage stratified clustered sampling techniques were used. Three districts (Mana, Dedo and Omoo nada) were selected purposively based on agro ecology. Households in the selected nine kebelles (one urban and two rural Kebelles from each district) with lactating mothers were identified through house-to-house visits by the researcher and kebelle health extension workers.

The sample size of the study site was calculated using G-power software (Faul et al., 2007). Accordingly, multiplying the total sample size, 278 by design effect of 2, the total sample size of the study was 556. But 558 total sample size was used to distribute first to the three districts (186 each) and then to urban and rural kebelles.

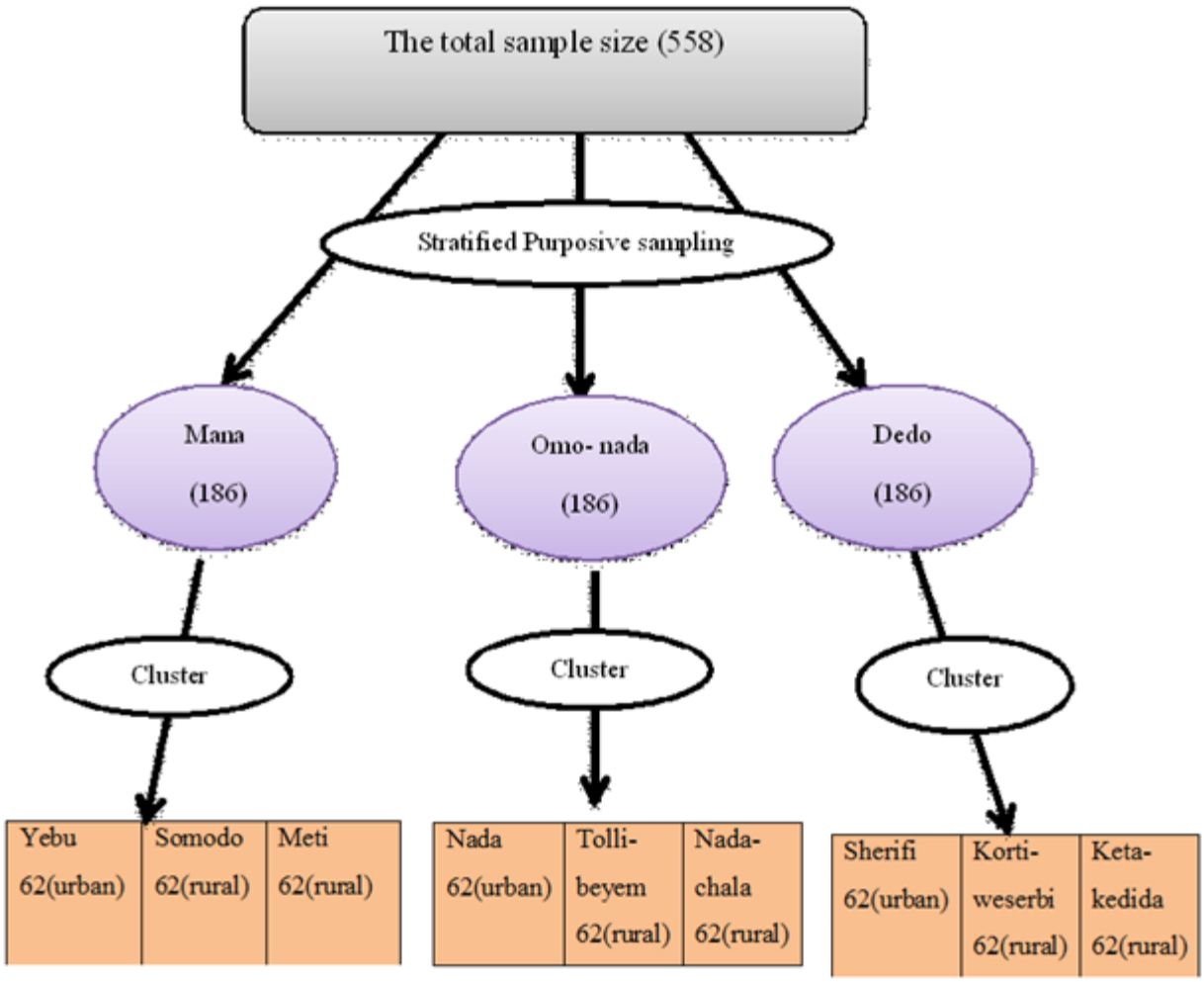

Figure 3: Schematic presentation of the sampling method.

3.3. Time and duration of the study

The survey study was carried out from March to May, 2014. The food sample consumed by lactating mothers was collected between August 10 and 17 and then directly go for analysis up to September, 2014.

3.4. Inclusion criteria

The study included respondents who were healthy and not on medication, whose consumption was not affected by illness, fasting, national holidays and festivals. The study was undertaken out of fasting and festival time and/or market day.

3.5. Data collected

The study employed both qualitative and quantitative data collection methods.

3.5.1. Measurements

The questionnaires were initially prepared in English language and later translated into Afan Oromo (local language) and then a pre-test of the interviews were carried out before the actual interviews were started. Data were collected by the study researcher and the supervisor together with health extension workers using structured questionnaire. The closed and open ended questions were organized into the following sections:

- Socio-demographic and economic information
- Facilities and health education
- Anthropometric measurement
- Feeding practice of lactating mothers
- 24 hour dietary recall

3.5.1.1. Socio- economic and demographic factors

educational status of lactating mothers, age of lactating mothers, marital status of mothers, lactating mother's employment, household wealth, educational status of husband, husband's employment status, family size and place of residence were included in the questionnaires.

3.5.1.2. Facilities and health related practices

The respondents were asked about different facilities available in their compound and near to their house as well as about health related practices and knowledge. For example, the availability of health post, center, shop, market place in their compound were some the facilities and the use of bed net, family planning, iodine salt in their meal are some the health education and related practices.

3.5.1.3. Dietary assessment

The food intake data of the lactating mothers were collected using single 24-hour dietary recall by female interviewers. Mothers were asked to recall all foods eaten and beverages taken in the previous twenty-four hours prior to the interview. The interviews included a detailed description of the foods eaten, ingredients added while they processed and the food eaten outside their home. Finally the respondents were probed for meal and snacks not mentioned (Ann et al., 2013).

3.5.1.4. Dietary diversity score (DDS)

The dietary diversity score was calculated by summing the number of food groups derived from food guide pyramid (USDA, 2005). A scale of seven food groups was used to assess the dietary diversity of food consumed over the last 24- hours. Consuming a single food item from the food group was given a score of "1" and not consuming any of the food items from the food groups was given a score of "0". Then the scores were summed to produce dietary Diversity Score (DDS). The DDS was converted into terciles and the highest tertiles was used to define ''high'' dietary diversity score, while the two lower terciles were combined and labeled as ''low'' dietary diversity score (Sanusi, 2010; Kumari et al., 2012; Warkicho et al., 2014). The food groups considered were cereals and grains, fruits, vegetables, protein rich foods, dairy products, oil and fat and discretionary calorie foods.

3.5.1.5. Anthropometric measurements

Weights of the lactating women were measured to the nearest 0.1 Kg on a battery powered digital scale (Seca, Germany) and heights were measured to the nearest 0.1 cm using a plastic height-measuring board with a sliding head bar floor model without weighing scale. Each subject was made to stand erect on the scale with light clothing and without shoes. The readings were taken in kilogram (Kg). The scale reading was always allowed to return to zero before the subject was asked to stand on it. Individual heights and weights were then used to calculate Body

Mass Index (BMI). BMI of the study subjects was calculated by dividing the weight in kilogram to the height in meter squared (kg/m^2) (Temesgen et al., 2015).

3.5.2 laboratory analysis of food samples

3.5.2.1. Commonly consumed foods

Based on the survey data, 12 predominantly eaten food samples were identified and collected from randomly selected lactating mothers of nine kebelles using plastic containers for liquid food type ("wot") and plastic bags for solid food type ("Enjera and kita). Then the composite food samples were dried (95-100^oC) immediately, and grinded, sieved through a 20-mesh and packed separately (Yeshajahu and Clifton, 1994) at Jimma University post-harvest management laboratory.

Those food types which were common for more than one kebelle were collected from each kebelle and then mixed while preparing the composite sample.

The prepared food samples were then eventually transported to Ethiopian Public Health Institute (EPHI), for laboratory analyses.

The AOAC (official) methods were used to analytically determine the composition of the food samples. Analysis was done in duplicates.

3.5.2.2. Proximate composition analysis

Determination of Moisture Content

Moisture of the samples was determined by air oven method (AOAC, 2011). The metal dish was dried at 130^oC ± 3^oC for 1hr in drying oven and placed in desiccators for 30 minutes and weighted after it was cooled. About 5g of well mixed sample was weighted and transferred to drying dishes. Then the dishes with samples were placed in the oven for 1 hr provided with opening for ventilation and maintained at 130^oC ± 3^oC. Finally, the dishes were taken out and transferred to desiccators and weighted soon after reaching room temperature.

Then, the moisture content was estimated by the formula:

$$Moisture(\%) = \frac{(M_{intial} - M_{dried})}{SW} x100\%$$

Where, M_{intial} =Weight of metal dish and fresh sample

M_{dried} = Weight of metal dish and dried sample

SW= Sample weight

Determination of Crude Fiber

The crude fiber was determined by the non-enzymatic gravimetric method (AOAC, 2000). About 2g of the sample was weighed and placed into 600 ml beaker and 200 ml of 1.25% H_2SO_4 was added. Then the beaker was placed on digestion apparatus and boiled exactly for 30 min., while shaking at 5 min intervals and keeping the solution on the standard level. Then after exactly 30 minute, 20 ml of 28% KOH was added and boiled for further 30 minute. The solution was passed through screen sieve and the digested sample was decanted. The digestion beaker was washed with 3 x 50 ml portion of near boiling point water and each transferred into the screen for filtration. The residue left on the screen was transferred into 600 ml digestion flask by washing the screen with 200 ml (50mlx4) 1 % NaOH. Then it was placed on digestion apparatus and boiled for 30 min. while shaking at 5 min interval. The digested sample was filtered in coarse porosity (75µm) crucible in apparatus at a vacuum of about 25mm. The residue was dried at 130^{o}C for 2 hours and cooled in desiccators and weighed (m_1). The dried residue was ignited for 2 hrs at 600±15^{o}C until ashing was completed and then cooled in desiccators and reweighed (m_2).

$$Crudefiber\ \% = \frac{M1 - M2}{weightofsample} x\ 100$$

Where, M_1 = mass of crucible and residue before ignition

M_2 = mass of crucible and residue after ignition

Determination of Crude Protein

Protein content was determined according to Kjeldahl method of crude protein analysis (AOAC, 2000).

