EFFECT OF COMPLEMENTARY FEEDING BEHAVIOUR CHANGE COMMUNICATION DELIVERED THROUGH COMMUNITY-LEVEL ACTORS ON INFANT FEEDING PRACTICES, GROWTH AND MORBIDITY IN RURAL COMMUNITIES OF WEST GOJJAM ZONE, NORTHWEST ETHIOPIA: A CLUSTER-RANDOMIZED CONTROLLED TRIAL

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Jimma, Ethiopia

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School of Graduate Studies

Effect of Complementary Feeding Behaviour Change Communication Delivered through Community-level Actors on Infant Feeding Practices, Growth and Morbidity in Rural Communities of West Gojjam Zone, Northwest Ethiopia: a Cluster-randomized Controlled Trial

A PhD Dissertation Submitted to the School of Graduate Studies of Jimma University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy (PhD) in Human Nutrition

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List of Abbreviations

ANC:	Ante Natal care
AOR:	Adjusted odd Ration
ASF:	Animal Source Food
BCC:	Behavior Change Communication
BCI:	Behavior Change Intervention
CFBCC:	Complementary Feeding Behavior Change Communication
CFBCI:	Complementary Feeding Behavior Change Intervention
CI:	Confidence Interval
COR:	Crude Odds Ratio
CSA:	Central Statistical Agency
DID:	Difference In Difference
EAP:	East Asia and the Pacific
EDHS:	Ethiopian Demographic Health Survey
ESA:	Eastern and Southern Africa
FDRE:	Federal Democratic Republic of Ethiopia
GEE:	General Estimated Equations
HAZ:	Height for Age Z score
HEP:	Health Extension Program
HEW:	Health Extension Workers
ITT:	Intention To Treat
IYCF:	Infant and Young Child Feeding
LAC:	Latin America and the Carrebean
LMIC:	Low and Middle Income Country
MAD:	Minimum Acceptable Diet
MD:	Mean Difference
MDD:	Minimum Dietary Diversity
MMF:	Minimum Meal Frequency
MOH:	Ministry Of Health
NGO:	Non Governmental Organization
OR:	Odds Ratio

PhD:	Doctor of Philosophy
PNC:	Post Natal Care
CONSORT:	Consolidated Standards of Reporting Trials
RR:	Relative Risk
SD:	Standard Deviation
SDG:	Sustainable Developments Goals
SRS:	Simple Random Sampling
UNICEF:	United Nations International Children‘s Emergency Fund
USAID:	United States Aid for International Development
WASH:	Water Sanitation and Hygiene
WAZ:	Weight for Age Z score
WCA:	West and Central Africa
WDA:	Women Development Army
WHO:	World Health Organization
WHZ:	Weight for Height Z score

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Abstract

It is well recognized that the age of 6-23 months is a complementary feeding period which has the most critical influence on the growth and development of an infant. The incidence of growth faltering, and micronutrient deficiencies is highest in this period as children have high demand for nutrients and there are insufficiencies in the quality and quantity of complementary foods. Improving feeding practices in this critical window of period is therefore among the most cost-effective strategies to improve overall infant health and ensure their nutritional wellbeing. This could be ensured by enabling mothers/caregivers to appropriately feed their children with safe and adequate complementary foods while maintaining frequent breastfeeding.

The quality of children's diets is more important before age two years than at any other time in life. Appropriate complementary foods and feeding practices contribute to child survival, growth and development. However, children may not receive safe and appropriate complementary foods at the right age, at the right frequency or in adequate quality.

Globally, complementary feeding practice is far from the WHO recommendations. Only about 65% of infants 6-8 months of age are fed solid, semisolid, or soft foods, less than one third (29%) of the children aged 6-23 months fulfill the minimum dietary diversity, half (52%) have the minimum meal frequency, and only one in six (16%) have the minimum acceptable diet. The situation is particularly worrying for the youngest children (6-11 months).

Attaining the recommended level of adequacy of an infant's diet remains a serious challenge in many developing countries. Complementary foods are mainly starchy-staples that lack the desired nutrient quality, amount, and density with limited consumption of animal-source foods, fruits and vegetables. In Ethiopia, inappropriate complementary feeding practices have been widely reported. Complementary foods are untimely introduced (either too early or too late), limited dietary diversity, and inadequate in calories. According to the Ethiopian Demographic Health Survey 2016, only 60% of children aged 6-8 months consumed solid, semisolid, or soft foods, 14% met the minimum dietary diversity, 45% had the minimum meal frequency, and 7% fulfilled the minimum dietary diversity.

The Ethiopian government carried out several efforts to enhance complementary feeding practices at different times through the implementation of infant and young child feeding guideline across the country. However, these efforts failed to improve feeding practices at the expected level. As a result, child undernutrition has remained pervasively high in the country. Hence, effective intervention strategies are needed to improve infant complementary feeding practices, growth, and health. We conducted a community-based cluster-randomized controlled trial to evaluate the effect of complementary feeding behavior change communication delivered through community-level actors on infant feeding practices, growth and morbidity.

Examining the level of maternal background knowledge and attitude, and the predictors is critical for to design evidence-based effective complementary feeding behavior change communication strategies. We have examined the level and predictors of mothers' knowledge and attitude on optimal complementary feeding at baseline (before the intervention was delivered). The overall level of mothers' knowledge and attitude on optimal complementary feeding was not appreciable especially regarding on age-specific meal frequency, animal-source foods, dietary diversity, feeding during and after illness, and bottle feeding. About 60% and 51% of mothers had good knowledge and favorable attitude towards optimal complementary feeding, respectively. On multivariable logistic regression model, mothers having formal education [AOR=2; 95% CI: 1.15-3.43], fathers having formal education [AOR=2.2; 95% CI: 1.26-5.13], having ANC [AOR=3.5; 95 % CI: 1.9-7.47], delivery at health facility [AOR=1.8; 95% CI: 1.13-2.83], having PNC [AOR=2.2; 95% CI: 1.32-3.73], and having IYCF counseling [AOR= 2.5; 95% CI: 1.46-7.52] were independent predictors of mothers' knowledge on complementary feeding. Likewise, mothers having formal education [AOR=2.5; 95% CI: 1.49-4.02], having ANC [AOR=2.7; 95 % CI: 1.54-4.57], having IYCF counseling [AOR= 2.2; 95% CI: 1.47-4.89], and possession of radio [AOR= 1.8; 95% CI: 1.35- 3.82] were significantly associated with mothers' attitude.

Although Ethiopian government has deployed community-level actors, the effect of behavior change communication through the community-level actors on child feeding practices have not been documented. We conducted a cluster-randomized controlled trial to investigate the effect of complementary feeding behavior change communication delivered through community-level

actors on the time of initiation of complementary foods. The main findings of this study indicated that the intervention significantly improved the probability of timely initiation of complementary food [78% vs. 56%, RR= 2.6; 95% CI: 1.78-5.86], and reduced the risk of late initiations [14% vs. 33%, RR= 2.8; 95% CI: 1.83-4.37]. The median age at the introduction of complementary food for infants was 6 months in the intervention group, and 6.7 months in the control group and the difference was statistically significant (P <0.001).

Furthermore, the effect of the intervention on infant dietary adequacy was investigated. On multivariable regression, the intervention showed a significant effect on the consumption of dairy products [RR=1.8; 95% CI: 1.04-3.13], eggs [RR=3; 95% CI: 1.35-6.56], vitamin A-rich fruits and vegetables [RR= 2.7; 95% CI: 1.17-6.1], other fruits and vegetables [RR=5; 95% CI: 2.49-10.58] and any of the animal-source foods [RR=2; 95% CI: 1.39-2.87]. The intervention also led to improvements in the complementary feeding indicators. The proportions of infants who achieved minimum dietary diversity [RR= 3; 95% CI: 1.34, 7.39], minimum meal frequency [RR= 2.4; 95% CI: 1.37-4.29], and minimum acceptable diet [RR= 2.7; 95% CI: 1.13-7.23] were significantly higher in the intervention as compared to control groups.

The effect of behavior change communication delivered though community-level actors on infant growth and morbidity has not been documented. This study investigated the effect of complementary feeding behavior change communication deliverer through community-level actors on the infant growth and morbidity. Infants in the intervention group had significantly higher weight gain [DiD: 0.46 kg; 95% CI: 0.36-0.56] and length gain [DiD: 0.96 cm; 95% CI; 0.56-1.36] as compared to those in the control group. The intervention also significantly reduced the rate of infant stunting by 7.5 percentage points [26.5% vs. 34%, RR=0.68; 95% CI: 0.47-0.98] and underweight by 8.2 percentage points [17% vs. 25.2%; RR=0.55; 95% CI: 0.35-0.87]. However, the intervention did not significantly affect the rates of infant wasting [9.9% vs. 8.8%; RR=0.91; 95% CI: 0.49-1.67]. No statistically significant differences were also found in the prevalence of fever [16.9% vs. 17.7%; RR = 0.90; 95% CI: 0.57–1.43], diarrhea [23% vs. 19.5%; RR = 0.82; 95% CI: 0.54–1.25] and cough [8.5% vs. 10%; RR = 0.82; 95% CI: 0.45–1.51] between the intervention and control groups, respectively.

Overall, findings from this PhD dissertation showed that complementary feeding behavior change communication delivered through community-level actors improved feeding practices and growth outcomes of infants. Thus, the intervention package investigated in this trial has potential policy implications on infant health and nutrition.

1

Chapter 1: General Introduction

1.1. Overview of Complementary Feeding

Complementary feeding is defined as the process starting food or liquids when breast milk alone is no longer sufficient to meet the nutritional requirements of infants, and therefore, other foods and liquids are needed, along with breast milk (WHO, 2008). It is the period of transition from breast milk to family foods, and entails, introducing a range of foods gradually until the baby is eating the same foods as the rest of the family (UNICEF, 2008 & WHO, 2015).

Complementary foods are, any food or liquids, whether manufactured or locally prepared, suitable as a complement to breast milk, fed to infants during the complementary feeding period (WHO, 2008). This should not include drinks and beverages that are low in nutrient content like coffee, teas, and sugary drinks. Proper complementary feeding is essential for healthy growth, survival and the attainment of a child's human potential (WHO, 2003). The introduction of complementary foods should be timely and adequate in nutritional content, tailored to meet the age-specific needs of the infant for adequate growth and cognitive development (Lutter, & Rivera, 2003).

Complementary feeding is a critical component of infant and young child feeding (IYCF) practices. The target age range for complementary feeding is between the age of 6 and 23 months, where most infants reach a general and neurological stage of development that enables them to be fed other foods in addition to breast milk (Monte, & Giugliani, 2004). Complementary foods are expected to address the gaps between the daily energy and nutrient requirement of infants and young children and the amount obtained from breastfeeding (WHO, 2009).

The World Health Organization (WHO) and United Nations Children's Fund (UNICEF) recommend that infants begin consuming safe and nutritionally adequate solid, semisolid, or soft foods starting at 6 months of age while continuing to be breastfed until two years of age or beyond. Recommended practices include the timely introduction of complementary foods, sufficient meal frequency and portion sizes, diversity of diet, appropriate food texture, safe food preparation, storage and hygiene behaviors, and responsiveness to feeding cues (WHO & UNICEF, 2003).

1.2. Dimensions of Complementary Feeding

Complementary feeding should be *timely* (start receiving from 6 months onward) and *adequate* (in amounts, frequency, consistency, and using a variety of foods). The foods should be prepared and given *safely* and be given in a way that is *appropriate* (foods are of appropriate texture for the age of the child) and applying *responsive feeding* following principles for psychosocial care (WHO & UNICEF, 2003).

Time of Introduction of Complementary Foods

Exclusive breastfeeding is critical and adequate for the first six months of the child. However, after six months breast milk alone is no longer sufficient to meet infant's nutritional requirements for optimal growth and development. Therefore, children should be introduced to their first soft, semi-solid or solid foods at the sixth month of age, maintaining breastfeeding until the age of two years and beyond (WHO, 2003). Timely initiation of first foods is critical since foods introduced either too early or too late have adverse consequences on infant's growth, development and survival (Dewey, 2013).

Dietary Diversity

Infants need to consume a variety of foods to meet their nutrient needs and expose them to various tastes and textures. A diverse diet includes meals consisting of foods from a variety of food groups each day including cereals, tubers, animal-source foods (ASF), and fruits and vegetables. Children who are fed a diverse range of foods are more likely to meet their micronutrient requirements (UNICEF, 2017; Moursi *et al*., 2008).

ASF such as eggs, meat, and dairy products are a good source of high-quality protein and essential fatty acids and they should be introduced early, as some of the first foods that children eat. They are also an important source of key nutrients, such as zinc, iron, vitamin B_{12} and calcium (Headey, Hirvonen, & Hoddinott, 2018). Emerging evidence shows that the consumption of at least five food groups, including animal-source foods, is associated with a reduced risk of stunting in young children (Iannotti, 2018; Millward, 2017).

Fruits and vegetables are vital components of a nutritious diet and a rich source of vitamins, minerals, dietary fiber and antioxidants. Consuming a variety of fruits and vegetables daily helps ensure an adequate intake of many essential nutrients (Slavin, & and Lloyd, 2012).

Nutrient Density

Infants have limited stomach capacity and must therefore eat small, nutrient-dense meals to maximize the nutrition in each bite. Nutrient density compares the amount of nutrients to the amount of calories consumed in a food product. A nutrient-dense food has lots of nutrients for the little calories (Solomons, & Vossenaar, 2013). They contain vitamins, minerals, complex carbohydrates, lean protein, and healthy fats. Examples of nutrient-dense local foods include meat, eggs and other ASF and legumes, such as groundnuts. Cereals or plant-based porridges may appease hunger, but alone they do not provide sufficient energy, protein and micronutrients to fill the gap between breast milk and the child's nutrient requirements. Nutrient- and energy-rich foods should be fed in age-appropriate and not excessive portions (Dewey, 2013).

Age-Appropriate Meal Frequency

Mothers/caregivers should increase the number of meals fed to children throughout the day as they get older. The appropriate number of feedings depends on the energy density of the food and the quantities consumed at each feeding. WHO recommends two meals a day for breastfed infants aged 6-8 months; three meals a day for breastfed children aged 9-23 months; and four meals a day of solid, semi-solid or soft foods for non-breastfed children aged 6-23 months (WHO, 2010).

Age-Appropriate Amounts

Mothers/caregivers should introduce children to small amounts of food at first and increase the quantity of each meal gradually as the child gets older. The recommended age-appropriate amounts per meal for breastfed and non-breastfed children are as follows: begin with 2-3 teaspoons of food and transition to about ½ cup per meal for children aged 6-8 months; provide ½ cup per meal to children aged 9-11 months; and ¾ cup to 1 cup per meal to children aged 12-23 months (WHO, 2016).

Age-Appropriate Food Consistency

Starting at 6 months, infants can eat pureed, mashed and semi-solid foods prepared from infant cereal, vegetables, fruits, meat, and other protein-rich foods. By 8 months, most infants will become capable of eating finger foods (WHO, 2017)

The consistency of food should gradually evolve (from soft to semi-solid to solid) with age, according to the child's requirements and abilities. Young children move from eating finger foods to family foods by the time they reach their first year. Inappropriate consistency can compromise nutrient intake, as children may only be able to consume a trivial amount. At the same time, diluting complementary foods to reduce viscosity can also lower their energy density which is an increasing concern with the rise of pureed food pouches. While pureed foods are needed for children with special needs (e.g., those with disabilities or developmental delays that make eating and drinking difficult), in most cases, the extended use of pureed foods can delay the consumption of foods with varied textures and consistencies (Koletzko *et al*., 2019).

Safe Preparation, Storage and Use

Complementary foods should be hygienically prepared, stored and fed with clean hands, dishes and utensils. Caregivers should wash their hands with soap and practice good hygiene (including safe disposal of child's faces) and proper food handling (WHO, 2002). Food will spoil quickly after contact with germs; thus children should be fed from a separate serving dish, with any leftovers discarded. Exposure to unsafe food and water increases the risk of microbial contamination and leads to diarrhea and nutrient loss. To avoid food spoilage and contamination food should be covered; cooked food should not be left at room temperature for more than two hours; food should be stored at low temperature and preferably refrigerated; raw and cooked food should be stored separately; and raw fruits and vegetables should be washed with clean water and stored in a cool place (Ruel, Brown, & Caulfield, 2003).

Responsive Feeding and Care Giving

Feeding requires a reciprocal relationship between children and their caregivers. There are four stages of responsive feeding: (1) the child signals hunger or satiety through actions and expressions; (2) the caregiver recognizes the cues; (3) the caregiver's response is prompt,

nurturing, and developmentally appropriate; and, (4) the child experiences the caregiver's response. Responsive feeding help children develop self-regulation over food intake and facilitate their transition to eating independently (Black, & Aboud, 2011). Social interactions between caregiver and child (such as speaking to the child, singing, and encouraging him/her) also stimulate connections in the child's brain and promote cognitive development. Several studies have shown a positive association between responsive feeding and improved child nutrition. Responsive feeding practices, where caregivers interact with the child and respond to his or her hunger and satiety cues, have been found to improve children's acceptance of food and adequate food intake (Bentley *et al*., 2011; Aboud, Shafique, & Akhter, 2009).

Feeding During and After Illness

Caregivers should increase children's fluid intake during illness (including by frequent breastfeeding) and encourage the child to eat (for example by offering soft, appetizing or favorite foods). After illness, caregivers should provide meals more frequently than usual and encourage the child to eat more (Owais *et al*., 2016; Marriott *et al*., 2012).

Continued Breastfeeding

Children should continue frequent, on-demand breastfeeding until 2 years of age or longer. Continued breastfeeding throughout the complementary feeding period provides essential fats, proteins and other nutrients that are important in all settings. Evidence shows that children aged 6-23 months who do not receive breast milk have a higher risk of all-cause mortality and infection-related mortality compared with breastfed children (Sankar *et al*., 2015; Oddy, 2012).

1.3. Why Do Improved Complementary Foods and Feeding Matter?

The period starting from birth to two years of age has been identified as a critical period in the life of infants for the promotion of optimal growth, health and development, and poor nutrition at this stage will result in malnutrition in many infants (Shrimpton *et al*., 2001; Victora *et al*., 2008). Most incidents of undernutrition occur in the first two years of life when there is increased demand for adequate nutrition to fuel infant growth and physiological development. Inappropriate complementary feeding practices during this period, such as early onset of complementary foods, inadequate nutritional content of complementary foods and poor hygiene behaviors, have been identified as the leading causes of undernutrition, growth faltering,

diarrhea, increased rate of infections, nutrient deficiency, poor cognitive development and increased mortality among children (WHO, 2015).

The quality of children's diets is more important before age 2 than at any other time in life (Begin, & Aguayo, 2017). Appropriate complementary foods and feeding practices contribute to child survival, growth and development; they can also prevent micronutrient deficiencies, morbidity and obesity later in life. However, children may not receive safe and appropriate complementary foods at the right age, may not be fed at the right frequency or may receive food of inadequate quality. The problem of poor quality of complementary food has been underemphasized in nutrition programming for quite some time (UNICEF, 2016).

The complementary feeding period is one of the most challenging times to meet children's nutrient demands. While children's stomachs can only hold a small amount of food, their nutrient needs reach a lifetime peak leaving them vulnerable to growth faltering (Dewey, & Adu-Afarwuah, 2008). In most countries, growth faltering is most evident particularly during the first phase of complementary feeding (6-12 months) due to the inadequate quality and/or quantity of first foods, poor feeding practices and increased rates of infection caused by food contamination are at their highest (Alderman, & Headey, 2018; Danaei *et al*., 2016; Stewart *et al*., 2013) (Figure 1.1).

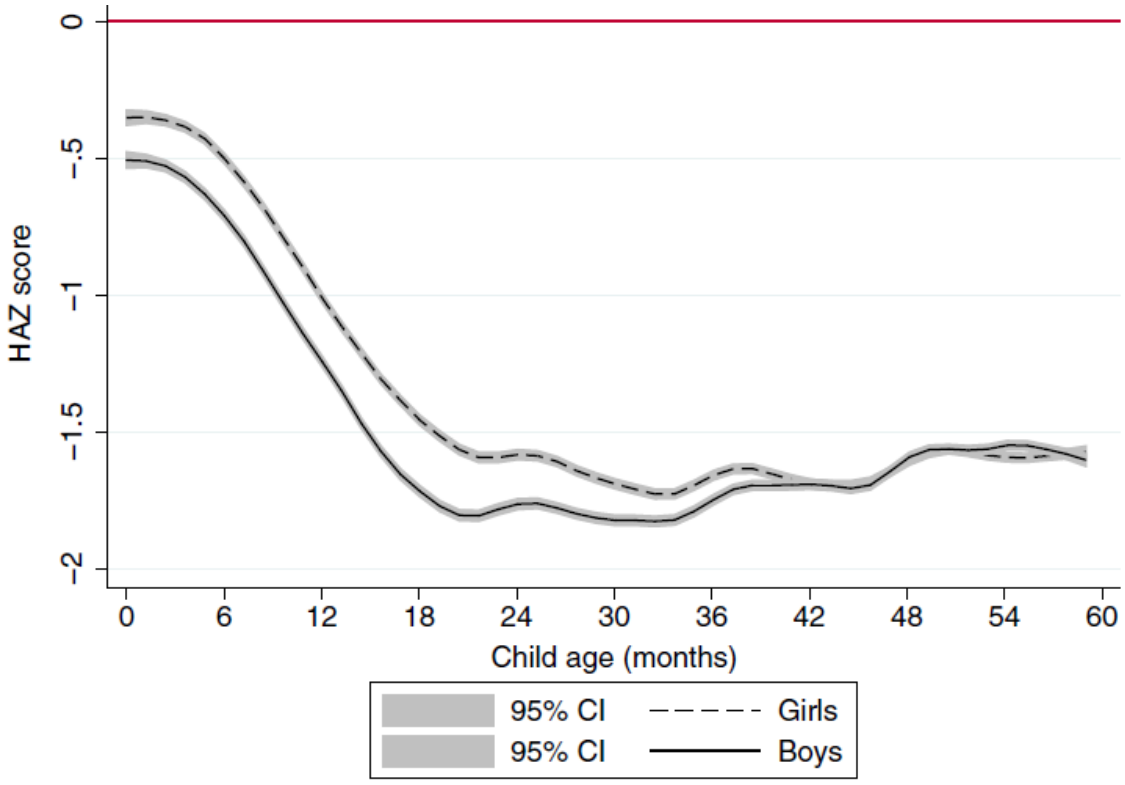

Figure 1.1. Growth faltering in height for age in children coincides with the complementary feeding period.

Source: Alderman, & Headey, 2018.

Appropriate complementary feeding is the main factor to ensure healthy growth and survival of young children in their early years of life. It has the potential to prevent 6% of all under-five mortality, mainly in developing countries. Although appropriate complementary feeding has important benefits, it was rarely practiced in many low and middle-income countries (LMICs) and these contribute to child growth retardation and undernutrition, morbidity and mortality (Victoria, 2000).

Good nutrition allows children to survive, grow, develop, learn, play, participate and contribute while malnutrition robs children of their futures and leaves young lives hanging in the balance. Indeed, undernutrition is responsible for up to 45% of deaths in children under 5 and is a significant cause of morbidity in this age group (Khara, & Dolan, 2014; Kane, Dinh, & Ward,

2015). More than two-thirds of undernutrition-associated deaths happen in the first year of life, and are usually correlated with poor complementary feeding practices (WHO, 2003).

Undernutrition puts children at greater risk of dying from common infections, increases the frequency and severity of such infections, and delays recovery. The interaction between undernutrition and infection can create a potentially lethal cycle of worsening illness and deteriorating nutritional status (Dewey, & Begum, 2011; Black *et al*., 2013). It is reported that 50-70% of the burden of diarrheal diseases, measles, malaria and lower respiratory tract infections in childhood is attributable to undernutrition. Diarrheal disease is the second-leading cause of death in under five children (UNICEF, WHO, and World Bank, 2019).

Undernutrition is a multifaceted condition, developing as a consequence of various dietary and non-dietary factors (Kimmons *et al*., 2005). While the causes of undernutrition are complex, inadequate complementary feeding practices have been identified as one of the major proximal factors contributing to stunted growth and development (Palwala *et al*., 2009; Kumar *et al*., 2006). Figure 1.2 highlights the role of complementary feeding within the layers of contextual and causal factors that lead to stunted growth and development and the resulting short- and long-term consequences. At the center of the conceptual framework, three aspects of complementary feeding have been delineated to represent its contribution to stunted growth and development: poor quality foods (Gibson *et al*., 2010; Roos *et al*., 2013), inappropriate practices (Dewey & Adu-Afarwuah, 2008), and food and water safety (Weisstaub & Uauy, 2012).

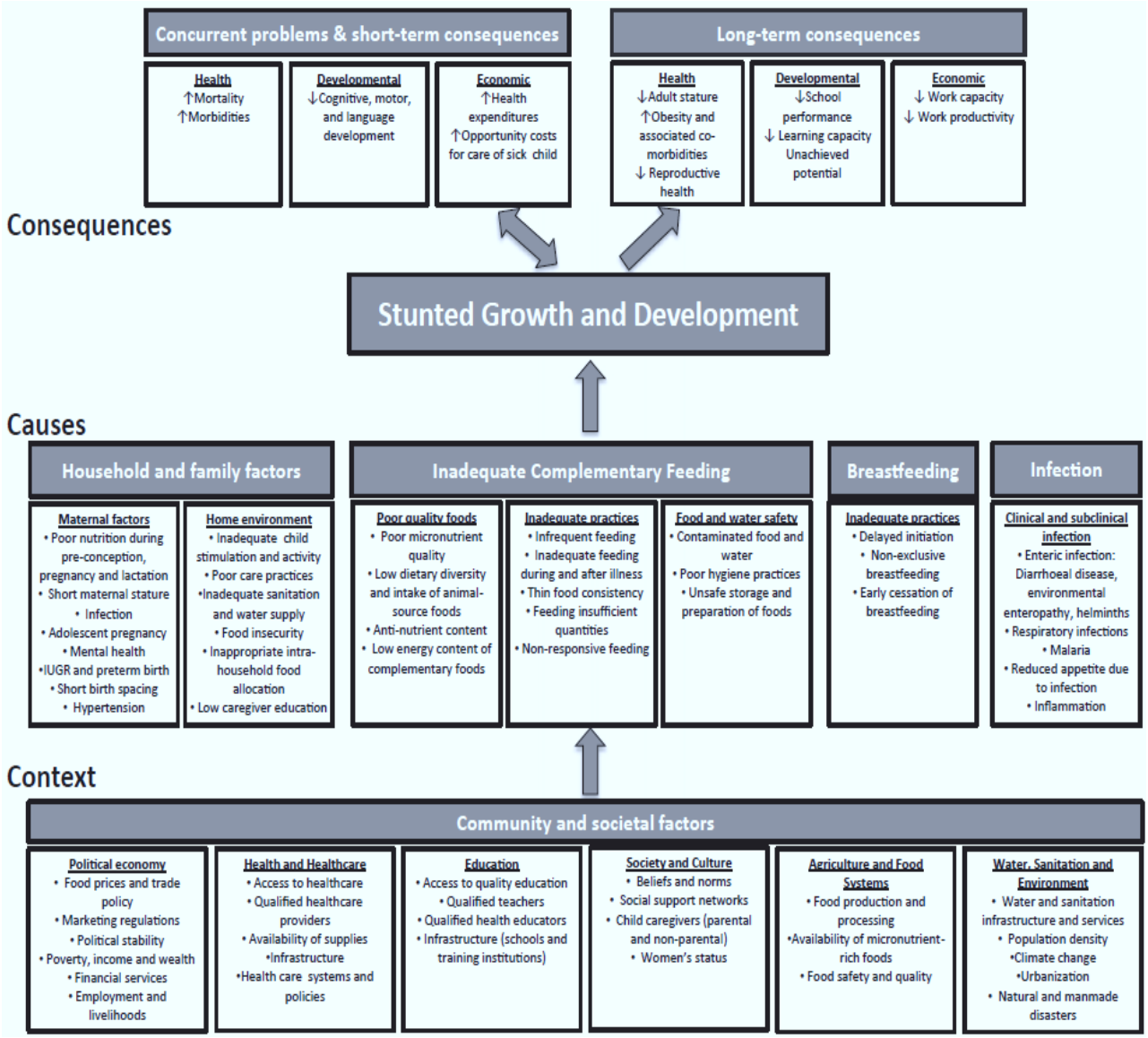

Figure 1.2. WHO conceptual framework on childhood stunting: context, causes, and consequences, with an emphasis on complementary feeding.

