

**ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
COLLEGE OF NATURAL SCIENCES
CENTER FOR FOOD SCIENCE AND NUTRITION**



**EFFECT OF FEEDING STYLE ON INTAKE OF COMPLEMENTARY
FOODS APPETITE AND NUTRITIONAL STATUS OF INFANTS
AGED 9-11 MONTH IN WEST GOJAM ETHIOPIA**

BY: Aster Tariku

A thesis submitted to the school of Graduate Studies of Addis Ababa University in partial fulfillment of the requirement for the Degree of Master of Science in Food Science and Nutrition.

January, 2016

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List of Abbreviations

AAP	American Academy of Pediatrics
AOAC	Association of Official Analytical Chemists
BMI	Body Mass Index
CDC	Center for Disease Control
CSA	Central Statistical Agency
DF	Dietary Fiber
DHS	Demographic and Health Surveys
DOA	Department Of Agriculture
EFSA	European Food Safety Authority
ENA	Emergency Nutrition Survey Software
FAO	Food and Agriculture Organization
G6PD	Glucose-6-Phosphate dehydrogenase Deficiency
HIV	Human Immunodeficiency Virus
HB	Hemoglobin
IRD	Institute of Research for Development
IOM	Institute of Medicine
IQ	Intelligence Quotient
IYCF	Infant and Young Child feeding
PEM	Protein Energy Malnutrition
RDA	Recommended Daily Allowance
RNI	Recommended Nutrient Intake

UNICEF United Nations Children's Fund

WHO World Health Organization

Acknowledgement

First and foremost, I would like to praise God for all the Devine guidance and strength He has given me throughout.

My most sincere thanks goes to Dr. Kaleab Baye, my instructor and major advisor, whom I hold to the highest esteem, for initiating me to work on this project from scratch providing all the necessary support and encouragement as well as for the countless hours he dedicated towards my work, without whose efforts all this would not have been possible. Dear Dr. Kaleab, thank you for always being there for me, for believing in me, for being my advisor and for your constant and relentless engagement in my work. I feel blessed to have been able to work with you and learn from you.

I would also like to warmly thank Dr. Claire Maquate River for taking the initiative to contribute to this document by providing important insights and for her exemplary dedication towards the project. I am very grateful for Nestle for granting the financial assistance needed to complete the study.

I would like to thank all Kebeles for welcoming me and to all the caregivers who showed such enthusiasm throughout the project. A huge thank you to all of the data collectors, this project would not have been possible without you and I am truly grateful for all your hard work. I would also like to thank the amazingly prompt Bahr-Dar Health Office staff as well as Fenote-Selam and Mecha wereda health officers, for facilitating the smooth undertaking of this study. Without your authorization and full cooperation, I wouldn't have been able to produce this piece of document.

Finally, but certainly not least, my heartfelt thanks go to my dear family and to all friends and colleagues at the center for food science and nutrition, college of natural sciences.

Abstract

Inappropriate complementary feeding, both in quantity and quality, is a major determinant of under-nutrition. In Ethiopia, the amount of food consumed by infants and young children is lower than the theoretical gastric capacity; hence, making intake requirements even more difficult to meet. Little is known on the role of the feeding styles adopted by the caregivers in determining the food and energy intake of the infants.

Using a cross-sectional study, infants' nutritional status, haemoglobin concentrations, and the adopted feeding styles by mothers' and infants' were assessed to investigate their relationship with infants' food and energy intakes. The study involved 106 mother-child pairs recruited from seven randomly selected kebeles of Mecha district, West Gojam, Ethiopia. The feeding styles were assessed using a one-day, in-home, feeding episode observations that were video-taped and coded into five categories, namely: self-feeding, responsive, active, distracting and social feeding behaviors. The feeding styles were also coded as: controlling, laissez-faire, and responsive feeding. Food-related characteristics that can affect food intake were controlled by using a standard commercial complementary food as a test meal.

All of the infants' were breastfed, but complementary feeding started late (~8 months). A quarter of the infants were anemic and stunted. The food intake of the infants was very low compared to the minimum theoretical gastric capacity. Negative feeding behaviors were dominant ($P < 0.05$). Infants' hemoglobin concentration was negatively associated with food and energy intake. Weight-for-age z-scores (WAZ) was inversely correlated with energy intake ($\rho = -0.168$, $P < 0.042$). After controlling for haemoglobin concentrations, maternal responsive and active positive feeding styles were positively associated with energy ($\rho = 0.237$, $p < 0.007$) and food intake ($\rho = 0.182$, $p < 0.03$). Maternal responsiveness was associated with infants' positive responsive, active, and social behavior feeding scores ($P < 0.05$).

Both anemia and adopted feeding styles are associated with infant's appetite. Anemia prevention and control measures should be reinforced in this setting. The findings also provide support for a greater emphasis on strategies to improve feeding style behaviors in existing national child nutritional programs.

Key words: *Feeding style, Responsive feeding, Food intake, Energy intake, Anthropometry, anemia*

CHAPTER ONE

1 Introduction

1.1.1.1 Background

OPTIMAL infant and young child feeding (IYCF) practices are crucial for growth, development, health, and ultimately the survival of infants and young children. Adequate nutrition during infancy and early childhood is fundamental to the development of each child's full human potential(Saha et al. 2008). It is well recognized that the period from birth to two years of age is a "critical window" for the promotion of optimal growth, health and behavioral development(Martorell et al. 1994). Longitudinal studies have consistently shown that this is the peak age for growth faltering, deficiencies of certain micronutrients, and common childhood illnesses such as diarrhea (Kalanda et al. 2006) . After a child reaches two years of age, it is very difficult to reverse the adverse effect of stunting(WHO 2009)

The World Health Organization (WHO) recommends exclusive breastfeeding for the first six months of life with continuation of breastfeeding for two years or more together with nutritionally adequate, safe, age appropriate complementary feeding starting at six month(WHO & UNICEF 2003). However, not only the quality of the complementary food, but also how the child is fed is important. Appropriate feeding practices are age-specific, and they are also defined within narrow age ranges(Lander et al. 2010) . Recognizing the role of infant and young child feeding practices on the nutritional status of children under two years of age, the World Health Organization (WHO) developed and validated a set of core indicators to assess infant and young child feeding (IYCF) practices(Ali et al. 2012).

The caregiver-child interaction (feeding style) critically influences dietary intake on top of the dietary aspect of child feeding (Ruel et al. 2003). Feeding styles refer to how the parent interacts with the child when it comes to feeding (Ferrucci et al. 2010). Feeding styles were conceptualized and defined by Birch and Fisher (Birch & J. a Fisher 1995) as controlling, laissez-faire, and responsive feeding styles and have been used in different researches. The "controlling" feeding style occurs when a caregiver has complete control of when, what and how much the child eats, and includes restriction and force-feeding the child. In the "laissez-faire" feeding style the caregiver makes little effort to encourage eating; feeding is not encouraged even when the child may be marginally nourished. Birch and Fisher (Birch & J. a

Fisher 1995) defined the term “responsive” feeding as a condition in which “the caregiver is in close proximity to the young child during the meal and responds to the child’s hunger cues in a reasonable time”. Responsiveness is now viewed by different authors as a three-step process, namely observation of child cues by the caregiver, interpretation of the signs and taking action as quickly as possible in response to those cues (Black & Aboud 2011) . Control over feeding appears to vary among cultures, socioeconomic status and child’s gender(Fotso & Kuate-Defo 2006).

Difficulties in early feeding evoke strong emotions in parents and can undermine parenting confidence and parents’ sense of competency. Thus feeding difficulties must be addressed in a timely manner. By nine months, infants start to sit without support, put objects in their mouth, open their mouth when food is provided, can lean forward when they want to be fed and lean backward to refuse. Besides, they can control head and neck muscles and can turn their head to refuse or can stop the extrusion reflex when you put food in their mouth(Carruth et al. 2004). Despite these advantages, the transition to complementary foods being new to mothers can be overwhelming, the infants’ inability to talk, along with mothers failure to identify and respond to infants cues may contribute to the stunting prevalence that reaches its peak in the 9-11 month of age(Zurich & Good 2009) . Hence, assessing of currently adopted feeding styles among 9-11 months age group may be important to devise responsive feeding strategies that can improve children’s appetite and nutritional status. This is of special importance given the high prevalence of stunting 44%(DHS 2012) in Ethiopia.

1.2 Statement of the problem

Currently in Ethiopia, but also in many developing countries, interventions mainly address the issue of what to feed infants and young children and have given less attention on how children are fed (Pelto et al. 2003). Although early childhood malnutrition can be attributable to poverty and lack of resources, family and caregiver characteristics, such as education and household management or coping skills of the mother, can determine normal growth and development. Lack of knowledge regarding appropriate foods and feeding practices can contribute to malnutrition to a greater degree than lack of food (Penny et al. 2005). It is not only providing the appropriate combination of complementary foods to meet the child's nutritional needs that is important, but also feeding practices such as frequency of feeds and feeding style need to be considered (Patrick et al. 2005). Therefore the aim of this study is to identify the different types of child feeding behaviors of parents or caregivers, factors that influence these behaviors, and understand how they are associated to children's nutritional status.

1.3 Significance of the study

Choosing adequate, safe and appropriate complementary foods is an important factor in preventing childhood malnutrition; however, a caregiver's behavior during complementary feeding is also important. During the feeding episode caregivers need to respond to various child signals. Caregivers may feed children or they may expect the child to feed themselves. They may encourage the child to eat through praise or they might use threats. In addition, caregivers frequently must decide how to deal with children who refuse to eat (Engle et al. 2000). In most developing countries, the amount of food consumed by infants and young children is lower than their theoretical gastric capacity, hence making intake requirements even more difficult to meet (Baye et al. 2013) & (Gibson et al. 2009). This can partly relate to inappropriate feeding style (Moore et al. 2006a) and thus promotion of responsive feeding practices together with appropriate nutrition education should be an important component of complementary feeding strategies (Aboud et al. 2008).

Only few studies exist on the feeding style behavior of Ethiopian mothers (Aboud & Alemu 1995) & (Wondafrash et al. 2012a) and the results are conflicting, suggesting that more studies are needed. Given the positive effect that responsive feeding may have on dietary intake and growth in general (Penny et al. 2005), strategies are needed to promote them. For

this end, information on the current feeding style of infants in Ethiopia is necessary to design culturally acceptable responsive feeding messages.

1.4 Hypothesis of the study

Inappropriate feeding style and feeding practice affecting food intake of infants are prevalent in West Gojam, Ethiopia.

1.5 Objective

1.5.1 General Objective

To investigate the effect of feeding styles on intake of complementary foods, appetite and nutritional status of infants aged 9-11 month in Mecha district, West Gojam, Ethiopia.

1.5.2 Specific Objective

- To characterize the current feeding styles and behaviors using in home feeding episode observation
- To investigate the relationship between feeding style and infants food and energy intake of a commercial complementary food test meal.
- To investigate the association between practiced feeding style and infant anthropometric measures.
- To investigate whether or not anemia is related to poor appetite

CHAPTER TWO

2 Literature Review

2.1 Malnutrition

Malnutrition is a broad term commonly used as an alternative to under nutrition, but technically it also refers to over nutrition. People are malnourished if their diet does not provide adequate nutrients for growth and maintenance or they are unable to fully utilize the food they eat due to illness (under nutrition) (Van de Poel et al. 2008). They are also malnourished if they consume too many calories (over nutrition). Under nutrition is the outcome of insufficient food intake, inadequate care and infectious diseases. It includes being underweight for one's age, too short for one's age (stunting), dangerously thin for one's height (wasting) and deficient in vitamins and minerals (micronutrient deficiencies) (UNICEF, 2006). The period from pregnancy to 2 years of age provides a crucial window of opportunity to moderate under nutrition and its adverse effects. It is during this time that proven nutrition interventions can offer children the best chance to survive and reach optimal growth, health and development (Mehta et al. 2013).

2.2 Prevalence of malnutrition

Malnutrition has become an urgent global health issue, with under nutrition killing or disabling millions of children each year. Malnutrition continues to be a major public health problem in developing countries. The high levels of under nutrition in children and women in South Asia and sub-Saharan Africa pose a major challenge for child survival and development (Müller & Krawinkel 2005). It is the most important risk factor for the burden of diseases. In Ethiopia, child malnutrition rate is one of the most serious public health problem and the highest in the world. High malnutrition rates in the country pose a significant obstacle to achieving better child health outcomes (Mengistu et al. 2013).

Although it is rarely the direct cause of death (except in extreme situations, such as famine), child malnutrition was associated with 54% of child deaths in developing countries (FAO 2008). Malnutrition is associated with about half of all child deaths worldwide. In Ethiopia, child malnutrition is of public health concern, With 44% of children under the age of five years being stunted, 10% wasted and 29% underweight, the country has one of the highest malnutrition rates in sub-Saharan Africa (DHS, 2012).

Underweight prevalence declined from 32 per cent to 28 per cent in developing countries over the past decade. The most remarkable progress has been in East Asia and the Pacific. Progress is made when provision of basic services is combined with support for initiatives that inform and empower communities and families (particularly women) to ensure adequate nutrient intake and prevent infectious disease UNICF et al. 2012).

2.3 Causes of malnutrition

Based on its etiology, malnutrition is either illness related (secondary to one or more diseases/injury) or non-illness related, (caused by environmental/behavioral factors), or both. In the developed world, malnutrition is predominantly related to disease, chronic conditions, trauma, burns, or surgery (henceforth referred to as illness-related malnutrition) (Mehta et al. 2013). In developing countries, the prevalence of bacterial and parasitic diseases contributes greatly to malnutrition (Müller & Krawinkel 2005). Similarly, malnutrition increases susceptibility to and the severity of infections, and is thus a major cause of illness and death from disease, and thus the most important risk factor for the burden of disease in developing countries. Poverty is the main underlying cause of malnutrition and its determinants. However the degree and distribution of protein-energy malnutrition and micronutrient deficiencies among a population depend on many factors, including: the political and economic situation; the level of education and sanitation; the season and climate conditions; food production, cultural and religious food customs; breast-feeding habits; prevalence of infectious diseases; the existence and effectiveness of nutrition programs; and the availability and quality of health services (Penny et al. 2005). It is anticipated that the definition of malnutrition will continue to evolve with improved understanding of the processes that lead to and complicate the treatment of this condition.

2.4 Consequences of malnutrition

Malnutrition increases the burden of disease in developing countries, adding to the human and economic impact of diseases such as tuberculosis, malaria and HIV/AIDS. Malnourished children have lowered resistance to infection; they are more likely to die from common childhood ailments like diarrhoeal diseases and respiratory infections; and for those who survive, frequent illness saps their nutritional status, locking them into a vicious cycle of recurring sickness, faltering growth and diminished learning ability (Black et al. 2008).

Malnutrition magnifies the effect of every disease, including measles and malaria. The estimated proportions of deaths in which under nutrition is an underlying cause are roughly similar for diarrhoeal (61 per cent), malaria (57 per cent), pneumonia (52 percent), and measles (45percent) (Blossener & Clugston, 2003).

Malnourished mothers often have malnourished children. Under nutrition among pregnant women in developing countries is responsible for 1 of 6 cases where infants are born with low weight. Poor maternal and child nutrition during the 1,000 day window of opportunity inhibits both physical and intellectual development (WHO, 2009). There is no question that a strong association exists between malnutrition early in life and late manifestations of intellectual impairment that contributes to diminished academic achievement during childhood, which translates into reduced earning potential as adults (Behrman et al. 2008).

Micronutrient deficiencies include: anemia (affecting 1.6 billion people) - mostly due to iron deficiency which increases the risk of low-birth-weight babies, undermines physical capacity and contributes to 19 per cent of deaths during childbirth; iodine deficiency, which is the world's most prevalent, yet easily preventable, cause of brain damage , Vitamin A deficiency, which reduces body defenses against infection (suffered by 190 million preschool children); and zinc deficiency, which impairs the immune system (Ahmed et al. 2008).