Digestion

About 0.1-1g of the food sample was weighed on an analytical balance into the digestion flask or larger test tube. Then the sample was digested by addition of small volume (3-5ml) of concentrated H_2SO_4 (an oxidizing agents which digests the food), anhydrous Na_2SO_4 or K_2SO_4 that speed up the reaction by raising the boiling points of H_2SO_4 and a catalyst ($CuSO_4$, selenium, titanium or mercury) to speed the reaction. About 1 g of catalyst mixture made of Na_2SO_4 or K_2SO_4 with anhydrous $CuSO_4$ in the ratio of 10:1 was used. Digestion converted any nitrogen in the food (other than that which is in the form of nitrates or nitrites) into ammonia and other organic matter to CO_2 and H_2O. In acidic solution, ammonia doesn't liberate as gas because rather it exists as ammonium sulfate salt.

$$\text{N (in food)} \longrightarrow (NH_4)_2\, SO_4$$

Distillation

After digestion was completed, the content in the flask was diluted by water and a concentrated NaOH (40%) solution. It was added to make the solution slightly alkaline and to liberate ammonia gas. The ammonia was then distilled into receiving flask that consist, a standardized strong acid, solution of excess boric acid (4%) for reaction with ammonia or sulfuric acid.

Titration

The borate ion was titrated with standard acid (0.1N HCI).

$$NH_3 + H_3BO_3 \text{ (boric acid)} \longrightarrow NH_4 + H_2BO_3 \text{ (borate ion)}$$

$$H_3BO_3 + H^+ \longrightarrow H_3BO_3$$

Calculation = Total nitrogen, percent by weight

$$Total\ nitrogen = \frac{(T-B)xNx14.007\ x\ 100}{w}$$

Where, T= Volume in ml of the standard acid solution used in the titration for the test material

B= Volume in ml of the standard acid solution used in the titration for the blank determination

N= Normality of standard sulphuric acid

W = Weight in grams of the test material

Crude protein = 6.25 * total nitrogen

Determination of Crude Fat

Crude fat was determined using soxhlet extraction methods according to (AOAC, 2011). About 1-5g of sample was weighed and placed into a thimble. The thimble and contents were placed into a 50 ml beaker and dried in an oven for 2 hr at 102 ± 2^{o}C. Thimble and contents were transferred in to extraction apparatus. The beaker was rinsed for several times with the solvent hexane. The sample contained in the thimble was extracted with the solvent hexane in a Soxhlet extraction apparatus for 6-8 hr. At the completion of the extraction, the extract was transferred from the extraction flask into a pre-weighted evaporating small beaker with several rinsing with the solvent. The hexane was evaporated until no odor of it was detected. The beaker and contents was dried in the oven for 30 minutes at 102^{o}C ± 2^{o}C to remove moisture. Then it was removed from the oven and cooled in desiccators. Finally, the beaker and contents were weighed and crude fat was calculated with formula below.

$$Crude\ fat\ (\%) = \frac{W2 - W1}{Weight\ of sample}\ x\ 100\%$$

Where, W_1= Weight of extraction flask before extraction

W_2 = Weight of extraction flask after extraction.

Determination of Total Ash

Total Ash was determined according to (AOAC, 2011). The crucibles used for the analysis were cleaned by drying at 120^{o}C and igniting at 550^{o}C in furnace for 3 hours. Then the crucibles were removed from the furnace and cooled in desiccators. The mass of the crucible was measured by analytical balance (M1). About 3-5g of the sample was weighed in to crucibles (M2). The sample was dried at 120^{o}C for 1hr in drying oven. The sample was removed from the drying

oven and carbonized by blue flame of Bunsen burner by placing the sample dish on wire gauze. The sample then placed in furnace at about 550^{o}C until free from carbon and the residues appear grayish white (about 8 hours). The sample was removed from the furnace and was moisten by the few drops of water to complete the ashing and placed in an oven at 120^{o}C for 1hr and re-ashed at 550^{o}C until white ash color is obtained. After complete ashing, it was removed from the furnace and placed in the desiccators and weighed (M3).

$$Ash(\%) = \left(\frac{M3 - M1}{M2 - M1}\right) x100$$

Determination of Crude Carbohydrate

Total carbohydrate content of the samples was determined by subtraction of the above tests parameters from 100%.

$$CHO(\%) = 100 - (\%\ moisture + \%\ fat + \%\ Ash + \%\ Crudefiber + \%\ Crudeprotein)$$

Determination of Calorific Value/Energy Value

Calorific value of food (in Kcal) was determined by multiplying each gram of protein, fat and carbohydrate obtained from laboratory analysis by their respective conversion factor.

Calculation:

$$calorific\,value(kcal) = (protein \times 4) + (carbohydrate \times 4) + (fat \times 9)$$

3.5.2.3 Mineral Analyses

Mineral analyses were done by Atomic Absorption spectrophotometer method (AOAC, 2011). 1.5g of sample was placed in the oven at 100^{o}C for 30 min. when dry, was heated on hot plate until smoke was finished and then the dish was placed in 525^{o}C furnace (carefully avoiding ignition) for minimum time necessary to obtain ash that is white and free from carbon normally 3-5h but ≤ 8h. The dish was removed from furnace and cooled. The ash was dissolved in 5ml 1M HNO_3 warming on steam bath or hot plate 2-3 min to aid in solution. The solution was added in to 50ml volumetric flask and repeated with 2 additional portion of 1M HNO_3 (Nitric acid).

Minerals were determined by adding $LaCl_3$ (Lanthanum chloride) solution to final dilution of standard and test solution to make 0.1% (w/v) La for determination of Ca and Mg only. Calibration curve (concentration vs absorbance) was prepared for each mineral to be determined using Atomic Absorption spectrophotometer wavelength for Ca 422.7nm, Fe 248.4nm, Mg 285.2nm and Zn 213.9nm and flame for Ca reducing air C_2H_2 and for Mg, Zn and Fe oxidizing air C_2H_2.

3.5.2.4. Anti-nutritional factors analyses

Determination of phytate

The method described by Vaintraub and Laptera (1988) was used for phaytate determination. 5 g of dried sample was weighed and extracted with 10ml of 0.2N HCl for 1 hr at an ambient temperature and centrifuge (3000rpm/30minut). The clear supernatant will be used for the phytate estimation. Then 2 ml of wade reagent will be added to 3ml of the supernatant sample solution then homogenized and centrifuged the solution (3000rpm/10minut). The absorbance at 500nm was measured using UV-Vis spectrophotometer. The phytate concentration was be calculated from the difference between the absorbance of the blank (3ml of 0.2N HCl +2ml of wade reagent) and that of assayed sample. The amount of phytic acid was calculated using phytic acid standard curve and result is expressed as phytic acid in µg/g fresh weight.

Standard solution Preparation

A series of standard solutions were prepared containing 4-40 µg/ml phytic acid in 0.2N HCl. 3ml of standards was pipetted in to 15 ml centrifuge tubes with 3ml of water used as a zero level (blank).Then 2ml of the Wade reagent was added to each tube and the solution was mixed on a vortex mixer for 5 seconds. The mixture was centrifuged for (3000rpm/10min) and the supernatant read at 500nm by using water to reset the spectrophotometer zero. SPSS were used to plot the calibration curve (absorbance vs concentration) and find out the slope and intercept. Finally the phytic acid content was calculated as follows:

Calculation:

$$phytic\ acid\ in \frac{\mu g}{g} = \frac{Absorvance - Intercept}{Slope \times Density \times weight\ of\ sample}$$

Determination of condensed tannin

The method described by Maxson and Rooney (1972) was used for condensed tannin determination. Weigh 1g of sample in a screw cap test tube and add 10ml 1% HCl in methanol to the tube containing sample, lid then put the tube on mechanical shaker for 24 hr at room temperature. Centrifuge the tube at 1000G for 5minute. Take 1ml supernatant and mix with 5ml of vanillin-HCl reagent in another test tube and wait for 20 minute to complete the reaction then read the absorbance at 500nm.

Standard solution Preparation

D-Catechin was used as the standard value of tannin in mg D-Catechin /g of sample. 40 mg of D-Catechin was weighed and dissolved in 100ml of 1%HCl in methanol (stock) then take 0, 0.2, 0.4, 0.6, 0.8 and 1ml of stock solution in a test tube. Adjust volume of each tube to 1ml with 1% HCl in methanol. 5ml of vanillin-HCl reagent in each tube was added. Wait for 20 minute to complete the reaction. Reading was recorded at 500nm absorbance. Reference curve was prepared from the series of standard solution.

Calculation:

$$Tannin\left(\frac{mg}{g}\right) = \frac{Abso - Intercept}{Slope\ x\ Density\ x\ weight\ of\ sample}$$

3.5.3. Determination of Nutrient adequacy (NAR)

Nutrient adequacy ratio (NAR) was used to estimate the nutrient adequacy of each sampled food types collected from study participants. NAR was calculated as the ratio of subject's intake to the current recommended allowance for the lactating mother. Then overall measure of nutrient adequacy, the mean adequacy ratio (MAR) was calculated. NAR was truncated at 1, so that a nutrient with a low NAR could not compensated by high NAR. Subject's daily nutrient intake was calculated based on the study done by WHO (2005), healthy eating. DRI (2000/2005) and FAO/WHO/UNU (2004) was used as a reference for recommended allowance.

The formula was specified as Ranthnayake et al., (2012).

$$NAR = \frac{Actual\ nutrient\ intake\ of\ a\ nutrient\ (per\ day)}{Recommended\ daily\ allowance\ of\ the\ nutrient}$$

$$MAR = \frac{\sum NAR(each\ truncated\ at\ 1)}{Number\ of\ nutrients}$$

3.6. Statistical analysis

Data entries were performed and data quality was ensured by checks at data entry and double entry with epi-data software, version 3.1. Statistical analysis was carried out using SPSS (version 20) software packages. The normal distribution, constant variance and homoscedasticity were checked.

Descriptive summaries using frequencies and proportions were used to present the study results. To investigate the socio-economic and demographic factors affecting the nutritional status of the lactating mothers, chi square and independent t-test were used. Significant variables observed in the bivariate analysis were subsequently included in to linear for BMI and logistic regression for Dietary diversity.

Household wealth status was determined using Principal component Analyses (PCA) as a data reduction tool. Fixed assets including productive (livestock, plough) and non-productive (radio/tape recorder/CD player, watch (hand/wall), television, bicycle, motorbike, phone, sofa, chair/ stool) assets were used for 558 household wealth index (Mary and Marie, 2004).

3.7. Model and explanatory variable selection

To identify the determinant factors of lactating mother's nutritional status, in the bivariate analysis, the chi-square test was employed to see the association between independent factors on dependent variable. The dependent variables are coded as 1 for chronic energy deficiency (CED) and 0 for not chronic energy deficiency (NCED). The cut-off point for CED was used mothers BMI<18.5 (FAO, 2000; Weldemariam and Timotiows, 2002). The explanatory variables used for bivariate analysis were socio demographic and economic factors (districts, place of residence, marital status, age, educational status, occupation, husband's education, husband's occupation, household wealth (WI), family size and number of children in the household) and dietary practices.

Since there is no cut-off point to say CED for Ethiopians, linear regression model was used to determine the association of the identified explanatory variables on BMI of the study participants. As stated by FAO (2000) some researchers believed that cut-off points based on country specific reference groups should be established to reflect differences in height and muscle mass. Paul et al (1998) also found that the relationship between percent body fat and BMI differs in the ethnic groups studied. For the same level of body fat, age and gender, American Blacks have a 1.3 kg=m^2 and Polynesians a 4.5 kg=m^2 lower BMI compared to Caucasians. By contrast, in Chinese, Ethiopians, Indonesians and Thais BMIs are 1.9, 4.6, 3.2 and 2.9 kg=m^2 lower compared to Caucasians, respectively.