Source: WHO conceptual framework on Childhood Stunting, 2013.

Despite widespread consensus on the importance of good nutrition in early life, an alarming number of young children are suffering the consequences of poor diets. At least 1 in 3 children is not getting the nutrition they need to grow well, particularly in the crucial first 1,000 days of life. An increasing number of children are surviving, but far too few are thriving because of malnutrition. Despite some declines, undernutrition continues to affect tens of millions of children. The most important forms of undernutition are stunting, wasting and wasting (White *et al.*, 2017).

Stunting affects 22% of under five children (149 million) worldwide diminishing their physical and cognitive growth and development (Begin, & Aguayo, 2017). It is reported that two out of five children in LMICs are stunted. Children affected by stunting often grow up to be stunted adults themselves, and stunted mothers are more likely to have stunted children (Dewey, & Begum, 2011). Children suffering from stunting may never attain their full possible height and their brains may never develop to their full cognitive potential. Stunted children begin their lives at a marked disadvantage: they face learning difficulties in school, earn less as adults, and face barriers to participation in their communities (Grantham-McGregor *et al*., 2007). Stunting and child growth deficits are difficult to reverse, while cognitive deficits may be permanent after two years. Stunting can also reduce a country's gross domestic product by up to 3% (World Bank, 2006).

Wasting affects more than 6% of under five children (49 million) globally putting them at increased risk of infection and death (UNICEF, WHO, and World Bank, 2019). Wasting in children is the life-threatening result of poor nutrient intake and/or disease. Children suffering from wasting have weakened immunity, are susceptible to long-term developmental delays, and face an increased risk of death, particularly when wasting is severe. These children require urgent feeding, treatment and care to survive (Black *et al*., 2013).

Globally, about 12% of children (80 million) are underweight. Underweight is a composite indicator of undernutrition and remains one of the most common causes of morbidity and mortality among children throughout the world (UNICEF, WHO & World Bank, 2019).

Africa and Asia bear the greatest share of all forms of undernutrition. More than half of all stunted children lived in Asia (54%) and two out of five lived in Africa (40%). More than two-thirds of all wasted children lived in Asia (69%) and more than one quarter lived in Africa (27%) (UNICEF, WHO & World Bank, 2019).

1.4. Determinants of Complementary Feeding Practices

The determinants of complementary feeding practices determine the quality, quantity, and safety of an infant's diet that promote and support survival, growth and development. The most proximal factors include:

Foods and the Food System

The adequacy of infant's food is determined by the availability, access, affordability and desirability of foods.

Availability: Poor production, storage and distribution of nutritious food reduce its availability within households and markets and increase its price (Muehlhoff *et al*., 2017). Vulnerabilities and shocks to the food system due to climate change, seasonal fluctuations, diseases, conflicts, political instability, unemployment and rising food prices can also impact food availability and livestock and crop production. The limited availability of nutritious food is a barrier to consumption, even when caregivers can afford such foods (FAO, 2008).

Access: Long distances to markets, poor roads and infrastructure, and humanitarian crises can make it difficult for families to access nutritious foods. Seasonality of production also impacts the availability of nutritious and diverse foods. Conflict may impede access to production activities, such as planting, harvesting and livestock movement. Children's access to nutritious foods is also influenced by food industry marketing and the presence or absence of a protective policy environment (Arsenault *et al*., 2014; Hirvonen *et al*., 2017).

Affordability: Nutrient-rich foods, particularly ASF, can be too costly for many families, leading to poor dietary diversity (Headey, Hirvonen, & Hoddinott, 2018). Fortified complementary foods are also expensive relative to unfortified cereals. Household purchasing power is often determined by income, intra-household allocation of financial resources and the

support provided by safety net programmes. Humanitarian crises can also significantly raise food prices by limiting food production and the supply of diverse foods (Maillot *et al*., 2007; Masters *et al*., 2018).

Health and Nutrition Services

Limited availability of preventive and curative services within the health system, such as nutrition counseling, micronutrient supplementation and the care of sick children, can undermine complementary feeding practices and limit the use of such services by families. Where health and nutrition services are available, high costs can deter their access and use (Lagarde, & Palmer 2014). User fees can make child health and nutrition services unaffordable to vulnerable households, thereby limiting contact with the health system and opportunities for counseling on complementary feeding (Lutter *et al*., 2013; Sanghvi *et al*., 2017).

It is not enough for services to be available; they must also be delivered with quality. High-quality nutrition counseling services to improve the diets of young children require consistent delivery of messages and support through multiple contact opportunities with caregivers (Aguayo, 2017). Low-quality health and nutrition services are ineffective in changing feeding behaviours and can reduce the demand for and use of these services by families (Nguyen *et al*., 2016). The limited knowledge, inadequate skills and misconceptions of health workers and inconsistent messaging can contribute to poor quality counseling. The capacity of health workers to deliver quality services is driven by multiple factors, including training methodology, supportive supervision, the availability of tools and job aids, access to adequate human resources, remuneration, regularity of payment and workload (Stewart *et al*., 2013).

Social and Cultural Norms

Social and cultural norms influence what, when and how children are fed (Collison *et al*., 2015). Deeply held beliefs may exist in the society about the types of foods or preparation methods that are healthy or unhealthy for young children, when and what types of complementary foods should be first introduced, who can and should feed young children, how to feed children when they are sick, how to feed a child who does not want to eat, or how food will help baby sleep or not (Pachon *et al*., 2007; Manikam *et al*., 2018). These beliefs are heavily influenced by the

individuals who surround the primary caregiver (husbands, mothers-in-law, grandmothers, other families/community members, and the health care providers) upon whom the caregivers depend for help and support (Karmacharya *et al*., 2017; Mukuria *et al*., 2016).

Food recipes and flavour preferences are heavily culturally rooted. The complementary feeding period is a time during which the infant is learning about foods and flavour combinations common to their families and cultural groups (Uvere, & Ene-Obong, 2013). Repeated exposure to a variety of foods facilitates acceptance, establishes food preferences and makes it more likely that the child will consume those foods in later life (Mannella, & Trabulsi, 2012). Thus, promoting a varied diet in infancy is likely to establish lifelong healthier eating patterns. However, in resource-constrained settings, caregivers may worry that providing higher-cost foods such as meat or eggs to young children may lead them to develop unrealistic food preferences that cannot be sustained within the household budget (Colecraft *et al*., 2006).

Household and Family Factors

Children's diets are shaped by the distribution of food within the household, the prioritization of nutritious diets for children, women's decision-making in food purchasing, and gender preferences in feeding children. The capacity of caregivers to respond to infant feeding recommendations will also depend on their ability to make decisions about infant feeding, seeking health care and use of household resources (Shroff *et al*., 2009). Men may serve as caregivers and may also directly or indirectly contribute to complementary feeding decision-making through their control over household finances and choices over food purchases or through decisions about the allocation of foods to family members (Alive & Thrive, 2010). Because women are usually the primary caregivers, female empowerment may be an important contextual factor underlying healthy child growth and development. The involvement of other members of the mother's social support network in complementary feeding programming therefore should be considered (Affleck & Pelto, 2012).

Caregivers' Knowledge and Skill

Caregivers' knowledge on how to produce, store, process and use nutritious foods is an important determinant of children's diets (Christian *et al*., 2016). Lack of knowledge, experience

and skills reduces caregivers' ability to decide, accept and adopt the complementary feeding recommendations (Savage, Fisher, & Birch, 2007).

Water, Sanitation and Hygiene (WASH) Services

Access to basic WASH services in the household, and community improves hygiene and sanitation behaviors and ensures the safety of complementary foods (Humphrey, 2009). The availability of toilet facilities, safe water and other sanitation services reduces the risk of contaminating feeding utensils and complementary foods (Spears, 2013).

Household-level hygiene practices such as hand washing, safe water source and storage, and sanitation conditions affect the risk of diarrhea and other morbidities interfering with growth. Complementary foods may be stored in open or contaminated containers or left at temperatures supporting microbial growth. Food preparation techniques such as inadequate cleaning or cooking time can also increase the risk of contamination (Fink *et al*., 2011).

Social Protection Services

Social protection services can improve household purchasing power and food security, increasing the likelihood that nutritious foods will be made available for young children (de Groot *et al*., 2017). Such services for vulnerable households are particularly important in times of stress or shocks. The provision of food vouchers for households with children, for example, can provide vital support for improving children's diets during emergencies. Well-planned, designed and implemented social protection services are most effective at targeting vulnerable and food-insecure households and influencing behaviors (Grijalva-Eternod *et al*., 2018).

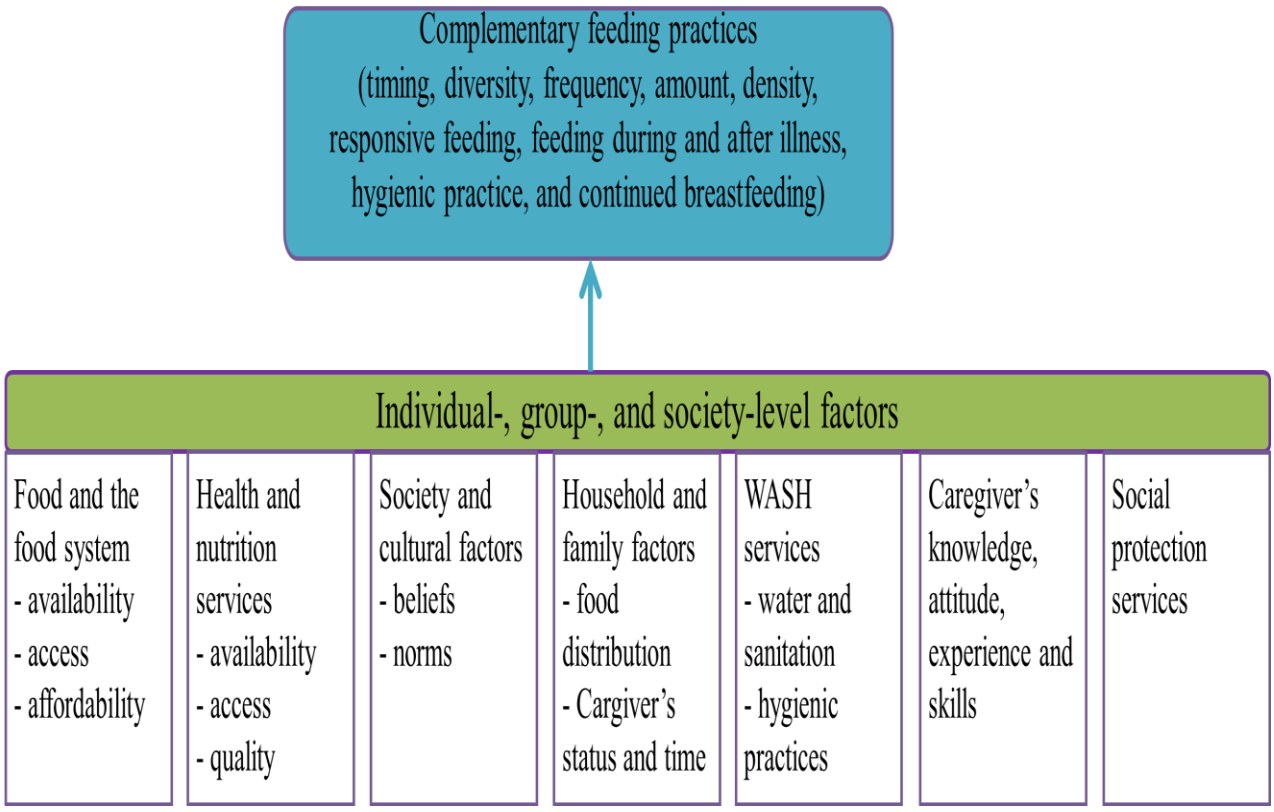

Figure 1.7. Determinants of complementary feeding practice.

Source: UNICEF global action framework for complementary feeding, 2016.

1.5. Food Items Used to Prepare Complementary Foods

From the sixth months onward, complementary foods should be of variety, and balanced mixtures of food. Only a varied diet guarantees the supply of micronutrients, enhances good eating habits, and prevents the development of anorexia caused by monotonous foods (WHO, 2009). Grain products can serve as sources for carbohydrates, fibers, and micronutrients. Protein-rich foods, such as meat, poultry, fish, egg yolks, cheese, yogurt, and legumes, can be introduced to infants between 6 and 8 months of age. Fruits and vegetables introduced over time can provide infants with carbohydrates including fiber, vitamins A and C, and minerals (Northstone, Emmett, & Nethersole, 2001).

Complementary foods usually are of two types; commercially prepared infant foods bought from the market and homemade complementary foods, which are prepared at the household by the caregivers following traditional methods. Commercially, complementary foods can be produced

following simple technologies such as malting, popping, fermentation, or using modern food-processing technologies. Some of the commonly available commercially prepared infant foods include iron-fortified infant cereal made of food items, juices, vegetable or fruit infant foods; and infant food meats (Ng, Dibley, & Agho, 2012; Hotz, & Gibson, 2007).

In many developing countries, commercial fortified food products are often beyond the reach of the poor. As a result, homemade complementary foods are frequently used during child feeding (Kuyper, Vitta, & Dewey, 2013). The basic recipe food items used for the preparation of the complementary food commonly base on locally available staples, while the choice of specific food item differs considerably between populations, owing to tradition, availability, and ease of access. The staples are cereals, roots, and starchy fruits that consist mainly of carbohydrates and provide energy. Cereals form the staple foods of virtually all populations. Cereals are an important source of energy, provide starch and dietary fibers. Grains comprise greater than 70% of all cereals, which usually are processed and cooked to make the starch more digestible. In cereals, 65-75% of the total weight is carbohydrate, 6-12% is protein, and 1-5% is fat. The protein quality, however, is very low compared to ASF (Ng, Dibley, & Agho, 2012).

In several developing countries, the first solid foods are based on thin cereal and are low in foods from meat, eggs, or fish, especially among low-income groups due to socio-economic, and cultural factors (Allen, 2012).

A commonly shared phenomenon about homemade complementary foods that are based on starchy roots and tubers or rice and available in many LMIC is their frequent shortfall in amounts of selected essential micronutrients. In contrast, the recipes prepared from maize and legumes or other cereal mixtures and legumes had higher iron and zinc contents, but they also have considerably higher phytate contents (Gibson *et al.*, 2010). Under both circumstances, they fail to meet the theoretical mineral requirements of young children due either to their low mineral content or as a result of low bioavailability, unless enriched with ASF. As a result, WHO designates calcium, iron, and zinc as “problem nutrients,” and deficiencies of these minerals can lead to adverse health consequences and restricted child growth and development (WHO, 2002).

Complementary foods need to be far more nutrient-rich compared to family foods. Yet, the opposite is the case in developing countries. The foods are often known to be of low nutritive value and are characterized by low protein, low energy density, and high bulk (Dewey, 2013). Bulk is one of the major problems of homemade complementary foods, where a problem of high viscosity, low energy density, or both may occur. Under such circumstances, it is usually possible to achieve an adequate protein and energy intake for adults and older children by increasing the daily intake. For infants and younger children, however, the volume of the diets may be too large to allow the child to ingest all the food necessary to cover his or her energy needs (Temesgen, 2013).

In Ethiopia, the complementary foods are predominantly made from staple cereals or starchy tubers, and mostly an extension of family foods that are not nutritious enough to fill the calorie, protein, and micronutrient gap between total daily needs and the amount provided by breast milk. The recipes are based on three major staples that are locally available, including maize/*enset*/*teff*, wheat/barley, and sorghum/maize (FMOH, 2006), while the target energy and nutrient composition and daily intakes from the complementary foods were drawn in line with the WHO's complementary feeding recommendations (Dewey, 2001). The usual complementary foods are served as gruel, porridge, "*Fetfet"*, "*Kitta"*, *and "Dabo"*. Consumption of ASF foods as well as fruits and vegetables is very low (Temesgen, 2013; Baye, 2012).

Literatures suggest that unfortified complementary foods that are predominantly plant-based generally provide insufficient amounts of the key nutrients to meet the recommended nutrient intakes (Dewey, & Brown, 2003). ASF are rich in protein, fat, and micronutrients their inclusion can therefore meet the gap in some cases. However, this might be impractical for lower-income households, given their high cost (WHO, 2009). The complementary food mixtures used in developing countries were evaluated including the ones consumed in Ethiopia, some of which included ASFs. None of the complementary foods achieved the desired nutrient density for iron, and while few achieved the desired level for calcium or zinc (Gibson *et al*., 2010). In general, the traditional complementary foods have been reported to be grossly inadequate both in quality and quantity of nutrients when compared to the estimated needs in developing countries (Temesgen, 2013; Baye *et al*., 2012; Abebe *et al*., 2006).

1.6. Global, Regional and National Estimates of Complementary Feeding Practices

WHO led the development of standard complementary feeding practice indicators amenable to population-level assessment. The four core indicators of appropriate complementary feeding practices recommended by WHO are introduction to solid, semisolid, or soft foods (Intro), minimum diet diversity (MDD), minimum meal frequency (MMF), and minimum acceptable diet (MAD). Indicators amenable to population-level assessment for other critical aspects of complementary feeding practices such as responsive feeding, adequate food texture, portion size and safe food preparation and storage are more complex to assess (WHO, 2010).

The recent global estimates of complementary feeding practices based on the standard indicators highlight a worrying situation. Figure 1.3 presents the global and regional estimates for the core complementary feeding practice indicators among children 6-23 months of age. Globally, only 65% of infants 6-8 months of age are fed solid, semisolid, or soft foods, with the lowest rates in South Asia (SA), at 54%, and highest in Latin America and the Carrebean (LAC), at 83% (UNICEF, 2016).

Globally, less than one-third (29%) are meeting the MDD; only about half (52%) of the children are meeting the MMF; and only about one-sixth (16%) of children are meeting the MAD, with large disparities across and within regions (UNICEF, 2016).

In West and Central Africa (WCA), Eastern and Southern Africa (ESA), and South Asia (SA), the rates of MMF are less than 50% and MDD less than 25%. Rates for both indicators are highest in East Asia and the Pacific (EAP) and Latin America and the Carrebean (LAC) where about three in four children are getting MMF and MDD. Rates for MAD are low across all regions with available data. Rates are highest in EAP (41%) and lowest in WCA (9%), ESA (10%), and SA (13%). Rates for all complementary feeding indicators are lowest in WCA, ESA, and SA (UNICEF, 2016).

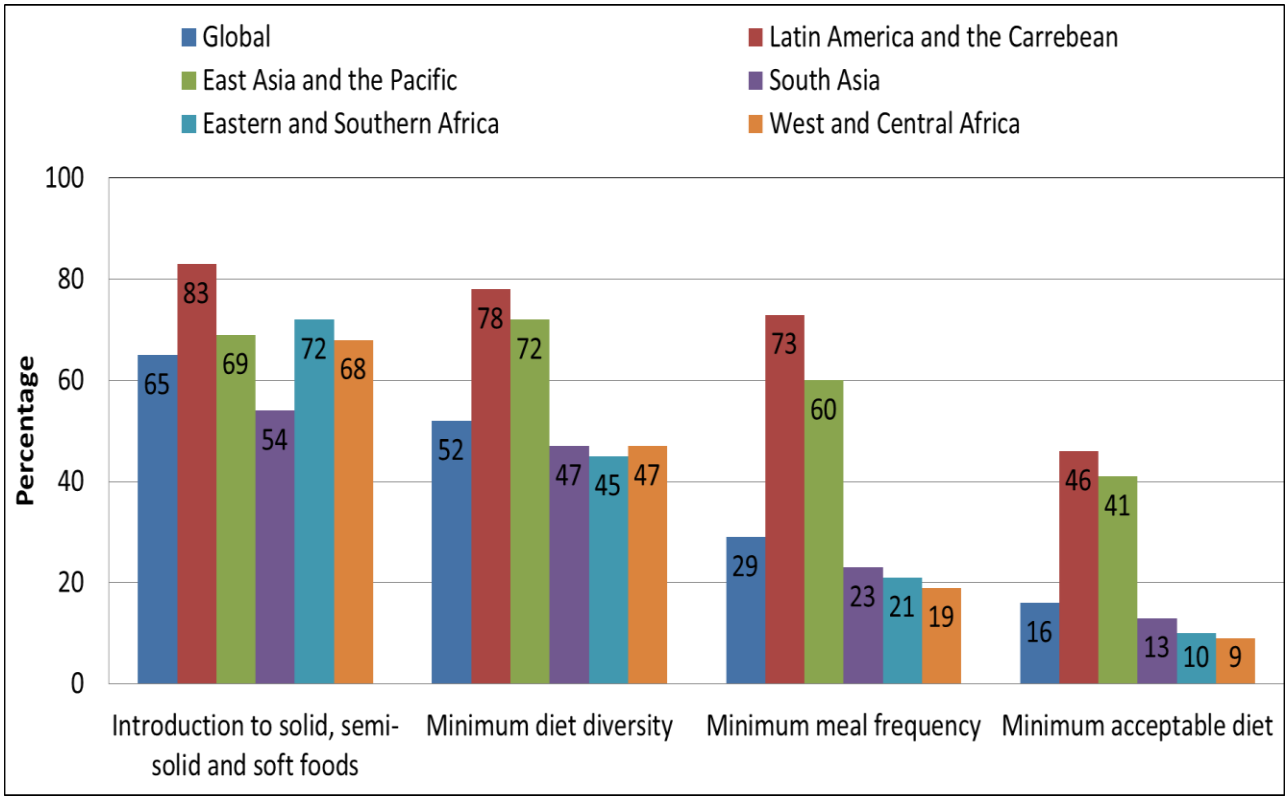

Figure 1.3. Global and regional estimates of complementary feeding practices.

Source: UNICEF global databases, 2016.

Rates for all complementary feeding indicators are particularly worrying for the youngest children (6-11 months) among whom globally only 17% meet MDD, 46% meet MMF, and 11% meet MAD (Figure 1.4).

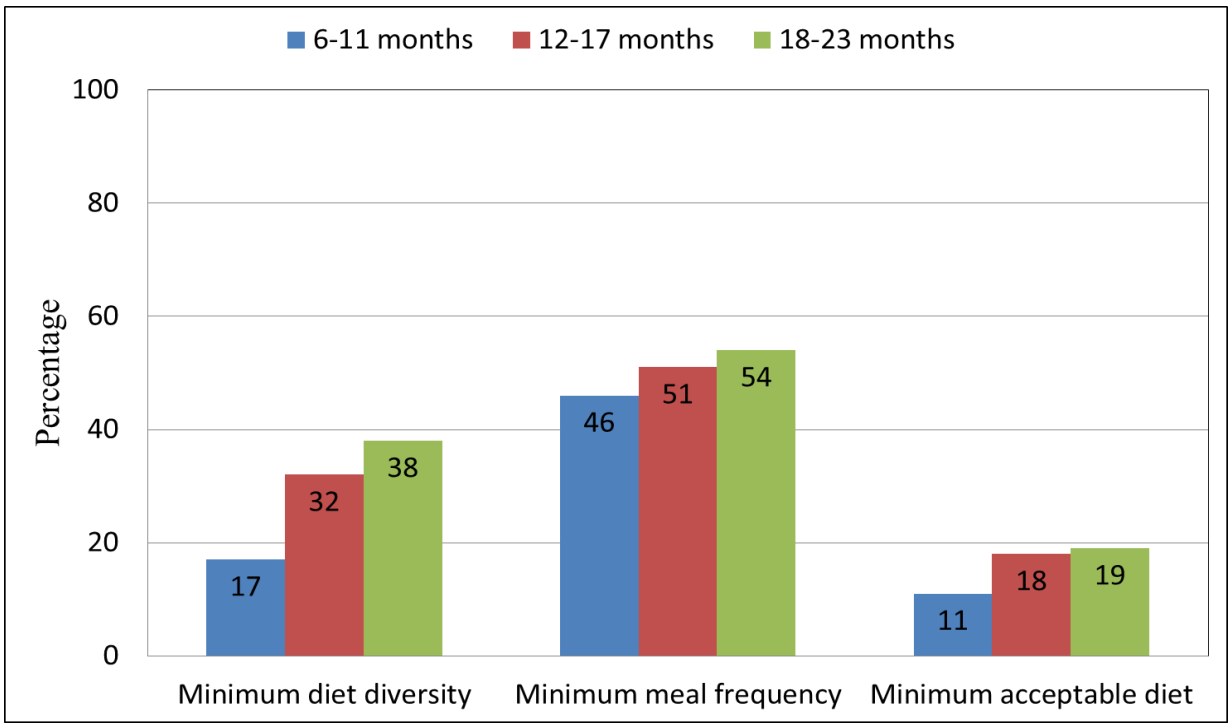

Figure 1.4. Global estimates of complementary feeding practices by children's age.
Source: UNICEF global databases, 2016.

Table 1.1 presents global and regional percentages for the consumption of each of the seven food group types used in MDD. At the global level, not surprisingly, consumption of staple foods (grains, roots, and tubers) is high with close to 80% of children having consumed them during the previous day. However, only 28% of children consumed any legumes, nuts, or seeds.

At the global level and across all regions, the consumption of fruits, vegetables, and ASF (flesh foods, eggs, and dairy products) is low. The consumption of vitamin A-rich fruits and vegetables was only 41%; which is highest in EAP (75.4%) and lowest in SA (31.5%). Consumption of other fruits and vegetables is 27% at the global level; highest in LAC (63%), and lowest in WCA (15.7%) (UNICEF, 2016).

The consumption of ASF is low across all three types; flesh foods, eggs, and dairy products, at the global level. Just two out of five (42%) children 6-23 months of age consumed dairy products in the previous day, with much lower rates for consumption of flesh foods (28%) and eggs (17%). The consumption of flesh foods, dairy products, and eggs is highest in EAP, at 62.5%,

54.8%, and 44%, respectively. The lowest rates of consumption of any type of ASF are found in ESA, WCA, and SA. In all three regions, consumption of eggs is similarly low (around 11%), whereas flesh food consumption is significantly higher in WCA at 38%, when compared to that in ESA (25%) or SA (12.5%). In addition, consumption of dairy products is nearly double in SA at 49% when compared to that in WCA at 22.5% and ESA at 25% (UNICEF, 2016).

Table 1.1 also shows the rates for children consuming no ASF in the previous day. No consumption is highest in the sub-Saharan Africa regions at about 50%. In contrast, only 9.8% and 17.5% of children in LAC and EAP did not receive any ASF in the previous day, respectively. Of those children consuming any ASF, in ESA, WCA, and SA, the vast majority are consuming only one type of ASF; a stark contrast to LAC where about two-thirds consumed two or more types of ASF in the previous day.

Table 1.1. Global and regional estimates for consumption of different food groups among children 6-23 months of age.

Food groups (percentage consumed)	Global	WCA	ESA	SA	EAP	LAC
Grains, roots & tubers	80	73	82	77	94	88
Legumes, nuts and seeds	28	17	32	33	28	25
Vitamin A-rich fruits and vegetables	41	40	50	32	75	-
Other fruits and vegetables	21	16	23	17	29	63
Dairy products	42	23	25	49	55	75
Flesh foods	28	38	25	13	63	62
Eggs	17	12	11	12	44	37
0 ASF groups	39	48	52	43	18	10
1 ASF groups	38	35	37	44	25	27
2 ASF groups	16	13	9	10	36	42
3 ASF groups	7	4	2	3	22	22

Source: UNICEF global databases, 2016.

In Ethiopia, inappropriate complementary feeding practices have been widely reported. Studies indicated that complementary foods were untimely initiated, limited dietary diversity, inadequate in calories and micronutrients, with limited ASF and poor intake of fruits and vegetables (Habtewold, 2018; Abeshu *et al*., 2016; Asres, Nana, & Nega, 2018). Only about 60% of children aged 6-8 months consumed complementary foods, 45% of children are meeting the MMF, 14% are meeting the MDD, and 7% are meeting the MAD. (CSA, 2016) (Figure 1.5). Inappropriate complementary feeding practices are a major contributor to childhood malnutrition and potentially have huge short- and long-term implications for child growth and development (Abeway *et al*., 2018; Tessema, Belachew, & Ersino, 2013).