2.5 Adequacy of complementary food

2.5.1 Overview of complementary food

Complementary feeding, as defined by WHO in 2002 is “the process starting when breast milk alone is no longer sufficient to meet the nutritional requirements of infants” so that “other foods and liquids are needed, along with breast milk”. In this Opinion “complementary feeding” means the period, when complementary foods are given together with either human milk or a breast-milk substitute (WHO, 2002).

Complementary foods as defined by WHO is the first foods introduced into an infant's diet in addition to breast milk. World health organization also defined complementary food as any food whether manufactured or locally prepared, suitable as a complement to breast milk or to infant formula, when either becomes insufficient to satisfy the nutritional requirement of the

infant (WHO, 2002). Complementary food is all liquid, semisolid and solid foods and can be beverages, spoon-fed food, or finger-food (European Food Safety Authority 2009).

Complementary foods should have a greater energy density than breast milk, that is, at least 0.8 kcal per gram. If a complementary food is more energy dense, then a smaller amount is needed to cover the energy gap, so that together with breast milk, they meet all his or her needs. If complementary food is more energy diluted than breast milk, the child's total energy intake may be less than it was with exclusive breastfeeding, an important cause of malnutrition (Dewey & Brown 2003).

Complementary foods in most developing countries are based on staple cereal or root crops. There is consensus on the types of foods recommended for the transition from breast milk/formula to solid foods, with the majority of studies concurring that young children require foods that are energy and nutrient dense as opposed to thin gruels that can hinder the absorption of certain micronutrients (Muhimbula et al. 2011).

An adequate diet has to be rich in energy, proteins and micronutrients (especially iron, zinc, calcium, vitamin A, vitamin C and folates), free from contamination (without pathogenic germs, toxins or harmful chemicals), not too salty or spicy, easily eatable (adequate for the age), in adequate amount, easily available and accessible. It is of paramount importance that infants be fond of the diet and that this diet be culturally acceptable (WHO, 2000).

2.5.2 Importance of appropriate complementary feeding

The global strategy for infant and young child feeding states that, infants should be exclusively breastfed for the first six months of life to achieve optimal growth, development and health, and thereafter, receive nutritionally adequate and safe complementary foods while breast feeding continues for up to two years or beyond (WHO, 2002).

Complementary feeding interventions alone were estimated to prevent almost one fifth of under five children mortality in developing countries (UNICEF, 2012). The most crucial time to meet child's nutritional requirements is the first 1,000 days (UNICEF, 2013). It is well recognized that the period of complementary feeding, from 6 to 24 months of age, is one of the most critical times for preventing malnutrition. Growth faltering is most evident during

this time period particularly during the first phase of complementary feeding (6–12 months) when foods of low nutrient density begin to replace breast milk and rates of diarrhoeal illness caused by food contamination are at their highest (Shrimpton et al. 2005). Protein-energy malnutrition generally occurs during the crucial transitional phase when children are weaned from liquid to semi-solid or fully adult foods. During this period, children need nutritionally balanced, calorie dense supplementary foods in addition to mother's milk because of the increasing nutritional demands of the growing body(Lander et al. 2010). Thus, weaning and complementary feeding improvement should be of highest priority for nutrition of infant and young children because of its crucial role in preventing mortality and enhancing children development (Temesgen, 2013).

After about 2 years of age, it is very difficult to reverse stunting that occurred at earlier ages (Martorell et al. 1994), suggesting 'critical window' for prevention of growth faltering. This is consistent with results of intervention trials showing that the greatest impact of food supplementation is seen among children under 2 years of age (Lutter et al. 1990 & Schroeder et al. 1995). Micronutrient deficiencies are also highly prevalent among infants and young children because of their high nutrient needs relative to energy intake and the effects of frequent infection (including subclinical infection) on appetite, nutrient absorption and nutrient losses. Deficiencies of certain nutrients, such as iron, are not limited to disadvantaged populations but are evident across all income groups. There may be irreversible sequela from micronutrient deficiencies that affect brain development and other functional outcomes (Lozoff et al. 2006). Therefore, it is essential to evaluate which strategies for improving complementary feeding are most effective at preventing malnutrition and enhancing growth and development of infant and young children.

2.5.3 Infant and young child feeding recommendations and safe preparation and storage of complementary food

After 6 months of age, it becomes increasingly difficult for breastfed infants to meet their nutrient needs from human milk alone. Furthermore most infants are developmentally ready for other foods at about 6 months. Optimal Infant and Young Child Feeding (IYCF) is presented in the WHO/UNICEF Global Strategy for Infant and Young Child Feeding (WHO & UNICEF 2003) as follows: As a global public health recommendation, infants should be exclusively breastfed for the first six months of life to achieve optimal growth, development and health. Thereafter, to meet their evolving nutritional needs, infants should receive safe

and nutritionally adequate complementary foods while breastfeeding continues for up to two years of age or beyond. Exclusive breastfeeding from birth is possible except for a few rare medical conditions as specified by WHO and UNICEF, and virtually every mother can breastfeed (WHO & UNICEF 2003).

The neuromuscular development of infants dictates the minimum age at which they can ingest particular types of foods (WHO/UNICEF, 1998). Semi-solid or pureed foods are needed at six months, until the ability for “munching” (up and down mandibular movements) or chewing (use of teeth) appears. When foods of inappropriate consistency are offered, the child may be unable to consume more than a trivial amount, or may take so long to eat that food intake is compromised. By 8 months most infants can also eat “finger foods” (snacks that can be eaten by children alone). Evidence from several sources (Dewey & Brown 2003a) indicates that by 12 months, most infants are able to consume “family foods” of a solid consistency, although many are still offered semi-solid foods (presumably because they can ingest them more efficiently, and thus less time for feeding is required of the caregiver). There is suggestive evidence of a “critical window” for introducing “lumpy” solid foods: if these are delayed beyond 10 months of age, it may increase the risk of feeding difficulties later on (Northstone et al. 2001). Thus, although it may save time to continue feeding semi-solid foods, for optimal child development it is advisable to gradually increase food consistency with age.

The small amount of complementary foods initially offered should be gradually increased with age. The amount and frequency of foods should be based on infant’s acceptance, which varies according to individual needs, the amount of breast milk ingested and the content of complementary foods. The infant should be encouraged to eat until he/she feels satiated and frequency of breastfeeding should be maintained. With the introduction of complementary feeding the infant will naturally begin to nurse less, therefore avoid an excessive number of meals with complementary foods in breastfed infants so as not to substantially decrease the amount of breast milk ingested by the infant (WHO, 2001).

The current recommendations regarding the frequency of meals with complementary foods for breastfed infants result from theoretical estimates based on the energy provided by complementary foods, assuming a gastric capacity of 30 g/kg and an energy intake of at least 0.8kcal/g (Dewey & Brown 2003a). The minimum frequencies of meals per age were calculated such that the requirements of almost all infants could be safely met. Thus, WHO

currently recommends two to three meals a day with complementary foods for breastfed infants between 6 and 8 months of life and three to four meals a day for those between 9 and 24 months, with additional nutritious snacks (pieces of fruit, cooked potatoes or cassava, bread or chapatti with peanut, butter or honey) once or twice a day at 12 months (WHO, 1998). If energy content or the amount of complementary foods per meal is small, or if the infant has been completely weaned, a higher frequency of meals may be necessary. It should be emphasized that meals with complementary foods do not replace (but complement) breast feedings (WHO, 2001).

Consumption of whole milk can lead to iron deficiency. High levels of calcium and phosphorous and the low level of vitamin C in whole cow's milk may inhibit an infant's ability to absorb iron from other foods. Furthermore, whole cow's milk has been shown to cause microscopic bleeding and nutritionally significant blood loss, thereby promoting the development of iron deficiency anemia (Fernandes et al. 2008).

Hygiene of complementary foods, which includes preparation, later storage and administration, is important for the promotion of infant nutrition. It is believed that more than half of diarrhea bouts in infants under the age of 5 is associated to infant nutrition; and complementary foods play a vital role in the transmission of diarrheal diseases. Microbial contamination of complementary foods is a major cause of diarrhoeal disease, which is particularly common in children 6 to 12 months old. Safe preparation and storage of complementary foods can prevent contamination and reduce the risk of diarrhea (Giugliani & Victora, 2000).

Contamination of complementary foods is very common in developing countries due to contaminated water, poor personal hygiene (contaminated hands of whom is preparing the food) and inadequate cleaning of eating utensils (especially baby bottles and their nipples) and inadequate storage of foods after preparation. Food contamination is common when it is stored at room temperature as the proliferation of pathogenic bacteria is favored (Black et al. 1989). Frequently, in poverty-stricken populations, foods that are stored under unfavorable conditions are given to infants without being heated or are inadequately reheated, resulting in the intake of a great number of pathogenic germs (WHO, 1989).

The following hygiene practices should be adopted when handling foods: washing hands with soap before their preparation; using always fresh food; washing raw foods properly; using

clean utensils; avoiding the use of bottles and their respective nipples; storing perishable or freshly prepared foods in the refrigerator whenever possible; cooking foods properly; eating foods within 2 hours after preparation if not stored in a refrigerator; properly reheating prepared foods or foods stored at room temperature for over 2 hours; and protecting foods and utensils against animals (rats, cockroaches, flies) and dust (Brown 2000). Interestingly, the use of cups was more efficient in reducing bacterial counts than the cleaning of eating utensils, since bottles and nipples which were washed in cold or hot water were more contaminated than cups that were submitted to the same procedure.

Some best-practice of feeding behaviors:-

- » Feeding with a balance between giving assistance and encouraging self-feeding, as appropriate to the child's level of development.
- » Feeding with positive verbal encouragement, without verbal or physical coercion.
- » Feeding with age-appropriate as well as culturally appropriate eating utensils.
- » Feeding in response to early hunger cues.
- » Feeding in a protected and comfortable environment.

- » Feeding by an individual with whom the child has a positive emotional relationship and who is aware of and sensitive to the child's individual characteristics, including his or her changing physical and emotional states (WHO, 2001).

2.5.4 Nutrient content and sensory acceptability of the complementary food

According to Nestle 2003 qualified complementary food should fulfil the following features: high energy content, low viscosity (i.e. of an acceptable thickness or consistency), balanced protein (containing all essential amino acids) content, required vitamins and minerals (Iron, folic acid, calcium) content, no (safe level) anti-nutritional components and pleasant taste (palatable) (Nestel et al. 2003).

Traditional cereals and grains played an important role in the infant diet in developing countries and were a major source of protein, carbohydrates, vitamins, and minerals. Unfortunately, these foods have major deficits in micronutrients such as calcium, iron, and vitamin A. Most complementary foods used are locally produced and based on local staple foods, usually cereals that are processed into porridges. Apart from their bulkiness reported as a probable factor in the etiology of malnutrition (WHO, 2001), cereal-based gruels are generally low in protein and are limiting in some essential amino acids, particularly lysine

and tryptophan. Supplementation of cereals with locally available legumes rich in protein and lysine, although, often limiting in sulphur amino acids, increases the protein content of cereal-legume blends and their protein quality through mutual complementation of their individual amino acids (Muhimbula et al. 2011).

Ethiopian, complementary food given to infants by mothers or caretakers, are deficient both in macro nutrients (protein, carbohydrates and fat) and micro-nutrients (minerals and vitamins). This leads to PEM and specific micro nutrient deficiency or both (Temesgen, 2013).

It appears that, in addition to a sufficient energy density, sensory qualities of complementary food formulations corresponding to food preferences of infants are of the highest importance. Sensory evaluation is easy in its principle but its implementation in the field is often complicated because of low literacy among the rural mothers' and the difficulty for them to understand some sensory testing methods.

It is important to keep in mind that individuals do not eat solely based on hunger. Taste is usually the number-one reason given for eating a specific food, and a decrease in good taste is often given as a reason for terminating or reducing food intake. Taste and more specifically palatability (a subjective measure of the pleasantness of food) have consistently been shown to influence food choice. Palatability and energy density, which is determined by comparing the food's caloric energy with the food's weight, are inextricably linked; foods are preferred because they are energy dense. On the other hand, low-energy-dense foods, foods that typically contain more water and less fat, tend to be more satiating but less palatable (Mattes et al. 2005).

In most developing countries, complementary foods do not provide sufficient iron, zinc and vitamin B6. Even in the U.S., iron and zinc were identified as problem nutrients in the first year of life, despite the availability of iron-fortified products. Certain nutrients are in short supply in some populations, but not in all, depending on the local mix of complementary foods. These include riboflavin, niacin, thiamin, folate, calcium, vitamin A and vitamin C. Others, such as vitamin E, iodine and selenium, may also be problem nutrients in certain settings, but there is insufficient information to make this judgment. Because there is so much variability in complementary food diets in different parts of the world, it is not feasible to

provide global dietary “prescriptions” that would guarantee adequate intake of all essential nutrients (Dewey & Brown 2003).

In industrialized countries, iron-fortified complementary foods have been widely consumed for decades, and some manufacturers have added zinc as a fortificant in recent years. Such products are not as widely available in developing countries (except through social programs that reach only a small proportion of the population), although there is increasing attention to this strategy for ensuring adequate infant nutrition (Lutter, 2000). An alternative to food fortification is the use of vitamin-mineral supplements that are provided directly to the infant (e.g. as medicinal drops) or mixed with complementary foods (e.g. “sprinkles”, or fat-based spreads). Evaluation of the nutrient shortfalls for a particular population (based on the types of complementary foods consumed) is necessary to decide whether single or multiple-micronutrient fortification or supplementation is appropriate (WHO, 2001).

Unfortified complementary foods that are predominantly plant-based generally provide insufficient amounts of certain key nutrients (particularly iron, zinc and calcium) to meet the recommended nutrient intakes during the age range of 6-24 months (WHO/UNICEF, 1998; Gibson *et al.*, 1998; Dewey & Brown 2003). Inclusion of animal-source foods can meet the gap in some cases, but this increases the cost and thus may not be practical for the lowest income groups. Furthermore, the amounts of animal-source foods that can feasibly be consumed by infants (e.g., at 6-12 months) are generally insufficient to meet the gaps in iron, calcium and sometimes zinc (WHO/UNICEF, 1998). However, it is advisable to include meat, poultry, fish or eggs in complementary food diets as often as possible. Dairy products are a good source of some nutrients, such as calcium, but do not provide sufficient iron unless they are fortified. In environments with poor sanitation, promotion of liquid milk products is risky because they are easily contaminated, especially when fed by bottle.

2.6 Recommended Nutrient Intake (RNI) of infants

Breast milk can make a substantial contribution to the total nutrient intake of children between 6 and 24 months of age, particularly for protein and many of the vitamins. However, breast milk is relatively low in several minerals such as iron and zinc, even after accounting for bioavailability. At 9-11 months of age, for example, the proportion of the Recommended Nutrient Intake that needs to be supplied by complementary foods is 97% for iron, 86% for

zinc, 81% for phosphorus, 76% for magnesium, 73% for sodium and 72% for calcium (Dewey 2001).

Given the relatively small amounts of complementary foods that are consumed at 6 - 24 months, the nutrient density (i.e., the amount of each nutrient per 100 kcal of food) of complementary foods needs to be very high. For most nutrients, the RNIs for infants, from birth to <6 mo are “adequate intakes” derived from the intakes of fully breastfed infants, based on an average daily milk consumption of 750 mL for the first six months multiplied by the nutrient concentration in breast milk. For older infants (6 to <12 mo), the RNI includes the amount of nutrient provided in both breast milk (based on average breast milk consumption of 600 mL) and complementary foods. Whenever data on the nutrient intake from complementary foods was not available, the recommended intake was extrapolated from the RNI of younger infants or from adult recommendations. Requirements for children were extrapolated from adult values. For children 1 - 18 y, RNIs for most nutrients were extrapolated from adult values. Additional requirements during pregnancy were based on estimates of amounts laid down in fetal and maternal tissues, while those for lactating women were based on amounts secreted in breast milk. These amounts were then added to the requirements of non- pregnant, non-lactating women (WHO, 2002).