The model is explained as (Samprit and Ali, 2006).

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon$$

Where,

Y= the dependent variable (BMI)

X= the independent variables (determinant factors)

β_0 = is the intercept term

$\beta_1, \beta_2 \ldots \beta_n$ are the coefficients of the explanatory variables X_1, X_2……Xn (β_i = effect on the dependent variable when increasing the i^{th} independent variable by 1 unit).

The explanatory variables included in the model were place of residence, marital status, occupation, husband's occupation, wealth index, and family size and having additional two meals. P-values less than 0.05 were considered as significant.

3.8. Ethical considerations

The study protocol was reviewed and approved by the Institutional Review Board of Jimma University College of Agriculture and Veterinary Medicine. Then the approved letter was taken to Jimma Zone health office and to the three districts included in the study. The nature of the study was fully explained to the study participants to obtain their oral informed consent prior to participation in the study and data was kept confidential. No resistance was made if a woman wanted to withdraw at any time from participating in the research.

4. RESULTS AND DISCUSSION

4.1. Socio-demographic characteristics

A total of 558 lactating mothers aged 15-49 years were interviewed from three districts, 186(33.3%) each, with a response rate of 100%. The study participants included 372 lactating mothers from rural areas (kebelles) and 186 lactating mothers from urban areas.

Table 2: Socio-demographic and other household characteristics of the lactating mothers in selected districts of Jimma Zone, March-May, 2014.

Variable	Categories	n	(%)
District (N=558)	Mana	186	33.3
	Omo nada	186	33.3
	Dedo	186	33.3
Residence area (N=558)	Rural	372	66.7
	Urban	186	33.3
Age group (N=558)	15-19	26	4.7
	20-24	145	26
	25-29	215	38.5
	30-34	115	20.6
	35-49	57	10.2
Religion (N=558)	Muslim	516	92.5
	Orthodox	33	5.9
	Protestant	9	1.6
Ethnicity (N=558)	Oromo	486	87.1
	Amhara	20	3.6
	Guraghe	8	1.4
	Tigray	3	0.5
	Yem	15	2.7
	Other	26	4.7

Table 2 continued……

Marital status (N=558)	Single	33	5.9
	Married and living together	501	89.8
	Married but not living together	16	2.9
	Widowed	5	0.9
	Divorced	3	0.5
Educational status (N=558)	Informal education	338	60.6
	Formal education	220	39.4
Husband's education (N=517)	Informal education	214	41.4
	Formal education	303	58.6
Occupation	House wife	436	78.1
	Farmer	3	0.5
	Government employee	7	1.3
	NGO employee	1	0.2
	Merchant	83	14.9
	Daily laborer	25	4.5
	Other (self-employed, home servant, broker)	3	0.5
Family size	2	3	0.5
	3	80	14.3
	4	118	21.1
	5	88	15.8
	6	103	18.5
	7	63	11.3
	8	56	10.0
	9	25	4.5
	10	18	3.2
	11	3	0.5
	12	1	0.2

The mean age of the respondents was 26.6±5.1 years and highest frequency was scored, 215 (38.5%) between 25 and 29 age group. Above 92 percent were Muslims. From 558 lactating mothers, 486 (87.1%) were Oromo ethnic group. Majority of the study participants, 501(89.8%) were married and living together with their husbands. Majority 436 (78.1%) of the participants were housewives. from the total 558 lactating mothers, 336 (60.2%) were illiterate/informally educated and 220 (39.4%) attended formal education whereas majority of their husbands 303 (58.6%) were formally educated and the rest 214 (41.4%) were informally educated. Almost ¾ of the study participants 436 (78.1%) were housewives and were not engaged in their own income generating activity. Majority 118 (21.1%), 103 (18.5%), 88 (18.5%) of the respondents had a family size of 4, 6, 5 respectively.

4.2. Facilities and Maternal Health Related practices

The respondents were asked about basic facilities available in their kebelle and the health related practices expected to do. According to the study large proportion of the respondents, 230 (41.2%), 278 (49.8%), 372 (66.7%), 348 (62.4%), 35 (6.3%), 366 (65.6%), 343 (61.5%) had and practiced protected well source of drinking water, ventilated improved pit toilet, market place in their kebelle, shop near to their home, use of iodine salt in their meal, bed net and family planning.

According to FoNSE (2010), health and nutrition are closely linked in a “malnutrition-infection cycle” in which diseases contribute to malnutrition, make an individual more susceptible to disease. One of the intervention programs by Government of Federal Democratic Republic Ethiopia, National Nutrition Program strives to lactating mother’s nutrition and health. Some of the initiatives are use of iodized salt, use of effective and efficient bed net in malaria area, ensuring access to reproductive health service (birth spacing) (GFDRE-NNP, June 2013- June 2015). Todd (2005) also stated, facilities and access to health services are important household and community characteristics in accounting for the prevalence of malnutrition. In view of this, the present study assessed about facilities and services accessed for (Table 3).

Table 3: Percentage facilities and maternal health related practices (rural, n=372 and urban, n=186) in Jimma zone selected districts, March-May, 2014.

Variable	Rural n (%)	Urban n (%)	Total n (%)	P
Source of drinking water	372 (100.0)	186 (100.0)	558 (100)	0.000
Protected well	164 (44.1)	66 (35.5)	230 (41.2)	0.056
Protected spring	131 (35.2)	85 (45.7)	216 (38.7)	0.021
Pipe	6 (1.6)	33 (17.7)	39 (7.0)	0.000
Unprotected well/spring/river	70 (18.8)	2 (1.1)	72 (12.9)	0.000
Toilet facilities	370 (99.5)	183 (98.4)	553 (99.1)	0.339
Pit latrine	168 (45.2)	107 (57.5)	275 (49.3)	0.007
Ventilated improved pit	203 (54.6)	75 (40.3)	278(49.8)	0.002
Market place in the kebelle	186 (50.0)	186 (100.0)	372 (66.7)	0.000
Shop near to home	198 (53.2)	150 (80.6)	348 (62.4)	0.000
Health center	0 (0.0)	186 (100.0)	186 (33.3)	0.000
Health post	310 (83.3)	124 (66.7)	434 (77.8)	0.000
Type of salt used in meal				
Iodized salt	6 (1.6)	29 (15.6)	35 (6.3)	0.000
Table salt	366 (98.4)	157 (84.4)	523 (93.7)	
Sleeping under bed net	263 (70.7)	103 (55.4)	366 (65.6)	0.007
Use of Family planning	204 (54.8)	139 (74.7)	343 (61.8)	0.000

In the study area there was a significant difference, ($p<0.001$) between different sources of drinking water among mothers placed in different residence area. Use of protected well was significantly higher, ($p=0.056$) in rural, 164 (44.1%) area than urban 66 (35.5%) area and oppositely unprotected well/spring/river, 2 (1.1%) were almost not used in urban area than rural areas, 70 (18.8%), ($p<0.001$). In other way, percentage of treated water were below 50 percent in both rural, 6 (1.6%) and urban, 33 (17.7%) residence area but urban residences were significantly

higher than rural, (p<001). Use of protected spring were also significantly higher, (p<0.05) in rural area 232 (35.5%) than urban area, 85 (45.7%). Regarding the toilet facilities, both rural and urban residence had toilet facilities, 553 (99.1%); but pit latrine were higher in urban and ventilated improved pit latrine were significantly higher in rural area (p<0.001).

All the study participants found in urban area, 186 (100.0%) have a market access in their respective kebelles than rural, 186 (50.0%) area respondents. availability of shop near to their home were also higher in urban areas 150 (80.6%) than rural 198 (53.2%), (p<0.001). In the other hand, health center was significantly available only in urban areas, 186 (100.0%), but the health post was found in both urban, 124 (66.7%) and rural, 310 (83.3%) place of residence, (p<0.001) (Table 3). So, most of the mothers had access to health post rather than health centers.

In this study, most of the rural area lactating mothers were slept 263 (70.7%) under bed net than urban 107 (55.4%) at p<0.001 significant level. Even though almost 40% of the total participants had the knowledge of using iodized salt in their daily meal, only less than ten percent, 35 (6.3%) of the participant from both urban and rural area together were used iodine salt whereas the rest above ninety percent, 523 (93.7) used table salt in their daily meal preparation (p<0.001). This result indicates, the lactating mothers in the study area might affected by iodine deficiency disorder (IDD) and goes beyond the most familiar one of goiter like preventable brain damage and mental retardation (Todd, 2005).

From the total of 558 participants, 204 (54.8%) of the rural residents and 139 (74.7%) of urban residents were used significantly different, (p<0.001) family planning programs from nearby health post or health center. This result is supported by EDHS (2011) which reported that married women in urban areas are twice as likely as their rural counterparts to use any contraceptive method (53% and 23%, respectively).

4.3 **Dietary practices**

The food intake habit were assessed and more than eighty percent of the study participants, 480 (86%) do not change their previous food intake habit during lactation, while only 14% practiced a diversified food preparation and eating habit. As shown in Figure 3, of the total participants, 124 (22.2%) had increased the amount of food intake at a time and only 81 (14.5%) consumed

two additional meals. None of the respondents were taking source of vitamin A supplements during the first six months of lactating period.

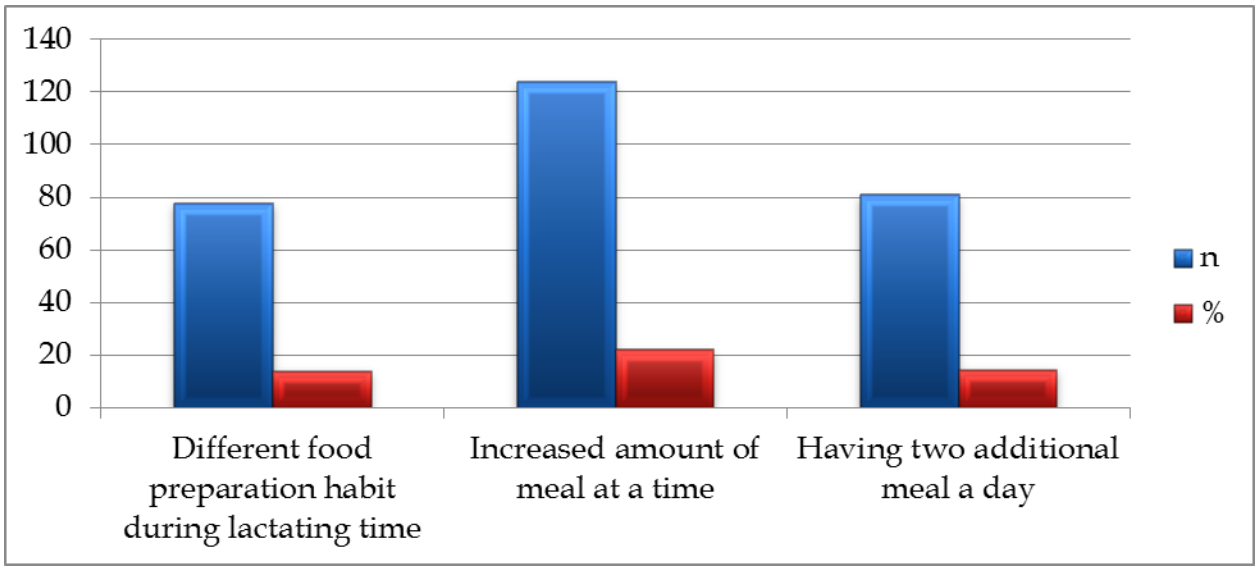

Figure 4: Eating habits of lactating mothers (N=558), in selected districts of Jimma Zone, March- May 2014.