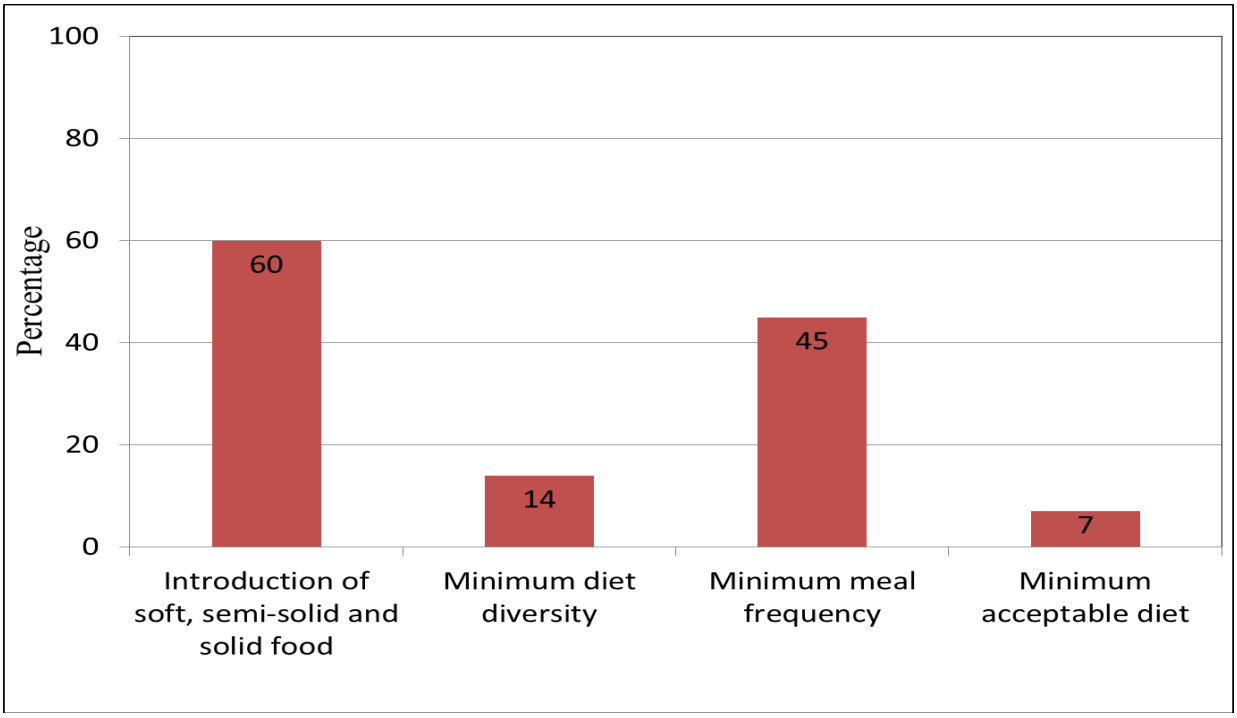

Figure 1.5. Rates of the core of complementary feeding practices indicators in Ethiopia.
Source: CSA, 2016.

Figure 1.6 presents percentages of children 6-23 months of age consuming from the seven food groups in Ethiopia. As expected, food consumption is concentrated on staple foods (grains, roots, or tubers) at 80% while 21% of the children consumed legumes or nuts. Only about 25% percent of the children consumed dairy products, 8% flesh foods, and 17% eggs. Vitamin A-rich fruits and vegetables were consumed by 28% of the children while only 10% percent consumed other types of fruits and vegetables.

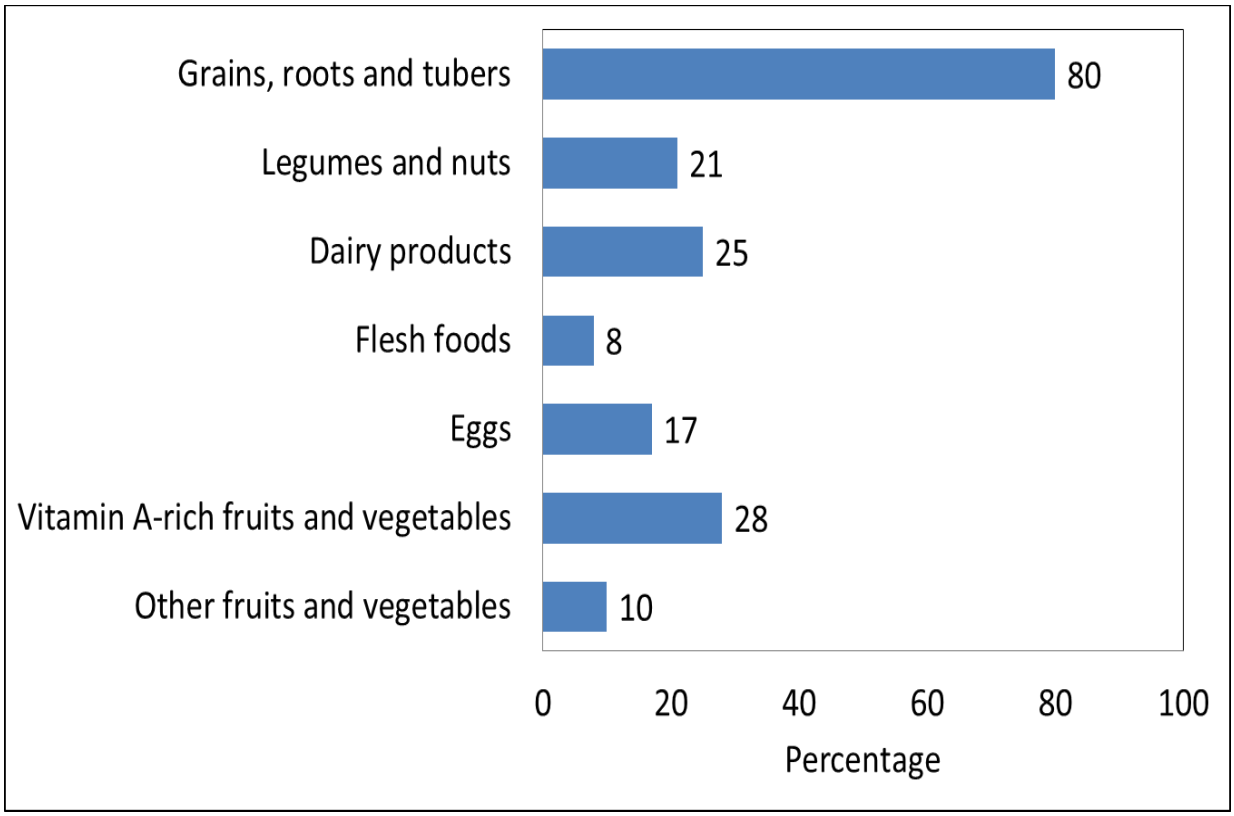

Figure 1.6. Food groups consumed by children aged 6-23 months in Ethiopia.

Source: CSA, 2016.

1.7. Use of Behavior Change Approaches to Improve Complementary Feeding Practice

Preventive nutrition approaches such as IYCF practices, specifically complementary feeding have received attention and have been well defined and implemented since 2003 (WHO, 2003; Shrimpton, 2010). Behavior change interventions (BCI) aiming to improve complementary feeding practices are commonly referred to as 'complementary feeding behavior change communication (CFBCC). It involves working with communities to understand their perceptions and constraints and ultimately identifying solutions for addressing nutritional problems. This may require improving the self-efficacy of caregivers, or changing physical and social environments to support positive behavior change (Arikpo *et al*., 2018).

BCI involves the strategic use of communication approaches across a variety of channels to promote changes in knowledge, attitudes, norms, beliefs and behaviors. To date, BCIs have been the primary approaches used to improve complementary feeding practices. When context-specific infant feeding messages promoting the use of local foods are delivered directly to mothers/caregivers significant improvements in feeding practices, and thereby dietary intake, health, and growth outcomes of infants are possible. Providing clear and motivating information through multiple communication channels about the benefits of modifying feeding behaviors are also important for facilitating the adoption of the recommended practices (Garg, & Chadha, 2016; Nikiema *et al*., 2017).

To make an impact, BCI must be intensive, sustained, action-oriented and integrated with other health and nutrition services (Kim *et al*., 2018). While BCIs can improve complementary feeding outcomes, their effectiveness depends on access to diverse and nutritious foods at the household level (Aguayo, 2017).

Improving complementary feeding requires an understanding of what drives feeding behaviors and how to facilitate the adoption of improved practices in a variety of cultural and economic settings (PAHO, 2003; WHO, 2008). To accelerate progress, we need to understand not only the design principles but also how to implement, monitor, scale-up, and sustain the delivery of interventions to address the determinants of complementary feeding. Specifically, we need to:

- *Systematically review emerging experience and lessons learned* in varied settings on how to address operational issues related to behavior change interventions for complementary feeding;
- *Identify useful tools to facilitate different steps* in program implementation including capacity building, communication, advocacy, strategic use of data, use of media, and measurement and learning; and
- *Document and disseminate lessons learned* so they can provide a continuing stream of ideas and experiences for upcoming programs

BCI has a great potential to improve feeding practices, by helping caregivers to make the right choice, prepare and feed their children with nutrient-rich foods. BCI is more than just educating individuals or delivering information about healthy practices (Bluethmann, 2017; Davis, 2015; Glanz, 2010). This is done by improving knowledge, attitudes, behaviors, skill, experiences, and the self-efficacy of caregivers to take action, or changing physical and social environments to support positive behavior change. Improvements in infant feeding practices are possible by making caregivers aware of childhood nutritional problems and enhancing their confidence and skills in order to take action (Glanz, 2014; Walingo, 2104).

BCI that provides knowledge alone, without addressing barriers as a result of social norms and perceived behavioral controls, may not be effective in improving complementary feeding practices. Interventions may therefore seek to address social norms, such as cultural practices, which may pose as barriers to adopt recommended complementary feeding practices (USAID, 2011).

BCI that make effective use of formative research to identify barriers and enablers and have clearly outlined impact pathways are more effective in improving feeding practices. Complementary feeding practices, in particular dietary diversity, can be improved rapidly in a variety of settings using available programme platforms if interventions focus on specific constraints to food access and enable families to prepare and feed appropriate foods (Fabrizio, van Liere, & Pelto, 2014).

The following five steps are proposed for BCI to be effective in improving feeding practices, and nutritional outcomes: (a) Select a few priority complementary feeding behaviors; (b) Focus on underlying determinants and key influencers of those behaviours; (c) Test concepts, recipes, messages, and tools for feasibility/acceptability and clarity; (d) Select programme channels to achieve desired coverage, intensity, and scale; and (e) Sustain exposure while continually monitoring and adjusting the programme (Sanghvi *et al*., 2017).

In general, complementary feeding is a complex set of behaviors, comprising timing of introduction, food choices and dietary diversity, preparation methods, quantity, feeding frequency, responsiveness to infant cues, and safe preparation and storage of foods. Each behavior may have context-specific barriers, making recommendations for changes in behavior difficult to apply as a 'one package fits all' model (Girard *et al*., 2012).

1.8. The Role of Community-level actors on Complementary Feeding Practice

In this study context, community-level actors are people living in the community who have influence in changing mothers/caregivers feeding behaviors and provide a supportive environment for the adoption of the recommended practices. These included Women Development Army (WDA) leaders, and the family members of mothers/caregivers (husbands, mothers-in-law, and grandparents).

The Ethiopian government started the WDA in 2011 intending to consolidate the gains made by the HEP and promote community ownership of the programs. In the Amhara Region, a total of 117,428 WDA groups and 532,259 one-to-five networks were established in 2011 (FMOH, 2015). The one-to-five networks are women volunteers who are empowered as WDA to transform their society. They are trained to focus more intensively on sparking local behavior change making regular rounds to check on neighbors and encourage healthy lifestyles. They are from "model families" and serve as living examples that the health extension workers (HEW) messages are being heard (Maes, & Tesfaye, 2015; FMOH, 2015).

WDA leaders are selected from the model families. A household that implemented all of the government's 16 priority health interventions, from vaccinating their children and sleeping under mosquito bed-nets to building separate latrines and using family planning, is recognized as a

model family (Damtew *et al*., 2018). Model families are selected by HEW in collaboration with the *kebele* administration. They get certificates, are celebrated at *kebele* ceremonies and asked to support five other households in adopting the priority interventions (Maes & Tesfaye, 2015). WDA leaders are unpaid health volunteers that undertake various preventive and promotive health services supported and supervised by HEWs (Linnander *et al*., 2016).

Once the WDA groups are formed through participatory community involvement, the WDA leaders provided an intensive 7 to 10 days training (FMOH, 2015), whose primary objective is to educate and mobilize the communities to utilize the maternal, neonatal and child health services delivered by the health post and health centers. On average, there are approximately 30 WDA team leaders and 200 WDA network leaders in each *kebele* (Summary & Bissau, 2018).

Each WDA group is comprised of 25-30 households (women) which are further organized into the "1 to 5" network where a model woman leads five other women within her neighborhood. The one-to-five network functions as a forum for the exchange of concerns, priorities, problems, and decisions related to the health status of women (Teklehaimanot, & Teklehaimanot, 2013).

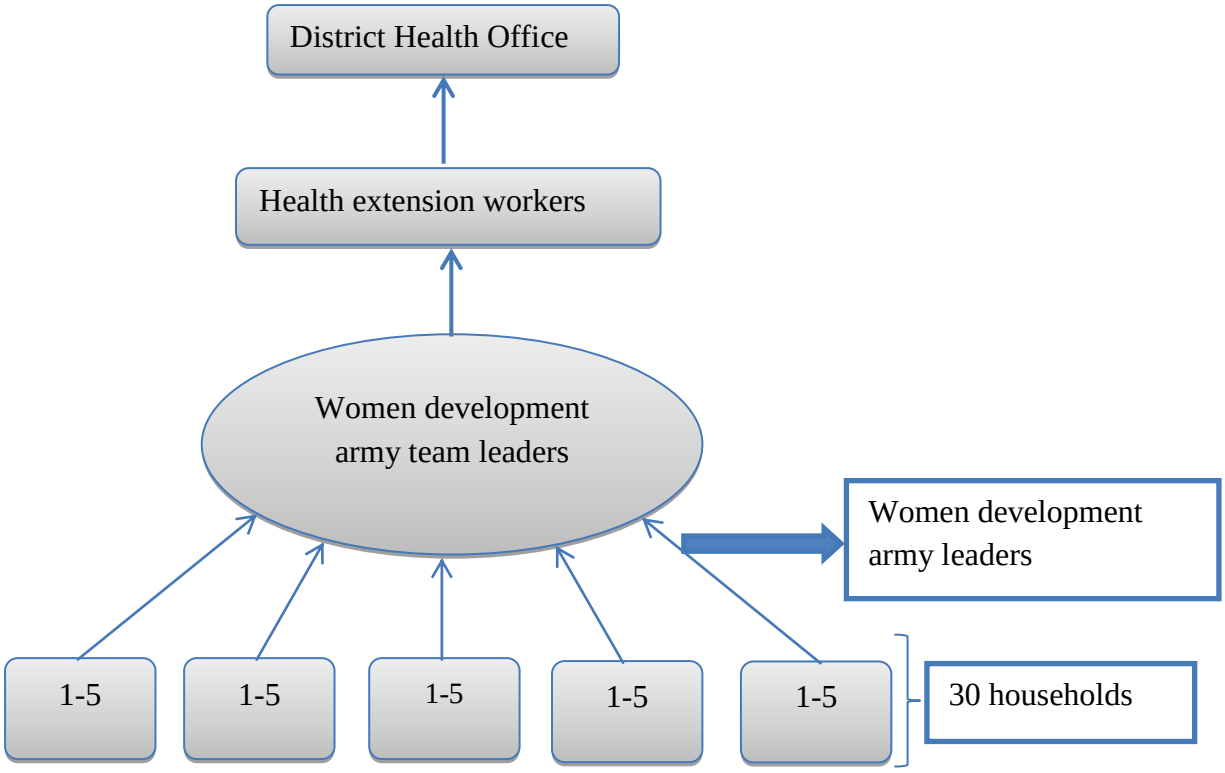

Figure 1.7. Hierarchy of women development army and reporting.

Community health and nutrition programs have historically targeted mothers/caregivers as individual actors in infant feeding and nutrition practices. However, a number of studies have shown that family members (fathers, mother-in-law, and grandparents) are key social influencers of mothers'/caregivers' infant feeding practices, including offering advice, providing food, and feeding children (Ssemukasa *et al*., 2014; Owino *et al*., 2008). Some studies report that family members work to maintain cultural norms and practices, resisting adoption of new practices (Kerr et al., 2008; Mukuria, 2009). Other evidence has suggested that success in improving infant feeding and nutritioon practices depends on effectively engaging key influencers, including fathers, mother-in-law, and grandmothers (Israel-Ballard *et al*., 2014; Thuita, 2008; Nduati, 2008).

A father giving support practically or emotionally to the mother is recognized as key influencer for improved infant nutrition. Health structures are seen as important avenues to support actualization of the provision of this support by the fathers (Matovu *et al*., 2008). Engagement of fathers is vital because of his involvement in making decisions on infant feeding, providing support physically, psychologically and financially to the mother during the complementary feeding period as well as the overall well-being of the mother and the family (Young *et al*., 2009).

Fathers' participation in child-care is positively linked to developmental, cognitive, social and behavioral child outcomes in addition to improved feeding practice (Aubel., 2008). In recognition of this influence, global guidance recommends including fathers in complementary feeding counselling and BCC activities (UNICEF, 2020). Designing programs for fathers that include specific and tailored recommendations is recommended to improve complementary feeding ractices (Pelto & Armar-Klemesu, 2015; Sanghvi *et al*., 2014).

1.9. Rationale of the Study

Ethiopia has made considerable progress in reducing infant, child, and maternal mortality during the past decade by expanding primary health care services and improving the quality of health service provision (Banteyerga, 2011). Child undernutrition remains pervasively high, however, with a prevalence of stunting 38%, underweight 24%, and wasting 10% in children under five years old (CSA, 2016).

Appropriate IYCF practices, which include exclusive breastfeeding (EBF) until 6 months of age and the age-appropriate provision of safe and nutritious foods in sufficient quantity, in addition to breast milk, from 6 to 23 month of age, are important for optimal child growth and development (Imdad, Yakoob, & Bhutta, 2011; Lassi, 2013). In Ethiopia, breastfeeding is universal and practiced for a relatively long period, with 92% continued BF at age of 1 year and 76% at age of 2 years, although EBF of infants <6 months of age was only 59% (CSA, 2016). Complementary feeding practices, however, are very poor. Complementary foods are untimely introduced (either too early or too late), inadequate both in quality and quantity, and prepared in an unhygienic way. This is due to not only because of lack of food but also associated with poor knowledge, lack of awareness, cultural beliefs, and inappropriate feeding behaviors. The ability of the mothers/caregivers to apply the recommended complementary feeding practices is associated with their knowledge, attitude, beliefs, and perceptions on complementary feeding (CSA, 2016; Habtewold, 2018).

Inappropriate complementary feeding practices, with their adverse health and nutrition consequences, remain a significant public health problem worldwide, particularly in developing countries (Manikam *et al*., 2017). Promoting optimal complementary feeding practices is a global health priority to improve infant feeding practices, health and growth. The Ethiopian government carried out several efforts to enhance complementary feeding practices at different times through the implementation of IYCF guidelines across the country. However, these efforts failed to improve feeding practices at the expected level. As a result, child undernutrition has remained pervasively high in the country (FMOH, 2004). And hence, effective intervention strategies are critical in improving infant feeding practices with the view of mitigating child undernutrition, improving their health and growth.

BCC has a great potential in improving the feeding behaviors of caregivers, and thereby infant's health and nutritional outcomes. Community-based BCIs have been employed in different parts of the world on an individual or group basis, through health facilities or home visiting programs, using printed materials such as leaflets, counseling, teaching sessions, peer support, videos, and practical demonstrations (Inayati *et al*., 2012; Zhang *et al*., 2013; Penny *et al*., 2005). However,

only a few randomized-controlled trials evaluated the effect of such interventions delivered through community-level actors on infant feeding practices, growth and morbidity (Kuchenbecker *et al*., 2017; Bhandari *et al*., 2004; Waswa *et al*., 2015). Moreover, the interventions targeted only mothers//caregivers of infants and studies that engaged their family members are limited worldwide.

In Ethiopia, there is no rigorously designed study that evaluated the impact of CFBCC on infant feeding practices, growth and morbidity. A few BCC aimed at improving IYCF practices have been conducted by non-governmental organizations projects (Kim *et al*., 2015; Negash *et al*., 2014; USAID, 2011). However, the reports of these projects focus either on implementation fidelity (Kim *et al*., 2015) or are implementation research (USAID, 2011), and large scale in scope (Kang *et al*., 2016). Moreover, none of the interventions are randomized, used control groups, and targeted infants younger than 6 months of age. Therefore, findings from this randomized-controlled trial will help to design policy and effective intervention strategies to improve infant's feeding practices, health, and growth.

1.10. Aims of the Study

The overall aim of this PhD work was to evaluate the effect of complementary feeding behavior change communication delivered through community-level actors on infant feeding practices, growth and morbidity.

1.10. Specific Objectives

1. To examine the level and predictors of mothers' knowledge and attitude on optimal complementary feeding practice.
2. To evaluate the effect of CFBCC delivered through community-level actors on the time of initiation of complementary foods.
3. To investigate the impact of CFBCC delivered through community-level actors on the dietary adequacy of infants.
4. To evaluate the effect of CFBCC delivered through community-level actors on infant growth and morbidity.

1.11. Outline of the dissertation

Chapter 1 presents the general overview, dimensions, determinants, and global, regional and national estimates of complementary feeding practices. It also presents the rationale, general aim, and specific objectives of the study. **Chapter 2** outlines the methods employed in conducting this study providing detailed information about the study setting, intervention and measurements. **Chapter 3** presents the level and predictors of mothers' knowledge and attitude on optimal complementary feeding. Effects of CFBCC delivered through community-level actors on the time of initiation of complementary foods; dietary adequacy of infants; and infant growth and morbidity are elaborated in **chapters 4**, **5**, and **6**, respectively. **Chapter 7** synthesizes the findings from the various studies, elaborate the possible implications of the findings for programs and policies targeting complementary feeding period and also indicate future research directions. The dissertation outline is schematically depicted in figure 1.8.

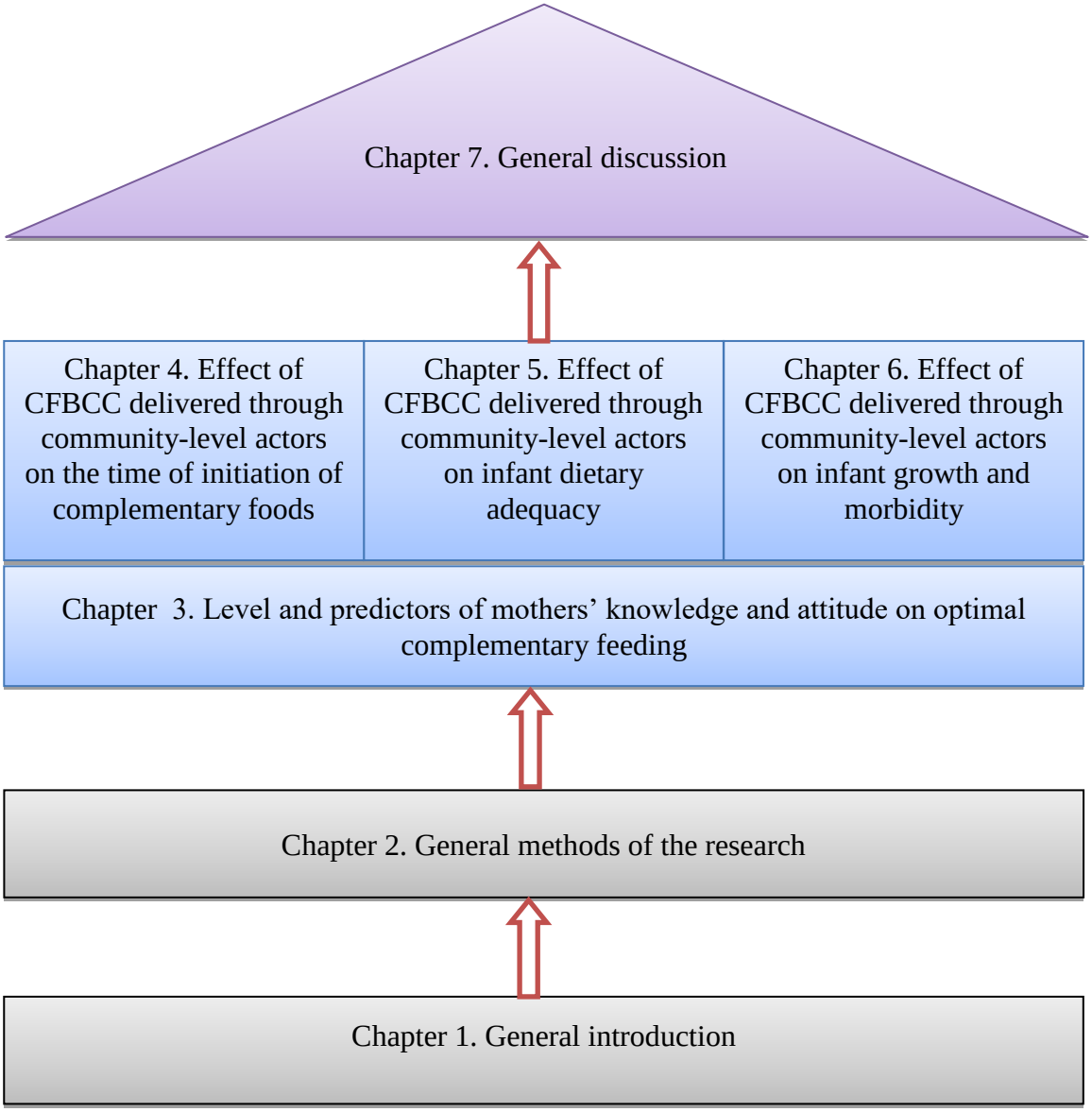

Figure 1.8. Schematic representation of the PhD dissertation.

2

Chapter 2: General Methods

2.1. Study setting, and period

This study was conducted in West Gojjam Zone from February 2017 to March 2018. West Gojjam Zone is one of the 11 administrative Zones in Amhara Regional State, divided into 13 rural *woredas* (districts), and 5 town administrations. It has a population of 2.6 million of which 92% are rural inhabitants. Each district is divided into *kebeles;* the lowest administrative units in Ethiopia. A total of 480,255 households were counted in this zone, with an average of 4.39 persons per household. From the total population mentioned, 315,228 were children under five years of age of whom 160, 214 were under two years of age (CSA, 2007).

Finote Selam Town is the capital of West Gojjam zone, which is located 387 km away from Addis Ababa, capital city of Ethiopia, and 178 km from Bahir Dar, capital city of Amhara regional state. In the zone, there are 8 public hospitals, 102 health centers, and 372 health posts. Each health centers operates with satellite health posts. Under each health post, two health extension workers (HEW) are assigned to implement the national health extension program (HEP). They deliver a package of preventive and basic curative community-based health care services (ANRS Health Burea, 2017).

Teff, maize, millet, bean, pea, grass pea, pepper, barley, wheat, cabbage, collard green, tomato, potato, papaya, mango, and avocado are foodstuffs commonly produced in the zone. Cattle, chicken, sheep, and goat are the common livestock in the study area (ANRS Agriculture Bureau, 2017).