2.7 Style of feeding

Feeding is a primary event in the life of an infant and young child. It is the focus of attention for parents and other caregivers, and a source of social interaction through verbal and non-verbal communication. The eating experience provides not only sustenance but also an opportunity for learning. It affects not only children's physical growth and health but also their psychosocial and emotional development. The feeding relationship is affected by culture, health status and temperament (Liu & Stein, 2013). Appropriate child feeding practices and behaviors of parents have a positive effect on growth of infants and young children (Saha et al. 2008). For instance, an analysis of data sets from several Latin American countries demonstrated that appropriate breastfeeding and complementary feeding practices were positively associated with child height-for-age in most of the countries studied (Ruel & Menon 2002). However, the majority of the literatures on child feeding and parental practices are based on women in affluent societies and their emphasis has been on child overweight or obesity (Hurley et al. 2011).

Feeding style appears to vary among cultures, socioeconomic status and child's gender. Hence, results of the effect of different parental or caregiver feeding behaviors among various socio-cultural settings should be used cautiously (Wondafrash et al. 2012).

2.8 The importance of portion size

The proven link between diet and risk of disease, along with the importance of diet during childhood for health in adult life, requires that children's diets be measured accurately (Foster et al. 2006). A strong environmental factor influencing energy intake is food portion size (Steenhuis & Vermeer, 2009). For intakes of food to be converted into nutrient intakes, a measure or estimate of the amount of each food consumed is required (Fotso & Kuate-Defo 2005).

Food guidance for children 2 years of age and older is plentiful. For infants and toddlers, however, guidance is less available and tends to be much more general. The rule of thumb that toddlers should be served "one Tbsp (table spoonful) for each year of age" is frequently cited (Smiciklas-Wright et al. 2003). While this rule may apply to the introduction of new foods, data indicate that this is not a realistic guideline for parents to use in determining reasonable portion sizes for routinely eaten foods. Moreover, research has shown that most

people are unaware of what constitutes an appropriate portion size and do not notice variations in portion size (Kral & Rolls 2004).

In very young children, food intake appears to be relatively unaffected by portion size. Nationally representative data indicate that the average portions of foods consumed by 2-y-olds have remained stable over a 20-y period (McConahy et al. 2002), although many commercially available products have increased in portion size during this time (Young & Nestle 2003). Data from a controlled study show that, when 3-y-old children were served different portions of macaroni and cheese on three separate occasions, they consumed similar amounts at each meal (Rolls et al. 2000). This suggests that very young children, rather than responding to food cues such as portion size, are able to self-regulate their intake by responding to physiologic cues for hunger and satiety (Ello-Martin *et al.*, 2005).

As children age, however, it appears that internal cues have less effect on food intake, whereas external factors exert more influence. In the study cited previously, when the different portions of macaroni and cheese were served to 5-y-old children, they consumed significantly more energy as the portion size was increased. This response to portion size occurred although their hunger did not differ at the start of the meals (Rolls et al. 2000). Similarly (Birch & J. a Fisher 1995) found that 4-y-old children ate 25% more when they were served an entrée that was twice the size of an age appropriate portion. The children who increased their intake the most when served large portions were those who had been identified as more likely to eat in the absence of hunger (Rolls et al. 2000).

It is not clear why children are more influenced by portion size as they age. Data suggest that early experiences lead to the development of behaviors that shape eating habits. In one experimental study, the 4-y-old children who were rewarded for cleaning their plates increased their energy intake. Conversely, the children who were taught to focus on satiety cues, indicated by the fullness in their stomachs, ate an appropriate amount of food. Thus, the response to portion size by children could be a learned behavior that leads to a shift of attention away from internal hunger and satiety cues toward food cues in the external environment. A lack of response to satiety signals may predispose children to overeat in an environment in which large portions of palatable foods are readily available (Barkeling et al. 1992). The influence of large portions on intake, however, has been shown to be moderated simply by allowing children to serve themselves. One study demonstrated that children ate 25% less of a large entrée when they decided for themselves how much food to put on their

plates compared with when they were served the large portion of the entrée by an adult (Fisher & Birch 2002).

Although there is a need for more data, these studies suggest strategies for parents and caretakers that may help children to eat appropriate portions. One approach is for adults to provide children with a variety of nutritious foods and allow children to determine how much they will eat by serving themselves (Ello-Martin et al. 2005). Adults should also encourage children to recognize hunger and fullness cues and to rely on these cues for the initiation and termination of eating; children should not be required to clean their plates nor be rewarded for doing so. As we understand more about eating behavior, it is likely that additional strategies will become available to help children preserve their ability to recognize and respond appropriately to internal signals and to resist environmental influences on intake such as portion size. Parents and caregivers should be encouraged to offer infants and toddlers appropriate portions of healthful foods from the basic food groups, with a special emphasis on fruits, vegetables, and whole grains, and allow them to eat until they are satiated (Ledikwe et al. 2005).

2.9 The impact of feeding style on child dietary intake

Research concerning child's food intake have considered various influencing factors, for example parental feeding strategies, demographic and weight factors. At this time, however, there are few findings that explore these factors simultaneously (Warschburger & Kröller 2009).

There are three strategies (rewarding, child's control and pressure) which turned out to be significant predictors. Additionally, the child's weight, family income and educational level have an effect on the choice of feeding strategies and their impact on the child's food intake. The results are evidence of the influence of parental feeding practices on the child's food intake (Hurley et al. 2011).

During early childhood years parents use feeding strategies as one way to influence their child's eating. Several reviews concerning the effects of feeding strategies showed evidence of a relationship between feeding behavior, food intake and weight of the child (Clark et al. 2007). Despite these findings, numerous inconsistencies regarding the effects of different strategies still exist. Restriction (the control about kind or amount of the child's food intake) is the feeding strategy that has most consistently been related to a higher risk for getting

overweight. Prospective and experimental studies show a relation to a heavier weight (Faith et al. 2004), a lower ability to regulate energy intake and a higher preference for the restricted food. However, findings providing evidence of a lower child's energy intake due to tighter parental restriction also exist (Jansen et al. 2007).

The majority of findings from prospective and cross-sectional studies regarding pressuring the child to eat more or to eat certain foods showed that these strategies correlated with lower weight and a higher intake of fruits and vegetables of the child. However, results indicating a more frequent use of parental pressure on the child were also found to be related to heavier weight as well as a higher energy intake by the child (Campbell et al. 2006). With regards to using food as a reward, the current results appear consistent: rewarding the consumption of disliked food with unhealthy food or snacks seems to increase the preference for the unhealthy food and decreases the preference for the food that was initially promoted (Bante *et al.*, 2008).

Unfortunately, studies that investigate indirect strategies such as monitoring the child's eating, modeling healthy eating, and giving the child more control over his or her food are still rare. These strategies were reported to have positive effects such as lowering a child's weight, decreasing his or her intake of unhealthy food and increasing their intake of healthy food (Campbell et al. 2006).

The use of feeding strategies and their impact on children's food intake both depend on demographic and weight factors of the child and the parents. One relevant factor is the educational and economic family background. There is evidence of more frequent control over the child's food intake in households with higher socioeconomic status (Ogden et al. 2006). Other studies, which considered different aspects of controlling strategies simultaneously, found a lower use for a restrictive and pressured feeding in this group. Regarding the mother's own weight, there were also inconsistent findings which indicated that mothers who weigh more control their child's food intake less or more often than mothers who weigh less (Orrell-valente *et al.*, 2007). This discrepancy can be attributed to the use of different definitions of feeding. Studies that found a positive association between mother's weight and her control over the child's eating usually used a combined factor of rewarding and controlling behavior, whereas contrary results analyzed these behaviors as separate feeding strategies. In regards to the child's weight, results from cross-sectional analyses

suggest that mothers, who use less pressure, but more restrictive strategies tend to have heavier children(Matheson et al. 2006).

Healthy eating behavior and food intake of children is a highly relevant topic. Therefore it is essential to understand the relationship between feeding strategies and the child's eating in association with socio demographic and weight factors. Current research has concentrated mostly on either a particular feeding strategy, such as restricting and pressuring, or on combined factors of different feeding aspects. Furthermore, previous studies have typically focused on special foods such as fruits or sweets or on specific details of the relationship between parenting and food intake (Kröller & Warschburger 2009).

In several studies, child energy intake and weight status showed opposite associations with parental feeding style within the same investigation. There are several potential reasons. First, these findings may reflect the aforementioned difference between children's single-meal intake as opposed to their habitual eating patterns and weight status. For example, (McKenzie 1994) found that observed parental encouragements to eat were positively associated with child eating at home meals but negatively associated with child BMI. These seemingly discordant findings may be plausible if parental feeding encouragement, in the short run, promotes increased child food intake at individual meals but, over longer periods, is elicited by child underweight and accompanying parental perceptions that their child is “scrawny”. In (Drucker et al. 1999) total discouragement to eat per minute was negatively associated with child BMI and child eating rate. However, total discouragement to eat (unadjusted for meal time) was positively associated with child energy intake, suggesting that meal duration can be an important confounding variable in observational studies (Faith et al. 2004).

Despite parents' good intentions, they use many feeding practices that are associated with negative outcomes. For example, restrictive feeding practices can actually promote the liking and increased intake of palatable, energy dense nutrient poor foods, and foster the development of overeating (Fisher & Birch 2002). Pressuring children to eat foods that are ‘good for them’ has been associated with lower fruit and vegetable intake, and picky eating in children; although the directionality of these findings is still in question as most findings are based on observational data(Galloway et al. 2006). These data do not shed light on whether children who do not eat their vegetables elicit more pressure from parents to do so; or whether parental pressure fosters the development of dislikes and food rejections in children (Galloway et al. 2006).

Retrospective reports reveal that many common food dislikes can be traced back to children's experiences of being pressured to eat specific foods (Batsell et al. 2002), suggesting that this parenting practice is causally implicated in the development of food dislikes and rejections. Children were more likely to increase their intake of an initially unfamiliar food if they were not pressured to eat it. Although pressure increased intake among some children during the conditioning trials, when the cost of reduced liking for pressured foods is considered along with the negative behavior in the form of comments, this strategy has negative long-term consequences. When parental reports on the use of pressure at home were related to laboratory findings, children of parents who reported routine use of pressure to eat at home consumed less food when pressured in the laboratory setting than children who were not reported to be pressured at home. This suggests the possibility that either children learn to oppose or ignore requests to eat over time or that these children have always been difficult to feed and that they are exhibiting a behavior that may have troubled their parents from the beginning, eliciting more pressure to eat from parents (Galloway et al. 2006).

The interaction between controlling parents and their infants became circular; when the infants refused to eat, the parents would try harder to make them eat, which eventually made the situation worse. Current findings suggest that this type of relationship may exist among parents and normally developing children who do not show failure to thrive. Despite a parent's best intentions, a child may react with the least desired response from the parent's perspective. From the child's perspective, eating or not eating is one of the few ways in which they can exert control over their own environment and over their parents. Therefore, from an early age, a child's reaction to parental desires about eating may have more to do with control than with food (Galloway et al. 2006).

Repeated exposure to foods is known to increase intake of foods that were initially rejected (Birch & Marlin, 1982). Foods used to reward children, which are usually already preferred, energy-dense foods, become even more desirable after they have been used as a contingency. In contrast, when disliked foods are used as a contingency for receiving a reward (e.g. finishing vegetable before being allowed to play) these already disliked foods become even less desirable. This is not surprising given that the contingencies are typically used by parents to pressure children to eat more of foods they are not consuming in amounts parents would like (Galloway et al. 2006).

Mere exposure to food increases liking but that attempts to control intake reduces the strength of the exposure effect. Pressuring children to eat more food ultimately lead to a lower intake of those foods even in situations when they were not being pressured to eat those foods. The use of pressure at home is associated with a lower intake of food when those children were asked to finish eating compared to their classmates who were not reported to be pressured to eat at home. Children are much more likely to respond emotionally, in the form of negative comments, when pressured to eat compared to when they were not pressured to eat. Taken together, these data reveal that pressuring children to eat is not an effective strategy for promoting intake (Galloway et al. 2006).

2.10 Caregivers feeding behavior and child nutritional status

The importance of child feeding practices for child nutrition is well recognized in the nutrition literature (WHO, 1995). However, efforts to measure and quantify child feeding practices and to assess the strength of their association with child nutritional status have been hampered by methodological problems. This is primarily because child feeding practices encompasses a series of interrelated behaviors that must be considered simultaneously and are therefore difficult to summarize in. For example, recommended practices for a 7 month old infant include, among other things, breast feeding, feeding the infant nutrient dense complementary foods 3 times per day and actively helping and motivating the infant to eat (Ruel & Menon 2002).

Child feeding practices in the first 3 years are also age specific within narrow age ranges, which adds to the complexity of measurement. Thus, evaluating the overall quality of child feeding behaviors can be challenging, and few researchers have ventured in this direction. Most research on the relationship between child feeding practices and health outcomes has focused on single behaviors, e.g. exclusive breast feeding, timing of introduction of complementary foods or the importance of animal products in complementary feeding (WHO 2009). These approaches, although valuable for evaluating the role of these individual practices, do not allow an examination of the effect of child feeding practices as a whole on children's health and nutrition outcomes. Qualitative approaches have also been popular for research on feeding practices and care because their flexibility makes them suitable for capturing complex behavior patterns. The knowledge acquired through the use of qualitative research methods is invaluable, but it does not allow quantifying the importance of child feeding and care practices for child nutrition outcomes (Ruel & Menon 2002).

During the past two decades, the role of care as an input into child health and nutrition alongside with food security, availability of health services and healthy environment has been the focus of investigation. Nutritionally, care encompasses all behaviors and practices at the household level of those who give care to children (caregivers), translating available food and health care resources into a child's growth and development. Care is therefore manifested in the ways a child is fed, nurtured, taught and guided. The significance of care in child nutrition has been articulated in the UNICEF's framework for analyzing the causes of malnutrition among young children in developing countries. The framework suggested that not only were food security and health care services necessary for child survival, growth and development, but care for women and children was equally important (WHO/UNICEF, 1998). The document argued that food, health and care are all necessary, but none alone is sufficient for healthy growth and development. Research has shown that even when there is adequate food in the house and a family lives in a safe and healthful environment and has access to health services, children can still be malnourished. It is also believed that even when poverty causes food insecurity and limited health care, enhanced care giving can optimize the use of existing resources to promote good health and nutrition in women and children. These assertions bring to the fore the need for further investigation of the importance of care in child health and nutrition (Engel *et al.*, 2000).

The importance of parental education for the health and wellbeing of the child has been stressed by many. Positive associations between maternal educational level and children's health and nutritional status have been reported by (Penny *et al.* 2005). Parental education could function by lowering fatalistic attitudes to illness, increased belief in the possibility of changing children's health status, acceptance of new ideas, greater confidence in dealing with health professionals and taking more direct responsibility for child rearing practices. In Bangladesh, (Guldan *et al.*, 2000) reported a close association between maternal education and child nutrition. Educated mothers gave their children complementary foods more frequently, fed in a more protected and cleaner setting and had healthier babies. Among Ghanaian mothers, various studies have identified maternal education as a crucial asset for good care giving practices and an important determinant of child growth in the first 18 month of life. Similar studies elsewhere have also reported positive associations between maternal education, child health and nutrition (Nti & Lartey 2007).

Dietary diversity, the number of different foods or food groups consumed by an individual, provides a measure of the quality of the diet and it is particularly important for micronutrient status. With the exception of breast milk, nutrients essential to meet the nutritional requirements of an individual are not found in a single food item but come from a diet composed of a variety of foods. Diverse diets have been shown to protect against chronic diseases such as cancer as well as being associated with improved health, nutrition and longevity of life. Several dietary guidelines have emphasized the importance of eating a variety of foods. Dietary diversity has been reported to be associated with child nutritional status (Brown 2000).