It is known that a lactating mother should produce about 700 to 800ml of milk per day and this requires an extra energy need of about 500 calories per day (Kiday et al., 2013; Ukegbu, 2014). As The Man Off Group (2011) indicated in Guidance for formative research on maternal nutrition, lactating mothers should take two extra meals (500kcal). Accordingly, from the total 558 participants, only 81(14.5%) lactating mothers consumed additional two meals, which meet the national recommendations, the rest 85.5% of participants were vulnerable to malnutrition.

4.4. Dietary intake of the study participants

Majority of the study participants 554 (99.3%) consumed cereal based foods (made of Corn/maize, Rice, Wheat, Millet, Sorghum, Oats, Teff, Barley) and vegetables, 553 (99.1%). Onion was the predominant vegetable 486 (86%) used as a basic ingredient for cooking stew (wot).

Table 4 percentage individual food types intake by lactating mothers within 24-hr recall (N= 558) in Jimma zone selected districts, March-May, 2014

Food Groups	N	(%)
Cereals and grain	554	99.3
Corn/maize	414	74.2
Rice	34	6.1
Wheat	243	43.5
Millet	2	0.4
Sorghum	388	69.5
Oats	9	1.6
Teff	441	79.0
Barley	39	7
Fruits	140	25.1
Mango	12	2.2
Avocado	62	11.1
Orange	9	1.6
Papaya	6	1.1
Banana	65	11.6
Peaches	15	2.7
Guava	5	0.9
Vegetables	553	99.1
Tomato	78	14.0
Carrots	1	0.2
Sweet potato	5	0.9
Potato	142	25.4
Green pepper	39	7.0
Onion	480	86.0
Dark green lettuce	281	50.4
Lettuce	9	1.6
Cabbage	25	4.5
Ginger	36	6.5
Shallot	3	0.5
Protein rich foods	442	79.2
Meat	15	2.7
Bean	287	51.4
Egg	7	1.3
Chicken	3	0.5
Nuts and seeds	13	2.3
Lentils	249	44.6
Dairy products	72	12.9
Milk	13	2.3
Yoghurt	3	0.5
Cheese	11	2
Butter	52	9.3

Table 4 continued…….

Oil and fat	543	97.3
Vegetable oil	3	0.5
Commercial oil	540	96.8
Discretionary calorie foods	212	38.0
Sugar	134	24.0
Soft drink	10	1.8
Honey	6	1.1
Juice drink	3	0.5
Chocolates	1	0.2
Candies	1	0.2
Cookies	12	2.2
Other (sugarcane)	107	19.3

In this study, more than three-fourth of the mothers 442 (79.2%), reported that they consumed protein rich foods but from those, bean and lentil account for the highest scores 287(51.4%) and 249(44.6%), respectively. Almost all of the participants, 540 (96.8%) cooked their foods using commercial oil bought from their nearby markets. One hundred forty (25.1%) of the study participants were consumed fruits, majorly avocado and banana, (11.1% and 11.6%) respectively. Relatively small number, 72 (12.9%) of the participants consumed Dairy products (milk, yoghurt, cheese and butter). Among discretionary calorie foods, sugar 134 (24.0%) and other (sugarcane) 107 (19.3) were the predominantly consumed food types (Table 4).

4.5. Dietary Diversity Score (DDS)

This study showed the distribution of dietary diversity over different influencing factors. Accordingly Dietary diversity score was significantly ($P<0.01$) influenced by districts, residence area, age, educational status and the wealth status of the household.

Among the seven food groups, the mean (±SD) DDS of the study participant was 4.51(±1.1) with a maximum score of 7 and minimum of 0 score. More than fifty percent of the total participants (53.6%) had low DDS. From the total participants, significantly ($p<0.01$) large proportion of rural mothers had low DDS (59.1 rural vs 42.5% urban). Some findings also support that the DDS of rural sector were lower than urban (Sanusi, 2010). This shows that most of the lactating mothers, especially in the rural, were not getting adequate macro and micro nutrients from their

daily meal. Since the mean DDS of the study participants was 4.51±1.1SD, majority of the DDS laid down between 3.41 and 5.61, which is found in the lower and bottom of higher tercile group.

Table 5: Distribution of DDS by different Variables in Jimma Zone, South West Ethiopia, March –May 2014.

Variables	Categories	Low DDS n (%)	High DDS n (%)	$\chi 2$ (P-value)
Districts	Mana	86 (46.2)	100 (53.8)	
	Omo-Nada	120 (64.2)	66 (35.5)	0.001**
	Dedo	93 (50.0)	93 (50.0)	
Place of residence	Rural	220 (59.1)	152 (40.9)	0.000**
	Urban	79 (42.5)	107 (57.5)	
Age group	15-19	10 (38.5)	16 (61.5)	
	20-24	61 (42.1)	84 (57.9)	
	25-29	122 (56.7)	93 (43.3)	0.002**
	30-34	68 (59.1)	47 (40.9)	
	35-49	38 (66.7)	19 (33.3)	
Educational status	Informal education	212 (62.7%)	126 (37.3%)	0.000**
	Formal education	87 (39.5%)	133 (60.5%)	
HH Economic status	Poor	132 (71.0)	54 (29.0)	
	Medium	98 (52.7)	88 (47.3)	0.000**
	Rich	69 (37.1)	117 (62.9)	

The prevalence of "low DDS" was high in Omo-Nada district (64.2%) followed by Dedo (50.0%) and Mana (46.2%) districts. This indicates that there was a highly significant difference between the three districts. Omo- Nada is a cereal crop growing area whereas Dedo and Mana are fruit and vegetable, and cash crop growing areas respectively. Since Mana is a cash crop area, mothers could have enough money for household expenditure so as to buy diverse food commodity and might have diverse diet. On the other hand, Omo Nada is from cereal crop growing area, therefore the study participants highly rely on few staple foods and often include little or no animal products and few fresh fruits and vegetables as compared to Dedo and Mana districts. This finding is consistent with previous reports (Christine, 2011; Lindsay, 2005; Marie, 2002; Sanusi, 2010) who stated that diversified agricultural production and income from

agricultural product market even in poorer household has a positive relationship with dietary diversity.

Similarly, DDS was significantly different among lactating mothers placed in different residence. Large proportion (59.1%) of mothers in rural area showed a low DDS than urban residence area. This is consistent with the previous findings by Marie (2002) where urban households had a consistently higher dietary diversity than rural households. Although in contrast, higher DDS was reported in rural sector (Sanusi, 2010).

Majority (66.7%) of the study participants in the older age group (35-49 year) had a "low DDS" and the younger age group (15-19 year) had a "high DDS". This may probably be related to family size. As the mother's age increased the probability of having more children also increased, therefore preparing diversified foods for large family size will be difficult to the mothers.

The other socio-economic status of the study participants also continued to have a highly significant influence on diversified food intake. The educated mothers had high score, (60.5%) of "high DDS" than the informally educated, 37.3%. The same was true for economic status of the households. The prevalence of having "low DDS" was high in poor (71.0%) followed by medium (52.7%) and Rich (37.1%) households. According to Sanusi (2010) educational status and household wealth were inter related had a positive association with dietary diversity, because higher education attainment is likely to be associated with higher income so as the mothers would have money to buy different food commodity for household food preparation.

4.6. Anthropometric status of lactating mothers

The median height, weight and BMI of the study participants were 1.55 (±0.6) m, 50 (±6.6) kg and 20.5 (±2.32) kg/m^2 respectively.

4.7. Socioeconomic, demographic and dietary practices associated with malnutrition

As presented in Table 6, some of the factors showed a significant association with chronic energy deficiency while the other factors did not. According to the bivariate analysis, districts, residence area, marital status, DDS, educational status, occupation, husband's education and family size had no significant association, (0.660) with chronic energy deficiency. These findings are supported by others; Hailesilassie et al. (2013) also found DDS, education and family size were not associated with mothers nutritional status. No significant correlation was found between Dietary Diversity Scores and BMI in this study ($p = 0.307$). Though, some studies have discovered a positive relationship between DDS and malnutrition (Sanusi, 2010) and some others are not.

According to Woldemariam and Timotiows (2002), DDS had no significant association with prevalence of malnutrition. In contrary to the current study, they found a significant association with chronic energy deficiency regarding education, residence area, marital status and family size. On the other hand Fikrewold and Daniel (2010) on malnutrition among women in Ethiopia reported that marital status was significantly associated with malnutrition in 2000 year whereas didn't show significant association in 2005 , this indicate sometimes DDS had a direct influence on prevalence of malnutrition and sometimes not.

Table 6: Results of Chronic Energy Deficiency and Body Mass Index (CED= <18.5 BMI and NCED= >18.5 BMI), of lactating mothers from selected districts of Jimma zone Southwest Ethiopia, (N= 558), March –May 2014

Variable	CED (BMI< 18.5) n (%)	No CED (BMI≥18.5) n (%)	p
District (N=558)			
Mana	31 (16.70)	155 (83.30)	0.660
Omonada	31 (16.70)	155 (83.30)	
Dedo	25 (13.40)	161 (86.60)	
Residence area (558)			
Rural	64 (17.20)	308 (82.80)	0.173
Urban	23 (12.40)	163 (87.60)	
Marital status(N=558)			
Single	4 (12.10)	29 (87.90)	0.703
Married and living together	79 (15.80)	422 (84.20)	
Married but not living together	3 (18.80)	13 (81.20)	
Widowed	0 (0.00)	5 (100.00)	
Divorced	1 (33.30)	2 (66.70)	
Age (Mean±SD)	25.64 (5.31)	26.77 (5.10)	0.060
DDS (Mean±SD)	4.38 (0.93)	4.53 (1.09)	0.171
Educational status(N=558)			
Illiterate/informal education	51 (15.10)	287 (84.90)	0.721
Formal education	36 (16.40)	184 (83.60)	
Occupation (N=558)			
House wife	73 (16.70)	363 (83.30)	0.162
Other (farmer, government employee, NGO employee, daily laborer)(Ref)	14 (11.50)	108 (88.50)	
Husband's educational status(N=517)			
Illiterate/informal education	33 (15.40)	181 (84.60)	0.903
Formal education	49 (16.20)	254 (83.80)	
Husband's occupation(N=517)			
Farmer	62 (19.40)	257 (80.60)	0.004
Other (Government employee, NGO employee, Merchant, Daily laborer)	25 (10.50)	214 (89.50)	
HH economic status(N=558)			
poor	30 (16.10)	156 (83.90)	0.029
medium	38 (20.40)	148 (79.60)	
rich	19 (10.20)	167 (89.80)	
Family size(Mean±SD)	5.33 (1.82)	5.63 (1.98)	0.197
No. of children (Mean±SD)	2.89 (1.79)	3.24 (1.85)	0.075

Husband's occupation and household wealth status were significantly associated ($p<0.05$), while all the others variables (districts, residence area, age of the lactating mothers, DDS, marital status, educational status, occupation, husband's education, family size and number of children were non-significantly associated ($p< 0.05$) with chronic energy deficiency of the lactating mothers.