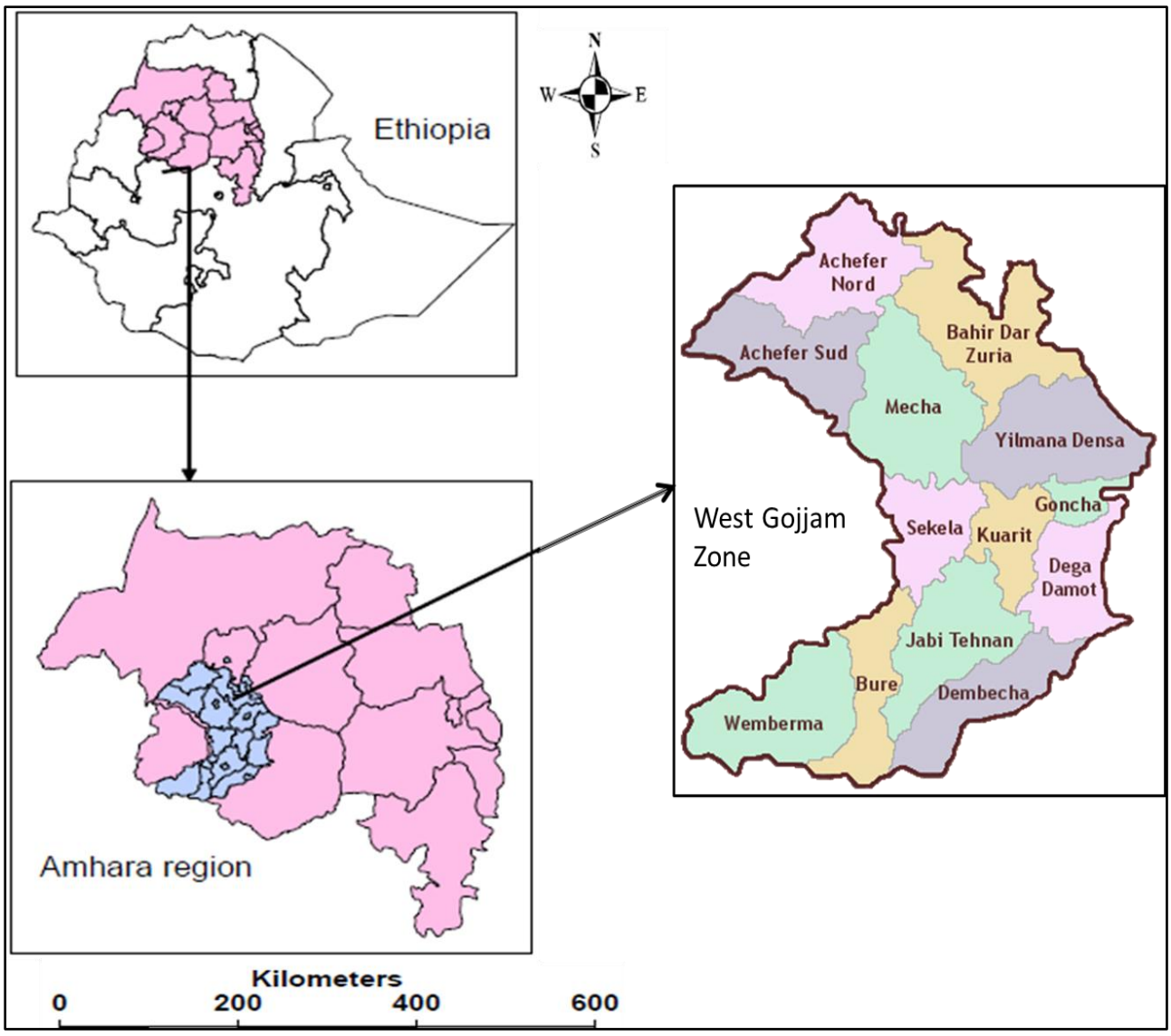

Figure 2.1. A regional map of Ethiopia showing the study area

Source: CSA, 2007 census.

2.2. Study Design

A community-based cluster-randomized controlled trial parallel-group with two arms of equal size was carried out among mothers of infants younger than 6 months at the time of enrolment. The trial was reported in line with the CONSORT recommendations for cluster-randomized trials (Campbell *et al*., 2012). The intervention was delivered in community settings that encourage collective participation. Hence, the unit of randomization was clusters (*kebeles)* to minimize intervention contamination and facilitate logistical convenience (Figure 2.2).

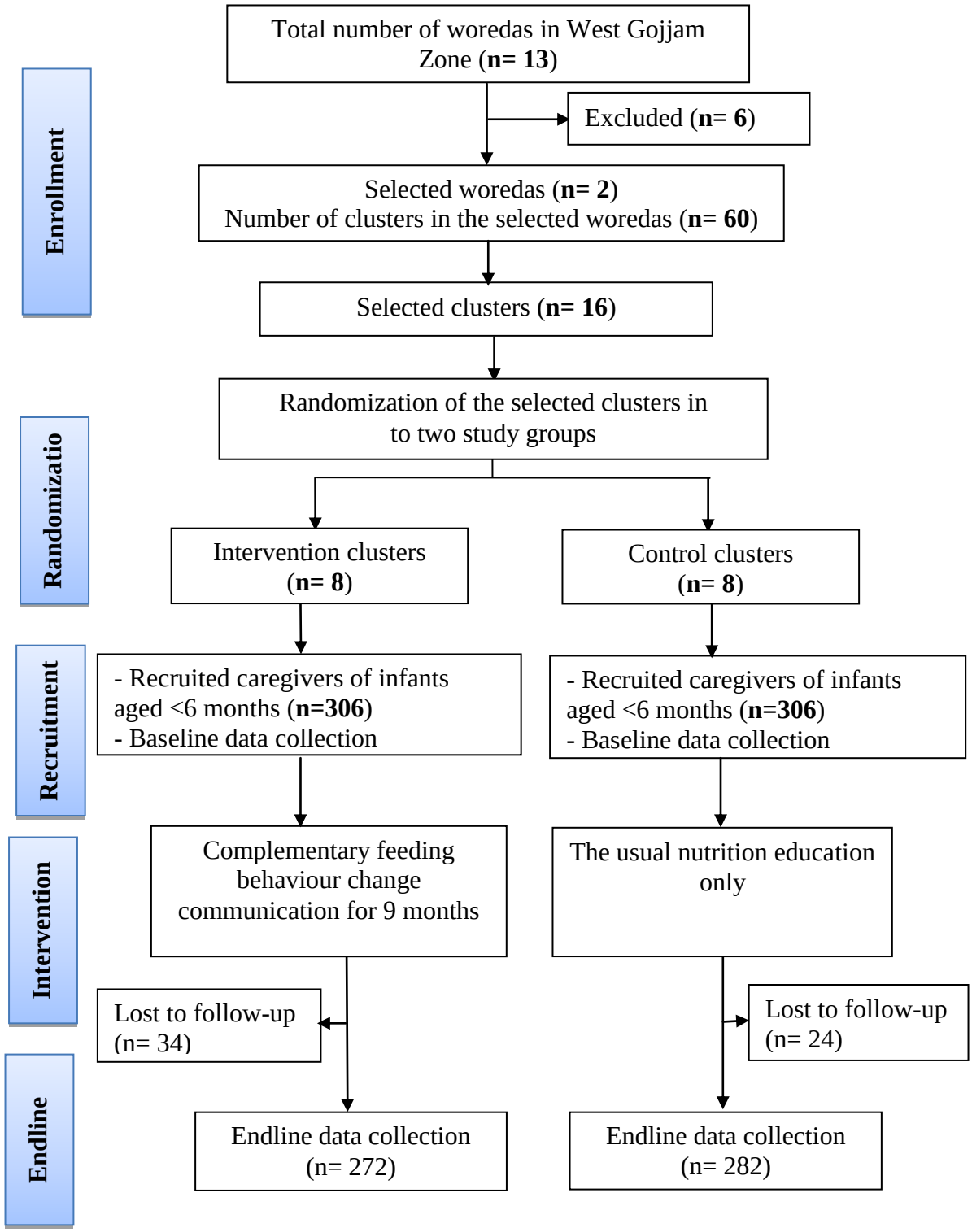

Figure 2.2. Trial profile.

2.3. Sample size determination

In accordance with the main objectives of the trial, the sample size estimates were designed to detect changes in the: 1) rate of timely initiation of complementary feeding 2) dietary adequacy 3) linear growth. The sample sizes were calculated using *G-power* based on the following assumptions. Tail (s): One; α error probability= 0.05; power = 0.8; allocation ratio (N1/N2)= 1. Based on these assumptions, we arrived at the following sample size estimates: 1) 76 per group to detect a 20-percentage point anticipated difference in the timely initiation of complementary feeding (an increase from 46% to 66%). 2) 60 per group to detect a 15-percentage point anticipated difference in the minimum dietary diversity (an increase from 5% to 20%). These estimates were based on the baseline feeding practices reported in the EDHS (CSA, 2011). 3) 139 per group to detect a 0.3 cm anticipated mean difference in linear growth (length gain) based on a systematic review of complementary feeding education interventions in developing countries that found a mean effect size of 0.21 cm (range 0.01-0.41 cm) for length gain (Imdad, Yakoob, & Bhutta, 2011).

The sample size estimate based on linear growth was considered since it was the sample size estimate that gave the maximum sample size (n=139 per group). To account for cluster design, it was multiplied by a design effect of 2 and allowing for a 10% loss to follow up; the final sample size was 306 per group (a total of 612 in both study groups).

2.4. Sampling and Randomization

Clusters (*kebeles*) in the districts (*woredas)* formed the unit of randomization for the trial, while caregiver-infant pairs within the clusters formed the units of observation. From 13 *woredas* in West Gojjam Zone, six had an ongoing intervention on IYCF. These six *woredas* were excluded from the study. From the seven eligible *woredas*, two namely; *Bahir Dar Zuria woreda*, and *Sekela woreda* were selected using simple random sampling (SRS) technique. Then, based on proportional to size allocation, a total of sixteen non-adjacent clusters (*kebeles*) were selected from the two woredas (eight from each woreda) using SRS method. Finally, clusters were randomly allocated to intervention and control arms at a 1:1 ratio.

Cluster randomization was used to prevent information contamination because caregivers in the same cluster had a high probability of communicating and discussing the intervention messages. To avoid this, all eligible trial participants in one cluster were enrolled in the same arm; either in the intervention or control arms. Moreover, buffer zones (non-selected clusters) were also left between the intervention and control clusters to prevent information contamination.

Generation of the allocation sequence and the randomization of clusters was done by a statistician that was blinded to study groups and not participated in the research. Data collectors were masked to the cluster allocation by not informing them of the cluster allocation, not being part of trial implementers and not being residents in any of the clusters. Trial participants were blinded to intervention status during recruitment, and baseline data collection. However, due to the design, and nature of the intervention under study, blinding of the trial participants receiving the intervention was not possible.

2.5. Recruitment

After cluster randomization, eligible caregiver-infant pairs were identified in the selected clusters through the house-to-house survey. All eligible caregiver-infant pairs were included within the selected cluster (complete enumeration). Inclusion criteria were consented caregivers of infants aged younger than 6 months, with singleton birth, residents in the sampled cluster for at least 6 months, and have no plans to move away during the study period. Exclusion criteria were caregivers or infants severely ill, and infants with congenital or chronic abnormalities.

2.6. The Intervention

Mothers of infants and the family members in the intervention clusters received CFBCC for 9 months whereas those in the control clusters received only the usual health and nutrition services. The language of communication during the intervention period was Amharic (the local language). The intervention had three parts.

Part 1: Training of WDA Leaders

A total of 24 WDA leaders were recruited by HEWs in the intervention clusters (3 in each cluster) and centrally trained. The first training session was conducted at the beginning of the

intervention whereas the second session with similar content was repeated in the middle (4 months) of the intervention period.

The training sessions focused on the theoretical aspects (key messages) of optimal complementary feeding practices followed by practical sessions (complementary food cooking demonstrations). The key messages emphasized the right time to introduce complementary foods; specific foods to be offered or avoided and how to offer them; meal frequencies; amounts of foods to be fed to infants at different ages while continuing breastfeeding; offering a variety of foods from different food groups; practice responsive feeding; practice good hygiene, and continue to feed the child during and after an illness (Table 2.1).

Cooking demonstrations aimed to show how different food items can be used to prepare nutritious meals, illustrate the appropriate amount and consistency of meals and demonstrate responsive feeding. The procedure for preparing nutritious meals based on the promoted recipes was demonstrated during the sessions. The recipes are based on grains, legumes, root/tuber, ASF, fruits and vegetables. The WDA leaders centrally prepared meals based on the proposed recipes. Posters containing the key messages, recipe examples and promoted recommendations were distributed to WDA leaders after the training sessions.

Direct, interactive and participatory learner and activity-oriented instructional strategies were delivered during training sessions. Talks, group discussions, experience-sharing, role-plays, and demonstrations were used to enhance knowledge, attitude, and reinforce behavior change about complementary feeding practices. The training contents were adopted from the Alive and Thrive program, Ethiopia (Piwoz, Baker, & Frongillo, 2013).

Table 2.1. Complementary feeding practice key messages in the intervention clusters.

No.	Key messages
1	Start feeding your baby soft and thick porridge made from a combination of cereal flours at 6 months. Continue breastfeeding up to 2 years and beyond.
2	Enrich baby's porridge by adding one or more ingredients from animal-source foods (milk, egg, dried meat powder), finely chopped vegetables (kale, carrot, cabbage, tomato, potato) and mashed fruits (avocado, papaya, mango, banana, pumpkin) in each meal.
3	Cook and feed animal-source foods (e.g. eggs, beef, pork, chicken, liver, fish) at least 3 times per week. Feed your child fruits (e.g. ripe banana, mango, orange, papaya, avocado) after a meal at least once per day.
4	Increase variety, amount and frequency of feeding with age for the baby. Amount of food per meal: Begin with 2 to 3 tablespoons at 6 months of age and increase gradually to half a cup (125 mL) between the ages of 6 and 12 months. Between the ages of 12 and 24 months, increase the amount of food to three-quarters of a cup (188 mL). Frequency of feeding per day: 2-3 times at 6-8 months, 3-4 times at 9-23 months. Feed 1-2 snacks (e.g. sliced bread, fruits) between two major meals.
5	Encourage your baby to eat with patience and love. Don't force your baby to eat. Provide extra food during and after an illness.
6	Feed your baby using a clean cup and spoon, and avoid bottle feeding. Wash your hands with soap and water before preparing food, and before feeding young children.
7	Enriched baby's porridge preparation: • Prepare a germinated flour made up of $3/4^{th}$ staples (one or more ingredients from maize, wheat, rice, millet, sorghum, oat) and $1/4^{th}$ legumes (one or more ingredients from beans, lentils, chickpeas, groundnuts). • Use milk instead of water for preparing porridge. • Add butter/oil which will make the thick porridge easier to eat. • Add finely chopped meat, fish or eggs. • Add one or more ingredients from finely chopped vegetables and mashed fruits. • Increase the consistency and thickness of the porridge with child age. • Do not forget to use iodized salt.

Part 2: Group Training of Caregivers by WDA Leaders

Each member of the trained WDA leaders was assigned to 10-15 mothers of infants aged younger than 6 months residing in their cluster. WDA leaders delivered a total of nine group training sessions including cooking demonstrations (once per month) for the caregivers they are assigned with the same training procedure discussed in part 1. They applied a learner-centered and discussion-oriented approach to motivate and reinforce caregivers for behavior change and build confidence in their abilities to adopt the recommended feeding practices at home. WDA leaders applied culturally appropriate training sessions, and used a language the caregivers can easily understand.

Part 3: Home Visits

Each WDA leader conducted a total of nine home visits (once per month) in the intervention clusters that aimed to bring behavior change at the family level. During each visit, individual counseling and support were offered for each caregiver to reinforce the adoption of feeding practices she had been taught during the group training sessions, to observe feeding practices, to demonstrate cooking procedures, to correct the harmful practices and to provide appropriate feedback focusing on the key complementary feeding recommendations. A participatory discussion was held with family members (husbands, mothers-in-law, and grandparents) regarding optimal complementary feeding practice, its impact on infant's health, growth and survival; and how can they support the caregiver in feeding the baby. Posters containing the key messages, recipe examples and promoted recommendations were distributed to the caregivers, and family members. WDA leaders were supervised and monitored by HEWs and supervisors. The overall supervision and monitoring were done by the researcher.

All the activities done during the study period are presented in Table 2.2. Recruitment of study participants and baseline data collection was conducted between February and March 2017. Following the baseline survey, the intervention was delivered for the intervention clusters from April 2017 to December 2017. The end line data collection was carried out between January and February 2018.

Table 2.2. Schedule of activities during the study period

Activities	Time points in months												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Enrollment and baseline data collection	x^{I+C}	x^{I+C}											
Training of WDA leaders			x^{I}				x^{I}						
Group training of mothers			x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}		
Home visits			x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}		
Process evaluation			x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}		
Endline data collection												x^{I+C}	x^{I+C}
Supervision	x^{I+C}	x^{I+C}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I}	x^{I+C}	x^{I+C}

^{I} Intervention groups; ^{C} Control groups; $^{I+C}$ Activities both in intervention and control groups

2.7. Process Evaluation

Process evaluation was conducted to document the intervention implementation process and assess whether the intervention activities were implemented as planned, evaluate the performance of WDA leaders and the extent to which the intervention reached the intended trial participants (Table 2.3).

Table 2.3. Process Evaluation

Data sources	Process indicators	Characteristics
1. Assess whether the intervention activities are implemented as planned		
Activity logs	• Number of recruited WDA leaders • Number of WDA leaders trained • Number of training sessions (including cooking demonstrations) delivered to WDA leaders • Number of visual materials distributed to WDA leaders • Number of training sessions (including cooking demonstration) delivered to mothers • Number of home visits conducted • Number of visual materials distributed to mothers	Fidelity
2. Evaluate the extent to which the intervention reaches the intended mothers and family members		
Attendance records	• Number of recruited mother-infant pairs • Number of mothers trained • Number of mothers who attended home visits • Number of family members who attended home visits	Reach (participation rate)
3. Determine the degree to which targeted mothers and family members are exposed to the intervention		
Attendance records	• Number and duration of training sessions (including cooking demonstration) delivered to mothers. • Number and duration of home visits conducted.	Dose delivered (exposure)

2.8. Conceptual Framework

Figure 2.3 presents the conceptual framework illustrating how the intervention components in this trial influence mothers feeding behaviors, infant growth and morbidity. Mothers with improved knowledge, awareness, attitude, perceptions, skills, and self-efficacy on complementary feeding through training sessions, cooking demonstrations and home visits are more likely to adopt the recommended feeding behaviors. Adoption of the recommenced complementary feeding practices leads to increased intake of adequate and safe diets, and reduces the incidence of morbidity and, thereby improving infant growth outcomes (Bartholomew *et al*., 2006; Hamilton *et al*., 2011).

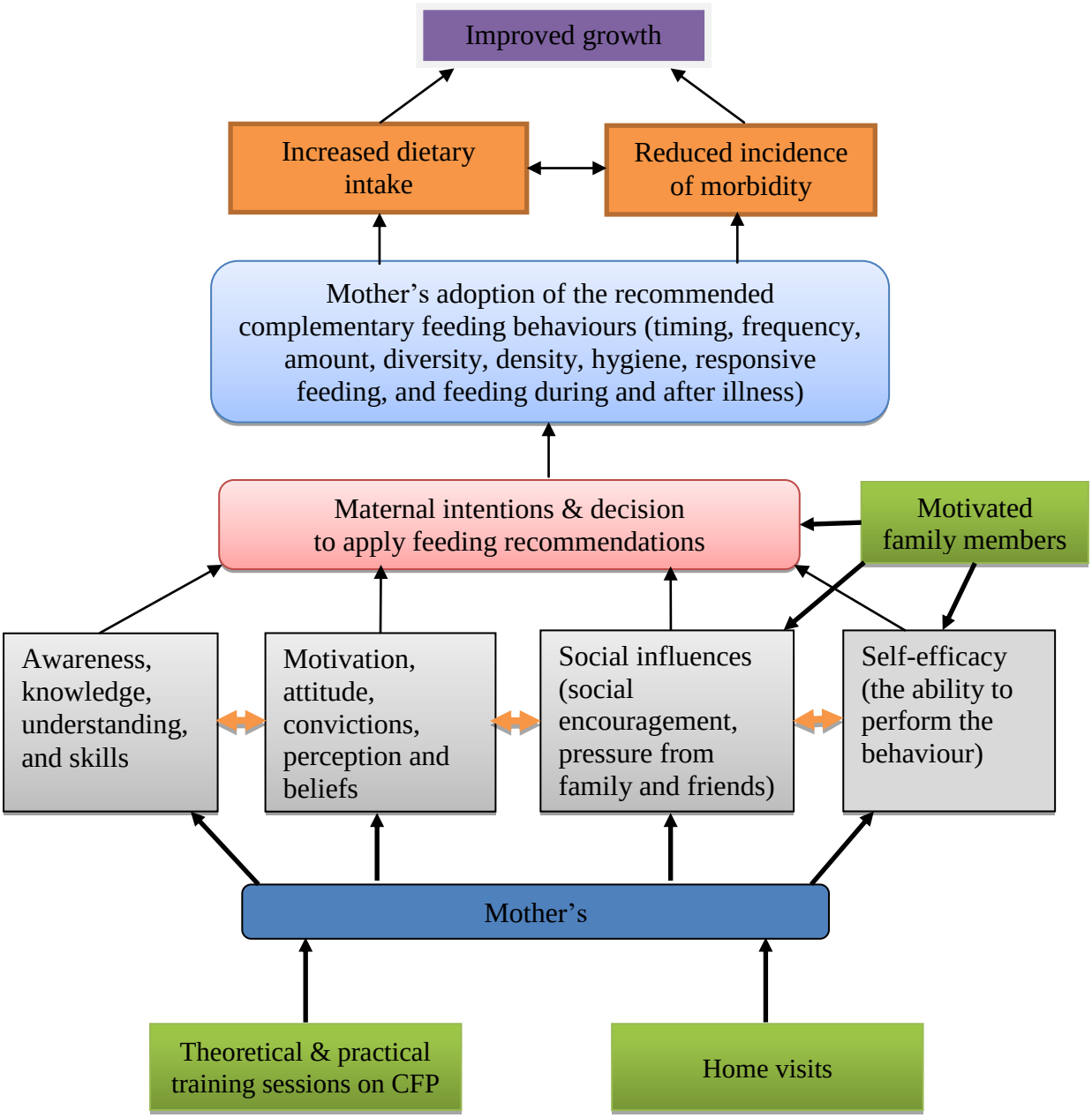

Figure 2.3. Conceptual framework illustrating the effect of complementary feeding behavior change intervention on mother's/caregiver's feeding behaviors, infant growth and morbidity.

Source: Hamilton *et al*., 2011.

2.9. Measurements

Data were collected using a pre-tested structured interviewer-administered questionnaire adapted from WHO (WHO, 2017) and EDHS (EDHS, 2011). Measurements included examination of baseline infant, caregiver and household characteristics presented in **chapter 4**; mothers' background knowledge and attitude on optimal complementary feeding (explained in **chapter 3**); complementary feeding practices based on the standard indicators (presented in **chapter 4, and 5**); infant anthropometry, and morbidity (elaborated in **chapter 6**).

2.10. Data quality

A pre-test was done on 5% of the total sample that was not included in the final main sample before the actual data collection. Training on the contents, questionnaire, and measurements were given to all data collectors and supervisors. The training focused on how to conduct anthropometric measurements, how to ask questions, their meaning, and how to record the answers. The trainees were also encouraged to ask about issues that are unclear, pay close attention, and take careful notes on issues that they are not familiar with. During and after data collection, supervisors monitored the data collection team to ensure their adherence to the study protocol. In addition, the data manager checked all the data submissions from the field on a weekly basis. The local language (Amharic) was used to collect the data for more understanding of the questions. The detailed data quality assurance measure is presented in the upcoming respective chapters.

2.11. Ethical considerations

All procedures involving the research were approved by Jimma University College of Health Sciences institutional and review board. Permission to undertake the study was obtained from the regional, zonal and *woredas* administration and health offices of the study area. After the identification of eligible caregiver-infants pairs in each cluster, all the trial procedures were explained for the caregivers along with their right to refuse. The informed consent document was tailored to the study group (intervention or control) to which a particular cluster was allocated. Mothers that agreed to participate in the trial signed or put their fingerprints according to their literacy status. The right of the participant to withdraw from the study at any time was respected.

The data were not accessed by a third person, except the researcher, and were kept confidential. The trial was registered at clinicaltrials.gov with a registration number NCT03488680.

2.12. Funding

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3

Chapter 3: Level and Predictors of Mothers' Knowledge and Attitude on Complementary Feeding in West Gojjam Zone, Northwest Ethiopia

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Nutrition and Dietary Supplements

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Abstract

Introduction: In Ethiopia, inappropriate complementary feeding practices have been widely documented. Mothers' knowledge and attitude on complementary feeding have a significant effect on feeding behaviors. The ability of the mothers to apply the recommended feeding practice is associated with their knowledge and attitude on complementary feeding. It is essential to examine the level and predictors of mothers' knowledge and attitude on complementary feeding to design evidence-based effective intervention strategies.

Methods: A two-stage cluster sampling technique was applied to select the study subjects. A total of 612 mother-infant pairs were recruited in the study. Data were collected using a pre-tested, structured interviewer-administered questionnaire. Data were double entered into the EPI-Info, exported to SPSS 21 for cleaning and statistical analysis. The levels of mothers' knowledge and attitude on complementary feeding were computed based on data-driven mean scores. Binary and multivariable logistic regressions were used to examine the predictors of mothers' knowledge and attitude on complementary feeding. Odds ratio with a 95% confidence interval was computed to assess the strength of association. A P-value of <0.05 was considered statistically significant.

Results: Overall, 60% and 51% of mothers had good knowledge and favorable attitude towards complementary feeding, respectively. Mothers having formal education [AOR=2; 95% CI: 1.15-3.43], fathers having formal education [AOR=2.2; 95% CI: 1.26-5.13], having ANC [AOR=3.5; 95 % CI: 1.9-7.47], delivery at health facility [AOR=1.8; 95% CI: 1.13-2.83], having PNC [AOR=2.2; 95% CI: 1.32-3.73], and having IYCF counseling [AOR= 2.5; 95% CI: 1.46-7.52] were significantly associated with mothers' knowledge on complementary feeding. Likewise, mothers having formal education [AOR=2.5; 95% CI: 1.49-4.02], having ANC [AOR=2.7; 95 % CI: 1.54-4.57], having IYCF counseling [AOR= 2.2; 95% CI: 1.47-4.89], and possession of radio [AOR= 1.8; 95% CI: 1.35- 3.82] were positively associated with mothers' attitude towards complementary feeding.

Conclusion: The overall levels of mothers' knowledge and attitude on complementary feeding were low especially regarding age-specific meal frequency, animal-source foods, fruits, and

vegetables, feeding during and after illness, and bottle feeding. Maternal and paternal educational status, place of delivery, ANC status, PNC status, IYCF counseling & possession of radio were the main predictors. Hence, behavior change intervention focused on optimal complementary feeding should be strengthened in the community.

3.1. Introduction

The first 2 years of life are a critical period for optimal growth and development of children. Most events of malnutrition happen in this period since there is a high demand for adequate diets. Malnutrition during the first 2 years of life will result in an irreversible impairment in physical growth, and brain development. Hence, enhancing feeding practice during this period is an important aspect to improve health and nutrition in children (WHO, 2017).

From all established health and nutrition intervention approaches, appropriate infant and young child feeding (IYCF) has the highest degree of impact on the growth and survival of children (Ruel & Hoddinott, 2008). Suboptimal feeding practices account for more than half of the deaths of under five children worldwide. Greater than two-thirds of the deaths are related to inappropriate feeding practices during the first 2 years of life (Souza *et al*., 2014). On the other hand, studies indicate that the application of the optimum complementary feeding practices might stop 6% of deaths in under five children (WHO, 2001).

Child undernutrition remains a serious public health challenge in Ethiopia. The prevalence of stunting, underweight and wasting were 38%, 24%, and 10%, respectively in children under five years of age (CSA, 2016). The study area particularly has a high rate of malnutrition regardless of the area being a surplus crop producer. This could be caused by suboptimal child feeding practice which is in turn influenced by the knowledge and attitude of mothers on child feeding practice (Chung *et al*., 2004).

The complementary feeding period is a critical time of transition in infants characterized by a gradual shift from breast milk to family food. The incidence of growth faltering increases significantly at 6 months of age when complementary foods are being introduced particularly in most LMIC including Ethiopia (Al-mekhlafi *et al*., 2008). Suboptimal complementary feeding practices are associated with a high burden of malnutrition and mortality in children (WHO, 2019).

Children need adequate quantities and quality of complementary foods to support their optimal growth and development, as breast milk alone is nutritionally insufficient after the age of 6 months. WHO recommends that mothers should introduce nutritionally sufficient, safe, age-

specific complementary foods at the age of the sixth month, keeping breastfeeding until the age of two years and beyond (WHO, 2019).