Several studies have reported significant associations between caregiver's active role in child feeding and child nutritional status (Dettwyler 1986) reported significant associations between feeding activity and child's height-for-age among children between the ages of 8 to 22 months. More active feeding behaviors were associated with increased dietary intake and greater anthropometric scores. (Dettwyler 1986) also observed positive caregiver attitude as a predictor to child weight-for-age than socio-economic status in Mali. The quality of care provided by a caregiver has a significant effect on nutrition deviance status of children. From the perspective of young child nutrition, positive deviants are children who grow and develop adequately in low-income families living in impoverished environments, where majority of the children suffer from growth retardation and malnutrition (Dettwyler 1986).

A study of care practices in Accra, reported a strong association between caregiver quality of care practice and child nutritional status in terms of weight-for-age and height-for-age. The findings of the observational study corroborated that childcare was one of the important discriminating factors between positive and negative deviant children. Caregivers who exhibited better quality of care practice produced positive deviant children in the community. Thus care practices on nutritional status as reported among urban poor in Accra is similar to that observed among the rural poor in Manya Krobo. There was however a loss of association between immunization and child nutritional status when the effects of the other four care variables were taken into consideration. This suggests that for this sample, immunization primarily affected child nutritional status through its association with good hygiene, good dietary diversity, high responsiveness and good hygienic practices during feeding. The findings of this study have confirmed the notion that better caregiving promotes growth and nutrition among young children. Caregiving behaviors that contribute to good nutritional

status of children include among others, good young child complementary feeding practices, immunization, and good hygiene and sanitation. Promoting the practice of these behaviors could lead to improved child health and nutrition. The development of mother support groups in communities could be a good strategy to provide emotional help to mothers, with mothers of positive deviant children being used as role models to transfer and share their maternal practices with mothers of poor growing children.

In view of the known effects of illness on the nutritional status of the child, requirements of protein and energy should not be thought of in terms of physiological requirements alone. The food consumed must provide a substantial cushion for the stress of infection, in addition to supplying the physiological requirements of maintenance and growth. The importance of breast milk in the first and second years of life by providing additional energy and protein helps to offset the energy constraints of a poor diet after an infection. Again the amount of bulk in the diet is an important consideration. If the food contains as little as 1kcal/g a child weighing 10 kg would need to eat 1 kg of the food daily to consume enough calories. A sick child who is anorexic, coughing or vomiting would need to consume 300-500 g of the food at each meal and this may well be beyond his capacity (WHO, 2000).

2.11 Inadequate feeding practice and impaired growth

Growth is a highly sensitive process which requires the optimal functioning of the body's physiological processes together with an adequate supply of nutrients (Stewart et al. 2013). During the first two or three years after birth, children in developing countries grow more slowly than those in wealthier regions of the world. It is difficult for them to regain this lost growth potential in later years, especially if they remain in the same environment. Under nutrition of the mother at conception and during pregnancy has a strongly adverse influence on early growth of her foetus, which is then a risk factor for subsequent growth stunting of the infant and young child (Gluckman & Pinal 2003). However, there is no doubt that feeding practices during the first years of life also have an important influence on the nutritional status, growth and function of the young child (Imdad et al. 2011). The most common immediate causes of poor growth of humans in developing countries include: poor maternal nutrition status at conception and under nutrition in utero; inadequate breastfeeding; delayed complementary feeding, inadequate quality or quantity of complementary feeding; impaired absorption of nutrients due to intestinal infections or parasites; or combinations of these problems(Stewart et al. 2013).

A number of studies have analyzed the effect of age of introduction of complementary foods or duration of exclusive breast-feeding on growth. The age of introduction of complementary feeding seems not to have a strong impact on growth velocity (both weight and length). However, some data suggest that late introduction in fully breast-fed infants, after 6 months, could result in a decline of length and weight gain and that early introduction from 3 to 4 months, could result in increased weight gain which could have long term negative consequences with regard to an increased risk for obesity, type 2 diabetes and cardiovascular disease in adult life (European Food Safety Authority 2009) Interpreting studies on the effect of age of introduction of complementary food on growth can be difficult for several reasons. First, most studies are observational. In observational studies introduction of complementary foods could be influenced by factors associated with the weight of the infant. A mother might introduce complementary foods earlier, because she is not satisfied with the weight gain of the infant (reverse causation), or a heavy infant might signal interest in complementary food earlier, because breast feeding might not be sufficient at an earlier age. Second, the composition of the complementary foods can influence growth (European Food Safety Authority 2009).

Kramer and Kakuma have performed a large Cochrane review of the effects of duration of exclusive breast-feeding which was last updated in 2009 (Kramer and Kakuma, 2009). The overall conclusion was that neither controlled clinical trials, nor observational studies from developing or developed countries show deficits in weight or length gain for those who continued to be exclusively breast-fed for 6 months. However, they also concluded that the data were insufficient to rule out a modest increase in risk of under nutrition in children exclusively breast-fed for 6 months and also that the data were grossly inadequate to reach conclusions about the effect of exclusive breast-feeding beyond 6 months (Kramer & Kakuma, 2009).

It is universally accepted that anthropometry is the most useful tool for assessing the nutrition status, and risks of poor health and survival of infants and young children. Three anthropometric indices are commonly used to assess infants and children: length-for-age (LA) or height-for-age (HA), weight-for-age (WA), and weight-for-length (WL) or weight-for-height (WH). Length is usually measured before a child is two years old, and height thereafter. Reported changes in growth rates or size at around 2 years are sometimes an artefact of the discontinuity of the growth curves at this age. Growth data are usually

expressed as Z-scores, calculated as the deviation of the value for an individual from the reference population at that age, divided by the standard deviation for the reference population. Z-scores correct for differences in age among a group of children. Low LA or HA (stunting) is usually an indication of long term under nutrition. Low WA is a less useful measure because it can be caused by stunting, accompanied by low, normal, or larger than normal amounts of fat and muscle. Low WL or WH (wasting) may be the result of recent under nutrition that has caused tissue loss but has not yet affected stature (WHO, 2006).

The WHO has established ranges that can be used to classify populations on the basis of the prevalence of stunting. Stunting is defined as more than 2 standard deviations below the median value of the NCHS/WHO International Growth Reference for length- or height-for-age. For children less than 5 years old, a low prevalence of stunting is <20%, whereas 20-29% indicates a medium prevalence, 30-39% a high prevalence, and $\geq 40\%$ a very high prevalence. Stunting usually becomes more prevalent after 3 months of age. The rate of decline in Z-scores starts to slow down at around 18 months and is very gradual after 24 months. Height Z-scores usually stop declining after around 3 years of age (Tessema et al. 2013).

2.12 Culturally adapted responsive feeding

During early childhood, children are introduced to many foods of their culture's adult diet. This is a time when children are neophobic and often reject new foods initially (Birch, Gunder, & Grimm-Thomas, 1998). However, with repeated exposure, children can either learn to prefer and consume, or dislike and reject foods depending on the social contexts and physiological consequences in which the foods are eaten (Birch, 1998). Parents shape the development of children's food acceptance pattern by determining what foods are offered to children and by providing the social contexts in which children are eating. Parental child feeding practices are central in shaping children's eating environments and their developing preferences (Birch & Fisher, 1998).

There is increasing recognition that feeding behaviors and styles, particularly responsive feeding (RF), could influence acceptance of food and dietary intake and thus the growth of IYC. RF was the result of applying the principle of psychosocial care, drawn from the field of developmental psychology, to the feeding situation. RF defined as: "reciprocity between child and caregiver...conceptualized as a three-step process: 1) the child signals requests

through motor actions, facial expressions, or vocalizations; 2) the caregiver recognizes the signals and responds promptly in a manner that is emotionally supportive, contingent on the signal, and developmentally appropriate; and 3) the child experiences a predictable response to signals (Black & Aboud 2011).

One of the first studies to document an association between caregiver feeding practices and child growth was conducted in the 1980s by a nutritional anthropologist, Kathryn Dettwyler, 1980, who used extensive ethnographic observation in Mali, West Africa. She visited study households ~6 times over the course of 1 year and conducted both open-ended conversational interviews and observations of mealtimes. A key theme that emerged was that many mothers were observed to be *laissez-faire*, providing the child high autonomy in deciding when and how much to eat: “When a child stops eating, pushes food away, or leaves the area where the food is being served, the mother interprets this...that the child is full. A mother does not encourage, cajole, or bribe the baby to return and eat more food.” However, noting variation among the mothers, developed a rudimentary maternal attitude scale and reported that children of attentive mothers had better growth than children of inattentive mothers. This study is noteworthy for its mixed methods and suggestion that caregiver practices are related to child growth (Bentley et al. 2011).

Studies conducted in Nigeria and Peru in the 1980s, employed mixed methods, including collection of ethnographic, observational, and survey data, to inform an intervention to improve dietary intake during episodes of diarrhea and convalescence. The Nigeria study reported on the style of hand-feeding a dilute, fermented maize (‘eko’) (Oni 1996). Ethnographic data (Bentley et al. 1991) showed that this highly controlling feeding style was normative, occurring as early as 1 month of age, and that a variation on hand-feeding, force-feeding, was used when children resisted. During force-feeding, the mother occluded the nose with her cupped hand, rendering the child unable to breathe, and forced the child to swallow the food (Bentley *et al.*, 2011).

Origins of RF emerged from a study in the mid-1990s in Nicaragua that focused on caregivers’ verbal encouragement of eating and offer of additional food, along with the relation between caregiver and child mealtime behaviors, and was termed active feeding. To capture behaviors, direct observations were conducted in the home on 2 unanticipated days, 2 wk apart, for 3–5 h/observation. A key finding was that both caregiver and child feeding

behaviors varied significantly across meal occasions, thus highlighting the importance of observing more than 1 type of meal (Bentley et al. 2011).

Two studies in Vietnam utilized videotape in the observation of meals and snacks as part of an evaluation of a community-based nutrition intervention to improve child growth. While researchers previously used videotaped data to examine variation in infant feeding among urban compared with rural caregivers in central Peru, these are among the first published studies to use the methodology. Both studies utilized in-home observations of a main meal on 2 occasions, separated by 7 or more days. A key finding across studies was that positive verbalizations were associated with greater child acceptance of food (Ha *et al.*, 2002).

Two studies, conducted in India and Peru, were the first to include RF messages as part of a nutrition education intervention delivered through existing local primary health care systems. In both settings, non-responsive feeding behaviors were observed during the formative phase of research. In Peru, caregivers were worried about child food refusals and problems of appetite, which were not currently addressed in health facility counselling. In India, IYC were observed to eat very small quantities at each meal. The RF message in Peru was “Teach your child to eat with love, patience, and good humor” (Bentley et al. 2011).

One of the published trials to isolate the effect of RF on child diet and growth was a cluster-randomized field trial in 37 villages (19 interventions and 18 controls) in rural Bangladesh. In both intervention and control villages, mothers of infants 8–20 month old received education on child development and child health and nutrition, which included advice on CF. Mothers in the intervention villages also received education on RF: 1) self-feed; let your child pick up food and eat; 2) be responsive; watch, listen, and respond in words to your child’s signals; and 3) when your child refuses, pause and question why; do not force feed or threaten. Although the intervention significantly increased maternal verbal responsiveness during meals and child self-feeding, there were no differences between groups in either attained weight or WAZ (Bentley et al. 2011).

In many low and middle income countries/LAMI/ setting, where the nutrition transition is well underway, it is likely that more pressuring, controlling, or indulgent feeding styles will increasingly emerge that may result in overfeeding (Hurley et al. 2011).

A more balanced view is that cultural beliefs, knowledge, and perceptions influence food behaviors to varying degrees, except under the most severely constrained economic

conditions. Many aspects of culturally shared understandings and interpretations are positive with respect to current scientific knowledge, some aspects are best regarded as neutral, and some are counterproductive from the perspective of contemporary biomedical theory. The complex nature of beliefs in relation to infant and young child feeding behaviors is clearly apparent in the case studies.

2.13 Relationship between nutritional status and appetite

2.13.1 Malnutrition related to anorexia

Some factors should be considered so that infants can have an adequate diet. These factors include appetite/ anorexia, variety/monotony and taste/smell. Lack of appetite could lead to a significant reduction in energy intake and, consequently, growth deficiencies (Chatoor et al. 2004). The incidence of anorexia during the first year of life increases with age from 2.2% in the first month to 31.7% in the 12th month. The factors that cause anorexia or low intake of complementary foods include repeated diets; micronutrient deficiencies, especially iron and zinc; and emotional problems.

Anorexia, inadequate food intake or lack of food supplies and loss of appetite are probably the most common causes of malnutrition worldwide, especially in developing, but also in developed, countries. Anorexia can result from patho-physiological, psychological and general social problems. Different types of chronic and inflammatory diseases such as cystic fibrosis, chronic renal failure, stroke, Parkinson's disease, respiratory and orthopedic problems, childhood malignancies, chronic inflammatory bowel diseases, fatigue/muscle weakness and difficulties with tasting, chewing and swallowing can lead to reduced food intake and malnutrition (Lucarelli *et al.*, 2007). Also, nausea and vomiting, which may result from certain diseases, and the use of certain drugs or specific treatments (chemotherapy, radiotherapy) may have a negative effect on appetite. Also, psychological factors such as anxiety and depression or the presence of dementia can cause malnutrition. Finally, malnutrition can have social causes, such as the institutionalization of individuals (e.g. in hospitals, nursing homes), poverty and famine, poor food hygiene, inappropriate food supplies and the early cessation of breastfeeding (Fairburn, 2002).

When breast-fed infants are anorexic, the intake of energy from complementary foods is markedly reduced if compared to the energy intake from breast milk itself. Even infants who are healthy and have good appetite should be assisted and encouraged to eat at mealtime. This

requires patience since infants eat slowly, spread food about the pace, and get easily distracted. Adults should encourage infants to eat by themselves, always making sure that they are ingesting enough food. Infants who are sleepy or have waited too long for being fed may lose their appetite and not feed properly. Adults cannot force or blackmail infants into eating. If infants are anorexic due to a disease, a more flexible attitude towards eating hours and habits can help them to feed more properly. During these periods, they should be fed more frequently (preferably breast-fed); they should be offered their favorite foods; and foods that have high energy density and a consistency that facilitates swallowing and does not irritate the mucosae (acid foods) if they feel pain when swallowing and/or chewing (Garner & Garfinkel 1979).

In the event of diseases that cause vitamin A depletion such as measles, diarrhea and acute respiratory infections, infants should be fed foods that are rich in this vitamin. After an infection, during rehabilitation, infants have an appetite that is above normal levels, as an attempt to compensate for weight loss. In this period, foods that are rich in energy and that contain a protein/energy ratio above normal should be offered more frequently. Additional protein should contain, preferably, high biological value (meat, dairy products and eggs), also offering more iron, zinc and vitamin A (Salgueiro et al. 2002).

2.18.2 Anemia

The prevalence of anemia in children has continued to be of interest to public health researchers in both developed and developing countries but it is often difficult to compare the prevalence rates reported from such studies (Zetterström 2004). This is largely because of the variations in age, physiological state, socio-economic status and geographic origins of the subjects used in the studies as well as the apparent lack of uniformity in setting Hgb. levels as cut-off points for the definition of childhood anemia, especially in the first year of life (Domellof et al. 2002).

Globally, half of the burden of childhood anemia is thought to be caused by Iron Deficiency. Factors that cause iron deficiency include inadequate iron intake or absorption, or increased iron requirements due to growth or to loss of iron from bleeding. Dietary inadequacies during the first two years of life, a critical period when children switch from a predominantly milk-based diet to a diet based on solid foods and require more iron for growth (World Health Organization 2001), are major determinants of anemia in young children. As a consequence, the WHO guidelines for primary prevention of anemia in young children have focused on

iron supplementation (WHO 2007). Additional factors, such as infections, glucose-6-phosphate dehydrogenase (G6PD) deficiency, and haemoglobinopathies, are understudied contributors to anemia in tropical settings (Cardoso et al. 2012).