Husband's occupation affects lactating mother's nutritional status ($p=0.004$); as their husbands occupation was farmer, mothers chronic energy deficiency increased by 19.4%. According to Fikrewold and Daniel (2010), in developing countries like Ethiopia, where women are highly dependent on their partners, women with low status partners (in terms of educational and occupational status) have less access to household food security and most of developing countries farmers are poor.

The prevalence of chronic energy deficiency was high in poor household's wealth. Those rich households showed a decreased percent (10.2%) of being lactating mothers chronic energy deficiency at 0.029 level of significant. On the other hand lower class and middle class households showed 16.1% and 20.4% increment of chronic energy deficiency, respectively. These finding is consistent with previous reports (Fikrewold and Daniel, 2010; Temesgen et al., 2015; Woldemariam and Timotiows, 2002), all of the listed authors reported that women residing in households with very poor/poor economic status were more likely undernourished than medium or higher economic status households.

The other factor seen in this study was parity or number of children in the household. There was no significant difference ($p>0.05$) between lactating mothers who have mean children number of 2.89 (±1.79 SD) and mothers having mean children number of 3.24 (±1.85 SD). Several studies revealed different findings related parity and malnutrition. A study done by Woldemariam and Timotiows (2002) and Tsegaye et al., (2003) were reported that no significant association existed between number of children and mothers undernutrition. On the other hand Bitew and Telake (2010) found nulliparous mothers were highly malnourished than mothers having children.

Among the demographic factors the lactating mother's age was non-significant ($p>0.05$) with chronic energy deficiency. As the mean age increased from 25.64 (±5.31 SD) to 26.77 (±5.10

SD), the prevalence of chronic energy deficiency among lactating mothers were the same at 0.06 significant levels. This result was in contradiction to the previous findings by Fikrewold and Daniel (2010), and Woldemariam and Timotiows (2002); a significant malnutrition was seen among the youngest age group of mothers than the older group.

4.8. Linear regression model (lactating mother's nutritional status (BMI)

After bivariate analysis, linear regression was performed to filter the net effect of each independent variable associated with chronic energy deficiency in the bivariate model analysis. As presented in Table 7, age, household wealth and husband's occupation were showed a strong significant association, while having additional two meals and marital status were non-significant with mothers BMI.

Table 7**:** Explanatory factors of nutritional status (BMI) of lactating mothers, (N= 558) from three selected districts, Jimma zone Southwest Ethiopia, March –May 2014

Determinants	Unstandardized coefficients		Standardized coefficients	
	B	Std.Error	Beta	P
Having additional two meals	0.529	0.302	0.079	0.080
Household wealth				
Poor	0.237	0.244	0.048	0.331
Rich	0.721	0.249	0.145	0.004
Marital status(N=558)				
Divorced	-0.412	0.587	-0.031	0.483
Other (single, married and living together, Married but not living together, Widowed) (Ref.)				
Age	0.72	0.20	0.156	0.000
Husband's occupation (N=517)				
Daily laborer	0.206	0.059	0.153	0.001
Other (merchant, farmer, employee) (Ref.)				

In the linear regression result, for a unit age increment, the BMI also increased by 0.72 (0.72, p= 0.000). This indicates that the adolescents of the study participants had lower BMI than the the olders. Fikrewold and Daniel (2010); Woldemariam and Timotiows (2002) supports the current result, the adolescent age (15-19) group of reproductive women were undernourished (bellow

18.5 kg/m^2). Adolescent mothers are likely to have low BMI because girls generally grow in height and weight until the age of 18 and do not achieve peak bone mass until about 25. So, if they were malnourished and didn't eat adequate and diversified diet before the age of 18, cannot support both her growth and that of her child (FAO, 2000).

Another important finding that influences lactating mother's BMI was husband's occupation. The result illustrate that, having an occupation of a daily laborer increases lactating mothers BMI by 0.206 (B=0.206, P=0.001) which indicates the other occupation included in the analysis like farmer will have a negative influence on mothers BMI. The probable explanation for the current result could be when the husbands are engaged in daily work they will have money every day and mothers will have enough money at hand so as to buy commodities for their household expenditure. On the other hand, women with agricultural or unemployed partners often have less autonomy than those whose husbands have higher occupational status or money in their pocket (Fikrewold and Daniel, 2010).

In this study, household wealth status was significantly associated with BMI. For a unit increase in household economy of the richer group, BMI also increased by 0.721 (B=0.721, P=0.004).but the poor and middle group of the study participant's BMI was not significantly different to each other. This might be because household wealth status is positively associated with household food security which is a prerequisite to adequate dietary intake and improve the mother's nutrition. It has been reported that the income of the household is an important determinant of its access to food which in turn the major determinant of wellbeing and nutritional status of mothers (Ukegbu, 2014). According to WHO (2011), low body mass index (<18.5 kg/m^2) and/or short stature (height <145 cm) are common in women in low-income countries, with the highest rates of the former observed in southern and southeastern Asia, followed by sub-Saharan Africa, with "serious" rates (20% to 39%%) in Ethiopia. The current finding also consistent with the recent study by Temesgen et al., (2015) on nutritional status of lactating mothers; comparing low monthly income family with the high monthly income family lactating mothers were almost 0.25 less likely vulnerable to undernutrition. Similar results have been reported by Woldemariam and Timotiows (2002).

On the other hand, marital status had a negative and non- significant association with BMI. Bing divorced decrease BMI by 0.412 (B= -0.412, P=0.483). Woldemariam and Timotiows (2002) also found that single women were more likely to malnourished than married women.

4.9. Nutritional and anti-nutritional composition of commonly consumed foods

Based on the survey data, a total of 12 food types were collected from nine kebelles and the nutritional and anti-nutritional contents were determined at EPHI. Depending on the nature and consumption culture, the 12 food types were categorized into three major groups. These were Stew or "Wot", Enjera and Kita. Lentil, Bean, Shiro and Kale were the four food types from the stew/wot group. Enjera was a predominantly eaten food in all kebelles, but ingredients/ grain formulation were different among districts. Therefore five types of Enjera were collected accordingly. These are: Enjera (teff), Enjera (teff, maize), Enjera (teff, sorghum), Enjera (teff, maize, sorghum) and Enjera (teff, sorghum, rice). The other food groups were kita with different ingredients kita (wheat, maize), kita (maize) and kita (wheat). According to Ethiopian tradition, the first food group (stew/ "wot") is often consumed together with Enjera or kita.

Table 8: The dominant food types collected from nine kebelles, Jimma zone, southwest Ethiopia (August 10-17, 2014).

Food types	Yebu	Nada	Sherifi	Somodo	Meti	Tolli-beyem	Nada-chala	Keta-kedida	Korti-weserbi
Lentil wot	*	*	*	*	*	*	*	*	*
Bean wot				*	*	*	*	*	*
Shiro wot	*	*	*	*	*	*	*	*	*
Kale wot		*	*	*	*	*	*	*	*
Enjera (teff)	*								
Enjera (teff,sorghum)		*				*	*		
Enjera (teff,maize)									
Enjera			*					*	*
(teff,maize,sorghum)	*	*	*	*	*	*	*	*	*
Enjera									
(teff,sorghum,rice)	*								
Kita (wheat,maize)									
Kita (maize)	*		*						
Kita (wheat)	*	*	*	*	*	*	*	*	*
	*		*						

As shown in table 8, Enjera (teff, maize, sorghum), kita (maize), lentil and shiro stew or "wot" were common for all kebelles, Enjera (teff) and Enjera (teff, sorghum, rice) were only from Yebu, injera (teff, sorghum) were from Nada Challa, Nada, Tolli Beyem , Enjera (teff, maize) were from Sherifi, Korti Weserbi and Keta Kedida. Kale were collected from six rural kebelles and two urban kebelles; Sherifi and Nada. Kita (maize, wheat) and kita (wheat) were common to Sherifi and Yebu while bean stew or "wot" were common for all rural kebelles.

4.9.1. Calorific value and proximate composition of foods

Moisture content, crude protein, crude fat, total ash, crude fiber, carbohydrate and energy contents of the foods are presented in Table 9.

According to WHO (2005), the average recommended gram of portion per day (550g/day, 450g/day and 175g/day from cereal, vegetable and, legume food type respectively) for a healthy life, the lactating mothers daily consumption of nutritional and anti-nutritional content of the sampled foods were calculated and compared with the recommendations. The nutritional intake of lactating mothers is presented in table.

Table 9: Mean daily nutritional intake by lactating mothers, from three districts of Jimma zone, southwest Ethiopia (March –May, 2014).

Food types	Energy (kcal)	Fiber (g)	Fat (g)	Ash (g)	Protein (g)	Moisture (ml)	CHO (g)
Lentil wot	524.26	9.10	40.39	20.90	31.82	64.42	8.38
Bean wot	483.87	9.27	30.54	19.29	34.69	63.65	17.57
Shiro wot	444.82	7.53	34.62	29.54	29.42	70.00	3.90
Kale wot	632.38	121.63	29.21	95.36	88.34	111.42	4.05
Enjera (teff)	1352.73	13.92	14.25	8.36	55.61	207.35	250.53
Enjera (teff,sorghum)	1339.14	11.83	15.62	10.07	58.91	212.85	240.74
Enjera (teff,maize)	1347.77	41.75	41.20	14.08	52.97	208.73	191.29
Enjera (teff,maize,sorghum)	1222.54	67.10	18.26	11.17	49.23	188.93	215.33
Enjera (teff,sorghum,rice)	684.69	44.22	30.20	11.55	54.56	360.80	48.68
Kita (wheat,maize)	1348.76	10.95	11.61	16.82	59.29	209.55	251.79
Kita (maize)	1282.05	10.73	19.20	5.28	41.80	237.49	235.51
Kita (wheat)	1157.92	11.38	19.20	8.03	63.36	265.10	182.93
RDA	**2750**	**30**	**69.1**		**65**	**3800**	**210**

Accordingly they were getting 524.26 kcal//day, 483.87, kcal/day, 444.81 kcal/day, 1157.97 kcal/day, 632.38kcal/day and 684.69kcal/day from lentil wot, bean wot, shiro wot, kita (wheat), kale wot and Enjera (teff, sorghum, rice) respectively. This result showed that none of the 12 food types fulfill the recommended daily allowance for Energy, 2750 kcal/day (FAO, 1981).