Mothers' knowledge and attitude on complementary feeding have a significant effect on their feeding behaviors. The ability of the caregivers to apply the recommended feeding practices is associated with their knowledge and attitude on complementary feeding. Caregivers who have poor knowledge and unfavorable attitude are more likely to have inappropriate complementary feeding practices (Sandra *et al*., 2014; Gudina *et al*., 2013). Even, poor knowledge and unfavorable attitude are often an important determinant of caregivers feeding practice than the availability of foods (Joyce and Joshua, 2015; Wu *et al*., 2014).

Several factors affect mothers' knowledge and attitude towards complementary feeding practice. These include the working status of the caregiver, family size, educational and marital status of the caregiver, age and sex of the index child (Egata *et al*., 2013; Fadare *et al*., 2019; Gyampoh *et al*., 2014). The majority of the rural communities in Ethiopia are illiterate, have low socioeconomic status, and have restricted access to the fundamental health care facilities which might have a negative influence on the knowledge and attitude of mothers on complementary feeding (CSA, 2016).

In Ethiopia, inappropriate complementary feeding practices have been widely documented (EDHS, 2016; Amanuel, 2013; Kibebew *et al.*, 2012; Fanos, 2015; Shukere, 2017). This may be due to barriers of translating feeding recommendations into practice that are related to knowledge, attitude and cultural norms existing in a particular community. It is essential to examine the level and predictors of knowledge and attitude on optimal complementary feeding prevailing in a community to design evidence-based effective intervention strategies. This study aimed to examine the level and predictors of caregivers' knowledge and attitude on optimal complementary feeding practice.

3.2. Methods

3.2.1. Measurements

The knowledge of mothers on complementary feeding was computed based on six knowledge questions with “yes” or “no” responses and for assessment of attitude, based on six attitude questions with “agree”, “disagree” and “don’t know” responses. A score of "1" was given for each correct response and "0" for the wrong response. The scores were summed and a mean score for knowledge questions was computed and respondents who scored less than the mean were labeled as having “poor” knowledge and those who scored equal to or above the mean were considered as having “good” knowledge. Likewise, the scores summed and a mean score for attitude questions was computed and respondents who scored below the mean were considered as having an "unfavorable" attitude and those scored equal to or above the mean were considered as having a "favorable" attitude (Fadare *et al.,* 2019). Data collector arranged a comfortable environment by keeping caregiver apart and making them free during the interview.

3.2.2. Statistical analyses

Data were double entered into the EPI-Info, exported to SPSS version 21 for cleaning and statistical analysis. Descriptive statistics were used to summarize the variables. Bivariable logistic analysis was done to show the crude effect of each variable on knowledge and attitude. Variables with a P-value of <0.2 in the bivariable analyses were entered into multivariable logistic regression analyses. Odds ratio (OR) with a 95 % confidence interval (CI) was computed to assess the strength of association. A P-value of <0.05 was considered statistically significant in the multivariable analyses.

3.3. Results

Maternal sociodemographic, obstetric and health-care characteristics

A total of 612 mothers were recruited in the study yielding a response rate of 100%. The mean (±SD) age of the caregivers was of 28 (±5) years. The majority of the mothers were married (93.6%) and had no formal education (77.3%). The majority of the mothers were housewives (85%) and all of their husbands (100%) were farmers. All of the study participants (100%) were from the Amhara ethnic group and Orthodox Christian in religion. The mean (±SD) family size of the respondents was 5.4 (±1.8).

Respondents' index children were almost in equal proportion for sex. The majority (82.5%) of mothers were multiparous and nearly half (47.0%) of them perceived their babies' birth weight as a medium. Nearly three-fourths (71.7%) of mothers had antenatal care (ANC) visits for the index child and 86% of them had less than four ANC visits. Nearly two-thirds (59.2%) of respondents delivered their index child in their home and three-fourths (74.5%) of them had no postnatal care (PNC). Almost one-third (32.2%) of mothers were counseled about child feeding during their pregnancy of the index child. Nearly three-fourths (79.6%) of respondents had no functioning radio at their homes. Among respondents who had a functioning radio, nearly a quarter (22.4%) of them did listen to *seven solutions* (a radio drama aimed at change in social norms abut IYCF). **(Table 3.1)**

Table 3.1. Maternal sociodemographic, obstetric and health-care characteristics.

Variable	Frequency	Percent
Maternal age (in years)		
≤24	147	24.0
25-29	236	38.6
≥30	229	37.4
Maternal marital status		
Married	573	93.6
Others	39	5.4
Maternal educational status		
Attended formal education	139	22.7
No formal education	473	77.3
Paternal educational status		
Attended formal education	76	12.4
No formal education	536	87.6
Mothers' occupation		
Farmer	74	12.1
Housewife	538	87.9
Sex of the index child		
Male	310	50.6
Female	302	49.4
Parity		
Primiparous	107	17.5
Multiparous	505	82.5
Preceding birth interval (in years)	158	31.3
1-2	347	68.7
>2		
Mothers' perception of child's weight		
Large	165	27.0
Medium	288	47.0
Small	159	26.0
ANC visit		
Yes	439	71.7
No	173	28.3
Number of ANC visits		
1-3	378	86.0
≥4	61	14.0

Table 3.1. Maternal sociodemographic, obstetric and health-care characteristics.

(continued)

Variable	Frequency	Percent
Place of delivery		
Home	362	59.2
Health facility	250	40.8
PNC check up		
Yes	156	25.5
No	456	74.5
IYCF counseling		
Yes	197	32.2
No	415	67.8
Possession of functioning radio		
Yes	125	20.4
No	487	79.6
Listen to the *seven solutions*		
Yes	28	22.4
No	97	77.6

Mothers' knowledge on complementary feeding

Overall, 60.0% of mothers had good knowledge about complementary feeding. Regarding the particular knowledge proportions, the majority of the respondents (82.0%) knew the duration of exclusive breastfeeding, and the right age to introduce complementary food (79.0%). Only 32.0% and 22.6% of mothers had known the recommended meal frequency for a 6-8 and 9-23 months of age baby, respectively. Small proportions of the caregivers (11.5%) knew the minimum number of food groups a 6-23 month baby should consume. Only 56.0% of mothers knew a non-breastfed baby needs extra meals (Table 3.2).

Table 3.2. Mothers' knowledge on complementary feeding.

Question	n (%)
The mothers knew:	
A baby should exclusively be breastfed for the first 6 months	503 (82.2)
A baby should begin complementary foods at 6 months	483 (79.0)
A breastfed 6-8 months baby should take complementary foods 2 times/day	196 (32.0)
A breastfed 9-23 months baby should take complementary food 3 times/day	138 (22.6)
A baby 6-23 months of age require a minimum of 4 food groups	70 (11.5)
Non-breastfed baby needs an extra meal	343 (56.0)
Overall Knowledge status	
Good	367 (60.0)
Poor	245 (40.0)
Total	612 (100)

Mothers' attitude on complementary feeding

Overall, only 51.0% of caregivers had a favorable attitude towards complementary feeding. Regarding the specific proportions, the majority of the caregivers (72.0%) believe breastfeeding alone is not sufficient for a child after 6 months, and giving complementary foods after 6 months makes a baby healthy (75.0%). Only 45.1% and 42.0% of mothers feel giving fruits and vegetables; and ASF is good for a baby, respectively. Few numbers of respondents (12.6%) believe bottle feeding is not good for a child's health, and giving extra meals is important before and after an illness, 15.0% (Table 3.3).

Table 3.3. Mothers' attitude towards complementary feeding.

Statement	n (%)
The mothers feel/believe:	
Breastfeeding alone is not sufficient for a child after 6 months	440 (72.0)
Giving complementary foods after 6 months makes a baby healthy	459 (75.0)
It is good to give baby fruits and vegetables	276 (45.1)
A baby needs animal-source foods	257 (42.0)
Bottle feeding is not good for a child's health	77 (12.6)
Giving extra meal is desirable before and after an illness	91 (14.8)
Overall Attitude status	
Favourable	312 (51)
Unfavourable	300 (49)
Total	612 (100)

Predictors of mothers' knowledge and attitude on complementary feeding

On multivariable logistic regression analysis, mothers' having formal education [AOR=2; 95% CI: 1.15-3.43], fathers having formal education [AOR=2.2; 95% CI: 1.26-5.13], having ANC [AOR=3.5; 95 % CI: 1.9-7.47], delivery at health facility [AOR=1.8; 95% CI: 1.13-2.83], having PNC [AOR=2.2; 95% CI: 1.32-3.73], and having IYCF counseling [AOR= 2.5; 95% CI: 1.46-7.52] were significantly associated with mothers' knowledge on complementary feeding. Likewise, mothers having formal education [AOR=2.5; 95% CI: 1.49-4.02], having ANC [AOR=2.7; 95 % CI: 1.54-4.57], having IYCF counseling [AOR= 2.2; 95% CI: 1.47-4.89], and possession of radio [AOR= 1.8; 95% CI: 1.35- 3.82] were positively associated to attitude of mothers towards complementary feeding (Table 3.4).

Table 3.4. Multivariable logistic regression model predicting mothers' knowledge and attitude on optimal complementary feeding practice.

Variable	Knowledge		AOR	Attitude		AOR
	Good	Poor	(95% CI)	Favorable	Unfavorable	(95% CI)
Maternal educational Status						
No formal education	106	367	1	143	330	1
Had formal education	70	69	2 (1.15-3.43)*	89	50	2.5 (1.49-4.02)**
Paternal educational status						
No formal education	136	400	1	184	352	1
Had formal education	40	36	2.2 (1.26-5.13)*	48	28	1.9 (0.57-5.39)
Parity						
Primiparous	52	55	1	56	51	1
Multiparous	180	325	1.3 (0.84-2.26)	176	329	1.2 (0.75-1.72)
ANC status						
No	17	156	1	30	143	1
Yes	159	280	3.5 (1.91-7.47)**	202	237	2.7 (1.54-4.57)**
Place of delivery						
Home	98	264	1	121	241	1
Health facility	104	146	1.8 (1.13-2.83)*	94	156	1.2 (0.68-1.75)
Maternal perception of the child's weight						
Large	16	148	1	41	124	1
Medium	85	203	1.7 (0.88-3.56)	97	191	1.6 (0.85-2.94)
Small	75	85	2.2 (0.98-4.98)	94	65	1.8 (0.89, 3.49)
PNC status						
No	101	355	1	153	303	1
Yes	75	81	2.2 (1.32-3.73)*	67	89	1.4 (0.47-3.86)
IYCF counseling						
No	92	322	1	124	290	1
Yes	84	114	2.5 (1.46-7.52)**	108	90	2.2 (1.37-4.89)*
Possession of radio						
No	121	366	1	161	326	1
Yes	55	70	1.3 (0.28-5.87)	71	54	1.8 (1.35-3.82)*
Listen to *seven solutions*						
No	42	53	1	42	53	1
Yes	18	12	1.4 (0.34-5.49)	16	14	1.3 (0.28-3.82)

*P-value: <0.05; **P-value: <0.01; AOR: adjusted odds ratio; CI: confidence interval

3.4. Discussion

Mothers who have good knowledge and favorable attitude on complementary feeding practice are more likely to have better feeding practice than those who have poor knowledge and unfavorable attitude (Egata *et al*., 2013). This study examined the level and predictors of knowledge and attitude of mothers on optimal complementary feeding. The information generated could be useful for health and nutrition policymakers to design evidence-based and effective intervention strategies to improve child feeding practices thereby child's growth, development and survival.

In this study, overall 60.0% of the mothers had good knowledge about complementary feeding. This result was higher than the study done in Nigeria (15.0%) (Olatona & Adenihun, 2017) but lower than the result found in Kosova, (88.4%) (Berisha, Ramadani, & Hoxha, 2017). This may be due to differences in sociodemographic characteristics of the study subjects.

Regarding the specific knowledge levels, 71.6% of caregivers knew the recommended duration of exclusive breastfeeding, which was consistent with the findings done in Bahir Dar, (84.3%) (Demilew, 2017), and Fiche Town (80.0%) (Shukure, 2017). It was higher than the study finding in Mizan Aman, (34.7%) (Tadele *et al.,* 2016), and lower than the result found in Ghana, (97.5%) (Nukpezah *et al*., 2018). Exclusive breastfeeding in the first 6 months of life saves lives. During this period, an infant who is not breastfed is more than 14 times more likely to die from all causes of mortality than an exclusively breastfed infant (Black *et al*., 2018).

WHO recommends that babies should begin complementary foods at the age of the sixth month. Locally accessible and affordable foods that enrich the baby's diet with additional calories and micronutrients should be offered (Black *et al.,* 2018). In this study, 79.0% of the mothers knew the right age to introduce complementary food which was lower than the study done in Bahir Dar, (88.0%) (Demilew, 2017), but higher than the result found in Fiche Town (80.0%) (Shukure, 2017).

Only 32.0% of mothers in this study knew the recommended complementary feeding frequency per day which was consistent with the findings in Bahir Dar, (31.0%) (Demilew, 2017), and Nigeria, (29.6%) (Olatona & Adenihun, 2017). However, it was much lower than the study done

in Ghana (86%) (Gyampoh *et al*., 2014). This could be differences in the study settings. In this study, 56.0% of respondents knew that non-breast feed infants need extra meals which was slightly lower than the study done in Bahir Dar, (67.0%) (Demilew, 2017).

Regarding mothers' attitude towards complementary feeding, overall 51.0% of the caregivers in this study had a favorable attitude towards complementary feeding which was consistent with the study done in India, (50.0%) (Karnawat *et al*., 2015), but higher than the finding in Yemen (13.0%) (Dallak *et al*., 2016).

In Ethiopia, several determinants can affect mothers' knowledge and attitude towards complementary feeding. These determinants include maternal age, educational, marital, and work status of the mother, residence, exposure to mass media, family size, wealth status, antenatal care visits, place of delivery, age and sex of the child (CSA, 2016). Each woman who comes to the health facilities for different services is being counseled on child nutrition including IYCF practices. Moreover, education on IYCF is being given by health extension workers to all pregnant and lactating women at health posts and at home. All these have a direct contribution to caregiver knowledge and attitude on complementary feeding. However, caregiver's healthcare utilization habits and implementation of the recommendations are poor (Chung *et al*., 2004).

In this study, mothers who had formal education were more likely to have good knowledge and a favorable attitude about optimal complementary feeding than those who had no formal education. This might be due to the fact that literate mothers can understand nutrition information which empowers them to resist external interferences and pressures. Similarly, mothers who had ANC follow-up were more knowledgeable and had a favorable attitude towards optimal complementary feeding than those who had no ANC follow-up. The possible reason is that caregivers who have ANC follow-up are more likely to be counseled by health professionals about optimal complementary feeding practices.

The odds of having good knowledge and favorable attitude about complementary feeding were higher among mothers who had IYCF counseling as compared to those who had no IYCF counseling. This significant association can be explained by the fact that IYCF counseling has a

direct contribution and a pivotal role in enhancing mothers' complementary feeding knowledge and attitude.

The odds of having good knowledge about complementary feeding were higher among mothers who had PNC follow-up as compared to those who had no PNC follow-up. Likewise, mothers who delivered at health facilities were more likely to have good knowledge about optimal complementary feeding than those who gave birth at home. The likely explanation could be mothers who gave birth at health institutions have a better opportunity to access the appropriate child feeding information that can improve their knowledge about complementary feeding.

Mothers who had a functioning radio were more likely to have a favorable attitude on complementary feeding than those who had no radio. The likely reason could be respondents who had radio have a better opportunity to get child feeding education broadcasted by radio.

The strength of this study includes pre-test before the actual study and implementation of frequent supervision during data collection. There are also limitations to be mentioned. First, this study might have information bias for the knowledge and attitude questions which might have led to the over-reporting of the desirable answers due to fear of being judged. Second, since it was a cross-sectional study, causal inferences between variables cannot be investigated.

3.5. Conclusions

This study showed that the overall level of knowledge and attitude of mothers on complementary feeding was not appreciable especially regarding age-specific meal frequency, ASF, fruits, and vegetables, feeding during and after illness, and bottle feeding. Maternal and paternal educational status, place of delivery, ANC status, PNC status, IYCF counseling & possession of radio were the main predictors of mothers' knowledge and attitude complementary feeding. Hence, behavior change intervention on optimal complementary feeding should be strengthened in the community. Moreover, interventions that can improve the health care utilization of mothers have to be applied to use health facilities as an opportunity to deliver counseling and support on complementary feeding.

4

Chapter 4: Effect of Complementary Feeding Behavior Change Communication Delivered through Community-Level Actors on the Time of Initiation of Complementary Foods in Rural Communities of West Gojjam Zone, Northwest Ethiopia: a Cluster-randomized Controlled Trial

BMC Pediatrics

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Abstract

Introduction: Complementary foods are usually untimely initiated (either too early or too late) particularly in developing countries, which has adverse consequences on infant growth, development, and survival. The promotion of optimal complementary feeding through behavior change interventions is a global health priority. The focus of most studies conducted worldwide seemed to be on the effect of behavior change interventions on the adequacy of complementary diets; but not on the timing of initiations. Moreover, many of the interventions targeted only caregivers of infants, and studies that engaged the family members are scarce. This study aimed to evaluate the effectiveness of complementary feeding behavior change communication delivered through community-level actors on the time of initiation of complementary foods.

Methods: Generalized estimating equation regression and survival analyses were used to test differences in the time of initiation of complementary food between the study groups. Relative risks (RR) with a 95% confidence interval (CI) were computed as an outcome measure of the intervention effect. All analyses were conducted according to the intention to treat (ITT) principle and the adjusted effect measures were considered as the main results. P-value <0.05 was considered statistically significant.

Results: The intervention significantly improved the probability of timely initiation of complementary food [78% vs. 56%, RR= 2.6; 95% CI: 1.78-5.86], and reduced the risk of late initiations [14% vs. 33%, RR= 2.8; 95% CI: 1.83-4.37]. The complementary food initiation survival curve for the control group after 6 months was constantly above the curve than for the intervention group. The median age at the introduction of complementary food for infants was 6 months in the intervention group, and 6.7 months in the control group and the difference was statistically significant (P <0.001).

Conclusions: Complementary feeding behavior change communication improved the rate of timely initiation of complementary foods and reduced the risk of late initiations.

4.1. Introduction

From all known health and nutrition preventive intervention strategies, optimal IYCF has the best significant impact on child growth and survival (Yamauchi, 2008). Exclusive breastfeeding for the first six months followed by timely initiation of appropriate complementary foods with continued breastfeeding for the first year of life could avert 13% of the deaths among children under 5 every year (Saha *et al*., 2008). Nonetheless, suboptimal feeding practices account for more than half of the deaths of under five children worldwide. Over two-thirds of these deaths are related to inappropriate feeding practices during the first 2 years of life (WHO, 2001).

Adequate nutrition during infancy and early childhood is critical to the development of children's full human potential. Exclusive breastfeeding is critical and adequate for the first six months of age. However, after six months breast milk alone is no longer sufficient to meet an infant's nutritional requirements (Singer *et al*., 2011; Imdad *et al*., 2011). WHO recommends that mothers should initiate nutritionally adequate, safe, age-appropriate complementary foods at the sixth month of age, maintaining breastfeeding until the age of two years and beyond (Lartey, 2015).

The complementary feeding period is a critical time of transition in infants characterized by a gradual shift from breast milk to family food. The incidence of growth faltering increases significantly at 6 months of age when complementary foods are being introduced (WHO, 2019).

Attaining the recommended level of complementary feeding practices remains a serious challenge in developing countries (Zaman, Ashraf, & Martines, 2008). The rate of timely initiation of complementary food is lower than the WHO recommendation. Complementary foods are untimely initiated (either too early or too late), which has adverse consequences on the growth, development, and survival of infants. Early initiation of complementary foods (before the age of the sixth month) can lead to the displacement of breast milk and increased risk of infections, which further contributes to weight loss and malnutrition (Rao *et al*., 2011). Conversely, late initiation of complementary foods is also associated with negative consequences to the infants' health. As breast milk is no longer able to sustain the nutritional requirements of an infant after six months of age, continuing to feed only breast milk beyond this period leads to

nutritional deficiencies and therefore leads malnutrition, increased susceptibility to infections, and morbidity (Hasnain, Majrooh, & Anjum, 2013).

The promotion of optimal complementary feeding through behavior change interventions is a global health priority. The focus of most studies conducted worldwide seemed to be on the effect of behavior change interventions on the adequacy of complementary diets; but not on the timing of initiations (Dachi, Sewanu, & Friday, 2018). This trial aimed to evaluate the effectiveness of complementary feeding behavior change communication delivered through community-level actors on the time of initiation of complementary foods.

4.2. Methods

4.2.1. Measurements

Baseline data collection was conducted following enrolment of trial participants using a pre-tested structured interviewer-administered questionnaire to assess infant, caregiver and household characteristics in both the control and intervention groups. At the end of the intervention period, data were collected to determine the time of initiation of complementary food to children between the study groups.

The time of complementary food initiation was assessed according to the key indicators recommended by WHO (WHO, 2017). Accordingly, the outcome variables (early, timely and late initiations) were determined by asking the mothers to recall the age at which they first initiated any solid, semi-solid, or soft foods to the index child in addition to breast milk. If the mother initiated complementary food for the child before the sixth month (before 180 completed days), it was categorized as "early initiation"; if she had initiated exactly at the sixth month (180 completed days), it was categorized as "timely initiation" and if she had initiated after the sixth month (after 180 completed days), it was categorized as "late initiation". For a few mothers who encountered difficulties in remembering the right age they introduced complementary food for their children, data collectors conducted different probing techniques to help them recall. Some of the probing techniques were relating the time of initiation to known public events, occurrences of common childhood developmental milestones, and immunization schedules.

4.2.2. Statistical Analyses

Data were doubly entered into the EPI-Info, exported to SPSS version 21 for cleaning and statistical analyses. Baseline characteristics of the study groups were presented using descriptive statistics. Generalized estimated equations (GEE) regression analyses were used to test the effect of the intervention on the time of initiation of complementary food. Relative risks (RR) with a 95% confidence interval (CI) were computed as an outcome measure of the intervention effect. Life table survival analysis was conducted to estimate the likelihood of complementary food initiation to children at each month interval between the study groups. Kaplan-Meier survival analysis was used to examine the time to initiation of complementary food, and the log rank test was used as an effect measure. All analyses were conducted according to the intention to treat

(ITT) principle and the adjusted effect measures were considered as the main results. P-value <0.05 was considered statistically significant.

4.3. Results

At baseline, a total of 612 mother-child pairs (306 in the control and 306 in the intervention group) were recruited yielding a response rate of 100%. Of these, 34 (11%) in the intervention group and 24 (7.8%) in the control group were excluded from the study because they moved away from the study area, decided not to continue in the study or were lost to follow-up during the endline data collection. Overall, endline data were completed for 554 (90.5%) of the trial participants in both study groups.

Baseline characteristics

Baseline infant, caregiver, and household characteristics were comparable between the intervention and control clusters (Table 4.1).

Table 4.1. Baseline characteristics of the trial participants.

Variable	Control group (N= 282)	Intervention group (N= 272)
Infant		
Sex (%)		
Male	55.3	54.6
Female	44.7	45.6
Age (months), mean±SD	3.22±1.4	3.21±1.48
Anthropometry		
Weight (kg), mean±SD	5.50±1.06	5.47±1.05
Length (cm), mean±SD	59.56±3.77	59.22±4.04
Undernutrition		
Wasting (%)	27 (9.6)	24 (8.8)
Stunting (%)	64 (24)	69 (25.4)
Underweight (%)	54 (19)	50 (18.4)
Morbidity		
Fever	45 (14.7)	54 (17.6)
Diarrhea	44 (14.4)	39 (12.7)
Cough	34 (12)	30 (11)
Mother		
Age (months), mean±SD	27.2±5	28.05±4.8
Educational status (%)		
Attended formal education	23.8	19.4
No formal education	76.2	80.6
Occupation (%)		
Farmer	12.1	10.8
Housewife	87.9	89.2
Marital status (%)		
Married	93.6	94.6
Others	6.4	5.4
Parity (%)		
Primiparous	16.7	19.8
Multiparous	83.3	80.2
ANC visit (%)		
Yes	73.4	71.4
No	26.6	28.6
Place of delivery (%)		
Home	63.5	64.8
Health facility	36.5	35.2
PNC (%)		
Yes	27	22.7
No	73	77.3
IYCF counseling (%)		
Yes	33	30.4
No	67	69.6

Table 4.1. Baseline characteristics of the trial participants. ***(continued)***

Variable	Control group (N= 282)	Intervention group (N= 272)
Household		
Family size, mean±SD	5.5±1.8	5.3±1.9
Possession of radio (%)		
Yes	19.5	22
No	80.5	78
Listen to *seven solutions* (%)		
Yes	27.3	21.7
No	72.7	78.3

Effects of the Intervention

Binary GEE regression analyses were done to test the effects of the intervention on the time of complementary food initiation for children between the control and intervention groups. Complementary food was initiated for 264 (97%) children in the intervention group and 258 (91.5%) in the control group at the time of data collection. The proportions of early, timely, and late initiations of complementary food were compared among mothers who initiated complementary foods for their children between the study groups. The proportion of early initiation of complementary food was higher in the control, 28 (11%), than intervention group, 22 (8%), but the difference was not statistically significant [RR= 1.3; 95% CI: 0.75-3.86]. On the other hand, there was a statistically significant difference in the proportion of timely initiation of complementary food which was higher in the intervention, 206 (78%) as compared to the control group, 145 (56%) [RR: 2.6; 95% CI: 1.78-5.86]. The proportion of late initiation of complementary food was higher in the control, 83 (33%), than the intervention group, 36 (14%), and the difference was statistically significant [RR: 2.8; 95% CI: 1.83-4.37] (Table 4.2).

Table 4.2 Generalized estimated equation regression analyses on the time of initiation of complementary food for infants by study groups.

Variable	Study group	N (%)	RR (95% CI)
Early initiation	CG	28 (11)	1.3 (0.745-3.857)
	IG	22 (8)	1
Timely initiation	CG	145 (56)	1
	IG	206 (78)	2.6 (1.778-5.862)
Late initiation	CG	85 (33)	2.8 (1.825-4.370)
	IG	36 (14)	1

CG: control group; IG: intervention group; RR: relative risk; CI: confidence interval.

The proportion of time of initiation of complementary food between the control and intervention groups is also presented in figure 4.1. The proportions of early, timely, and late initiations were 8%, 78% and 14% in the intervention group, whereas it was 11%, 56% and 33% in the control group, respectively.

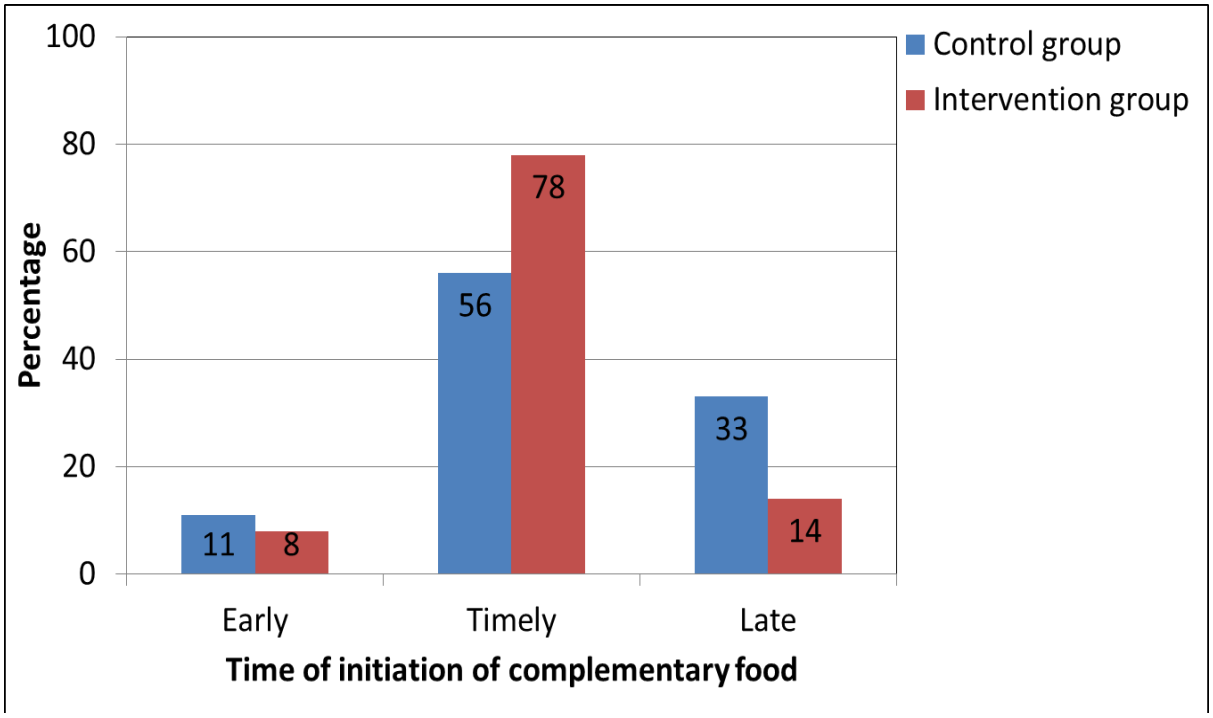

Fig 4.1. The proportion of time of initiation of complementary foods by study groups.