The haemoglobin concentration and hematocrit are the principal screening tests for detecting anemia. Haemoglobin can be measured quickly and accurately on a few drops of blood. In the literature reviewed, 10.0 g/dl and 11.0 g/dl were the commonest cut-off points used for the definition of anemia in infants (Antunes et al. 2002) while 9.5 g/dl, 7.0 g/dl and 5.0 g/dl were used as cut-off points for severe anemia (Alberico *et al.*, 2003). These cut-off values were chosen by consensus or based on statistical analysis of the distribution of laboratory values in the population. Some experts argue that normal limits for Hgb. and for iron studies should be based on analysis of the response to iron therapy, but efforts to define cut-off values in this manner have not yielded definitive results (Baker & Greer 2010).

Most cases of anemia are due to causes other than iron deficiency. When anemia is diagnosed, additional tests can determine whether iron deficiency is the cause. Center for Disease Control and Prevention (CDC) analysts diagnose iron deficiency when two or more of the following tests are abnormal: free erythrocyte protoporphyrin, transferrin saturation and serum ferritin (Frith-Terhune et al. 2000).

There is strong evidence that findings from animal studies also apply to humans. For example, iron deficiency anemia has been conclusively seen to delay psychomotor development and impair cognitive performance of infants of preschool and school-aged (UNICEF 2014) Child who had moderate anemia as infants achieved lower scores on intelligence (IQ) tests and other cognitive performance upon entry in school than did children who were non-anemic during infancy. This finding emerged even when the tests were controlled for a comprehensive set of socioeconomic factors. This result was recently confirmed in Chile. On the other hand, in Thailand the poor performance in Thai language and mathematics tests of children with low hemoglobin levels was not reversed by iron supplementation (Pollitt et al. 1989).

Thus, iron deficiency can impair cognitive performance at all stages of life. Moreover, the effects of iron deficiency anemia in infancy and early childhood are not likely to be corrected by subsequent iron therapy. An estimated 10-20% of preschool children in developed countries, and an estimated 30-80% in developing countries, are anemic at 1 year of age

(World Health Organization 2001). These children will have delayed psychomotor development, and when they reach school age they will have impaired performance in tests of language skills, motor skills, and coordination, equivalent to a 5 to 10 point deficit in IQ (Pollitt et al. 1989).

Supplementing dietary iron with iron tablets, syrups, drops, or elixirs, and fortifying processed foods and condiments with iron are the best offense and defense against this cause of anemia (while the RDA for iron in children below 6 months is 0.27 mg per day, the RDA for children aged between 7 and 12 months is up to 11.0 mg per day (Lynch & Stoltzfus 2003). Where fortification has been evaluated in specific populations, it has improved iron status and reduced anemia prevalence. In most developing countries, however, food industries are not well developed, and, where they are developed, most people cannot afford fortified foods. Supplementing dietary iron can meet the iron needs of vulnerable groups who do not consume fortified foods. Iron supplementation also has the advantage of meeting the needs of pregnant women and young children, whose high iron requirements cannot be met only with fortified foods (Yang et al. 2011). In countries where the feasibility of general dietary improvement is limited, iron supplementation for vulnerable groups and food fortification are the most cost effective means of addressing iron-deficiency anemia. Because anemia has many causes in addition to iron deficiency, many types of programs in the health sector and other social sectors have the potential to contribute to anemia prevention and control (Wang et al. 2004).

CHAPTER THREE

3 Methodology

3.1 Ethical approval

Ethical approval was obtained from the College of Natural Sciences Research Ethics Review Committee of Addis Ababa University and the Institute of Research for Development (IRD), France.

Legal guardians of each child participating in the study received an oral explanation of the study and had the opportunity to ask questions about the research. Risks and benefits were explained to them. Each child had the right to withdraw from the study at any time without further consequences. Infants were treated respectfully and in a friendly manner. Legal guardians have signed the informed consent (Annex I). In case of illiteracy, signing was done with fingerprint. The consent forms as well as all questionnaires were translated in the local language, Amharic. The health workers of the health center and local authorities were informed of the study and its objectives before it started.

3.2 Location of the study

The study was conducted in Mecha Woreda, West Gojam zone, Amhara region. The Woreda is located at 524 km north-west of Addis Ababa, 34 km South East of Bahir Dar, the capital city of Amhara region. It is situated at an altitude ranging from 1800-2500 meters above sea level (DOA, 2000). The Woreda has a total population of 292,080 (CSA, 2007) and 7.7 % of the total population are urban inhabitants. The population density is beyond the zone average.

3.3 Study Participants

One hundred six caregivers and their 9-11 month breastfed infants were randomly selected to participate in the study. The selection was based on the database of local health centers completed by a census that has been conducted before the study. The study included infant and mother pairs that are permanent residents of the study area and who are apparently healthy. In addition, the infants had to be already introduced to complementary feeding and should have no problem of consuming cereal-based complementary foods. Mothers/caregivers signed consent to participate in the study. Informed consent was obtained for each infant, whenever possible from both parents/caregivers. An information sheet

describing the study and its objectives was also left to the parents/caregivers. In the rare cases where two infants in one household (i.e. twins) are found fulfilling the inclusion criteria, only one was randomly selected.

Infants affected by severe malnutrition with length-for-age (LAZ) ,weight-for-age(WAZ) or weight-for-length (WLZ) z-score less than -3 based on WHO growth standard (Multicentre et al. 2006) were excluded. These infants were referred to the closest health center for follow up.

3.4 Socio-demographic status

The socio-demographic characteristics of the subjects were assessed using a pre-tested questionnaire. Data on livelihood activities, level of education of caregivers, household assets, and size of land owned, and ownership of livestock, health and sanitary facilities were generated.

3.5 Anthropometric measurements

All anthropometric measurements were made by the same person to avoid inter-examiner errors. Length and weight were measured in duplicate using standardized techniques with the children wearing light clothing and no shoes. Z-score for length-for-age (LAZ), weight-for-age (WAZ) and weight-for-height (WHZ) was calculated using ENA software (2007), based on WHO multicenter growth reference data (Multicentre et al. 2006).

3.6 Standard complementary food provision and preparation

Differences in food characteristics may significantly affect the energy intake and hence the appetite of infants. To better isolate the effect of feeding style and better control for confounders such as food characteristics, a standard commercially available complementary food was used. Although infants in this region are often fed cereal-based foods, the commercial complementary food was provided to households one week prior the actual survey to allow them to adapt to the taste. At the time of the complementary food provision, demonstration on the preparation of standardized porridges with appropriate consistency and texture that is thick enough to stay on a spoon and not drip off (WHO 2009)was demonstrated. The date when the data collector visited the household for feeding observation was communicated. Caregivers were also reminded of the visit the day before the feeding observation occurred.

Table. 1 Assay to optimize the dry matter concentration of the porridge (test meal)

Code	cerifam	(DMC)			calculated DMC
		estimated at 95%)	water	total porridge	
	20	19	120	140	13.6
B1	11.0	10.7	100	111.0	9.6
B2	14.0	13.3	100	114.0	11.7
B3	16.7	15.8	100	116.7	13.6
B4	20.0	19.0	100	120.0	15.8
B5	23.0	21.9	100	123.0	17.8
B6	26	24.7	100	126.0	19.6

B3 was the concentration of the porridge prepared in field, with 20g of flour+120g of hot water, 14.4 g DM/100g porridge.

Table.2

Viscosity of	TMS Ratio	viscosity	viscosity	Bostwick consistency, (mm/30s)	cerifam
		83 s-1, 45°C (mPa.s)	83 s-1, 45°C (Pa.s)		
	B1	10.0	143	0.143	153
	B2	12.6	419.2	0.4192	117
	B3	14.4	727	0.727	101
	B4	16.5	1458	1.458	60
	B5	18.8	2573	2.573	36
	B6	20.9	4183	4.183	6
		96.61			

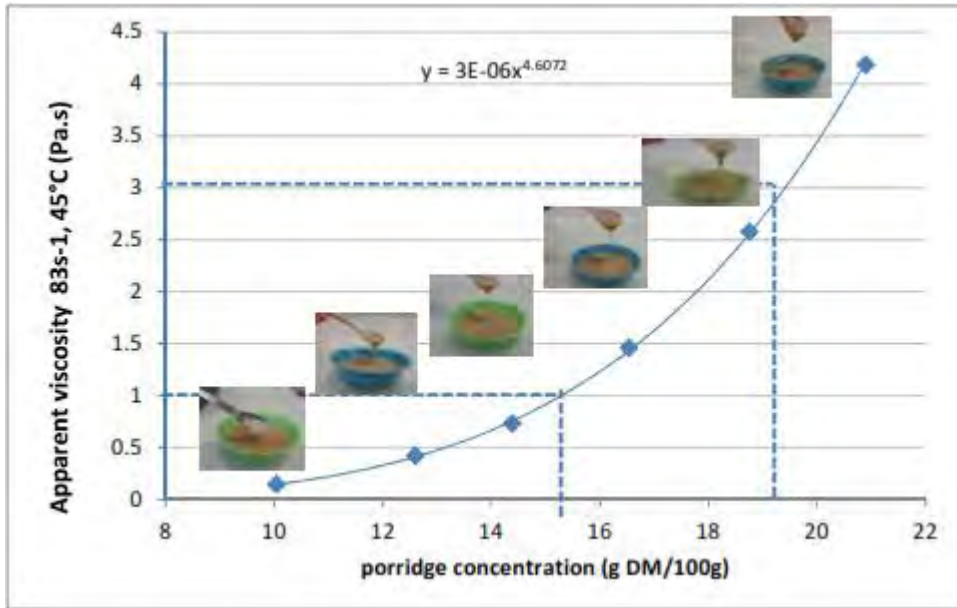


Figure.1 the viscosity of the porridge at different dry matter concentration of (test meal).

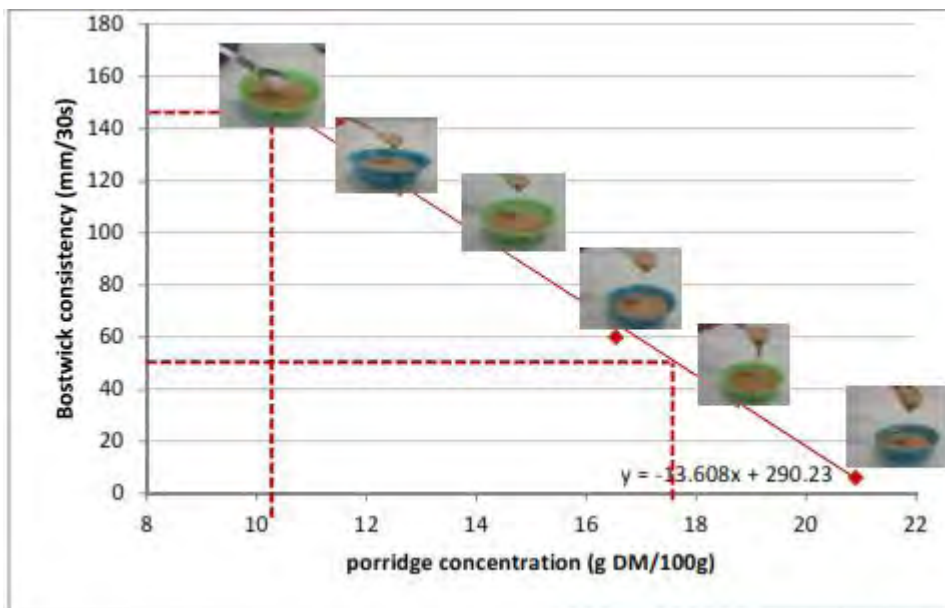


Figure.2 Determination of the consistency of the cerifam (test meal)

We generally considered that a consistency suitable for infant and young children is in the range: viscosity (83s-1, 45°C): 1-3 Pa.s, and Bostwick consistency 50-150 mm/30sec.

3.7 Feeding event observation

Feeding event was observed during breakfast time meal. The data collector arrived at the participants' home before the feeding event begun. During the feeding event, the data collector sat in a position that is not intrusive, but still allowing her/him to observe and hear the caregiver and child. Then all behaviors observed related to the caregiver and child during the feeding episode were recorded.

Observers were trained to record verbal and non-verbal behaviors, and noted the time every 5 minutes all of which was recorded on video. The complementary food was prepared by one of the caregivers following a standardized preparation procedure. The caregivers were asked to feed the infant sticking to their habitual feeding style. Then, the amount of food taken by the child was recorded. For the calculation, first the weight of the plate was taken, followed by the weight of the plate together with the food. The weight of the food was then determined by subtracting the weight of the plate from that of the meal served. After the feeding event was completed, the weight of the remaining food was determined in a similar way. The duration of the feeding episode, where the feeding took place, who fed the child and the serving (g) provided to the child and the amount consumed was recorded. A maximum time of 45 minutes was set.

The data was organized according to who was the actor, to whom or in whose presence the behavior was enacted, and exactly what was said or done. The behaviors of both mother and child were coded. The unit of behavior was the smallest meaningful action or word/statement. A coding system developed by (Moore et al. 2006), which consists of five behavioral categories: (1) self-feeding, (2) responsiveness, (3) active feeding (4) social behavior and (5) distraction, was used. Each category has a positive and negative classification. Frequency counts of each behavioral variable were subjected to descriptive analysis. Then, the three major styles of feeding have been identified. A controlling feeding style would be evidenced by a mother with low self-feeding, low responsiveness, and high active input including negative active. Laissez-faire feeding style would be evidenced by a mother whose profile will be low frequencies on all categories. A responsive style would be reflected in a high frequency of positive responsive behaviors.

3.8 Hemoglobin screening

Hemoglobin was assessed using Hem cue HB 301 system. This system consists of battery operated photometer and disposable micro cuvette, coated with a dried reagent that serves as the blood collection device. The test is performed using a drop of blood taken from the infant's fingertip.

After wearing glove for protection, the infants' middle or ring finger was cleansed with a disinfectant wipe and the side of it was pricked by using a lancet. After wiping away the first 2-3 drops of blood, light pressure was re-applied towards the fingertip and a drop of blood was collected directly into the testing cuvette and was filled in one continuous process but not overfilled.

The filled cuvette was placed into the cuvette holder immediately, lot number was given to the cuvettes, and hemoglobin reading was recorded on the chart. The cuvette and the lancet were discarded in the appropriate waste container and the instrument was cleaned with alcohol in between each measurement.

3.9 Biochemical analyses

3.9.1 Analysis of macronutrients

The proximate analysis of the complementary food was analyzed using the AOAC, (2000) method.

3.9.2 Moisture Content

AOAC (vol. II, 2000) method was used in order to measure the moisture content of the sample. A clean crucible was oven dried at 105⁰c for 1 hour and was placed in desiccators to cool. The weight of the crucible was determined after cooling and designated as weight one (W₁). The sample (5 g) was weighed accurately in the dry crucible (W₂) and was dried at 105⁰c for 3 hours. After being cooled in a desiccator to room temperature, the crucible containing the dry matter was weighed (w₃) again. The measurement was repeated until a constant weight was obtained. Finally, the moisture content was determined using the following equation:

Where: W₁= the weight of the crucible,

W2 = weight of the dry crucible and the sample before drying and

W3= weight of the crucible and the sample after drying

Since the water content of food vary widely, ingredients and foods are usually compared for their nutrient content on dry matter (DM) basis.

$$\%DM = 100 - \% \text{Moisture.}$$

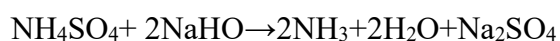
- The dry mater content of the complementary food was calculated as;

3.9.3 Crude protein analysis

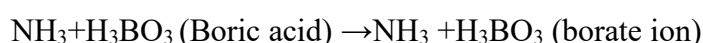
To measure the protein content of the sample AOAC (Vol. II, 2000) method was followed. 0.5 g. of the sample was weighed and transferred into the digestion tube. Then 6 ml of the acid mixture (85% Phosphoric acid and 98% sulphuric acid) and 3.5 ml of hydrogen peroxide solution was added into the digestion flask step by step. The tube was shaken until the violent reaction disappears. About 3 g. of a catalyst mixture made of 0.5 g. of copper sulphate and 100 g of potassium sulphate was added in to the digestion tube. The solution was then be digested at 370⁰ c for 1hr. and 30 minutes by a Gerhardt digester (TTM, Germany) until a clear solution was obtained. Then 30 ml. of water was added and shaken to avoid precipitation of sulphate in the solution.