Fiber (27.03%), ash (21.19%) and protein (19.63%) content was high in kale stew/wot. In other way fat (23.08%, 17.45%, 19.78%), protein (18.18%, 19.82%, 16.81%) and Ash (11.94%, 11.02%, 16.88%) were high in the three stew/wot type; lentil, bean and shiro stew. The lowest percent of fiber (1.95%), ash (0.96%), and protein (7.6%) were found in kita (maize) food type and similarly kita with ingredient of maize and wheat also scored a lowest percent of fat (2.22%).

According to FAO/WHO/UNU (2004) standard, fat content was below the recommended daily allowance, 69.1 g/day by far from 27.9 d/day to 57.49 g/day minimum and maximum range for all type of sampled food. The probable explanation for this finding could be majority of the study participants were using only vegetable oil and animal source like butter was not used in their daily meal preparation rather they are taking at the time of holly days.

Based on the recommended gram of portion for adults, except kale wot (88.33g/day), which is by far higher than the recommended nutrient intake (17.33g/day) other mean protein intakes of the lactating mothers in the study area were less than the recommended daily allowance (RDI, 20005). Similarly, kale wot had relatively high content of Ash (95.35g/day). Even though there is no recommendation of ash for lactating mothers, it is known that as ash content increase, it indicates there is adequate micro nutrients in that specific food type, therefore from 12 type of sampled foods kale wot provides relatively good micro nutrients to the lactating mothers (Aseffa, 2008).

Concerning the fiber content, the study participants had get above the recommended daily allowance of fiber from 4 food types. These are kale wot (121.64g/day), Enjera with ingredients of teff, maize, sorghum (67.10g/day), Enjera with teff, maize, rice ingredients (44.22g/day) and, Enjera with teff and maize ingredients (41.74g/day). The rest 8 types food were below the recommendation (FAO, 1981; FAO/WHO/UNU, 2004).

Carbohydrate content was almost similar in all Enjera type and in all kita type except injera (teff, maize, sorghum) and had a relatively high record than stew/ wot type. But only kita with ingredients of wheat and maize and Enjera with teff ingredient was fulfill the CHO recommendation, 250 g/day by FAO/WHO/UNU (2004). These are 251.79 g/day 250.5g/day, respectively.

The maximum moisture content was recorded by Enjera (teff, sorghum, rice) 357.5 ml/day which means 0.36 lit/day. This indicates since all the food types were by far much less than the recommended drinking water for lactating mothers and breastfeeding also increases the mother's need for water, it is important that the study participants need to drink enough amount of water and liquid foods like "Atmit" to satisfy her thirst.

4.9.2. Mineral composition of food samples

Among the mineral compositions analyzed, iron was the predominantly found in all sampled foods above the recommended amount. The lactating mothers were getting a high amount of iron (288.86 mg/day), which was by far higher (278.86 mg/day) than the recommended daily allowance by DRI (2001) from Enjera (teff, maize). The sampled food having the lowest iron content also recorded above the recommendation, lentil wot (34.98mg/day). All the mineral intake of lactating mothers in comparison with recommendation is presented in table 10.

Table 10: Mean daily mineral intake by lactating mothers in Jimma zone, southwest Ethiopia (March –May, 2014).

Food types	Fe (mg)	Z (mg)	Ca (mg)	P (mg)
Lentil wot	34.98	5.88	380.68	527.73
Bean wot	35.91	5.95	426.41	648.88
Shiro wot	48.28	7.26	478.96	521.27
Kale wot	111.56	12.56	191.52	1315.35
Enjera (teff)	119.74	18.48	1750.05	1911.25
Enjera (teff,sorghum)	218.52	17.38	1330.18	2054.53
Enjera (teff,maize)	288.86	16.78	1692.30	1817.97
Enjera (teff,maize,sorghum)	216.65	14.91	1031.36	2089.56
Enjera (teff,sorghum,rice)	121.06	12.05	1009.20	828.58
Kita (wheat,maize)	51.98	12.16	458.37	1471.69
Kita (maize)	68.70	13.75	1446.06	1457.83
Kita (wheat)	113.96	20.68	840.35	1923.08
RDA	**10**	**12**	**1000**	**1000**

With the exception of kale wot (12.55mg/day) all the stew/wot types of foods were below the recommended daily allowance for zinc. The remaining food types could meet the recommendation of zinc daily allowance (12mg/day). The highest amount of zinc was scored in kita (wheat), 20.68mg/day (DRI, 2001).

Similarly, except kale wot (1315.35mg/day), all stew types and Enjera with ingredients of teff, sorghum and rice were below the recommendation for phosphorous too. The study participants were getting high amount of phosphorous from enjera (teff, maize, sorghum), 2089.56 mg/day which was by far higher (1089.56 mg/day) than the recommendation by FAO/WHO/UNU (2004) and DRI (2001). The remaining six foods were also found to be above the recommended daily allowance.

Concerning the calcium content, all stew type, kita (wheat) and kita (wheat, maize) were below the recommendation while the other nine food types were above, 1000mg/day (FAO/WHO/UNU,2004).

4.9.3. Anti-nutritional content of commonly consumed foods by lactating mothers

It is well known that plants generally contain anti-nutrients acquired from fertilizers and pesticides and several naturally-occurring chemicals known as ‘‘secondary metabolites’’ and they have been shown to be highly biologically active (Kehinde and Oyediran, 2009). The nutritive value of foods to provide a usable form of nutrients depends on the absence of anti-nutritional and/or toxic factors (Vadde et al., 2006).

In this study the two anti-nutritional factors, tannin and phytate contents of commonly eaten foods by the lactating mothers were determined and presented in Table 1.Phytate was high in Enjera having ingredients of teff and maize, (178.89mg/100g) followed by Enjera with teff, sorghum and rice ingredients, (150.82mg/100g) and Enjera (teff, sorghum), (145gm/100g). In other way Bean wot and kita (maize) food types were BDL (below detectable level). The first three food types in Tannin composition were Enjera having ingredients of teff, maize, sorghum, (315.85 mg/100gm); kale wot, (205.05 mg/100g); and Enjera having ingredients of teff and sorghum, (81.64 mg/100g). Tannin in Enjera (teff) was below detectable level (BDL).

Table 11: Mean anti-nutritional contents of foods consumed by lactating mothers from three selected districts in Jimma zone southwest Ethiopia, 2014.

Food types	Phytate (mg/100g)	Tannin (mg/100g)
Lentil wot	92	14.17
Bean wot	BDL	27.06
Shiro wot	11.06	65.26
Kale wot	47.65	205.05
Enjera (teff)	120.45	BDL
Enjera (teff,sorghum)	145.01	81.64
Enjera (teff,maize)	178.89	6.64
Enjera (teff,maize,sorghum)	121.61	315.85
Enjera (teff,sorghum,rice)	150.82	13.71
Kita (wheat,maize)	80.21	3.71
Kita (maize)	BDL	8.36
Kita (wheat)	55.17	5.46

BDL: below detectable level

There is no recommendation or cut off points for availability of anti-nutritional factors in the food rather vast researches have been done to minimize the level of anti-nutrition found in different types of food grains and food types by using different methods of food processing system. In this study, all the 12 sampled foods were passed through traditional food preparation processes such as washing, and cleaning, grinding, fermentation, baking and cooking; But we cannot conclude that the anti-nutritional factors are decreased to the point in which the nutritional content in the foods are bioavailable to the lactating mothers. As Kehinde and Oyediran (2009) stated, there could be ways and means of eliminating or reducing the anti-nutrition levels to the best minimum should be discovered and they wrongly argued that since the African cultural method of food preparation involves cooking, there is no cause for alarm.

Based on the average portion size for healthy adults recommendation by WHO (2005); 550g/day, 450g/day and 175g/day, from cereal, vegetable and, legume food type were consumed by the study participants which was A maximum, 983.89 mg of phytate per day from Enjera (teff, maize). Numerous studies suggest that Phytic acid decreases the availability of Zinc, Manganese, Copper, Molybdenum, Calcium, Magnesium, Iron as well as Protein. Deficiencies of iron and zinc are a widespread public health concern. Dietary inadequacies of these two micronutrients are likely to occur in developing countries where staple diets are predominantly plant-based, and consumption of animal protein foods such as red meat, poultry, and fish is often small because of economic, cultural and religious constraints (Assefa, 2008; Marjoleine et al., 2001; Rosalind and Elaine, 2008).

The tannin composition in which the study participants consume daily was high in enjera having ingredients of teff, maize and sorghum, 1737.18 mg/day. Tannins had been reported to affect protein digestibility, adversely influencing the bioavailability of non-haem iron leading to poor iron and calcium absorption, also carbohydrate is affected leading to reduced energy value of a diet containing tannins (Assefa, 2008).

4.10. Nutrient adequacy

According to Ongosi (2010), the ideal cut-off for nutrient adequacy should be 1, which would mean that all the nutrients were consumed in sufficient amount. As presented in the Table 14 above, all the food types had a sufficient iron content which had NAR above 1 (Kumari et al., 2012). These could be because of Ethiopian foods especially Enjera had a significantly high amount of iron (Kiday et al., 20013). The other reason could be, since breast feeding usually suppresses menstruation for a few months, lactating mothers iron requirement is decreased to10 mg/day RDA (Anita et al., 2014).

In other way, the calorific value/energy throughout the whole sampled food types was found to be below 1 NAR, which means that all the commonly eaten foods by lactating mothers were not sufficient to meet the energy requirements. This could be because of lack of dietary diversification and the foods lack vegetables, fruits, and animal source food types (Marie, 2002). The overall nutrient adequacy was different for the twelve type food types. MAR was below the cut-off point for all food types.

Table 12: Nutrient Adequacy Ratio (NAR) of the twelve commonly consumed food types by lactating mothers in selected districts of Jimma zone, southwest Ethiopia (March –May, 2014).

Nutrients	Lentil wot	Bean wot	Shiro wot	Kale wot	Enjera (teff)	Enjera (teff, sorghum)	Enjera (teff, maize)	Enjera (teff, maize, sorghum)	Enjera (teff, sorghum, rice)	Kita (wheat, maize)	Kita (maize)	Kita (wheat)
Energy (kcal)	0.19	0.18	0.16	0.23	0.49	0.49	0.49	0.44	0.25	0.49	0.47	0.42
CHO	0.04	0.08	0.02	0.02	1.19	1.15	0.91	1.03	0.23	1.20	1.12	0.87
Fat	0.58	0.44	0.50	0.42	0.21	0.23	0.60	0.26	0.44	0.17	0.28	0.28
Protein	0.49	0.53	0.45	1.36	0.86	0.91	0.81	0.76	0.84	0.91	0.64	0.97
Fiber	0.30	0.31	0.25	4.05	0.46	0.39	1.39	2.24	1.47	0.36	0.36	0.38
Fe	3.50	3.59	4.83	11.16	11.97	21.85	28.89	21.66	12.11	5.20	6.87	11.40
Z	0.49	0.48	0.61	1.05	1.54	1.45	1.40	1.24	1.00	1.01	1.15	1.72
Ca	0.38	0.43	0.48	0.24	1.75	1.33	1.69	1.03	1.01	0.46	1.45	0.84
P	0.53	0.65	0.52	1.32	1.91	2.05	1.82	2.09	0.83	1.47	1.46	1.92
MAR	0.44	0.45	0.44	0.65	0.78	0.78	0.86	0.82	0.73	0.71	0.75	0.75

5. SUMMARY AND CONCLUSION

The target of this study was to better understand the influence of the socioeconomic and demographic factors as well as the dietary quality on lactating mother's nutritional status. The findings showed that sixty nine percent (69.17%) of lactating mothers were between the age of 15-29; had lower BMI and vulnerable to malnutrition, with the rate being higher in younger mothers (15-19). Nutritional status was positively predicted by age of the mothers, having additional two meals during lactating time, house hold wealth and husband's occupation. However, marital status negatively predicted the nutritional status.