Table 4.3 shows the cumulative survival probabilities of complementary food initiation at different ages of children for control and intervention groups. The life table, for example, indicated that the cumulative survival probability of complementary food initiation for the first 6 months was higher in the control group, 37%, than the intervention group, 17%. This showed that a higher proportion of children in the control group as compared to those in the intervention group did not receive complementary food for the first 6 months. Likewise, complementary food was not introduced for 14% of children for the first 8 months in the control group, which was only 3% in the intervention group.

Table 4.3. Cumulative survival probabilities and hazard rates of complementary food initiation at different ages of infants in months between the study groups.

Study group	Time of complementary food initiation (months)	Interval start time (months)	No. of cases entering this interval	No. of censored cases	No. of terminal events	Proportion of surviving	Cumulative survival probability at the end of interval	Hazard rate
Control group	0-1	0	282	0	0	1.00	1.00	.00
	1-2	1	282	0	0	1.00	1.00	.00
	2-3	2	282	0	3	.99	.99	.01
	3-4	3	279	1	5	.98	.97	.02
	4-5	4	273	0	2	.99	.96	.01
	5-6	5	271	2	18	.93	.90	.07
	6-7	6	251	3	146	.41	.37	.83
	7-8	7	102	6	31	.69	.26	.37
	8-9	8	65	6	27	.56	.14	.56
	9-10	9	32	6	24	.17	.02	1.41
	10-11	10	2	0	2	.00	.00	.00
Intervention group	0-1	0	272	0	0	1.00	1.00	.00
	1-2	1	272	0	0	1.00	1.00	.00
	2-3	2	272	1	0	1.00	1.00	.00
	3-4	3	271	0	4	.99	.99	.01
	4-5	4	267	0	4	.99	.97	.02
	5-6	5	263	1	14	.95	.92	.05
	6-7	6	248	2	202	.18	.17	1.38
	7-8	7	44	0	24	.45	.08	.75
	8-9	8	20	4	12	.33	.03	1.00
	9-10	9	4	0	4	.00	.00	2.00

Kaplan-Meir survival analysis in figure 4.2 shows that the time to initiation of complementary food for the control group after 6 months was constantly above the curve for the intervention group. The difference was statistically significant on a Log Rank (Mantel-Cox) test (p-value <0.001). The median age for initiation of complementary food was estimated 6.7 months for control groups and 6 months for the intervention groups.

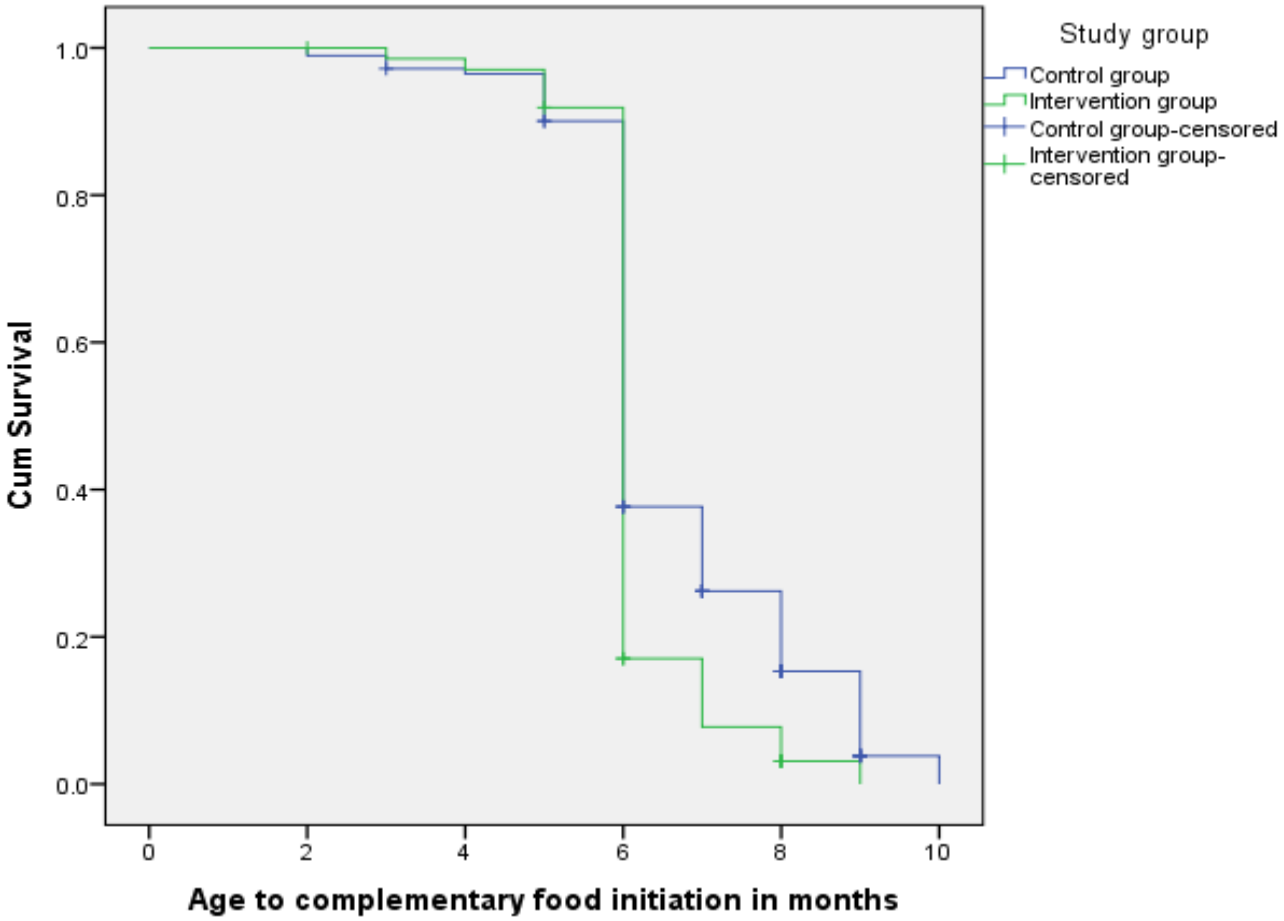

Fig 4.2. Kaplan-Meier curve on time to initiation of complementary food by study groups

4.4. Discussion

The main findings of this study indicated that the intervention had statistically significant effects on the rates of time of initiation of complementary food between the study groups. The likelihood of timely initiation of complementary food was 2.6 times more in the intervention group as compared to those in the control group [RR: 2.6; 95% CI: 1.78-5.86]. Conversely, mothers in the control group were 2.8 times more likely to initiate complementary food lately as compared to those in the intervention group [RR: 2.8; 95% CI: 1.83-4.37].

Our finding is in line with the results of a systematic review of four cluster-randomized trials (Dachi *et al*., 2018). In this review, the pooled effect estimate suggests that, compared to standard care, the educational intervention significantly reduced the risk of early introduction of complementary food (before four to six months of age) by 12 percentage points [average RR: 0.88; 95% CI: 0.83-0.94). Studies used intervention delivery strategies that ranged from counseling sessions to the use of printed materials, flip charts and videos, with some studies using a combination of at least two of the listed delivery strategies.

A cluster randomized controlled trial conducted in rural Cambodia found no significant differences in the proportions of children on which complementary food is introduced at 6-8 months between the intervention (88%) and control group (92.6%), (P= 0.349) (Reinbott *et al*., 2016). Trained community nutrition promoters together with local NGO conducted seven nutrition education sessions for interested caregivers with children aged 5-18 months in the intervention villages. The insignificant effect of the intervention in the Cambodian study could be due to the rate of timely initiation of complementary food was already high at baseline in both control and intervention groups. There was also a difference in the definition of the right age for the introduction of complementary foods between the Cambodian study (at the age of 6-8 months), and our study. WHO recommends the right age for the introduction of complementary food for infants is at the age of the sixth month (Lartey, 2015).

The life table survival probability distribution, in our study, indicated that a higher proportion of children did not receive complementary food for the first 6 months in the control group (37%) as compared to those in the intervention group (17%). Likewise, complementary food was not

introduced for14% of children for the first 8 months in the control group, which was only 3% in the intervention group.

In our study, the Kaplan-Meir survival analysis showed that the survival curve for the control group after 6 months was constantly above the curve for the intervention group. The median age for initiation of complementary food for children was higher in the control group (6.7 months) as compared to those in the intervention group (6 months), and the difference was statistically significant (P <0.001).

A similar result was found by a cluster-randomized controlled trial conducted in rural Brazil. In the Brazilian study, mothers and grandmothers in the intervention group received a total of five counseling sessions on breastfeeding and healthy complementary feeding at the maternity ward and home whereas the control group received the usual care. The median age at the introduction of complementary food was 5 months in the intervention group and 4 months in the control group and the difference was statistically significant (P <0.01). The educational intervention improved the age at which complementary foods are introduced for infants (Schwartz *et al*., 2015).

In general, the focus of most of the studies conducted worldwide was to investigate the effect of behavior change interventions on the adequacy of complementary foods of children. Studies that evaluated the effect of such interventions on the time of initiation of complementary food are very limited worldwide. Nonetheless, the age at which complementary foods are introduced is an important factor for the optimal growth and development of children. Both early and late initiations have adverse consequences on children's health and nutrition.

Early initiation of complementary feeds can lead to the displacement of breast milk and increases the risk of infections, which further contributes to weight loss and malnutrition. Conversely, late initiation of complementary food is also associated with negative consequences to the infant's health. As breast milk is no longer able to sustain the nutritional requirements of an infant after six months of age, continuing to feed only breast milk beyond this period leads to nutritional deficiencies and therefore as a consequence of malnutrition, the child is susceptible to morbidity (Victora *et al*., 2010).

Strength and limitation of the study

The strengths of this study are the use of the cluster-randomized design, and the intervention engaged not only mothers/caregivers but also family members. The intervention effects would be also sustainable because it was delivered in a community supportive environment. This study has some limitations to be mentioned. First, due to the nature of the study, it was not possible to conduct a double-blind trial. So, mothers in the intervention group might over-report the desired practices rather than the actual practice. Second, the age to the introduction of complementary food was determined based on maternal recall. Hence, recall bias can not be excluded even if data collectors applied various probing techniques to help mothers remember the correct age.

4.5. Conclusions

This study indicates the potential effectiveness of complementary feeding behavior change communication delivered through community-level actors in improving the rate of the timely initiation of complementary foods and reducing the risk of late initiations. The result suggests also behavior change intervention that engaged not only mothers of infants but also their family members could be an effective approach.

5

Chapter 5: Effect of Complementary Feeding Behavior Change Communication Delivered through Community-level Actors on Dietary Adequacy of Infants in Rural Communities of West Gojjam Zone, Northwest Ethiopia: a Cluster-randomized Controlled Trial

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Abstract

Introduction: Attaining the recommended level of adequacy of the infant's diet remains a serious challenge in most developing countries, including Ethiopia. Complementary foods are inadequate both in quality and quantity that can result in adverse health and nutrition consequences in infants. Effective interventions are needed to improve the overall dietary adequacy of complementary diets and promote the consumption of a variety of foods including local foods, especially in poor rural communities. Studies have demonstrated that behavior change interventions have positive effects on the knowledge of caregivers, and the dietary adequacy of infants. This trial aimed to evaluate the effectiveness of complementary feeding behavior change communication delivered through community-level actors on the dietary adequacy of infants.

Methods: GEE regression analyses adjusted for baseline covariates and clustering were used to test differences in the rates of MDD, MMF, and MAD between the intervention and control groups. Relative risks (RR) with a 95 % confidence interval (CI) were computed as an outcome measure of the intervention effect. All analyses were conducted according to the intention to treat principle and the adjusted effect measures were considered as the main results. P <0.05 was considered statistically significant.

Results: The intervention showed positive statistically significant effects on the consumption of dairy products [RR=1.8; 95% CI: 1.04-3.13], eggs [RR=3; 95% CI: 1.35-6.56], vitamin A-rich fruits and vegetables [RR= 2.7; 95% CI: 1.17-6.1], other fruits and vegetables [RR=5; 95% CI: 2.49-10.58] and any of the animal-source foods [RR=2; 95% CI: 1.39-2.87]. The proportions of infants who achieved minimum dietary diversity [RR= 3; 95% CI: 1.34, 7.39], minimum meal frequency [RR= 2.4; 95% CI: 1.37-4.29], and minimum acceptable diet [RR= 2.7; 95% CI: 1.13-7.23] were significantly higher in the intervention as compared to control groups.

Conclusions: Complementary feeding behavior change communication delivered through community-level actors significantly improved the rates of the dietary adequacy of infants.

5.1. Introduction

Children between 6 and 23 months are the most vulnerable to malnutrition, because of the transition from total exclusive breastfeeding to solid foods. This period is of particular importance because this is the period when infants and young children experience rapid growth and development. During this period, growth faltering and micronutrient deficiencies are highly prevalent owing to children's high nutrient demand relative to their energy and micronutrient intakes (WHO, 2013). This transition stage presents with the challenges of optimal complementary feeding that are linked to dietary diversity, dietary quality, food safety, and energy density. Ensuring adequate nutrition during the complementary feeding period, between 6 and 23 months of age, is a major global health priority (Dewey *et al*., 2013).

The complementary feeding period is a critical time of transition in infants characterized by a gradual shift from breast milk to family food. The incidence of growth faltering increases significantly at 6 months of age when complementary foods are being introduced particularly in developing countries (Shrimpton *et al*., 2001). The sharp rise in the occurrence of stunting, and other forms of undernutrition in young children is usually associated with suboptimal complementary feeding practices (Daelmans *et al*., 2013). As children younger than 24 months old do not consume a sufficient amount of food to cover the high nutrient needs for growth and development, food given to them should be of high nutrient density (Dewey *et al*., 2013).

Theoretically, infants should receive the most nutrient-dense diet in the family. Complementary foods should contain high-biological value protein, furthermore, vitamins and minerals. Infants in low-income countries, however, are typically fed with nutrient-poor foods like thin porridges (WHO, 2003).

Improvement of infant and young child nutrition is fundamental to reduce malnutrition. When children are around 6 months old, breast milk is insufficient to provide all the energy and nutrients they need (Udoh & Amodu, 2016). Their nutritional needs for growth and development between 6 and 23 months are greater per kilogram of body weight than at any other time of life, making them especially vulnerable to nutritional deficiencies and growth faltering. Introducing a healthy and diverse range of complementary foods along with breastfeeding can help protect against illness and death, while also ensuring healthy growth and development. Equally, children

between 6 and 23 months can suffer lifelong consequences if they eat unhealthy diets that lack diversity, and low in essential nutrients (UNICEF, 2019).

Starting from 6 months of age, children benefit especially from foods of animal origin, including meat, eggs and dairy products, which are effective in providing them with essential nutrients and vitamin A, iron, zinc and calcium that are so needed between the ages of 6 and 23 months (UNICEF, 2019).

Globally, the complementary feeding practice is far from the WHO recommendation. Only less than one-third (29%) of the children aged 6-23 months are meeting the MDD, half (52%) are meeting the MMF, and only one-sixth of children (16%) are meeting the MAD (Micha *et al*., 2020). The situation is particularly worrying for the youngest children (6-11 months).

Attaining the recommended level of adequacy of an infant's diet remains a serious challenge in many developing countries, including Ethiopia. The challenges during complementary feeding are context-specific, but many are common across settings. They are often characterized by poor feeding practices and poor dietary quality of homemade complementary foods (Krebs *et al*., 2011; Dewey & Adu-Afarwuah, 2008). Complementary foods are mainly starchy-staples that lack the desired nutrient quality, amount, and density with limited consumption of animal-source foods (meat, eggs or dairy products), fruits and vegetables (Plessis *et al*., 2013; Arimond & Ruel, 2004).

Often infants and young children are not given the care and attention needed during the selection of nutritious foods and the encouragement needed to eat sufficient amounts of foods (Nti & Lartey, 2007). In addition, even when food resources are available in the home, caregivers might not make the best use of them due to a lack of knowledge of the best foods for young children, cultural beliefs and practices, and inappropriate advice (Bhandari *et al*., 2004; Guldan *et al*., 2000).

Most of the complementary feeding indicators are worse in rural areas than in urban settings, and children living in the poorest households. However, MFF, MDD, and MAD are suboptimal even in households from higher wealth quintiles, suggesting that other factors such as cultural

practices, traditional beliefs, and poor knowledge regarding adequate diets for young children need to be addressed (White *et al*., 2017).

Inappropriate complementary feeding practices, with their negative health consequences, remain a significant public health problem worldwide (Manikam *et al*., 2017). Suboptimal complementary feeding practices are not only caused by the lack of food, but also associated with poor knowledge, attitude, cultural norms and behaviors of mothers/caregivers (Guldan *et al*., 2000).

Promoting optimal complementary feeding practices is a global health priority to improve infant feeding practices particularly in developing countries. Effective interventions are needed to improve the overall dietary quality of complementary diets and promote the consumption of a variety of foods, including local foods, and not merely the intake of individual foods or nutrients, especially in poor rural communities in developing countries (Lutter & Rivera, 2003).

To date, a variety of programme strategies to improve complementary feeding have been implemented all over the world with different rates of success, most notably through the use of nutrition education and BCI approaches, locally available foods and food systems, and/or supplementary foods and food fortification initiatives. Studies have demonstrated that BCI interventions have positive effects on the knowledge of caregivers, and the dietary adequacy of infants (Shi *et al*., 2010; Inayati *et al*., 2012; Frongillo, 2017). Therefore, this trial aimed to evaluate the effectiveness of complementary feeding behavior change communication delivered through community-level actors in improving the dietary adequacy of infants. We hypothesized that the intervention would be effective in improving the dietary adequacy of infants.

5.2. Methods

5.2.1. Measurements

At the end of the intervention period, data were collected to examine complementary feeding practices of mothers for their infants in both the intervention and control groups. Recruited infants aged <6 months at baseline survey achieved 9-15 months of age at the time of endline data collection.

The key dietary adequacy indicators; MDD, MMF and MAD, were determined based on WHO guidelines (WHO, 2010). The dietary intake of infants was determined based on the 24 hours dietary recall of mothers.

MDD is defined as the proportion of children 6-23 months of age who received foods from four or more food groups in the previous day or night. It is computed using the following equation:

$$\text{MDD} = \frac{\text{Children 6–23 months of age who received items from } \geq 4 \text{ food groups during the previous day}}{\text{Children 6–23 months of age}}$$

There are 17 sub-food groups that are recommended by WHO. These sub-food groups were further aggregated into seven food groups. Each trial participants were requested to describe everything the child ate during the previous day or at night from the time the child woke up until going to sleep the next day. As the respondents mentioned the food, the data collector underlined the corresponding sub-group to which the food item belongs. Then, the main seven food groups were generated. The seven standard food groups include: (i) Grains, roots, and tubers; (ii) Legumes and nuts; (iii) Dairy products (milk, yogurt and cheese); (iv) flesh foods (meat, fish, poultry, and liver/organ meats); (v) Eggs; (vi) Vitamin A-rich fruits and vegetables; and (vii) Other fruits and vegetables.

MMF is defined as the proportion of breastfed and non-breastfed children 6-23 months of age who received solid, semisolid, or soft foods the minimum number of times or more in the previous day or night. It is computed using the following equations:

$$\text{MMF} = \frac{\text{Breastfed children 6–23 months of age who received soft, semi–solid or sold foods the minimum numbers of times or more during the previous day}}{\text{Breastfed children 6–23 months of age}}$$

$$\text{MMF} = \frac{\text{Nonreastfed children 6–23 months of age who received soft ,semi –solid or solid food the minimum numbers of times or more during the previous day}}{\text{Nonbreastfed children 6–23 months of age}}$$

The recommended MMF differs by child age and current feeding mode (breastfed or nonbreastfed). Respondents were asked whether the child breastfed in the previous day. The response to this question was used to screen breastfed from nonbreastfed children. The age question responses were used to screen the required age for each category. The MMF is 2 times for breastfed children 6-8 months, 3 times for breastfed children 9-23 months, or 4 times for nonbreastfed children aged 6-23 months.

MAD is defined as the proportion of children 6-23 months of age who received at least the MDD and the MMF in the previous day or night.

$$\text{MAD} = \frac{\text{Children 6–23 months of age who received the MDD and MMF during the previous day}}{\text{Children 6–23 months of age}}$$

5.2.2. Statistical Analyses

Baseline characteristics of the study groups were presented using descriptive statistics. Binary GEE regression analysis adjusted for potential covariates and clustering were used to test differences in the rates of MDD, MMF, and MAD between the intervention and control groups. Relative risks (RR) with a 95 % confidence interval (CI) were computed as an outcome measure of the intervention effect. All analyses were conducted according to the intention to treat (ITT) principle and the adjusted effect measures were considered as the main results. P-value <0.05 was considered as statistically significant.

5.3. Results

Baseline characteristics

Baseline infant, caregiver, and household characteristics were comparable between the intervention and control clusters as presented in **chapter 4**.

Effects of the Intervention

The consumption frequencies of food items used for measuring infants and young children's dietary adequacy indicators recommended by WHO are presented in Table 5.1. The intervention showed positive effects on the food items consumed ranging from 2 to 27 percentage points with statistically significant differences in the consumption of dairy products, eggs, vitamin A-rich fruits and vegetables, other fruits and vegetables and any of the ASFs.

The proportions of infants who consumed grain, roots, and tuber were almost similar between the control group, 88.4%, and intervention groups, 90.7%, [RR=1.1; 95% CI: 0.45-2.65]. Likewise, there was no significant difference in the percentage of legumes and nuts consumed; 24% in the control and 28.6% in the intervention groups, [RR=1.1; 95% CI: 0.45-2.65]. There was also no statistically significant difference in the consumption frequencies of flesh foods between the study groups; 4.4% in the control and 6.6% in the intervention groups, [RR=1.2; 95% CI: 0.33-4.64].

On the other hand, the intervention showed a positive statistically significant effect on the proportion of dairy products consumed; 53.3% in the intervention and 37.6% in the control group, [RR=1.8; 95% CI: 1.04-3.13]. The consumption of eggs was higher in the intervention group, 25.5% as compared to the control group, 9.6%, and the difference was statistically significant, [RR=3; 95% CI: 1.35-6.56]. Similarly, the intervention significantly influenced the consumption frequency of vitamin A-rich fruits and vegetables; 9.2% in the control and 23% in the intervention group, [RR= 2.7; 95% CI: 1.17-6.1]. Likewise, there was a statistically significant improvement in the consumption frequency of other fruit and vegetables; 14.4% in the control and 32.4% in the intervention group, [RR=5; 95% CI: 2.49-10.58]. Consumption of any of ASF was higher in the intervention, 54.8%, as compared to the control group, 38.4%, and the difference was statistically significant; [RR=2; 95% CI: 1.39-2.87].

Table 5.1. Generalized estimated equation regression analyses on the food items consumed by infants at endline by study groups

Food items	Study groups	n (%)	*RR (95% CI)
Grains, roots & tubers	CG	221 (88.4)	1
	IG	235 (90.7)	1.1 (0.451-2.647)
Legumes & nuts	CG	60 (24.0)	1
	IG	138 (28.6)	1.1 (0.451-2.647)
Dairy products	CG	94 (37.6)	1
	IG	138 (53.3)	1.8 (1.044-3.128)
Flesh foods	CG	11 (4.4)	1
	IG	17 (6.6)	1.2 (0.326-4.636)
Eggs	CG	24 (9.6)	1
	IG	66 (25.5)	3 (1.347-6.558)
Vitamin A-rich fruits & vegetables	CG	23 (9.2)	1
	IG	59 (23.0)	2.7 (1.173-6.1)
Other fruits & vegetables	CG	36 (14.4)	1
	IG	84 (32.4)	5 (2.491-10.579)
Any of the Animal-source foods	CG	96 (38.4)	1
	IG	142 (54.8)	2 (1.392-2.869)

CG: control group (N=250); IG: intervention group (N= 259); RR: relative risk; CI: confidence interval.
*RRs were as yielded by the "Generalized estimated equation regression analyses."

The proportions of infants who achieved the WHO dietary adequacy indicators between the study groups are presented in Table 5.2. The proportions of infants who achieved MDD (21% vs. 8%; RR= 3; 95% CI: 1.34-7.39), MMF (62% vs. 39%; RR= 2.4; 95% CI: 1.37-4.29), and the composite indicator MAD (16% vs. 5.6%; RR= 2.7; 95% CI: 1.13-7.23), were significantly higher in the intervention as compared to control groups, respectively.

Table 5.2. Generalized estimated equation regression analyses on the proportion of infants who achieved the dietary adequacy indicators at endline by study groups.

Indicator	Study groups	n (%)	*RR (95% CI)
MDD	CG	20 (8)	1
	IG	55 (21)	3 (1.339-7.393)
MMF	CG	97 (39)	1
	IG	158 (62)	2.4 (1.369-4.292)
MAD	CG	14 (5.6)	1
	IG	41 (16)	2.7 (1.131-7.229)

CG: control group (N=250); IG: intervention group (N= 259); MDD: minimum dietary diversity; MMF: minimum meal frequency; MAD: minimum acceptable diet; RR: relative risk; CI: confidence interval.
*RRs were as yielded by the "Generalized estimated equation regression analyses."

5.4. Discussion

Complementary foods, particularly in developing countries, are inadequate both in quality and quantity which lack a variety of essential nutrients for optimal growth and development of infants (Piwoz, Baker, & Frongillo, 2013). It is critical to design behavior change intervention strategies that can improve the dietary adequacy of complementary foods for infants

This study was a community-based cluster-randomized controlled trial aimed to investigate the effectiveness of complementary feeding behavior change communication delivered through community-level actors on the dietary adequacy of infants. The main focus of the intervention was to promote the use of a variety of locally available and affordable nutritious foods to improve the adequacy of traditional homemade complementary diets. The intervention had significantly influenced the adequacy (both quality and quantity) of complementary diets consumed by children. This suggests that behavior change intervention on optimal complementary food without food supplements can improve dietary diversity and adequacy.

Inappropriate complementary feeding practices with the associated adverse nutrition and health effects in infants remain a significant public health problem worldwide, especially in developing countries (Abdurahman *et al*., 2019). The dietary adequacy of an infant's food is dependent on meal frequency and food groups contained in the diet (Human, 2018). Improving the quantity and quality of infant's food in this critical window of period is among the most cost-effective strategies to improve overall health and ensure nutritional wellbeing (Bhutta & Salam, 2012).

In this study, the intervention had positive statistically significant effects on the consumption of dairy products, eggs, vitamin A-rich fruits and vegetables; other fruits and vegetables; and animal-source foods. The consumptions of dairy products (53.3% vs. 37.6%; RR=1.8; 95% CI: 1.04-3.13), eggs (25.5% vs. 9.6%; RR=3; 95% CI: 1.35-6.56), vitamin A-rich fruits and vegetables (23% vs. 9.2%; RR= 2.7; 95% CI: 1.17-6.1), and other fruits and vegetables (32.4% vs. 14.4%; RR=5; 95% CI: 2.49-10.58) were significantly higher in infants in the intervention as compared to those in the control groups, respectively. Similarly, the proportion of infants who consumed any of the animal-source foods was significantly higher in the intervention group, 54.8%, as compared to the control group, 38.4% (RR=2; 95% CI: 1.39-2.87).

Complementary foods mostly are plant-based which lack the essential nutrients for the growth and development of children 6-24 months of age, particularly in developing countries. It is therefore recommended to feed children a variety of animal-source foods (flesh meats, eggs, and dairy products) since they are rich in protein and micronutrients which are important for optimal health and nutrition.