After digestion is completed, 40% sodium hydroxide was added to the flask to neutralize the acid and make the solution slightly alkaline.



The ammonia was then distilled into the receiving flask that consists a solution of excess of 5% boric acid solution for reaction with ammonia. The borate ion formed as the result of the reaction of the boric acid and ammonia and this was titrated with a standard acid (0.1N Sulphuric acid solution) until the solution changes from green to violate or pink with the end point.



The nitrogen content was then calculated from the equation,

The protein content was calculated from the equation:

Crude protein (%) = Total Nitrogen (%) x Factor specific for different products

Where; V= Volume of sulphuric acid consume

B= Volume of sulphuric acid consumed blank

N= Normality of the acid (0.1N sulphuric acid)

W= Weight of the sample (g)

3.9.4 Crude fat

To measure the fat content of the samples, AOAC (vol. II 2000) method was used as follows. Empty extraction flask was cleaned and dried at 92°C for at least an hour and then kept in the desiccator for at least half an hour. The mass of cool flask was weighed (W_1). About 5 g. of the sample was weighed (W_2) in to each of the thimbles line with fat free cotton at their upper and bottom. The thimbles with their sample content was placed in to the Soxhlet extraction chamber.

A 40 ml. of petroleum ether was added in to each flask used for extraction. The extraction process was done for about 4 hr. then the flasks with their contents was removed from the Soxhlet and placed in drying oven at 92°C for 1hr. the flasks was then placed in desiccator for 30 min. The masses of each flask together with its fat contents was weighed immediately after it has been taken out of the desiccator (W_3).

The crud fat content was calculated from the equation;

Weight of fat

Where; W = Weight of fat

W_3 = Weight of fat + flask after extraction and drying

W_1 = Weight of empty extraction flask

W_2 = Weight of the sample

3.9.5 Dietary (crude) fiber

To measure the dietary fiber content of the sample AOAC (Vol. II 2000) method was followed. About 2.0 g. of defatted sample was weighed in each of 600 ml. beaker. A 200 ml of 1.25% sulphuric acid solution was added to each beaker and allowed to boil on hot plate for 30 min. by rotating and stirring periodically, during boiling the level was kept constant by addition of hot distilled water. After 30 min., 20 ml. of 28% potassium hydroxide solution was added to each beaker and again allowed to boil for another 30 min. The level was still kept constant by addition of hot distilled water. The solution in each beaker was filtered through crucibles containing sand by placing each of them on Buchner funnel fitted with rubber stopper. During filtration the sample was washed with hot distilled water. The final

residue was washed with 1% sulphuric acid solution, hot distilled water 1% sodium hydroxide solution and finally with acetone. Each of the crucibles with their contents was dried for 2 hr. at 130⁰c and cooled in desiccators and weighed (W_1) then again will be ashed for 30 min at 550⁰c in furnace and then cooled in desiccators. Finally the mass of each crucible was weighed (W_2).

The crude fiber was calculated from the equation;

Where; W_1 = crucible weight before drying

W_2 = Crucible weight after drying

W_3 = sample dry weigh

3.9.6 Total Ash

To measure the total ash content of the sample AOAC (Vol II.2000) method was followed. Porcelain crucible was cleaned and dried in an oven at 105⁰c for 30 min. the crucible was cooled in a desiccator for 30 min. and weighed to the nearest mg (W_1). About 3.75g of the sample was weighed in to each crucible (W_2). Then the sample was charred at low temperature on a hot plate under a fume-hood and slowly increased the temperature until smoking ceased and the sample becomes thoroughly charred. The crucibles was placed in a furnace at about 550⁰c for 1 hr. The crucible was removed from the furnace and to be cooled. A 5 drop of de-ionized water was added to each of the crucible to moisten the ash and evaporated the water on hot plate for 15 min. and it was placed in the furnace at 550⁰ for 30 min. crucible was again removed from the furnace, allowed to cool and 5 drops of nitric acid was added to each. Then the crucibles once again was inserted in to the furnace until they become free from carbon and the residue appears grayish white then they were removed from the furnace and placed in desiccators for 60 min. Finally the mass of each crucible was weighed as (W_3).

The total ash will be calculated from the equation:

Where: W_1 = weight of crucible

W₂= weight of ash + Crucible

W₃= weight of fresh sample

3.9.7 Carbohydrate

The content of carbohydrates was determined by difference that was subtracted from the sum of the percentage of moisture, curd protein, lipid, crud fiber and ash content from 100.

Total carbohydrates (%) = 100- (% moisture + % Protein + % of fat + % ash).

3.9.8 Energy values

Gross energy was determined by calculating the energy from fat, carbohydrate, fiber and protein contents using the Atwater's conversion factors. In recent years, an energy factor for dietary fiber is 8.0KJ/g (2.0kcal/g). Several studies show that part of dietary fiber is fermented in the colon by microorganisms and that the produced short chain fatty acids are absorbed. It is estimated that the metabolizable energy (ME) from this short chain fatty acids provide on average 8 KJ/g (2 Kcal/g) dietary fiber (FAO, 2003).

Total energy (Kcal/100g) = [(% available carbohydrate x 4) + (% protein x 4) + (% fat x 9)+(% fiber x 2)].

➤ The energy intake of the infant was calculated as;

3.9.9 Data analysis

Data analysis was undertaken using EPI INFO and SPSS version 20. For presentation of descriptive statics the distribution household and child characteristics was calculated and frequency and percentages were reported. Each of the independent variables (family size, household food security status, and child care practice) were analyzed and p-value were obtained and statistical significance was determined at an alpha level of 0.001 and 0.05. The normality of the data distribution was checked using Chapiro-Wilk test. Spearman correlations were used to investigate associations of feeding style, hemoglobin, and infants' anthropometry with food/energy intake. Partial correlations adjusting for hemoglobin were also performed to investigate the association between feeding style and energy/food intake.

CHAPTER FOUR

4 Results

4.1 Socioeconomic status and household characteristics

Of the total number of infants ($n = 106$), 52 were female and the remaining 54 were male. The mean infant's age was 11 month (**Table 3**). Most of the households were male-headed farming households (95%) with an average land size of 0.8 hectare. Most mothers were in their twenties and had 2-3 children, only few (24 %) had one or more years of formal education. The average family size was 5.7. Almost all had households with roofing made from corrugated iron sheet. More than 85 % of the households reported to have a food stock that would last them for one or more years. Nearly one third (32.1%) and less than one in every ten (8.5%) of the households owned radio and TV set, respectively.

Table 3: Socio-demographic and household characteristics of mother-child (9-11 months) pairs (n=106) in Mecha district, West Gojam, Ethiopia

Variables	Mean \pm SD	Frequency (%)
Male headed household		106(100)
Farming households		95(89)
Family size	5.7 \pm 2.1	
Number of siblings	2.7 \pm 2.2	
Boys: girls	1.03	
Infant's age (months)	10.3 \pm 0.8	
Mothers age(Year)	28.2 \pm 6.3	
Mother education(illiterate)		76(71.7)
Farming land size(hectare)	0.81 \pm 0.7	
Occupation of the caregivers(housewife)		83(78.3)
Religion(Orthodox Cristian)		106(100)
Food stock(\geq one year) [†]		93(87.7)
Have CIS roofing		105(99.1)
Owens a radio		34(32.1)
Owens a TV set		9(8.5)

[†]based on self-report, CIS= corrugated Iron sheet, TV= Television

4.2 Infants' anthropometric measures, prevalence of anemia, and feeding practices

The mean height-for-age, weight-for-age, and weight-for-height Z-scores were -1.0,-1.1, and 0.7, respectively (**Table 4**). Overall, 15.1% were underweight, 25.4% stunted and 5.7% wasted.

The infants' mean \pm SD hemoglobin concentration was 11.7 ± 1.3 g/dl, and after adjusting for altitude (1,500 m), 26.4% of them were anemic.

Table 4: Anthropometric measures and anemia among infants aged 9-11 months (n=106) in Mecha district, West Gojam, Ethiopia

Variables	Mean \pm SD	Frequency (%)
Weight(Kg)	7.9 \pm 0.9	
Length (cm)	70.1 \pm 3.4	
LAZ	-1.0 \pm 1.2	
WAZ	-1.1 \pm 0.9	
WLZ	-0.7 \pm 1.0	
Stunted		27 (25.4)
Underweight		16 (15.1)
Wasted		6 (5.7)
Hemoglobin (g/ dl) ^β	11.7 \pm 1.3	
Anemia		28 (26.4)

<11g/dl anemic, Z score < -2, corrected for altitude (1500m) based on (Ref)

All of the infants were still breastfed at the time of the survey (**Table 5**), but were introduced to complementary foods fairly late (~8 months). Mothers and grandmothers were the most responsible for feeding the child, occasionally sisters and other siblings were also involved. The caregivers identified making noise (45%), crying (43%), and restlessness (15%) as infants' behaviors expressed in response to hunger. In contrast, spitting out food (38.7%), playing (7 %), clenching teeth (14.5 %), and pushing food away (40.6 %) were identified as behaviors related to fullness, and mothers' response to child food refusal was to take food away.

Table 5: Self-reported Infant feeding practices in Mecha district, West Gojam, Ethiopia

Variables	Mean \pm SD	Frequency (%)
Infant ever breastfed		106 (100 %)
Age of introduction of CF (months)	8.3 \pm 0.7	
Who feeds the child		
Mother		27 (25.5)
Mother and grandmother		38 (35.8)
Mother and sister		35 (33)
Others		6 (6)
Infant's reaction when hungry		
Cry		43 (40.6)
Disturb		15 (14.2)
Make noise of anger		48 (45.3)
Infant's reaction when full		
Refuse		24(22.6)
Spit food		17 (16)
Play		7 (6.6)
Clench teeth		15 (14.5)
Push food away		43 (40.6)
Caregivers reaction to food refusal		
Take away food		106 (100 %)

4.3 Proximate analysis of the complementary food

The proximate composition of the commercial complementary food (*Cerifam*) used for the meal observation was analyzed and the results are presented in **Table 6**. The complementary

food (flour) had the following composition (per 100g on wet basis): moisture (4.81%), fat (5.44%), protein (12.22%), carbohydrate (75.62g), ash (1.91), and crude fiber (2.1%). The energy (calculated by difference) was 403.8 Kcal/100g.

Table 6: The proximate composition of the commercial complementary food used for the meal observation.

Nutrient composition of Cerifam®	
Moisture (%)	4.81
Fat (%)	5.44
Protein (%)	12.22
Ash (%)	1.91
Carbohydrates(g)	75.62
Energy (Kcal)	403.8
Fiber(g)	2.10

4.4 Infant feeding

Most infants (78.3 %) were fed by their mothers, while sisters were also involved in infant feeding (**Table 7**). Although a standard commercial complementary food was used for the meal observation, the consistency of its preparation was done according to mother's preference. As a result, of the prepared complementary foods 45 % were of intermediate consistency, 26 % thick, 22 % thin and 8% solid.

The mean CF intake during the meal observation was low (6.5 ± 4.4 g) and very low when compared to the minimum theoretical gastric capacity (g/kg BW/meal). About 88 % of the infants consumed less than 10 g/Kg BW/meal, 10 % consumed 10-20 g/kg/BW/meal and only 2% between 20-30 g/kg/BW/meal and less than one percent met the minimum theoretical gastric capacity.

Table 7: Infant’s feeding characteristics during meal observation

	Mean ± SD	Frequency (%)
Who feeds the child		
Mother		83(78.3)
Sister		9(8.5)
Others		14(12.5)
Consistency of CF served		
Thin		23(21.5)
Intermediate		48(45.3)
Thick		23(21.7)
Solid		8(7.5)
Food intake (g/meal)	6.5±4.4	
Food intake (g/kg BW/ meal)		
0-10		93(87.7)
10-20		10(9.4)
20-33		2(1.9)
≥30		1(0.9)

BW, body weight, CF= Complementary food

4.5 Caregivers and child feeding behavior during feeding episode

The overall caregivers’ feeding behaviors when categorized according to Birch and Fisher (1995) showed that “controlling/active” feeding was pre-dominant (54.7 %), followed by laissez-faire (32.1 %), and responsive feeding (13.2%) (**Fig. 3**).

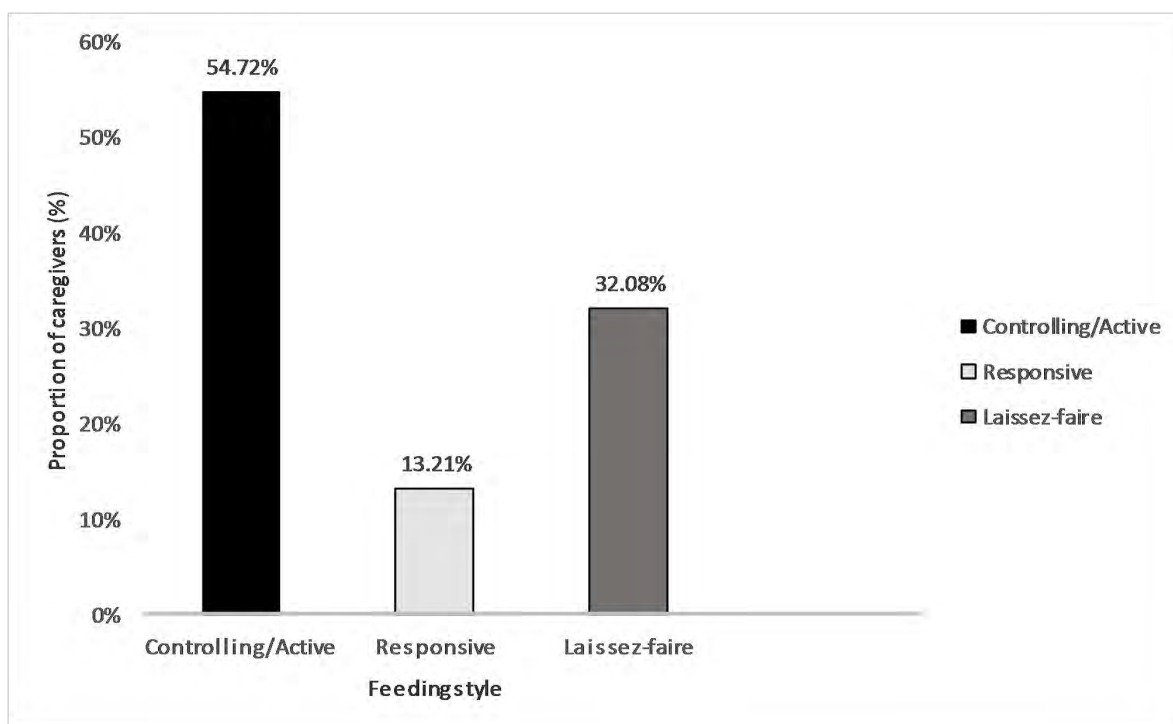


Figure.3 Proportion of caregivers with Controlling/Active, Responsive, and Laissez-faire feeding style[†]

[†]The feeding styles were categorized on the basis of Birch and Fisher's (1995)

The more comprehensive feeding behavior classification of Moore et al., (2006), illustrated that overall, maternal negative feeding behaviors were more dominant than positive ones (**Table 8**). In contrast, infant's positive feeding behavior scores including self-feeding, responsive feeding and active feeding were significantly higher than negative scores.