The observations made in this study revealed that the dietary quality of lactating mothers was inadequate as measured by MAR, NAR and DDS. Fifty four percent (53.6%) of mothers had low DDS which implies that they were at risk of developing nutrient deficiency. The prevalence of "low DDS" was significantly high among rural mothers (59.1% vs 42.5%) urban mothers. Similarly, "low DDS" was prevalent in Omo-nada district (64.2%) because it was cereal crop growing area and also among mothers who reside in poor household wealth (71.0%).

Based on these and other related findings, this study concluded that the feeding practice, dietary intake in relation to diversified diet and nutritional adequacy of common foods of lactating mothers were below national and international standards, resulting maternal malnutrition.

Therefore, supporting informally educated, very poor and younger lactating mothers is highly recommended. The different government bodies like health and agricultural sectors should collaborate and work together so as to develop a community based intervention giving priority to lactating mothers as a short term solution. Urgent implementation of poverty reduction strategies must be installed for the long term solution.

6. FUTURE LINE OF WORK

This study has some limitations, it doesn't include the bioavailability of commonly consumed foods, and the nutritional content of beta carotene therefore further study must be directed on bioavailability of common foods consumed by lactating mothers. It might need focus on the method of traditional food processing and means of minimizing the anti-nutritional factors inhibition level.

The other important future line of work recommended by this study will be the dietary intake habit and its effect on lactating mother's health. Furthermore, study on effect of basic facilities and access to health related practices on lactating mother's nutritional status of the study area must be addressed in the future.

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8. APPENDICES

Annex 1. Questioner used for the data collection

I am Frehiwot Tadesse, MSc student from Jimma University. I am doing a research about nutritional status of lactating mothers in Jimma Zone, three districts (Manna, Omo-nada and Dedo).

I got your name from the health extension worker.

Right now, I am going to give you information about our research project and invite you to be part of this research. If you have any questions, please ask me to stop as we go through and I will explain.

As we already mentioned, I am interested in better understanding the nutrition of lactating mothers. I believe that you can help us by telling us what you know about foods that you eat during your lactation and other related factors.

Your participation in this research is entirely voluntary. You are free to withdraw from the research at any time and the information that we collect from this research project will be kept private.

Furthermore, I may come back and collect food sample from you after analyzing the data that you are going to tell me.

Do you have any questions about this research project?

Thank you for your cooperation, and we look forward to our work together.

Name of the Interviewer _____Date:
(DD____/MM_____/YYYY) _____

District _____

Kebele/Gott_____

Indicate time in 24 hour system

Start of Interview (HRS/MIN)_____

End of Interview (HRS/MIN) _____

Individual ID_____

Appendix Table 1: socio- economic and demographic part

	A. Background characteristics of woman and their husbands	Response
1.	What is your age? *Age in Completed Years*	_____Years
	Maternal Weight	_____:_____Kg
	Maternal height	_____:_____Cm
2.	What is your religion? 1. Muslim 2.Orthodox 3.Protestants 4.Catholic 5.Other (specify)_____	_____
3.	What is your Ethnicity? 1.Oromo 2.Amhara 3.Guraghe 4.Tigray 5.Wolayta 6. Yem 7. Other(specify)----------	_____
4.	What is your Marital status 1. Single	

	2. Married and living together 3. Married but not living together 4. Widowed 5. Divorced	_____
5.	What is your educational status? 0. Illiterate/ informal education 1. Formal education, Grade____	_____
6.	Are you currently attending education? 0. No 1. Yes	_____
7.	What is the level of educational you are attending? 0. informal education 1. Formal education, Grade_____	_____
8.	What is the educational status of your husband? 0. Illiterate/ informal education 1. Formal education, Grade_____	_____
9.	What is your occupation? **1.** Housewife **2.** Farmer **3.** Government Employee **4.** NGO Employee **5.** Merchant **6.** Daily laborer **7.** Other (specify)_____	_____
10.	What is the occupation of your husband? 1. Farmer 2. Government Employee 3. NGO Employee 4. Merchant 5. Daily laborer 6. Other (specify)_____	_____
11	What is the household size (number of people living in the Household)?	_____
12	Does this change throughout the year? 0. NO 1. YES	_____
13	Where is your place of residence of the respondent? 1. Rural 2. Urban	_____

	B. Household income		
1.	What is the main source of income for the household? 1.Farming 2.Cattle production 3.Business 4. Salary 5.Wedge 6.Other (specify) _____	_____	
2	Does the household have new or alternative income-generating activities? 0. No 1. Yes	_____	
3	If YES, What is the new income generating activity?	_____	
4	Who is making the money in the new income generating activity? 0. Husband 1. Wife	_____	
	C. Household Wealth		
1.	Does any member of this household have a land that can be used for agriculture? 0. No 1. Yes	_____	
	Does the household have any of the following animals?	0.NO 1.YES	How many
2	Cows		
3	Oxen		
4	Goats		
5	Sheep		
6	Chicken		
7	Bees		
8	Donkeys		
9	Horses		
10	Donkeys		
11	Mules		

Does the household have any of the following properties? **(Circle)**		0.NO	1.YES
12	Functioning radio/Tape recorder/CD player	0	1
13	Functioning Television	0	1
14	Watch (Hand/Wall)	0	1
15	Sofa	0	1
16	Chair/Stool	0	1
17	Mattress	0	1
18	Sponge/Foam mattress	0	1
19	Cotton mattress	0	1
20	Grass Mattress	0	1
21	Refrigerator	0	1
22	Gas Stove	0	1
23	Electric stove	0	1
24	Phone (Mobile or fixed)	0	1
25	Bicycle	0	1
26	Motor Cycle	0	1
27	Cart/Gari	0	1
28	Plough	0	1

Appendix Table 2: Facilities and Maternal Health related practices

	A. Facilities	
1.	Where does your household obtain drinking water from? 1.Protected well 2. Protected spring 3.Pipe 3. Unprotected well/spring/river…	_____
2.	Does your household have toilet facilities? 0. NO 1. YES	_____
3	If YES, what type is it? 2. Pit latrine 3. Ventilated improved pit 4. Flash type 5. Other(Specify)	_____
4	Is there any health post or health center in your area? 0. NO	_____

	1. YES	
5	If YES, How far is it from your home/kebelle (write the minutes it takes both way travel)?	HP_____HC_____
6	Is there any market place in your kebelle? 0. NO 1. YES	_____
7	If NO, where do you exchange goods?	_____
8	Are there any shops near to your home? 1. NO 2. YES	_____
	B. Health Education on Essential Nutrition Actions	
How do you prepare your food during your pregnancy period? Is it different from the other time?		_____
What type of salt do you use in your meal?		_____
What type of techniques do you practice to protect yourself from malaria?		_____
Do you eat the same amount of meal as you were not lactating or not?		_____
Are you taking additional diet in addition to your daily food consumption?		_____
If Yes to Question #5, What are they?		

Appendix Table 3: Food consumption habit

What is the food dominantly eaten in your family (staple food)		0. NO 1. YES	Ingredients of the stew **(list)**	Method of processing **(circle)**
1	Injera with stew			1. Baked 2. Fermented 3. Cooked 4. Other (specify) _____
2	Kita			**1.** Baked **2.** Fried **3.** Fermented **4.** Other (Specify) _____
3	Kocho			**1.** Baked 2. Fried **3.** Cooked 4. Other (Specify) _____
4	Porridge			**1.** Cooked **2.** Baked **3.** Fried 4. Other (Specify) _____
5	Other (spesify) _____			1.Raw **3.** Boiled **4.** Roasted **5.** Baked **6.** Fried **7.** Whole **8.** De-Hull **9.** Fermented 10. Germinated 11. Other (Specify) _____
6	Is there any special food you prepare and eat during your lactating time? _____			1. Raw **0.** Boiled **1.** Roasted **2.** Baked **3.** Fried

				4. Whole **5.** De-Hull **6.** Fermented 7. Germinated 8. Other (Specify) _____
7	Is there any special food you prepare and eat during festival? _____			1. Raw **2.** Boiled **3.** Roasted **4.** Baked **5.** Fried **6.** Whole **7.** De-Hull **8.** Fermented 9. Germinated 10. Other (Specify) _____
8	Is there any special food you prepare and eat during fasting? _____			1. Raw **2.** Boiled **3.** Roasted **4.** Baked **5.** Fried **6.** Whole **7.** De-Hull **8.** Fermented 9. Germinated 10. Other (Specify) _____
9	Is there any special food you prepare and eat during your sickness (mother)? _____			1. Raw **2.** Boiled **3.** Roasted **4.** Baked **5.** Fried **6.** Whole **7.** De-Hull **8.** Fermented 9. Germinated 10. Other (Specify) _____
10	Is there any special food you prepare and feed your child? _____			1. Raw **2.** Boiled **3.** Roasted

				4. Baked **5.** Fried **6.** Whole **7.** De-Hull **8.** Fermented 9. Germinated 10. Other (Specify) _____
11	Is there any special food you prepare and feed your child during sickness? _____			1. Raw **2.** Boiled **3.** Roasted **4.** Baked **5.** Fried **6.** Whole **7.** De-Hull **8.** Fermented 9. Germinated 10. Other (Specify) _____
		0. NO 1. YES		**List**
12	Is there any type of foods forbidden to consume due to your religion?			
13	Is there any type of foods forbidden to consume due to your ethnicity?			
14	Is there any type of foods forbidden to consume due fasting?			

Appendix Table 4: 24-hour dietary recall part for the lactating mother

Please describe the foods (meals and snacks) that you ate or drank yesterday during the day and night, whether at home or outside the home. Start with the first food or drink of the morning.

Dietary diversity score (DDS) with in 24-hour (lactating mother)

Food group	**Break fast**	**Snack**	**lunch**	**snack**	**dinner**	**snack**	**Score**
1. Cereals and grains Corn/Maize, Rice, Wheat, Sorghum, Millet Oats Teff							
2.Fruits Mango, Avocado, Orange, Papaya, Banana, Apple, Jack Fruit, Grape, Pineapple, Passion Fruits Peaches, Watermelon, Strawberry, Guava, Others							
3.Vegetables Tomato, Broccoli, Carrots, Squash, Sweet Potato, Potato, Beet Root, Eggplant, Green Pepper, Onion, Dark green Lettuce, Lettuce,							

Cabbage, Cucumber Mushrooms, Ginger Leeks Pumpkin Shallot Zuchinni Other_____							
4.protien rich foods Meat Beans Egg Fish Chicken Nuts and Seeds Lentils							
5. dairy products Milk Yogurt Cheese							
6.Oil and fat Butter, Animal Fat, Vegetable Oil, Commercial Oil							
7.Discretionary calorie foods Sugar, Honey, Soft drink, Juice Drinks, Chocolates, Candies, Cookies, Cakes, Other_____							

***When the respondent has finished, probe for meals and snacks not mentioned.**

* So, you , yesterday during the day and night ate and drank

_____ , _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

*Are all foods cooked during the 24hr recall period? If not which one is unique and when was it cooked?