The consumption of ASFs can also improve dietary adequacy in infants (Whaley *et al*., 2003). In our study, the significant effects of the intervention on the consumption of eggs and dairy products could be due to poultry and cow rearing are common practices in the study area that would make eggs and dairy products accessible in the intervention clusters. Nonetheless, the intervention had not shown a significant difference in the proportion of infants that consumed meats. This could be explained by meats are relatively expensive in the study area and might not be affordable for most households regularly.

The intervention had positive significant effects on the proportion of infants who achieved the WHO dietary adequacy indicators. The proportions of infants who achieved the MDD (21% vs. 8%; RR= 3; 95% CI: 1.34-7.39), MMF (62% vs. 39%; RR= 2.4; 95% CI: 1.37-4.29), and MAD (16% vs. 5.6%; RR= 2.7; 95% CI: 1.13-7.23) were significantly higher in the intervention than control groups, respectively. This was due to the achievement of higher consumption of frequencies of food groups in the intervention than control groups.

The result of this trial is supported by the findings of studies conducted in different parts of the world. A cluster-randomized controlled trial conducted in Malawi applied group training and individual counseling to promote optimal complementary feeding practices mainly targeting caregivers of children. The nutrition education intervention was designed as a series of ten facilitated sessions. Pairs of trained volunteers facilitated the sessions in their home villages. The sessions covered topics on the selection of age-appropriate food, nutrients, diet, feeding children, food preparation, water, sanitation, and hygiene. The intervention showed a significant positive effect on MDD and MAD but not on MMF (Kuchenbecker *et al*., 2017).

In another behavior change intervention carried out in India, health and nutrition workers in the intervention communities conducted counseling on complementary feeding for caregivers based on locally developed feeding recommendations through monthly home visits. The meal frequencies and energy intakes were significantly higher in the intervention communities but the intervention failed to improve significantly the proportion of infants who achieved MDD and MAD between the control and intervention groups (Bhandari *et al*., 2004).

A community-based educational intervention was conducted in Kenya. This nutrition education intervention consisted of four sessions comprising group training and cooking demonstrations that were conducted over a period of 5 months. In this trial, significantly higher proportions of children achieved the MDD, MMF, and MAD in the intervention group compared with the control group at endline. The consumption frequencies of different food groups also improved significantly among children in the intervention group after the nutrition education program but failed to significantly improve the consumption of animal-source foods (Waswa *et al*., 2015).

The trials discussed above were community-based behavior change interventions without the provision of food and the key messages were also focused on the use of locally available foods like our study. However, many of the interventions targeted only mothers/caregivers and did not engage the family members. This could be the reason why some of the interventions failed to improve either the quality or quantity of the complementary foods or the consumption of ASFs.

In our study, the behavior change intervention significantly improved the dietary adequacy (both the quality and quantity) of complementary foods including the consumption of the proportion of animal-source foods. This could be due to different reasons. First, our intervention was delivered through community-level actors who would have influence changes in traditional norms about feeding behavior and encourage the adoption of the recommended feeding practices in the community. Second, the intervention targeted not only mothers but also family members (fathers and grandmothers of recruited infants) that would provide a supportive environment for behavior change to mothers. The mothers were also taught how to incorporate locally available and affordable nutrition foods into the existing homemade complementary foods during cooking demonstrations that can be well accepted by mothers/caregivers.

Community-based nutrition education for behavior change has the potential to improve complementary feeding practices. Through raised awareness and knowledge, changes in behavior can be expected, thereby improving the adequacy of complementary diets (Muehlhoff *et al*., 2017). However, nutrition education alone may not be sufficient in improving complementary feeding practices particularly in countries with low agricultural productivity, and with poverty. This is due to the fact that low agricultural productivity and poverty can directly affect the availability, affordability and utilization of food in the caregiver's household. Improved agricultural production and/or purchasing power can increase access and consumption of nutritious foods, and result in improving the adequacy of complementary diet (Reinbott *et al*., 2016).

Strength and limitation of the study

The strengths of this study are the use of the randomized controlled design that included a fairly large sample size. Because the intervention was delivered through community-level actors, it improved the chance of sustainability. Our study has some limitations. First, due to the nature of the study, it was not possible to conduct a double-blind trial. Second, complementary feeding indicators measurement was based on maternal dietary recall. Hence, recall bias cannot be excluded even if data collectors applied various probing techniques. Third, using a single 24-hour recall to collect dietary data for constructing the indicators might not explain the usual food consumption. Forth, dietary adequacy was measured using self-reported data, not based on direct observation. These might have led to over-reporting of the desired practices rather than the actual practices.

5.5. Conclusion

This study indicates the potential effectiveness of complementary feeding behavior change communication delivered through community-level actors in improving the dietary adequacy of infants. The results suggest that behavior change intervention that engaged not only mothers of infants but also their family members could be an effective approach. Significant changes can also be achieved on dietary adequacy through the promotion of a variety of locally available and affordable nutritious foods that can be well accepted by mothers.

6

Chapter 6: Effect of Complementary Feeding Behavior Change Communication Delivered through Community-level Actors on Infant Growth and Morbidity in Rural Communities of West Gojjam Zone, Northwest Ethiopia: a Cluster-randomized Controlled Trial

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Abstract

Introduction: The incidence of growth faltering and morbidity increases significantly at 6 months of age when complementary foods are being introduced. Improving feeding practices in this critical window of period is among the most cost-effective strategies to improve overall infant health and ensure their nutritional wellbeing. Therefore, interventions are needed to improve caregivers' feeding behaviors, thereby enhancing infant growth and reducing morbidity, especially in rural areas. This trial aimed to evaluate the effect of complementary feeding behavior change communication delivered through community-level actors on infant growth and morbidity.

Methods: Linear generalized estimating equations regression analyses were used to test the effects of the intervention on weight and height gains. Binary generalized estimating equations model were used to test effects of the intervention on stunting, underweight, wasting and morbidity. All analyses were adjusted for baseline covariates and clustering. Mean differences and relative risks with 95% confidence interval were computed as a measure of intervention effects for continuous and categorical variables, respectively. All analyses were conducted according to the intention to treat principle.

Results: Infants in the intervention group had significantly higher weight gain [MD: 0.46 kg; 95% CI: 0.36-0.56] and length gain [MD: 0.96 cm; 95% CI; 0.56-1.36] as compared to those in the control group. The intervention also significantly reduced the rate of infant stunting by 7.5 percentage points [26.5% vs. 34%, RR= 0.68; 95% CI: 0.47-0.98] and underweight by 8.2 percentage points [17% vs. 25.2%; RR=0.55; 95% CI: 0.35-0.87]. However, the intervention did not significantly affect the rates of infant wasting [9.9% vs. 8.8%; RR=0.91; 95% CI: 0.49-1.67]. No statistically significant differences were also found in the prevalence of fever [16.9% vs. 17.7%; RR = 0.90; 95% CI: 0.57–1.43], diarrhea [23% vs. 19.5%; RR = 0.82; 95% CI: 0.54–1.25] and cough [8.5% vs. 10%; RR = 0.82; 95% CI: 0.45–1.51] between the intervention and control groups, respectively.

Conclusion: Complementary feeding behavior change communication delivered through community-level actors significantly improved infant weight gain, length gain and reduced the rate of stunting and underweight. However, the intervention did not significantly affect the rates of infant wasting, and morbidity.

6.1. Introduction

Growing recognition of nutrition as a global development priority and investment opportunity with high social and economic returns has catalyzed political commitment and increased the need to identify concerted actions to end childhood undernutrition. Yet the latest global figures indicated that 23% of children under age 5 years have stunted growth because of chronic nutrition deprivation (UNICEF, WHO, & World Bank, 2017). With most of the stunting occurring during the first thousand days, when complementary feeding plays a major role, the stakes are high for accelerating progress to improve the quality and quantity complementary foods for children aged 6-23 months (Aguayo & Menon, 2016).

It is well recognized that the period of 6-24 months of age is one of the most critical time in the growth of an infant (Imdad, Yakoob, & Bhutta, 2011). The incidence of growth faltering and morbidity is highest in this period as children have a high demand for nutrients and there are insufficiencies in the quality and quantity of complementary diets (Shrimpton *et al*., 2001). Infants from 6 to 18 months are especially vulnerable to developing malnutrition. Improving feeding practices in this critical window of period is among the most cost-effective strategies to improve overall infant health and ensure their nutritional wellbeing (Martorell, 2017). In order to sustain the gains made by promoting exclusive breastfeeding for the first six months of life, interventions need to extend into the second half of infancy and beyond. This could be ensured by enabling caregivers to appropriately feed their children with safe and adequate complementary foods while maintaining frequent breastfeeding (WHO, 2003).

Poor dietary intake is a proximal cause of child undernutrition (Black *et al.,* 2013). Although child's poor dietary intake is not the only factor associated with children's linear growth and risk of undernutrition, studies indicate that improved diet quality is strongly associated with a lower risk of stunted growth. Age-appropriate complementary feeding practices are far from optimal in the majority of LMICs as evidenced by low rates for MDD, MMF, and MAD (UNICEF, 2015). Studies have attempted to assess whether the WHO standard complementary feeding indicators are related to different growth outcomes and also had mixed results (Jones *et al*., 2014; Darapheak *et al*., 2013).

Findings indicate that poor dietary diversity is a risk factor for stunting. Compared to children 6-23 months of age who consumed five or more food groups, children consuming no food groups in the previous day were 34% more likely to be stunted, and children who consumed only one food group were 36% more likely to be stunted; while even children who consumed four food groups were 9% more likely to be stunted. Furthermore, children consuming no ASF were 44% more likely to be stunted when compared to children who consumed all three types of ASF (egg, meat, and dairy). The association of ASF consumption and stunting was ordinal, with children consuming only one type of ASF were 28% more likely to be stunted, and children who consumed two types of ASF had 16% higher odds of being stunted when compared to those consuming all three types of ASF (Krasevec *et al*., 2013).

Inappropriate complementary feeding practices may be related to insufficiencies in food availability and variety. However, caregivers' lack of knowledge and awareness on optimal feeding practices, cultural beliefs, and poor feeding behaviors are modifiable factors that can contribute to the deterioration of infant health and growth outcomes (Ogbo, Ogeleka, & Awosemo, 2018). Therefore, interventions are needed to improve caregivers' feeding behaviors, thereby enhancing infant growth and reducing morbidity especially in rural areas (Guldan *et al*., 2000). However, such interventions could be effective if they are appropriately contextualized, affordable and sustainable (Panjwani & Heidkamp, 2017; Shi & Zhang, 2011). The interventions must also address the key proximal factors that influence infant growth and morbidity. Both the adequacy and safety of complementary diets can influence infant growth and morbidity (Aboud, Moore, & Akhter, 2008).

Complementary feeding interventions have the potential to improve child growth outcomes and health in LMICs. Enhancing optimal complementary feeding among young children has been shown to be effective in improving child linear growth in underdeveloped settings (Imdad *et al*., 2011; Bhutta *et al*., 2013; Lassi *et al*., 2013). BCI on appropriate complementary feeding practices (e.g., offering a diversity of nutrient-dense food, safe and developmentally appropriate food preparation, age-appropriate frequency of feeding, continued breastfeeding) is an effective strategy for improving child dietary intake and reducing growth faltering in settings where households have sufficient resources to put the recommendations into practice (Dewey, 2005). In

food-insecure settings, improving child growth often requires the direct provision of foods, including fortified foods and lipid-based nutrient supplements (Lassi *et al*., 2013).

Studies on the impact of CFBCC on infant growth outcomes, and morbidity showed mixed results. A systematic review of studies conducted in developing countries showed that CFBCI significantly improved some growth parameters (HAZ score, and WAZ scores), and reduced the rates of stunting. However, no significant impacts were observed for height gain, weight gain and underweight (Lassi *et al*., 2013). Studies that evaluated the effects of such interventions on infant morbidity are also limited worldwide.

This trial aimed to evaluate the effect of complementary feeding behavior change communication delivered through community-level actors on infant growth and morbidity. We hypothesized that the intervention would improve infant growth, and reduce the rates of morbidity.

6.2. Methods

6.2.1. Measurements

Data on infant anthropometry and morbidity were collected both at baseline and endline for both study groups. Infants were weighed in light clothing using an electronic scale (SECA/Germany) to the nearest 0.01 kg. First, weight was taken for mother and infant together and secondly for mother alone. The difference was the infant's weight. The infant's recumbent length was measured to the nearest 0.1 cm using a portable wooden infant length board with a fixed head and sliding foot piece. All measurement instruments were calibrated before each measurement session. All measurements were performed in duplicate. Standardization exercises for anthropometric measurements were conducted during the initial training of data collectors, and supervisors.

Infant morbidity was examined through maternal recall of the prevalent illness symptoms (fever, diarrhea, and cough) in the past two weeks from the date of the interview.

6.2.2. Statistical Analyses

Data were double entered into the EPI-Info, exported to SPSS version 22 for cleaning and statistical analysis. The outcomes of the trial were infant's growth measured by weight gain, length gain, stunting, underweight and wasting; and infant morbidity (diarrhea, fever, and cough).

Weight gain was calculated by subtracting the weight of each infant at baseline from the endline and taken as an outcome variable for weight. The difference in mean weight gain (difference-in-difference) between in the study groups was used as a measure of intervention effect. A similar technique was applied for the length gain.

Stunting, underweight and wasting were calculated after generating *z*-scores for height-for-age (HAZ) and weight-for-height (WHZ) and weight-for-age (WAZ) by using WHO 2006 child growth standards in the ANTHRO software, respectively. Infants with a HAZ below -2 of the reference population were considered stunted, those with a WAZ below -2 were considered

underweight, and those with WHZ below -2 were considered wasted (WHO Child Growth Standards, 2006).

The presence of each infant illness symptom was coded as “1” and its absences as “0”. Diarrhea (3 or more loss of liquid stools during a 24 hours period), fever (an abnormally high body temperature) and cough (as rapid expulsion of air from the lungs) were determined by the mother’s report (WHO, 2017).

Linear generalized estimating equations regression analyses were used to test the effects of the intervention on weight and height gains. Binary GEE regression analyses were used to test the effects of the intervention on stunting, underweight, wasting and morbidity. All analyses were adjusted for baseline covariates and clustering. MD (mean differences) and relative risks (RR) with 95% confidence interval (CI) were computed as a measure of intervention effects for continuous and categorical variables, respectively. The adjusted effect measures were considered as the main results. All analyses were conducted according to the intention to treat (ITT) principle. All the analyses were conducted using SPSS version 22 and P values <0.05 were considered to indicate statistical significance.

6.3. Results

Baseline characteristics

Baseline infant, maternal, and household characteristics were comparable between the intervention and control clusters as presented in chapter 4 (Table 4.1).

Effects of the intervention

Effects on infant weight and length gains: Table 6.1 presents the effects of the intervention on infant weight and length gains. Infants in the intervention group had a higher weight gain (2.50±0.68 kg) as compared to those in the control group (2.04±0.61 kg) and the difference was statistically significant, [DiD= 0.46 kg; 95% CI: 0.36-0.56]. There was also a statistically significant difference in length gain between the study groups; 9.20±2.80 cm in the intervention groups, and 8.22±2.59 cm in the control groups, [DiD: 0.96 cm; 95% CI; 0.56-1.36].

Table 6.1. Effects of the intervention on infant weight and length gains.[1]

Variable	Groups	Baseline	Endline	Gain	Adjusted effect (DiD) (95% CI)[2]
Weight (kg)	CG	5.50±1.06	7.54±0.84	2.04±0.61	0
	IG	5.47±1.05	7.97±0.83	2.50±0.68	0.46 (0.36-0.56)*
Length (cm)	CG	59.47±3.74	67.69±2.49	8.22±2.59	0
	IG	59.22±4.04	68.42±2.51	9.20±2.80	0.96 (0.56-1.36)*

*P-value: <0.001; CG: Control group; IG: intervention group; DiD: difference-in-differences; CI: confidence interval;

[1]Data present means + SD unless otherwise indicated.

[2]Adjusted for baseline infant (age, sex, stunting, underweight, wasting, fever, diarrhea, cough), maternal (age, educational status, marital status, parity, ANC, place of delivery, PNC, IYCF counselling) and household characteristics (family size and possession of radio); and clustering.

DiDs were as yielded by the "Generalized estimated equation regression analyses."

Effects on infant stunting, underweight, and wasting: Table 6.2 presents the effects of the intervention on the rates of stunting, underweight and wasting. The rates of stunting (26.5% vs. 34%; RR= 0.68; 95% CI: 0.47-0.98) and underweight (17% vs. 25.2%; RR=0.55; 95% CI: 0.35-0.87) were significantly lower in the intervention as compared to control groups, respectively. However, there was no statistically significant difference in the rate of wasting between the intervention, 8.8%, and control groups, 9.9%, (RR= 0.91; 95% CI: 0.49-1.67).

Table 6.2. Effects of the intervention on infant stunting, underweight and wasting.

Variable	Study groups	N (%)	RR (95% CI)[1]
Stunting	CG	96 (34)	1
	IG	72 (26.5)	0.68 (0.465-0.988)*
Underweight	CG	71 (25.2)	1
	IG	46 (17)	0.55 (0.345-0.873)*
Wasting	CG	28 (9.9)	1
	IG	24 (8.8)	0.91 (0.493-1.667)

*P-value: <0.05; CG: Control group; IG: intervention group; RR: relative risk; CI: confidence interval;
[1]Adjusted for baseline infant (age, sex, stunting, underweight, wasting, fever, diarrhea, cough), maternal (age, educational status, marital status, parity, ANC visit, place of delivery, PNC, IYCF counseling) and household characteristics (family size and possession of radio); and clustering.
RRs were as yielded by the "Generalized estimated equation regression analyses."

Effect on infant morbidity: Table 6.3 presents the effect of the intervention on infant morbidity. No statistically significant differences were found in the prevalence of fever (16.9% vs. 17.7%; RR= 0.90; 95% CI: 0.57-1.43), diarrhea (23% vs. 19.5%; RR= 0.82; 95% CI: 0.54-1.25) and cough (8.5% vs. 10%; RR= 0.82; 95% CI: 0.45-1.51) between the intervention and control groups, respectively.

Table 6.3. Effect of the intervention on infant morbidity.

Morbidity	Groups	N (%)	RR (95% CI)[1]
Fever	CG	50 (17.7)	1
	IG	46 (16.9)	0.90 (0.57-1.43)
Diarrhea	CG	65 (23)	1
	IG	53 (19.5)	0.82 (0.54-1.25)
Cough	CG	28 (10)	1
	IG	23 (8.5)	0.82 (0.45-1.51)

CG: Control group; IG: intervention group; RR: relative risk; CI: confidence interval
[1]Adjusted for baseline infant (age, sex, stunting, underweight, wasting, fever, diarrhea, cough), maternal (age, educational status, marital status, parity, ANC visit, place of delivery, PNC, IYCF counseling) and household characteristics (family size and possession of radio); and clustering.
RRs were as yielded by the "Generalized estimated equation regression analyses."

6.4. Discussion

We implemented a community-based cluster-randomized controlled trial to investigate the effectiveness of complementary feeding behavior change communication delivered through community-level actors on infant growth and morbidity. In this trial, infants in the intervention group had significantly higher weight gain [MD: 0.46 kg; 95% CI: 036-0.56] and length gain [MD: 0.96 cm; 95% CI; 0.56-1.36] as compared to those in the control group. The intervention also significantly reduced the rate of stunting by 7.5 percentage points [RR= 0.68; 95% CI: 0.47-0.98] and underweight by 8.2 percentage points [RR=0.55; 95% CI: 0.35-0.87]. However, the intervention did not significantly affect the rate of wasting and morbidity.

The results of this trial are consistent with the findings of complementary feeding behavior change interventions conducted in different parts of the world. A cluster-randomized controlled trial was conducted in Pakistan to evaluate the impact of maternal educational messages regarding appropriate complementary feeding on the growth and nutritional status of their infants after 30 weeks of educational interventions delivered by trained community health workers. At the end of the study, infants in the intervention group had significantly higher weight gain [MD: 0.35 kg], length gain [MD: 0.66 cm] as compared to the controls. The intervention was also significantly reduced the rate of stunting by 10 percentage points, but no significant differences were found in the rate of underweight and wasting between the study groups (Saleem, Mahmud, Baig-ansari, & Zaidi, 2014).

A similar result was found by a behavior change intervention conducted in Philippines. In this study, caregivers of young children and their family members in the intervention group received counseling sessions on the appropriate complementary feeding through home visits for 8 months whereas those in the control group received the usual care. Children in the intervention group had significantly higher weight gain [MD: 0.25 kg] and length gain [MD: 1.2 cm] as compared to those in the control group (Dumaguing, Hurtada, & Yee, 2015).

In another cluster-randomized controlled trial conducted in rural China, infants were enrolled at age 2-4 months and followed up until 1 year of age. In the intervention group, complementary feeding educational messages and enhanced home-prepared recipes were disseminated to caregivers through group training and home visits. Infants in the intervention group gained 0.22 kg more weight and gained 0.66 cm more length than did controls over the study period, and the differences were statistically significant (Shi *et al*., 2009). A cluster-randomized controlled trial of an educational intervention delivered through health services in Peru also found a significantly higher length gain [MD= 0.71 cm], and 11 percentage points reduction in the rate of stunting for infants in the intervention as compared to those in the control group. However, no significant difference was found on weight gain [MD= 0.12 kg] between the study groups (Penny *et al*., 2005).

A community based behavior change intervention on optimal complementary feeding was conducted in rural India. This cluster-randomized trial tested the hypothesis that teaching caregivers appropriate complementary feeding and strategies for how to feed and play responsively through home visits would increase children's growth and morbidity compared with home-visit-complementary feeding education alone or routine care. The intervention resulted in improved dietary intake, but there were no statistically significant in mean differences for weight and length, the rate of stunting and morbidity among the groups. The possible reason is the number of messages given to include complementary feeding, responsive feeding and play together at the home visits, combined with constraints on available time at their disposal, could have limited the mothers'/caregivers' ability to implement all the messages recommended (Vazir *et al*., 2013).

In the present study, the effects of the intervention on infant weight and length gains were relatively higher than those found in the studies discussed above. This could be due to different reasons. First, in this study, the intervention was delivered through community-level actors who would have influence change in harmful feeding behaviors and encourage the adoption of the recommended complementary feeding practices that could lead to the improved physical growth of infants. Second, the intervention targeted not only mothers of infants but also engaged their family members that would provide a supportive environment for behavior change.

Third, the mothers were trained how to incorporate locally available and affordable nutritious foods into the existing homemade complementary foods during cooking demonstrations that can be well accepted by mothers.

Strengths and limitations of the study

The strengths of this study are the use of the randomized controlled design, the inclusion of fairly large sample size, and the intervention effect could be sustainable since it was delivered in a community supportive environment. Our study has limitations to be mentioned. First, due to the nature of the study, it was not possible to conduct a double-blind trial. Trial participants knew the existence of training on complementary feeding in their village, even if they did not know its specific purpose. Second, data on infant morbidity were collected based on maternal reports of the prevalent illness which was not a validated method and a recall bias can not also be excluded. Third, our study had only two data collection sessions (at baseline and endline). Hence, we recommend that similar studies in the future be accompanied by longer intervention period, more follow-up visits and measurements to investigate the long-term impacts of the intervention. Lastly, the study was not supported with qualitative data to explore the perceptions and experience of the study participants about the intervention delivered.

6.5. Conclusions

This study showed the potential effectiveness of complementary feeding behavior change intervention conducted in a community supportive environment in improving infant growth and reducing the rate of stunting and underweight. Significant changes in infant growth can be achieved through the promotion of a variety of locally available and affordable complementary foods that can be well accepted by the community. The result also suggests that a well-designed behavior change intervention without food supplements can improve infant growth and reduce the rate of undernutrition.

7

Chapter 7: General Discussion

7.1. Introduction

The complementary feeding period spanning 6 to 23 months, breastfeeding and access to a diverse range of nutritious foods provide children with the essential nutrients, vitamins, and minerals they need to develop to their full physical and cognitive potential, with benefits that endure well into adulthood (Victora *et al*., 2010). The complementary feeding period is also a critical opportunity to prevent all forms of childhood undernutrition, and micronutrient deficiencies. In addition, lifelong food preferences, tastes and habits are often established in childhood (Aguayo & Menon, 2016).

Yet, in nearly every part of the world, families face economic, political, market, social or cultural barriers to providing nutritious, safe, affordable and sustainable diets to young children. These challenges are exacerbated in developing countries, where access to nutritious food, clean drinking water, and good quality health services are limited, and the resources and capacities of caregivers are already stretched. Young children are often fed meals based mainly on staple cereals and grains, which are low in nutritive value (WHO, 2007; Bailey, West, & Black, 2015). Unhygienic feeding practices also increase the risk of infections and diarrhoea in young children, which, when combined with poor diets, can lead to growth failure. Accelerating progress to improve the quality and safety of complementary foods and feeding practices for young children is therefore critical (UNICEF, 2016; Begin, & Aguayo, 2017).

Globally, available data on complementary feeding practices reveals low and stagnant rates of the feeding indicators (UNICEF, 2018). Countries in sub-Saharan Africa (SSA) report the lowest rates of optimal feeding practices (White *et al*., 2017). The common inappropriate complementary feeding practices include introducing foods too early or too late, limiting the diversity of foods, and providing an inadequate quantity of food caused by socio-economic, and cultural factors (Bhandari *et al*., 2004).

Improving children's diets is the foundation of sustainable and prosperous societies and paramount to achieving the 2030 Sustainable Development Goals (SDGs), including Goal 2 to improve nutrition and end all forms of malnutrition. Improving children's nutrition also supports the achievement of SDG targets on ending preventable childhood deaths and eliminating

poverty, among others. Lastly, improving children's diets is central to addressing three of the six World Health Assembly targets for reducing stunting, wasting and underweight by 2025 (WHO, & UNICEF, 2018).

BCI has been the primary approach used to improve complementary feeding practices. One approach focuses on changing behaviors of those who directly (mother/caregivers) or indirectly (extended family members, and community members) influence infant feeding practices, and nutritional status. When context-specific infant feeding messages promoting the use of local foods supported with cooking and feeding demonstrations are delivered directly to caregivers, or family/community member's, significant improvements in feeding practices, dietary intake, health status and growth outcomes of infants is possible (Nikiema *et al*., 2017; Sunguya *et al*., 2013; Kim *et al*., 2018; Panjwani, & Heidkamp, 2017). However, it requires an understanding of what drives feeding behaviors and how to facilitate the adoption of improved practices in a variety of cultural and economic settings (PAHO, 2003; WHO, 2008). This chapter discusses the main findings of the researches conducted under this PhD work, their practical implications, methodological issues and research and policy recommendations to be taken up subsequently.

7.2. Main research findings

This PhD work was conducted to generate evidence on the effect of complementary feeding behavior change communication delivered through community-level actors on infant feeding practices, growth and morbidity in rural communities of West Gojjam Zone. The major findings showed that:

- The intervention had significant effects on the rates of time of initiation of complementary foods between the control and intervention groups. The study findings revealed that more mothers in the intervention group practiced timely initiation of complementary foods as compared to those in the control group. Conversely, mothers in the control group were more likely to initiate complementary food lately as compared to those in the intervention group. The median age at the introduction of complementary food for children was significantly higher in the control group (6.7 months) as compared to those in the intervention group (6 months) **(Chapter 4)**.

- The intervention showed positive significant effects on the consumption of dairy products, eggs, vitamin A-rich fruits and vegetables, and other fruits and vegetables. The intervention also led to improvements in the complementary feeding indicators. The proportions of infants who achieved the MDD, MMF, and MAD were significantly higher in the intervention as compared to control groups **(Chapter 5)**.
- Infants in the intervention group had significantly higher weight and length gains as compared to those in the control group. The intervention also significantly reduced the rate of infant stunting and underweight. However, the intervention did not significantly affect the rates of infant wasting, and morbidity (fever, diarrhea, and cough) **(Chapter 6)**.

In summary, this PhD dissertation research showed that complementary feeding behavior change communication delivered through community-level actors improved feeding practices and growth outcomes of infants.

7.3. Implication of the research findings

Interventions to improve infant feeding practice and reduce undernutrition are urgently needed in developing countries. Findings from this PhD work indicated that when context-specific complementary feeding messages promoting the use of locally available and affordable foods are delivered through community-level actors, significant improvements in feeding practices and growth outcomes of infants are possible. Community-level actors have a huge influence on change in harmful cultural norms about infant feeding and encourage the adoption of the recommended feeding behaviors, and caring practices in a given community.