Table 8: Caregiver and Infant’s (N= 106) feeding behaviors during a test meal feeding episode

Feeding style	Feeding scores (score/feeding time)					
	Caregiver			Infant		
Median (Q1,Q3)	Positive	Negative	P-value	Positive	Negative	P-value
Self-feeding	0.000 (0.000,0.531)	0.971 (0.000,0.207)	<0.001	0.102 (0.032,0.215)	0.073 (0.000, .118)	<0.000
Responsive	0.068 (0.000,0.164)	0.120 (0.070,0.235)	<0.001	0.098 (0.055,0.209)	0.051 (0.000,0.151)	<0.004
Active	0.191 (0.084,0.282)	0.194 (0.123, .338)	<0.05	0.073 (0.000,0.140)	0.000 (0.000, .088)	<0.000
Social behavior	0.196 (0.081,0.385)	0.89 (0.064,0.140)	<0.001	0.000 (0.000, .082)	0.214 (0.000,0.096)	<0.001
Distractive	0.000 (0.000, .000)	0.083 (0.083,0.150)	<0.001	0.000 (0.000, 0.01)	0.000 (0.000, 0.00)	<0.001
Total score	0.496 (0.31, 0.94)	0.67 (0.41,0.98)	<0.001	0.395 (0.246, .686)	0.245 (0.139, .457)	<0.000

Values are Median (1st quartile, 3rd quartile) of feeding category, Non-Parametric Independent sample test KrushalWalis test, Statistically significant: * at P<0.05 level; ** at P<0.01 level.

4.6 Food and energy intake of infants and associated factors

Except for WAZ that was negatively associated with food intake/kg/BW/meal ($\rho = -0.168$, $P = 0.04$), the other anthropometric indices were not associated to food and energy intakes (Table 9). In contrast, infants’ hemoglobin concentration was positively correlated with energy intake ($\rho = 0.178$, $P < 0.03$).

Maternal positive responsive feeding score was associated with increased energy ($\rho = 0.237$, $P < 0.007$) and food intake/kg/BW/meal ($\rho = 0.182$, $P < 0.03$). On the other hand, maternal distractive positive feeding score and responsive negative feeding score were negatively associated with infants’ energy and food intake ($P < 0.05$).

Infant’s responsive positive ($P < 0.05$), and active and social positive feeding scores ($P < 0.001$) were significantly associated with increased energy and food intake/Kg BW/meal. On the other hand, self-feeding negative and active negative feeding scores were inversely associated with energy and food intake/Kg BW/meal. Infants’ overall positive feeding score is

associated with increased food intake (/kg BW/meal) ($P < 0.001$), but not energy intake ($p = 0.02$). In contrast, the overall negative feeding behavior score was inversely associated with infants' energy ($p = 0.01$) and food intake ($P < 0.001$).

Factors	Energy intake (kcal)		Food intake (g/Kg BW)	
	Correlation		Correlation	
	Coeff. †	p- value	Coeff. †	P-value
Child's Characteristics				
Age	0.132	0.089	0.099	0.155
LAZ	0.005	0.598	-0.155	0.056
WAZ	-0.008	0.939	-0.168	0.042*
WLZ	-0.003	0.939	-0.096	0.327
Hemoglobin (g/dl)	0.178	0.03*	0.147	0.067
Mother's Feeding Behavior score				
Self-feeding positive	0.052	0.297	0.042	0.336
Self-feeding negative	-0.199	0.110	0.144	0.071
Responsive positive	0.237	0.007**	0.182	0.031*
Responsive negative	-0.179	0.033*	-0.132	0.089
Active positive	-0.003	0.489	-0.016	0.434
Active negative	-0.088	0.186	-0.049	0.310
Social behavior positive	0.016	0.435	-0.019	0.423
Social behavior negative	0.055	0.288	0.106	0.139
Distraction positive	-0.199	0.020*	-0.209	0.016*
Distraction negative	0.021	0.416	0.017	0.429
Overall positive scores	0.056	0.283	-0.073	0.229
Overall negative scores	-0.131	0.091	-0.152	0.060
Infant Feeding Behavior				
Self-feeding positive	0.019	0.425	0.022	0.423
Self-feeding negative	-0.271	0.002**	-0.265	0.003**
Responsive positive	0.258	0.004**	0.267	0.003**
Responsive negative	0.100	0.155	0.084	0.196
Active positive	0.432	0.000**	0.419	0.000**
Active negative	-0.542	0.000**	-0.544	0.000**
Social behavior positive	0.291	0.001**	0.264	0.003**
Social behavior negative	-0.155	0.057	-0.146	0.067
Distraction positive	0.097	0.162	0.063	0.262
Distraction negative	0.095	0.166	0.096	0.164
Overall positive scores	0.137	0.082	0.330	0.000**
Overall negative scores	-0.220	0.012*	-0.410	0.000**

Table 9: Factors associated with energy and food intakes from the test meal

Bivariate correlation: Spearman correlation coefficient (one-tailed); Correlation is statistically significant: * at P<0.05 level; ** at P<0.01 level

4.7 Infant feeding behaviors associated with maternal responsiveness

Mother's responsiveness was associated with various infant feeding behaviors.

Maternal positive responsive feeding score was positively associated with the infants' positive responsive ($\rho=0.397$; $P\leq 0.001$), active ($\rho=0.187$; $P<0.03$), and social behavior ($\rho= 0.320$; $P\leq 0.001$) feeding scores (**Table 10**). In contrast, infants' negative distractive feeding score was negatively associated with maternal positive feeding score ($\rho= -0.191$; $P< 0.03$).

Table 10: Infant feeding behaviors associated with maternal responsiveness

Maternal responsiveness†	
Positive	
Infant feeding behavior score	
Positive responsive	0.397 (≤ 0.001)
Positive active feeding	0.187 (0.03)
Positive social behavior	0.320 (≤ 0.001)
Negative distractive	-0.191(0.03)
Negative	
Positive distractive	-0.175 (0.05)
Negative self-feeding	0.327(≤ 0.001)

†Values are spearman correlation coefficients (p-values)

On the other hand, negative maternal responsive feeding scores were negatively associated with infants' positive distractive feeding ($\rho= - 0.175$; $P<0.05$). Infants' negative self-feeding score was positively associated with negative maternal responsiveness ($\rho= 0.327$; $P\leq 0.001$).

CHAPTER FIVE

5 Discussion

The study aimed to investigate the association between feeding style and food/energy intake of infants (aged 9-11 months). Continued breastfeeding was the norm, but complementary feeding started late. A quarter of the infants were anemic and stunted. Mothers and sisters were the most responsible for feeding the infants. Infants' hemoglobin concentration was negatively associated with food and energy intake. Negative feeding behaviors were dominant and were associated with the very low food intake of the infants relative to the minimum theoretical gastric capacity. Maternal responsive and active positive feeding styles were positively associated with energy/food intake even after controlling for hemoglobin concentrations. Maternal responsiveness was associated with infants' positive responsive, active, and social feeding behavior scores.

Despite families' report having food stocks that can last them for one or more year, the prevalence of stunting, wasting, and underweight was high. This is not surprising considering the cereal dominated agricultural production in the area. In fact, families may have stocks of cereals like maize, but their production is not diversified enough to supply the different food groups required to meet the nutrient demands of the children. This underlines the urgency to revisit the agricultural production of the area to make it nutrition-sensitive. Nevertheless, the availability of a nutritious food alone, unless complemented by optimal infant and young child feeding (IYCF) practices, is not sufficient to improve the nutritional status of the children.

Breastfeeding was a norm, but introduction to complementary feeding (~ 8 months) was very late. Such delayed introduction of complementary foods is associated with inadequate energy and nutrient intakes (Melaku *et al.*, 2005). For instance, after six months of age, approximately 98% of the intake of micronutrients like iron and zinc should come from complementary foods (FAO/WHO, 1988, WHO, 1998). Therefore, such delayed introduction of complementary foods predisposes the infants to micronutrient deficiencies; and hence, along with the frequent infections, may explain the relatively high prevalence of anemia among these infants. This can further compromise the food intake of infants, thus trapping them in a viscous cycle of under-nutrition and disease.

The meal observations conducted in the present study confirmed the low food intake of the infants. Although based on few earlier studies, the minimal gastric capacity of infants is estimated to be 30 g/ kg BW/meal (WHO/UNICEF, 1998; PAHO/WHO, 2001). Relative to this figure, most if not all, had food intakes that were inadequate. This is in line with previous studies that also reported low food intakes among Ethiopian children.(Baye et al. 2013) reported that young children (aged 12-23 months) had food intakes that were below the minimal gastric capacity. More recently, the national food consumption survey also reported the low energy intake of infants and young children.

Elsewhere, anemia can also be a cause for the low food intake. Studies have shown that treatment of anemia or iron deficiency is associated with improved appetite and food intake (Lawless et al. 1994). Similarly, the present study found that hemoglobin concentration is positively associated with food intake. Nevertheless, little is known as to whether it is the anemia that is leading to poor appetite or vice versa. From the perspective of poor feeding practices leading to inadequate micronutrient intake, that if prolonged leads to anemia, it is key to investigate the feeding styles adopted by the caregiver as well as the caregiver-infant interaction during meal time. Prolonged exclusive breastfeeding, delayed introduction of complementary foods (which are of ten of poor quality) and feeding inappropriately contribute to iron deficiency (Zlotkin et al. 2004).Some disadvantageous socio-demographic characteristics including poor household, increased sibling number, lower maternal education, crowded living conditions, and low birth weight were significantly associated with anemia. And inappropriate feeding practices were also significantly associated with anemia (Yang et al. 2011).

According to the feeding behavior category proposed by (Birch & J. A. Fisher 1995) , “controlling/active” feeding style was dominant (54.7 %), followed by laissez-faire (32.1 %), and responsive feeding (13.2%) (Fig.3). However, the more comprehensive feeding behavior classification of (Moore et al. 2006) highlighted that all the five distinct behavioral categories, namely: self-feeding, responsive, active, distractive and social behavior, were present, but to a varying extent. Negative maternal feeding behaviors were more dominant than positive ones (Table 8).

Among the five feeding behaviors, maternal positive responsiveness was associated with increased energy and food intake of the infant. Indeed, a cluster randomized trial in India has shown that Indian toddlers that received responsive feeding in addition to the WHO's recommendations on breastfeeding and complementary foods had higher energy and nutrient intake than those who received the complementary feeding recommendations alone (Vazir et al. 2013). In the present study, maternal responsiveness was associated with infants' positive responsive and active feeding scores, which along with positive social behavior feeding scores were associated with increased energy and food intake/Kg BW/meal.

In contrast, maternal positive distractive and negative responsive feeding styles were associated with lower energy and food intake. In the immediate term, infant may respond to the non-responsiveness by rejecting mouthfuls. Indeed, infants' with higher negative self-feeding and active feeding scores had lower energy and food intake/Kg BW/meal. In the long-term, such non-responsive interactions can have negative implications on the infants' recognition of hunger and satiety cues and thus the development healthy appetite. Besides the ill-effects of negative self-feeding scores on food/energy intake could be partly explained by not allowing the infant to appreciate the texture of the food, which otherwise could have contributed to increased acceptance of mouthfuls.

Many of the feeding styles adopted by the mothers were associated with those of the infant. For instance, infants' positive responsive, active, and social feeding behavior scores were associated with maternal responsiveness and food/energy intake. Similarly, infant's positive distractive and negative self-feeding scores were inversely associated with maternal responsiveness and infant's food intake. Such interactions reveal that by promoting maternal responsiveness, it could be possible to modulate the infant's feeding style and vice versa to ultimately improve the infants' food intake.

Because of the one-time observation nature of the data collected, correlation between child anthropometry and feeding styles is not to be expected. Statistical results in this study however, indicate that WAZ score was inversely correlated with food intake of the infant. This could partly be explained by the fact that children with low weight can overfeed to catch-up their peers when food is made available to them (Black & Aboud 2011).

Nevertheless, the present study had several limitations that need to be considered when interpreting the findings. First, the study relied on a very narrow age range, and thus the findings should not be extrapolated to children outside 9-11 months of age, this is particularly in light of the dynamic feeding behaviors across age. Nevertheless, by focusing on age range where the child is unable to talk and thus more engagement and responsiveness from the mother is required increases the programmatic implication of the present study. The observation of only one meal per infant may not be adequate to classify the feeding style adopted at the individual level (mother/ child), but this will have little negative effect as the main aim of the study is to determine the dominant feeding styles at the population level to investigate their association with infants' food/energy intake. We have used as standard complementary food for the meal observations, although this aimed to control food-related factors, this was partly true since it was not possible to control for the consistency of the porridge that was guided by the mothers' preference. However, accounting for dry matter, the association with energy intakes may offset the variability in porridge consistency. The video-taping of the meal observations is a major strength of this study, as this allowed more settle observations of each mouthfuls and thus minimized feeding styles being missed from being coded. Although, the video-taping was conducted cautiously, it was impossible to avoid self-consciousness among some caregivers.

CHAPTER SIX

6 CONCLUSION AND RECOMMENDATION

The findings of this study have identified that inadequate complementary feeding practice such as late introduction to complementary feeding, dominated by controlling and negative feeding styles. About one third of the studied children were anemic, and hemoglobin was found to be negatively correlated with food and energy intake from complementary foods. Maternal responsive and active positive feeding styles were positively associated with energy/food intake even after controlling for hemoglobin concentrations. Maternal responsiveness was associated with infants' positive responsive, active, and social feeding behavior scores.

Based on the major findings of this study, the following recommendations are made:

- Contextually adapted responsive feeding messages should be developed and be integrated into the package delivered by the Health Extension Program (HEP)
- Adequate knowledge should be created regarding the age of introduction of complementary food and different food consistencies that corresponds to the developmental stage/age of their infant.

Further research should be conducted to assess the nature, appropriateness of feeding style and appropriate age for the introduction complementary foods. Findings documented in this study need to be supported and/or validated with additional studies on larger catchment areas and bigger samples, preferably using a longitudinal study design. Furthermore, the relationship between local cultural norms and feeding style behaviors must be studied, across several representative ethnic groups.

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Annex

Annex I

Consent form

Subject: Informed consent form

Dear Sir, Madam,

I am Aster Tariku a postgraduate student of the Center for Food Science and Nutrition, Addis Ababa University. I am collecting data on the feeding style of infants aged 9-11 months. Therefore, I would like to kindly ask your permission so that you can participate on the study. The whole study will last 45 minutes.

If you accept that you and your infant participate in our study, you will be asked some basic socio-demographic information. Please note that the questioner is anonyms and confidential. A research assistant will come to observe a feeding event during breakfast time meal and the weight and height of your infant will be measured.

If you decide to refuse, for whatsoever reason, there will not be any repercussions. We guarantee you that the confidentiality of all information collected. You are free to quit any moment of the survey, without any prior notice or justification. This survey will not have any consequence neither to you nor to your surroundings. Don't hesitate to ask us any questions regarding the objectives or the process of the investigation.