- _____, _____
- _____,_____
- _____, _____
- _____,_____

*Is there anything else that I did not ask, that you think it is important to tell with regards to the topic (challenges, habits, additional foods or restrictions or possibilities not included).

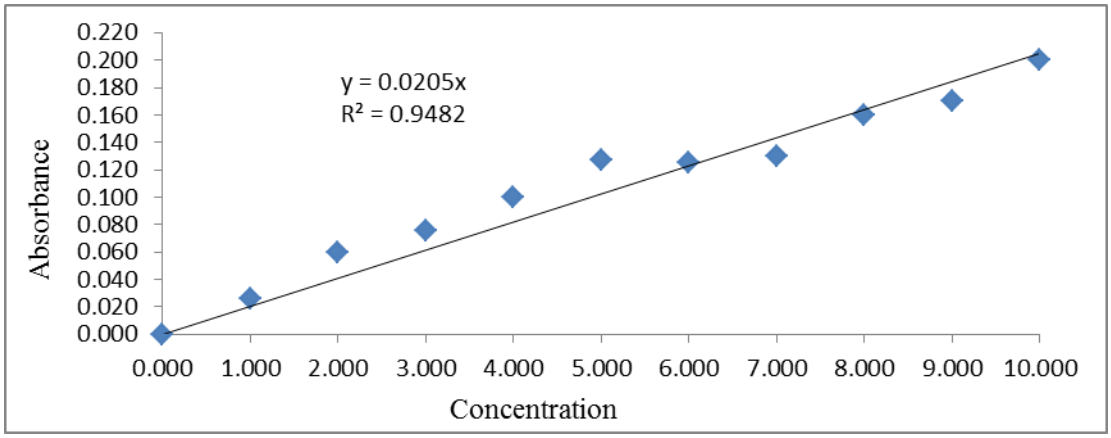
Appendix Table 5: Variables used in principal component analysis (wealth index)

Variables	
Non- productive assets	Productive assets
Radio/Tape recorder/CD player	Livestock
Watch (Hand/Wall)	Plough
Television	
Bicycle	
Motorbike	
Phone	
Sofa	
Chair/ Stool	
Sponge/Foam mattress	
Cotton mattress	
Grass mattress	
Refrigerator	
Gas Stove	
Electric stove	

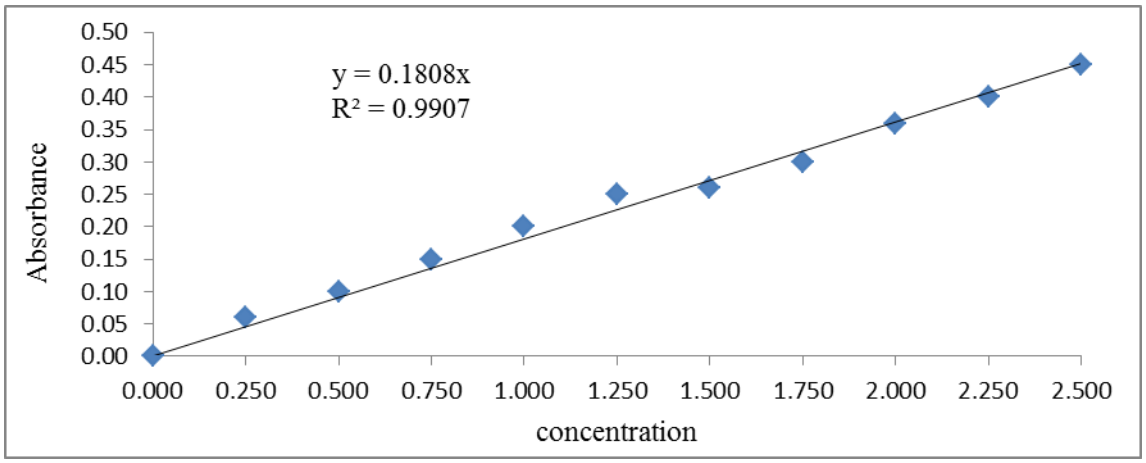
Appendix Figure 1: Data collection (Questioner)

Appendix Figure 2: Commonly eaten food sample collection

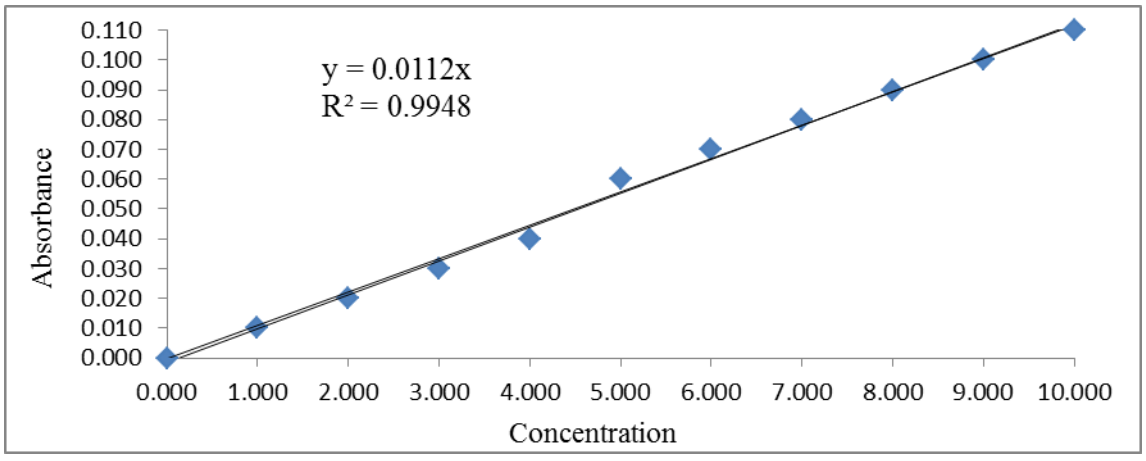
Appendix Figure 3: proximate and mineral composition of commonly consumed foods by lactating mothers.



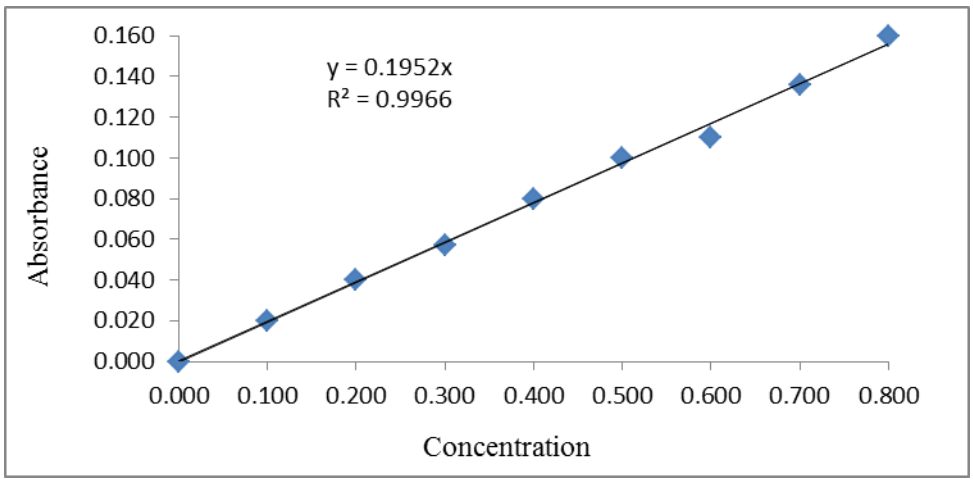
Appendix Figure 4: Iron standard curve



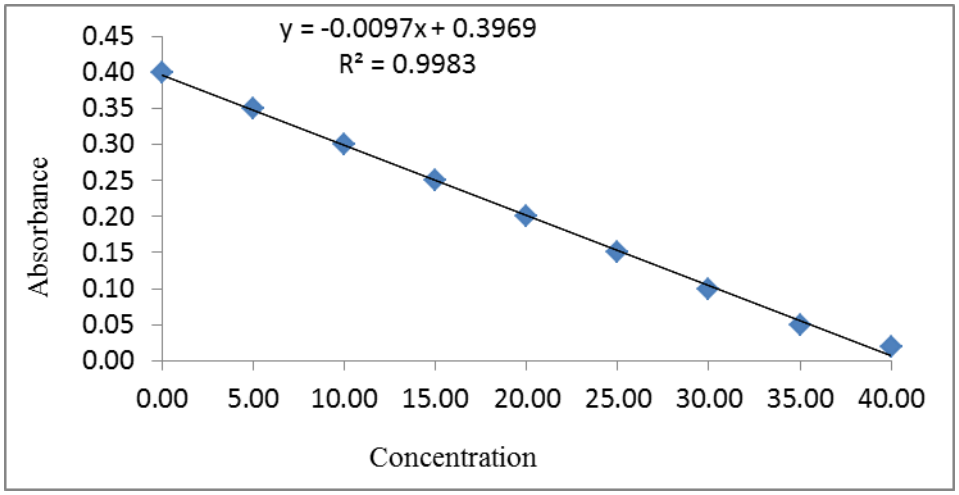
Appendix Figure 5: Zinc standard curve



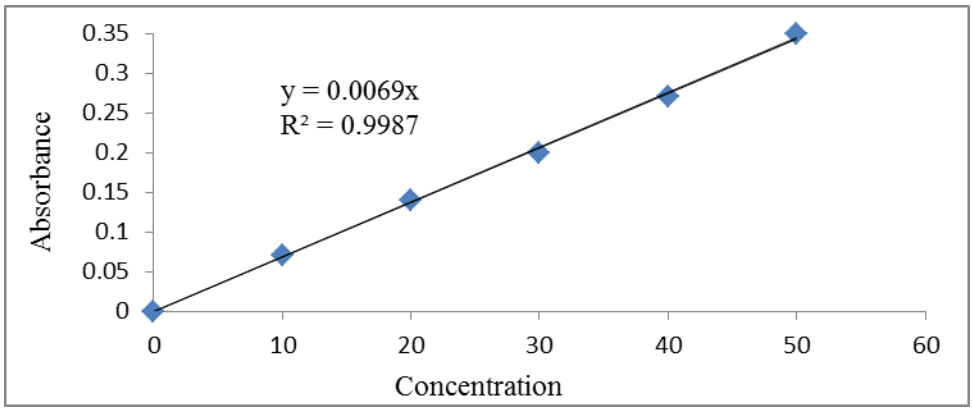
Appendix Figure 6: Calcium standard curve



Appendix Figure 7: Phosphorus standard curve



Appendix Figure 8: Phaytate standard curve



Appendix Figure 9: Tannin standard curve