This trial also demonstrated that behavior change intervention targeted not only mothers/caregivers but also engaged family members of the recruited infants is an effective intervention approach. Well-informed, motivated and reinforced family members on complementary feeding practice provided a supportive environment for behavior change which is reflected by the adoption of appropriate feeding practices. Furthermore, in this trial, the mothers were demonstrated how to incorporate diverse and nutritious foods into the existing home-made complementary foods though practical sessions (cooking demonstrations). The use of locally available foods, which required fewer family resources such as money and time to

acquire, was well accepted by the mothers, and facilitated the adoption of the recommended feeding practices.

Therefore, we believe, the intervention package investigated in this trial has potential implications on infant health and nutrition.

7.4. Methodological considerations: strength and limitations

The strength and limitations of each study are presented in their respective chapters. In this section, we describe the general strengths and limitations of the trial. The strengths of this trial are the use of the randomized controlled design, the inclusion of fairly large sample size, and the intervention effect could be sustainable since it was delivered in a community supportive environment.

This trial is not free of limitations. Due to the nature of the intervention under study, it was not possible to conduct a double-blind trial. Hence, mothers in the intervention group might over-report the desirable practices rather than the actual feeding practices. Complementary feeding indicators were determined based on maternal recall and were not based on direct observations. Hence, recall bias cannot be excluded even if data collectors applied various probing techniques. Similarly, using a single 24-hour recall to collect dietary data for constructing dietary diversity, and meal frequency might not explain the usual food consumption. The trial had only two data collection sessions with relatively short intervention period. Hence, we recommend that similar studies in the future be accompanied by longer intervention period, more follow-up visits and measurements to investigate the long-term impacts of the intervention. Another limitation is the trial was not supported with qualitative data to explore the perceptions, opinions and experiences of the trial participants about the intervention strategy.

7.5. Conclusion

To summarize the key issues, the following conclusions are drawn based on the findings:

- Complementary feeding behavior change intervention delivered in a community supportive environment is effective in improving feeding practices, and growth outcomes of infants. However, the intervention did not significantly affect the rates of infant morbidity.
- Community-level actors have significant influences to change traditional practices about infant feeding and encourage the adoption of the recommended feeding behaviors.
- Significant changes in infant feeding practices and growth can be achieved through the promotion of locally available and affordable foods.
- Behavior change intervention that engages not only mothers but also the family members of infants is an effective intervention approach.

7.6. Recommendations for policy and research

7.6.1. Recommendations for policy

To address poor complementary feeding practice and child undernutrition in Ethiopia, the following policy recommendation should be taken to account:

- Implement evidence-based, socio-culturally appropriate, and context-specific complementary feeding messages that are well accepted by mothers/caregivers in particular and the community at large.
- Design strategy that incorporates all CFBCC activities in the broader health and nutrition communication activities.
- Design behavior change strategies that target not only mother/caregivers, but also enhance the involvement of family members (fathers, mother-in-low, and grandparents) in infant feeding and caring programs.
- Promote the use of locally available and affordable complementary foods and included them a component of national nutrition policies particularly in resource-poor rural households.
- Design strategies that enhance women’s empowerment and decision-making on infant feeding, use of household resources, and food purchases.

- Design interventions and prioritize actions to address key barriers to quality diets for children.
- Implement multiple communication channels to deliver consistent complementary feeding messages and achieve desired coverage, quality, intensity, and scale.
- Strengthen complementary feeding counseling, cooking and feeding demonstrations in individual or group settings, and peer-to-peer problem-solving via WDA leaders.
- Implement behavior change strategies in conjunction with other evidence-based interventions, such as food-based approaches or system strengthening interventions.
- Enhance agricultural production of nutritious foods to improve access to diverse complementary foods.
- Sustain comprehensive long-term behavior change strategies with continuous monitoring and evaluation.
- Enhance access to basic WASH services at the household and community level.
- Strengthen multi-sectoral nutrition interventions and coordinated service delivery across sectors for better feeding practice and growth outcomes of infants.

7.6.2. Recommendations for future research

- CFBCC trials accompanied by longer intervention period, more follow-up visits and repeated measurements are needed to investigate the long-term impacts of the intervention on infant feeding practices, growth outcomes and health.
- CFBCC trials should be supported with qualitative data to explore the perceptions, opinions and experiences of the trail participants about the intervention strategy.
- Formative research and qualitative study should be conducted to investigate the underlying determinants and key influencers of inappropriate complementary feeding behaviors.
- Experimental studies are needed to evaluate the effect of positive-deviance behavior on complementary feeding practices. This will help to scale up existing indigenous knowledge, and practices in the community.
- The sustainability, replicability and cost-effectiveness of CFBCI should be evaluated to scale-up the interventions.

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Curriculum Vitae of the Author

Personal information

- First name: Chalachew Abiyu
- Surname: Ayalew
- Date of birth: 04/03/1988
- Place of birth: Addis Zemen, South Gondar
- Nationality: Ethiopian
- Marital status: Married
- Number of children: One
- Address: Jimma
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- Working place: Wollo University, Dessie, Ethiopia

Educational Back ground and qualifications

- From 20014 until present: PhD student in Human Nutrition in Jimma university.
- From 2009-2012: MSc in Medical Biochemistry in Addis Ababa University.
- From 2006-2008: BSc in Medical Laboratory Technology in Jimma University.
- From 2004-2005: Addis Zemen Preparatory School.
- From 2002-2003: Addis Zemen Secondary School.
- From 1995-200: Yifage Elementary School

Nutrition course attended

- Nutritional Assessment
- Nutritional Epidemiology
- Nutrition in the life cycle
- Nutrition in emergency
- Nutrition policy, program planning and intervention
- Anthropology of Food, Nutrition and Agriculture

Trainings attended

- Advanced biostatistics
- Research methodology
- Qualitative data analysis
- Health care and research ethics
- Systematic review and meta-analysis
- Scientific writing and communication

Social skills and competences

- Excellent ability of communication and teamwork especially developed during the community based education programs both in my undergraduate and post graduate programs where I worked as a team leader and reporter in both occasions. I have positive experience of living together and working with a team of different backgrounds.

Scientific Publications

1. Abiyu C, Belachew T. Level and Predictors of mothers' knowledge and attitude on optimal complementary feeding in West Gojjam Zone, Northwest Ethiopia. Dove Press Nutrition and Dietary Supplements 2020:12, 113-121. doi: https://doi.org/10.2147/NDS.S257206.
2. Abiyu C, Belachew T. Effect of complementary feeding behavior change communication delivered through community-level actors on the time of initiation of complementary foods in rural communities of West Gojjam Zone, Northwest Ethiopia: a cluster-randomized controlled trial. BMC Pediatrics (2020) 20: 509. doi: https://doi.org/10. 1186/s12887-020-02396-z.
3. Abiyu C, Belachew T. (2020). Effect of complementary feeding behavior change communication delivered through community-level actors on dietary adequacy of infants in rural communities of West Gojjam Zone, Northwest Ethiopia: a cluster-randomized controlled trial. PLoS ONE 15 (9): e0238355. doi: https://doi.org /10.1371/journal.pone.0238355.
4. Ayalew CA, Belachew T. Effect of complementary feeding behavior change communication delivered through community-level actors on infant growth and morbidity in rural communities of West Gojjam Zone, Northwest Ethiopia: a cluster-randomized controlled trial. Matern Child Nutr. 2021; e.13136. doi: https://doi.org/10.1111/mcn. 13136.

Conference presentations

I have participated and presented scientific papers in various national conferences:

- Amhara public health institute (APHI) 1st and 2nd annual scientific conference.
- Ethiopian public health association (EPHA) 32th annual scientific conference.

Annex

Data collection tool

Part-I: Baseline data collection.

Section-A: Interview information

No.	Questions	Response
A1	Data collection date	____/___/_____
A2	Household ID	_____
A3	Woreda	_____
A4	Kebele	_____
A5	Cluster number	_____
A6	Outcome of the interview	1= completed 2= incomplete 3= absent 4= refused

Section-B: Maternal socio-demographic data

No.	Questions & filters	Responses & coding categories
B1	How old are you?	_____years
B2	What is your current marital status	1= Single → B6 2= Married 3= Divorced → B6 4= Widowed → B6
B3	Did your partner attend any formal school?	1= Yes 2= No → B5
B4	What is the highest level of school your partner completed?	1= Primary 2= Secondary 3= Preparatory 4= Technical /Vocational certificate 5= College/University

B5	What is your partner occupation?	1= Government employee 2= Farmer 3= Merchant/ small scale trading 4= Laborer 5= Other (specify):…….
B6	Have you ever attended school?	1= Yes 2= No → A8
B7	What is the highest level of school you completed?	1= Primary 2= Secondary 3= Technical/Vocational certificate 4= College/University
B8	What is your occupation?	1= Government employee 2= Farmer 3= Merchant/small scale trading 4= Laborer 5= House wife 6= Other (specify):…….
B9	What is your religion?	1= Orthodox 2= Catholic 3= Protestant 4 =Muslim 5= Others (specify):……..
B10	How many people usually live together in your household?	……..peoples
B11	Does this household currently have a functioning radio?	1 Yes 2 No → **Section-B**
B12	Did you listen to a radio drama about IYCF known as “seven solutions”?	1 Yes 2 No

Section-C: Maternal obstetric and health service utilization history

No.	Questions & filters	Responses & coding categories
C1	Sex of the index child	1= Male 2= Female
C2	Age of the index child?	……..months
C3	How many pregnancies have you ever had?	……...pregnancies
C4	What is the birth order of *[Name]*?	……
C5	How many times did you receive ANC during this pregnancy?	……..
C6	Where did you give birth to *[Name]*?	1= Home 2= Health facility
C7	When [Name] was born, how was of his/her weight?	1= Large 2= Medium 3= Small 8= DNK
C8	After you gave birth to *[Name]*, did anyone check your health?	1= Yes 2= No
C9	Did you have a discussion about IYCF with HEWs or health professionals during this pregnancy or after delivery?	1= Yes 2= No

Section-D: Maternal attitude about complementary feeding practices

Now I would like to ask you about your opinion about complementary feeding practices and please tell me if you agree, disagree or do not know.

No	Statements	Responses 1 Agree 2 Disagree 8 Do not know (DNK)
D1	Breastfeeding alone is not sufficient for a child after 6 months	
D2	Giving complementary foods after 6 months makes a baby	

	healthy	
D3	It is good to give baby fruits and vegetables	
D4	A baby needs animal source foods	
D5	Bottle feeding is not good for a child's health	
D6	Giving extra meal is desirable before and after an illness	

Section-E: Maternal knowledge on complementary feeding practices

Now I would like to ask you some questions about complementary feeding practices.

No.	**Questions**	**Responses**
E1	For how long in months your baby can survive and grow on breast milk alone even without water?	1…….months 8 DNK
E2	When should a mother start to give her baby complementary food?	1…….months 8 DNK
E3	How many times should a 6-8 months age breastfed baby eat complementary foods each day (24 hours)?	1……..no of times 8 DNK
E4	How many times should a 9-23 months age breastfed baby eat semi-solid, solid and soft foods each day (24 hours)?	1……..no of times 8 DNK
E5	A baby 6-23 months of age require a minimum of 4 food groups	……..
E6	Non-breastfed baby needs extra meal	1 Yes 2 No 8 DNK

Section-F: Infant morbidity

No.	**Questions and filters**	**Responses & coding categories**
Did your baby have any of the following illness symptoms in the last 2 weeks?		
F1	Fever	1=Yes 2= No 8=DNK
F2	Diarrhea	1=Yes

		2= No 8=DNK
F3	Cough	1=Yes 2= No 8=DNK

Section-G: Infant anthropometry

No.	Anthropometric measurement	Finding
G1	Weight	_____.__ __kg
G2	Length	_____.__cm

Part-II: Endline data collection.

Section-H: Infant complementary feeding practices.

No.	Questions & filters	Responses & coding categories
H1	Was your baby breastfed yesterday during the day or at night (from sunrise yesterday to sunrise today?	1= Yes 2= No
H1	Have you started giving for *[Name]* any solid, semi-solid, or soft foods?	1= Yes 2= No ⟶ **Stop**
H2	At what age in months did you first give solid or semi-solid food to [Name]?	…….months 8 DNK
H3	Yesterday during the day or at night, did *[Name]* eat any solid, semi-solid, or soft foods?	1= Yes 2= No ⟶ **Stop**
H4	How many times did *[Name]* eat solid, semi-solid or soft foods yesterday during the day or at night?	1……..no of times 8 DNK
H5	**A 24-hour diet recall:** Please describe the foods your child ate yesterday during the day and night (from sunrise yesterday to sunrise today) in your home. *[Write down all food and drinks mentioned by the respondent. When the respondent has finished, probe for meals and snacks not mentioned. Once you listed the foods and drinks, tick the food items consumed mentioned in the following table]*.	

Food groups consumed

No	Food groups	Questions and filters	1= Yes 0= No
1	Grains, roots & tubers	*Injera*, bread, rice, noodles, or other foods made from grains, such as teff, oats, maize, barley, wheat, sorghum, millet or other grains, white potatoes, white yams, bulla, kocho, manioc, cassava or any other foods made from roots?	
2	Legumes & nuts	Any foods made from beans, peas, lentils, nuts?	
3	Dairy products	Cheese, yogurt, or other milk products?	
4	Flesh food	Any meat such as beef, pork, lamb, goat, chicken, or fish?	
5	Eggs	Egg?	
6	Vitamin A-rich fruits and vegetables	Pumpkin, carrots, sweet potatoes?	
7	Other fruits and vegetables?	Any other vegetables & fruits?	

Section-I: Infant morbidity

No.	Questions and filters	Responses & coding categories
Did your baby have any of the following illness symptoms in the last 2 weeks?		
I1	Fever	1=Yes 2= No 8=DNK
I2	Diarrhea	1=Yes 2= No 8=DNK
I3	Cough	1=Yes 2= No 8=DNK

Section-J: Infant anthropometry

No.	Anthropometric measurement	Finding
J1	Weight	_____.__ __kg
J2	Length	_____.__cm

<u>የመረጃ መሰብሰብያ ቅፅ (በአማርኛ)</u>

<u>የመጀመርያ ዙር የመረጃ መሰብሰብያ ቅፅ</u>

ክፍል-A፡ አስተዳደራዊ ዝርዝር

ቁጥር	ጥያቄወች	መልስ
A1	የጉብኝት ቀን	_____/_____/_____
A2	የቤትቁጥር	
A3	ወረዳ	
A4	ቀበሌ	
A5	የቀበሌ ቁጥር	
A6	የክለስተር ቁጥር፡	
A7	የቃለ መጠይቁ ዉጤት	1 የተሟላ 2 ያልተሟላ 3 ያልተገኘች 4 የተቃወመች

ክፍል-B: አጠቃላይ መረጃ

ቁጥር	ጥያቄዎችና ማጣርያዎች	መልስና መለያ ቁጥር
B1	እድሜሽ ስንት ነዉ	.....ዓመት
B2	በአሁኑ ሰአት የትዳር ሁኔታሽ	1 ብቻየን → B6 2 ባለትዳር 3 አግብቸ የፈታሁ → B6 4 ባሌ የሞተብኝ → B6
B3	ባልሽ የተማረ ነዉ?	1 አዎ 2 አይደለም → B5

B4	ባልሽ እስከ ስንት ተምሯል?	1 መጀመርያ ደረጃ 2 ሁለተኛ ደረጃ 3 መሰናዶ 4 ሙያና ቴክኒክ/ሰርትፊኬት/ 5 ኮሌጅ/ዩኒቨርስቲ
B5	የባልሽ ስራ ምንድን ነዉ?	1 የመንግስት ተቀጣሪ 2 ገበሬ 3 ነጋዴ 4 የቀን ሰራተኛ 5 ሌላ ካለ ይጠቀስ
B6	አንች ተምረሻል?	1 አዎ 2 የለም → B8
B7	እስከ ስንት ተምረሻል?	1 መጀመርያ ደረጃ 2 ሁለተኛ ደረጃ 3 ሙያናቴክኒክ/ሰርትፊኬት/ 4 ኮሌጅ/ዩኒቨርስቲ
B8	ስራሽ ምንድን ነዉ?	1 የመንግስት ተቀጣሪ 2 ገበሬ 3 ነጋዴ 4 የቀን ሰራተኛ 5 የቤት እመቤት 6 ሌላ ካለ ይጠቀስ፡.....
B9	የምን ሀይማኖት ተከታይ ነሽ?	1 ኦርቶዶክስ 2 ካቶሊክ 3 ፕሮቴስታንት

		4 እስልምና 5 ሌላ ካለ ይጠቀስ፡.....
B10	የቤተሰብ ብዛት?	.....ሰዎች
B11	በቤት ዉስጥ የሚሰራ ራዲዮ አለ	1 አዎ 2 የለም → ክፍል-C
B12	በራድዮ የሚተላለፈዉን ስለህፃናት አመጋገብ ሚያተኩረዉን ሰባት መላ የሚባል ድራማ ትከታተላላችሁ	1 አዎ 2 የለም

ክፍል-C: የእናትየዋ የእርግዝናና ጤና አገልግሎት አጠቃቀም በተመለከተ

ቁጥር	ጥያቄዎችናማጣርያዎች	መልስና መለያ ቁጥር
C1	የልጁ ጾታ	1 ወንድ 2 ሴት
C3	የልጁ እድሜ	.....ወራት
C4	ከአሁኑጋር ስንቴ አርግዘሻል	.....
C5	የአሁኑ ስንተኛ ልጅሽ ነዉ	.....
C6	የአሁኑን እርግዝና ክትትል አድርገሻል	1 አዎ 2 የለም
C6	የአሁኑን እርግዝና ክትትል ስንት ግዜ አድርገሻል	.....
C7	የአሁኑ ልጅሽን የወለድሽዉ የት ነዉ	1 ቤት ዉሰጥ 2 የጤና ተቋም
C8	በአንቺ ግምት ልጅሽ ሲወለድ መጠኑ ምን ነበር?	1 ትልቅ 2 መካከለኛ 3 ትንሽ
C9	ከወለድሽ በሃላየ ጤናሽን ሁኔታ ያየሽ አለ?	1 አዎ

		2 የለም
C10	በአሁኑ እርግዝናሽ ወይም ከወለድሽ በኋላ ስለጨቅላ ህፃናት አመጋገብ ከጤና ባለሙያ ወይም ከህብረተሰብ ጤና ሰራተኛ ጋር ዉይይት አድርገሽ ታዉቂያለሽ?	1 አዎ 2 የለም

ክፍል-D: እናት ስለህጻን ልጅ አመጋገብ ያላትን አመለካከት በተመለከተ

አሁን ስለጨቅላ ህጻናት አመጋገብ ያለሽን አመለካከት ስለምጠይቅሽ እስማማለሁ አልስማማም ወይም አላዉቀዉም በማለት መልሽልኝ

ቁጥር	ዓረፍተ-ነገር	መልስ 1 እስማማለሁ 2 አልስማማም 8 አላዉቀዉም
D1	ከስድስት ወር በኃላ ለልጅ የእናት ጡት ብቻ መስጠት በቂ አይደለም	
D2	ከስድስት ወር በኃላ ለልጅ ተጨመሪ መግብ መስጠት ልጁን ጤናማ ያድርገዋል	
D3	ለልጅ አትክልትና ፍራፍሬ መመገብ ጠቃሚ ነዉ	
D4	ልጅ የእንስሳት ተዋጽኦ ምግብ ይፈልጋል	
D5	ልጅን በጡጦ መመገብ ለጤናዉ ጥሩ አይደለም	
D6	ልጅ በታመመ ጊዜና ካገገመ በኋላ ከወተሮዉ ጨመር ያለ ምግብ መስጠት ጠቃሚ ነዉ	

ክፍል-E: እናት ስለህፃን ልጅ ህጻናት አመጋገብ ያላትን እዉቀት በተመለከተ

አሁን ስለጨቅላ ህጻናት አመጋገብ በተመለከተ አንዳንድ ጥያቄወች እጠይቅሻለሁ

ቁጥር	ጥያቄ	መልስ
E1	ልጅ በእናት ጡት ወተት ብቻ ያለምግብና መጠጥ ዉሃንም ጨምሮ ሳይሰጠዉ ለስንት ግዜ ያህል መኖርና ማደግ ይችላል?	1 .....ወር 8 አላዉቅም

E2	እናት ለጇ መቼ ነዉ ተጨማሪ ምግብ መስጠት መጀመር ያለባት	1 .....ወር 8 አላዉቅም
E3	ከ6 እስከ 8 ወር እድሜ ያለዉ ጡት የጠባ ልጅ በቀን ዉስጥ ስንቴ ተጨማሪ ምግብ መመገብ አለበት	1 .....ግዜ 8 አላዉቅም
E3	ከ9 ወር እስከ 2 አመት እድሜ ያለዉ ጡት የጠባ ልጅ በቀን ዉስጥ ስንቴ ተጨማሪ ምግብ መመገብ አለበት	1 .....ግዜ 8 አላዉቅም
E5	ከ6 ወር እስከ 2 አመት እድሜ ያለዉ ልጅቢያን አራት የምግብ አይነቶችን መመገብ አለበት	1 አዎ 2 የለም
E6	ጡት የምይጠባ ልጅ ከሚጠባ ልጅ ጨመር ያለ ተጨማሪ ምግብ መመገብ አለበት	1 አዎ 2 የለም

ክፍል-F: የህፃን ልጅ ህመም በተመለከተ

ቁጥር	ጥያቄዎች	መልስና መለያቁጥር
ልጅሽ ባለፉት ሁለት ሳምንታት ጊዜ ዉስጥ የሚከተሉት የህመም ምልክቶች ነበሩበት?		
F1	ትኩሳት ወይም የሰዉነት መሞቅ ነበረበት?	1 አዎ 2 የለም
F2	ተቅማጥ ነበረበት?	1 አዎ 2 የለም
F3	ማሳል ወይም ጉንፋን ነበረበት?	1 አዎ 2 የለም

ክፍል-G: የህፃን ልጅ ልኬት

ቁጥር	ልኬት	ዉጤት
G1	ክብደት	_____.___ __ኪ.ግ
G2	ርዝመት	_____.___ሴ.ሜ

<u>የሁለተኛ ዙር የመረጃ መሰብሰቢያ ቅፅ</u>

ክፍል-H: የህጻንልጅ አመጋገብንበተመለከተ

ቁጥር	ጥያቄዎች	መልስናመለያቁጥር
H1	ለልጁምግብመስጠትጀምረሻል?	1=Yes 2=No⟶ **ክፍል-B**
H2	ለመጀመርያግዜምግብስትሰጭዉ እድሜዉ ስንትነበር?	----------ወር
H3	ትላንትበቀንምበማታም ጨምሮልጅሽምግበልቷል?	1=Yes 2=No⟶ **ክፍል-B**
H4	ትላንትቀኑንምማታንምጨምሮልጅሽስንትግዜምግብተመግበል?	1=----------ግዜ 8= አላዉቀዉም
H5	ትላንትቀኑንምማታንምጨምሮበቤትሽዉስጥልጅሽየተመገበዉንየምግብአይነትዘርዝሪልኝ። *(ልጁ የተመገበዉን ምግብና መጠጥ በዝርዝር መልክ ከዚህ በታች አስቀምጥ::)*	

የምግብ አይነቶች

ቁጥር	የምግብ አይነቶች	ዝርዝር ይያቄወች	1 አዎ 2 የለም
1	እህሎች	እንጀራ፣ ዳቦ፣ ሩዝ፣ ጤፍ፣ አጃ፣ ማሽላ፣ ገብስ፣ ስንዴ፣ ዘንጋዳ፣ ኩኾ፣ ጓያ፣ ሽምብራ	
2	ባቄላና ጥራጥሬዎች	ባቄላ፣ አተር፣ ምስር፣ ኑግ፣ ሱፍ፣ ተልባ	
3	የወተት ተዋፅኦ ዉጤቶች	ጥሬ ወተት፣ እርጎ፣ አይብ፣ ምጣጣ	
4	ስጋ	ስጋ (የከብት፣ የፍየል፣ የበግ፣የዶሮ፣ የአሳ፣ የጥጃ ሌላም)	
5	እንቁላል	እንቁላል	
6	በባይታሚን ኤ የበለፀጉ አትክልትና ፍራፍሬወች	ማንጎ፣ ፓፓያ፣ ዱባ፣ ካሮት፣ ስኪርድንች	
7	ሌሎች አትክልትና ፍራፍሬወች	ሌሎችቅጠላቅጠሎችናፍራፍሬዎች	

ክፍል-I: የህፃን ልጅ ህመም በተመለከተ

ቁጥር	ጥያቄዎች	መልስናመለያቁጥር
ልጅሽ ባለፉት ሁለት ሳምንታት ጊዜ ዉስጥ የሚከተሉት የህመም ምልክቶች ነበሩበት?		
I1	ትኩሳት ወይም የሰዉነት መሞቅ ነበረበት?	1 አዎ 2 የለም
I2	ተቅማጥ ነበረበት?	1 አዎ 2 የለም
I3	ማሳል ወይም ጉንፋን ነበረበት?	1 አዎ 2 የለም

ክፍል-ሀ: የህፃን ልጅ ልኬት

ቁጥር	ልኬት	ዉጤት
J1	ክብደት	_____.___ __ኪ.ግ
J2	ርዝመት	_____.___ሴ.ሜ

CONSORT checklist of information to include when reporting a cluster randomised trial

Section/Topic	Item No	Standard Checklist item	Extension for cluster designs	Page No *
Title and abstract				
	1a	Identification as a randomised trial in the title	Identification as a cluster randomised trial in the title	
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)		
Introduction				
Background and objectives	2a	Scientific background and explanation of rationale	Rationale for using a cluster design	
	2b	Specific objectives or hypotheses	Whether objectives pertain to the the cluster level, the individual participant level or both	
Methods				
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	Definition of cluster and description of how the design features apply to the clusters	
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons		
Participants	4a	Eligibility criteria for participants	Eligibility criteria for clusters	
	4b	Settings and locations where the data were collected		
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	Whether interventions pertain to the cluster level, the individual participant level or both	
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	Whether outcome measures pertain to the cluster level, the individual participant level or both	
	6b	Any changes to trial outcomes after the trial commenced, with reasons		
Sample size	7a	How sample size was determined	Method of calculation, number of clusters(s) (and whether equal or unequal cluster sizes are assumed), cluster size, a coefficient of intracluster correlation (ICC or *k*),	

			and an indication of its uncertainty
	7b	When applicable, explanation of any interim analyses and stopping guidelines	
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	Details of stratification or matching if used
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	Specification that allocation was based on clusters rather than individuals and whether allocation concealment (if any) was at the cluster level, the individual participant level or both
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	Replace by 10a, 10b and 10c
	10a		Who generated the random allocation sequence, who enrolled clusters, and who assigned clusters to interventions
	10b		Mechanism by which individual participants were included in clusters for the purposes of the trial (such as complete enumeration, random sampling)
	10c		From whom consent was sought (representatives of the cluster, or individual cluster members, or both), and whether consent was sought before or after randomisation
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	
	11b	If relevant, description of the similarity of interventions	

Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	How clustering was taken into account
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	For each group, the numbers of clusters that were randomly assigned, received intended treatment, and were analysed for the primary outcome
	13b	For each group, losses and exclusions after randomisation, together with reasons	For each group, losses and exclusions for both clusters and individual cluster members
Recruitment	14a	Dates defining the periods of recruitment and follow-up	
	14b	Why the trial ended or was stopped	
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	Baseline characteristics for the individual and cluster levels as applicable for each group
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	For each group, number of clusters included in each analysis
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	Results at the individual or cluster level as applicable and a coefficient of intracluster correlation (ICC or k) for each primary outcome
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	
Harms	19	All important harms or unintended effects in each group (for specific guidance	

		see CONSORT for harms[i])	
Discussion			
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	Generalisability to clusters and/or individual participants (as relevant)
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	
Other information			
Registration	23	Registration number and name of trial registry	
Protocol	24	Where the full trial protocol can be accessed, if available	
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	

Declaration Form

I, the under signed, declared that this is my bona fide original work, has never been presented in this or any other university, and that all the resources and materialsused for the thesis, have been fully acknowledged.

Name: Chalachew Abiyu

Signature: _____

Date: _____

Place: Jimma University, School of Graduate Studies

Date of submission: _____

This dissertation has been submitted for examination with my approval as a university supervisor

Candidate's Supervisor

Name: Prof.Tefera Belachew

Signature: _____

Date: _____