Name of the caregiver _____

Signature _____

Annex II

Questionnaires and data sheets

Identification, anthropometric and socio-economic questionnaire

A. Characteristics of the child

1. Birth date: / /

2. Sex: 1=male 2=female

3. Birth weight of the infant (if known) _____

4. Does the child have brothers and sisters? 1=yes 2=no

a. if yes, how many in total?

b. number of brothers and sisters in the following age groups

<12months 12-23 months 24-59 months 5-18 years + 18 yr

c. Position of the child:

5. Who usually takes care of the child?

1= mother 2= grand-mother 3= brother/sister 4= father 5= others, *specify* _____

B. Anthropometry (measure up to 2 equal or approximating to 100g or 1mm)

1. Weight

1 st measure	2 nd measure	3 rd measure
<input type="text"/> <input type="text"/> . <input type="text"/> kg	<input type="text"/> <input type="text"/> . <input type="text"/> kg	<input type="text"/> <input type="text"/> . <input type="text"/> kg

2. Length

1 st measure	2 nd measure	3 rd measure
<input type="text"/> <input type="text"/> . <input type="text"/> cm	<input type="text"/> <input type="text"/> . <input type="text"/> cm	<input type="text"/> <input type="text"/> . <input type="text"/> cm

C. Characteristics of the caregiver

1. Relation to the child:
1=mother 2=grand-mother 3= sister 4= aunt 5=other (specify) _____
2. Age:
3. Educational status:
a. Can caregiver read and write? 1=yes 2=no
b. If yes, level of education?
1= Primary school 2= secondary school 3= higher education
6. Religion:
1= Orthodox 2= Catholic 3=Muslim 4= protestant 5= other
7. Caregivers' activities: _____

D. Characteristics of the household head

1. Livelihood strategy: _____
- | | | |
|--------------------------|------------|-------------------------------|
| Farmer | 1=yes 2=no | <input type="checkbox"/> |
| Pastoralist | 1=yes 2=no | <input type="checkbox"/> |
| Civil servant | 1=yes 2=no | <input type="checkbox"/> |
| Business man | 1=yes 2=no | <input type="checkbox"/> |
| Student | 1=yes | 2=no <input type="checkbox"/> |
| Other (<i>specify</i>) | 1=yes | 2=no <input type="checkbox"/> |
2. Is the household head the father of the child? 1=yes 2=no

E. economic status

1. How much land do you have? _____
2. Do you have a radio? 1=yes 2=no
3. Do you have a TV set? 1=yes 2= no
4. Is the roof of the house made of corrugated iron sheet? 1=yes 2=no
5. If you have stock, for how long does it last?
1= no stock 2=1 month 3= 1 to 3 month 4= 3 to 6 months 5= > 6months
6. How many cows and oxens do you have?

F. Feeding episode observation

Termination of feeding episode

If the meal was terminated before the child finished the served meal, ask the mother the following questions:

Possible reasons for ending the meal:

1= The child is no more hungry

2= The child refused to eat more

3= The child had eaten enough

Other, specify: _____

How do you evaluate your child's appetite in general: 1= small 2= normal 3= high

How do you evaluate your child's appetite today:

1= Ate his/her usual amount 2= ate more 3= ate less

If the child ate more or less than usual, how do you explain this?

G. Questionnaire on Feeding practices

1. Is your infant ever breastfed? 1. Yes 2. No

2. Is your infant currently breastfed? 1. Yes 2. No

3. Was your infant exclusively breastfed for the first six months? 1. Yes 2. No

4. Is your infant introduced to solid/semi-solid foods? 1. Yes 2. No

- If yes, when _____ months of the infant

5. How do you know whether your child is hungry? _____

6. How do you determine whether your child is full? _____

7. Who usually feeds the child?

1. Mother 2. Sister 3. Father 4. Other Specify _____

8. What do you do when your child refuses to eat?
1. Try other foods 2. Force feed 3. Take the food away 4. Other
specify _____
- _____
5. What is your opinion towards meal time?
- 1= Pleasant 2=Frustrating 3= Struggle
4= other, specify _____
6. Does your child dislike certain foods? 1. Yes 2. No
- If yes, what do you do then: _____
7. What is the child's reaction towards new food?
1. Accept 2. Reject 3. No reaction 4. Other specify: _____
8. If your child rejects new food what do you do then? _____
9. Does your daily activity allow you to feed your child the way you want? 1. Yes 2.
No
- If no, specify the reasons: _____

Annex III

Score sheets

A. Hemoglobin readings

Readings	Hb values

Active feeding:

- Positive: _____
- Negative: _____

Social behavior:

- Positive: _____
- Negative: _____

Distraction:

- Positive: _____
- Negative: _____

ከዘጠኝ እስከ አስራ አንድ ወር ዕድሜ ክልል ውስጥ ባሉ ህፃናት የአመጋገብ ስርዓት ዙሪያ በአማራ ክልል ሜጫ ወረዳ ለሚገኙ የህጻናት ተንከባካቢዎች እና የጤና ኤክስቴንሽን ባለሙያዎች የተዘጋጀ መጠይቅ

ANNEX IV

Consent form and Questioner (In Amharic)

ነ ሐሴ 2006

የስምምነት ቅጽ

ጤና ይስጥልኝ እኔ ስሜ-----ይባላል በአዲስ አበባ ዩኒቨርሲቲ የስነ ምግብ ትምህርት ክፍል ተማሪ ስሆን በአሁኑ ጊዜ ከዘጠኝ እስከ አስራ አንድ ወር ዕድሜ ክልል ውስጥ የሚገኙ ህጻናት አመጋገብ ስርዓትን በተመለከተ መረጃ በማሰባሰብ ላይ እገኛለሁ። ከ 20 ደቂቃ በላይ በማይወስደው እነዚህን የቃለ መጠይቅ ጥያቄዎች

በመመለስ ቢተባበሩኝ ብዙ ጠቃሚ መረጃዎችን እንደማገኝ ተስፋ አደርጋለሁ። በቃለ መጠይቁ የእርስዎንም ሆነ የማንንም ስም የማልጽፍና የሚመልሱልኝን መልስ ለማንም አሳልፌ እንደማልሰጥ ለረጋግጥሎት እወዳለሁ። በጥያቄ እና መልሱ መካከል መመለስ የማይፈልጉት ጥያቄ ካለ ይንገሩኝ እና ወደ ሌላ ጥያቄ አልፋለሁ። በተጨማሪም ቃለ መጠይቁን ማቆም ቢፈልጉ በማንኛውም ጊዜ እንዲቆም ማድረግ ይችላሉ።

የሚጠይቁኝ ጥያቄ አሎት?

አሁን መጀመር እችላለሁ?

ሀ) መጠይቁ ይጀመር

ለ) አይጀመር

እምቢታ	
ቤት አልተገኘች	
ም/ኘም	

የ አ ካ ባ ቢ ው ሁ ኔ ታ		ተ ጩ ማሪ መግ ለ ጩ
1	የ ቀ በ ሌ ው ስ ም	
2	የ አ የ ፍ ሁ ኔ ታ	ሀ) ደ ጋ
		ለ) ወ /አ ደ ጋ
		ሐ) ቆ ላ
3	የ ጠ ያ ቁ ው ስ ም	-----
4	መጠይቁ የ ተ ካ ሄ ደ በ ት ሰ ዓ ት	ከ ----- እ ስ ከ ----- ---

የ ል ጁ እ ና የ ቤ ተ ሰ ቡ ሁ ኔ ታ

1	የ ል ጁ መለያ ቁጥር	
2	ል ጁ የ ተ ወ ለ ደ /ች በ ት ቀ ን	ቀ ን ----- ወ ር ----- ዓ /ም -----
3	ጾ ታ	82 1) ሴ ት 2) ወ ን ድ

4	ልጁ በተወለደ ጊዜ የነበረው ክብደት ምን ያህል ነበር?	----- ኪ/ግ	
5	ህጻኑ በአሁኑ ሰዓት ያለው ክብደት (ኪ/ግ) ይለካ (3ጊዜ)	1. ----- 2. ----- 3. -----	
6	ህጻኑ በአሁኑ ሰዓት ያለው ርዝመት (ሜ) ይለካ (3ጊዜ)	1. ----- 2. ----- 3. -----	
7	በአሁኑ ሰዓት ልጁ ጡት እየጠባ ነው?	1) አዎ	
		2) አይደለም	
8	ህጻኑ ሙሉ በሙሉ በቤት ውስጥ የተዘጋጀ ማንኛውንም ምግብ መመገብ ጀምሮ ዋል?	1) አዎ	
		2) አልጀመረም	
9	በተራ ቁጥር 8 ላይ ለተጠቀሰው ጥያቄ የተሰጠው ምላሽ "አዎ" ከሆነ ምግብ የማዘጋጀቱ የመመገቡን እንዲሁም የመንከባከቡን ኃላፊነት የወሰደው ማን ነው?	1) እናት	
		2) አባት	
		3) እህት	
		4) ሌላ ይገለጽ	
10	ጠቅላላ የቤተሰቡ አባላት ቁጥር	-----	

	ምን ያህል ነው?		
11	ህጻኑ እህት ወይም ወንድም አለው?	1) አለው 2) የለውም	
12	በተራ ቁጥር 11 ላይ ለተጠየቀው ጥያቄ የተሰጠው ምላሽ "አለው" ከሆነ ቁጥሩ ይገለጽ፡፡	-----	
13	በተራ ቁጥር 11 ላይ ለተጠየቀው ጥያቄ የተሰጠው ምላሽ "አለው" ከሆነ በሚከተሉት የዕድሜ ክልል ውስጥ የሚገኙት ቁጥር ይገለጽ፡፡	1. < 12 ወር ----- --	
		2. 12-23 ወር ----- -	
		3. 24-59 ወር ----- -	
		4. 5-18 ዓመት ----- --	
		5. ከ 18 ዓመት በላይ -----	

የህጻኑን ተንከባካቢ በተመለከተ

1	የህጻኑ ተንከባካቢ ከልጁ ጋር ያለቸው ዝምድና ምን ድን ነው?	1) እናት	
		2) አባት	
		3) አያት	
		4) ሌላ ይገለጽ	
2	የህጻኑ ተንከባካቢ ዕድሜ ምን ያህል ነው?	-----	
3	የህጻኑ ተንከባካቢ ማንበብ እና መጻፍ ይችላሉ?	1) ይችላሉ	
		2) አይችሉም	
4	ከላይ ለተጠየቀው ጥያቄ የተሰጠው ምላሽ "ይችላሉ" ከሆነ የትምህርት ደረጃቸው ምን ያህል ነው?	1) የመጀመሪያ ደረጃ	
		2) ሁለተኛ ደረጃ	
		1) ከፍተኛ የት/ተ	
		4) ሌላ ይገለጽ ----- ---	
5	የህጻኑ ተንከባካቢ የሚከተለው	1) አርቶክስ	

	እ ምነት ምን ድን ነው?	2) ካቶሊክ	
		3) መስሊህ	
		4) ፕሮቴስታንት	
		5) ሌላ ይገለጽ -----	
6	የህጻኑ ተንከባካቢ ስራ ምን ድን ነው?	-----	
7	በቤት ውስጥ ህጻኑ ምን መብላት እንዳለበት እና እንደሌለበት የሚወስነው ማን ነው?	1) እናት	
		2) አባት	
		3) አያት	
		4) ሌላ ይገለጽ -----	
የቤቱ አስተዳዳሪ እና የኑሮ ሁኔታ በተመለከተ			
1	የቤቱ አስተዳዳሪ ከልጁ ጋር ያለው ዝምድና ምን ድን ነው?	1) እናት	
		2) አባት	
		3) ሌላ ይገለጽ -----	
2	የቤቱ አስተዳዳሪ የመተዳደሪያ ስራ ምን ድን ነው?	1) ግብርና 2) አርብቶ አደር	

		3) የ መንግስት ስራ	
		4) ንግድ 5) ተማሪ	
		6) ሌላ ይገለጽ -----	
3	ምን ያህል መሬት አላችሁ?	-----	
4	በቤት ውስጥ ሬዲዮ አለ?	1) አለ	
		2) የለም	
5	በቤት ውስጥ ቲቪ አለ?	1) አለ	
		2) የለም	
6	የቤቱ ጣሪያ የተሰራው ከምን ድን ነው?	1) ከቆርቆሮ	
		2) ከሳር	
		3) ሌላ ይገለጽ	
7	በቤትዎ ተከማቾ የተቀመጠ እህል አለ? ካለ ለምን ያህል ጊዜ ያገለግላል?	1) አለ	
		2) የለም	
8	ከላይ ለተጠየቀው ጥያቄ የተሰጠው ምላሽ "አለ" ከሆነ ያለው እህል ለምን ያህል ጊዜ ያገለግላል?	1) ለ 1 ወር	
		2) ለ 3 ወር	
		3) ሌላ ይገለጽ -----	

9	<p>ያሎት የበሬ እና የላምቄ ጥርምን ያህልነው?</p>	<p>-----</p>	
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ANNEX V: Feeding style category

MOTHER FEEDING STYLE BEHAVIOURAL CATEGORY

MOTHER	POSITIVE	NEGATIVE
Self-feeding	<ul style="list-style-type: none"> -When she allows to hold spoon -when she supports the child to feed by himself -when she promotes self-feeding by encouraging 	<ul style="list-style-type: none"> - when she disallow to hold the spoon -when she pushes the child hand -when she holds his/her hands tightly -when she interrupt feeding by herself
Responsive	<ul style="list-style-type: none"> - she gives the water when he/she anticipates -when she respond to child cues -eye to eye contact between the child and mother -When she shows smiley face during feeding 	<ul style="list-style-type: none"> -when she finish the feeding episode prematurely -when she ignore the child when he/she open her/his mouth -when she show disinterest for feeding the child because of her other duties.
Active	<ul style="list-style-type: none"> -when she encourage the child verbally -when she attempt to arouse the child's interest to take the food -Offers food by saying "take take the food" - fetches child by holding his/her cloth(hands) -when she blow on food 	<ul style="list-style-type: none"> -when she put the porridge by pushing the spoon -tries to give food into his/her mouth by force -when she holds his/her hands -when she shakes the child's head
social	<ul style="list-style-type: none"> -When she tries to calm down the child's distraction during feeding episode but is not related to feeding -When she talks with the child but not about the food -when she calls his name lovingly -when she/he don't cry when she clans his/her face 	<ul style="list-style-type: none"> -when she ignore his/her attention to calm down when he disturb during feeding. -when she slaps her child -when she cleans the child harshly -when she stop feeding and go to other staff
Distraction	<ul style="list-style-type: none"> -when she talking with somebody while she feeding the child -when she shows him/her something outside during feeding -when she give him/her something to play 	<ul style="list-style-type: none"> -when she stop feeding and talks with somebody , calling somebody's name -when she loses her attention during feeding and she stop feeding for long time. -when she chase domestic animals.

INFANT FEEDING STYLE BEHAVIRAL CATEGORY

INFANT	POSITIVE	NEGATIVE
Self-feeding	<ul style="list-style-type: none"> -put some porridge into his/her mouth by spoon. -when he/she hold spoon or cups 	<ul style="list-style-type: none"> -when he/she throw the food -when mother offers the spoon he/she refuse to accept(hold)
Responsive	<ul style="list-style-type: none"> -when he drinks water when she offers by his anticipation -when he/she accept when it offered -eye to eye contact between mother and infant 	<ul style="list-style-type: none"> -Goes away from his/her mother during feeding episodes -when he/she turns face and cries when porridge is offers and disallow opening his/her mouth -sticks out his/her tongue -when he/she cries
Active	<ul style="list-style-type: none"> -when he/she looks/want to touch the food -when he/she opens mouth or cries for food -when he/she accept the porridge with pleasure 	<ul style="list-style-type: none"> -when he/she loss interest to feeding -when he/she pushes the porridge away when she offered
social	<ul style="list-style-type: none"> -when he/she touches his/her mother -smiling or playing with his/her mother -when he/she is not crying when she cleans his/her face - 	<ul style="list-style-type: none"> -when he/she cries but not in response to food -when he/she hits his/her mother -when he/she cries when the mother cleans his/her face
Distraction	<ul style="list-style-type: none"> -when he/she interacts with his brother or sister(relatives) but is still fed -when he/she keep eating the food but stile interact with the other people. 	<ul style="list-style-type: none"> -when he/she is not attentively feeding the child -when he/she is distracted from his/her food due to conversations with other relative -when the child is distracted due to the mother chases domestic animals