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SCHOOL OF GRADUATE STUDIES

EFFECTS OF BEHAVIOUR CHANGE COMMUNICATION ON CHILD FEEDING KNOWLEDGE AND PRACTICE OF MOTHERS, AND UNDERNUTRITION AMONG CHILDREN AGED 6-23 MONTHS IN JIMMA ZONE, ETHIOPIA: A CLUSTER RANDOMIZED CONTROLLED TRIAL

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DEDICATION

I dedicated this dissertation to my father, Moges Mengesha, who has passed away, you were the greatest influence in my life, and your memory will always remain with me.

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ABBREVIATIONS AND ACRONYMS

ACFP	Appropriate complementary feeding practice
AOR	Adjusted Odd Ratio
BCC	Behavioural Change Communication
CIAF	Composite Index of Anthropometric Failure
COR	Crude ratio
CRCT	Cluster Randomized Controlled Trial
DID	Difference-in - Difference
Diff	Difference
EDHS	Ethiopia Demographic and Health Survey
EPHI	Ethiopia Public Health Institution
FANTA	Food and Nutrition Technical Assistance
FNP	Food and Nutrition Policy
GDP	Gross domestic product
GEE	Generalized Estimating Equation
HAZ	Height-for-Age
HEW	Health Extension Workers
HFIAS	Household Food Insecurity Access Scale
IYCF	Infant and Young child Feeding
LAZ	Length –for-Age
LMICs	Low- and Middle-Income Countries
MAD	Minimum Acceptable Diet
MDDS	Minimum Dietary Diversity Score
MMF	Minimum Meal Frequency
NNP	National Nutrition Program
OCFP	Optimal Complementary Feeding Practice
PACTR	Pan African Clinical Trial Registration
SDG	Sustainable Development Goal
SE	Standard Error
SNNPR	Southern Nations, Nationalities and Peoples' Regional State
THFP	Traditional Household Food Processing
UNICEF	United Nation of Child Fund
WAZ	Weight-for-Age
WDA	Women Developmental Army
WHO	World Health Organization
WHZ	Weight-for-Height
WLZ	Weight-for-Length

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EXECUTIVE SUMMARY

Background: The children's initial 24 months are crucial for children's optimum development and growth, largely driven by proper nutrition. However, infant and young children in low-income countries, including Ethiopia, face significant challenges in obtaining adequate nutrients. Furthermore, conventional analyses of stunted, underweight, and wasting children indices often fail to provide an accurate overall assessment of undernutrition, as children may exhibit multiple anthropometric failures concurrently. Using a single, unified index of full nutritional status evaluation Composite Index of Anthropometric Failure (CIAF) helps decision-makers more effectively to reduce the rate of undernutrition compared to assessing the three indices separately. This efficient method simplifies the identification of overall predictors, making it easier to implement effective interventions. It is essential to address cultural beliefs and knowledge gaps through Behavioural Change Communication (BCC) to ensure optimal complementary feeding. Exploring the influence of BCC on mothers' knowledge and optimal complementary feeding practices (OCFP) is a crucial step in alleviating the impact of undernutrition.

Objective: This research aimed to examine the magnitude and factor influencing the OCFP and undernutrition among children between the ages of 6-23 months in Jimma zone, Southwest Ethiopia. Also, the study evaluated the effect BCC delivered by the Women Developmental Army on CIAF and OCFP.

Materials and methods: A community based cross-sectional study centered was carried out on 845 mother-child pairs in different rural agro-ecological districts (Midland, lowland, and highland) of southwest Ethiopia. Mothers / caregivers were interviewed to gather data on socio-demographic characteristics, food habits, maternal knowledge, and health-related factors Multivariable logistic regression analysis was performed to identify the factors that contribute to OCFP (Chapter 3). A baseline evaluation was carried out on 440 mother-child pairs in the rural Kersa districts of Jimma Zone using a cluster randomized controlled trial. A multi variable logistic regression analysis was performed to identify the contributing factors of anthropometric failure (Chapter 4). This interventional study assessed the impact of BCC on undernutrition (CIAF) on 440 children. Of these, 220 mothers of children were part of a group that received intervention by the WDA for 12 months. Difference-in-difference analysis and Generalized Estimating Equation (GEE) analysis were used to assess the impact of the intervention (Chapter 5). The effect of BCC on improving maternal nutrition

knowledge and OCFP was evaluated using the same population and methods as Chapter 5 (Chapter 6).

Results: This study showed that, the percentage of children between 6-23 months old received the recommended OCFP was 9.4% (95% CI: 7.19 11.08). But the percentage of children who received OCFP varied by agro-ecological areas, relatively with the lower percentage (4.4%) occurring in the midland. Factors associated with OCFP included being in midland and lowland districts, good maternal knowledge, maternal education (primary school or higher), and smaller family sizes (Chapter 3). More than half (57.3%) of children experienced anthropometric failure. Male children, inadequate minimum acceptable diet, larger family size, comorbidities, and food insecurity were positively associated with anthropometric failure, while higher maternal education was negatively associated (Chapter 4). Following the delivery of BCC to mothers in the intervention group, CIAF was found to have significantly decreased by 18.5% (DID: 18.5, $p<0.001$). The GEE analysis shown that the intervention significantly reduced CIAF over time. CIAF had a negative association with both father and mother educational status and received MAD, while positively associated with increased child age, household decision-making by parent-in-law, food insecurity, and larger family size (Chapter 5). Furthermore, the intervention group showed a significant improvement in OCFP by 1.064(±0.154) (DID: 1.064, $p<0.001$) and knowledge scores 15.9% (DID 15.9%, $P<0.001$). Mothers who got BCC were five times more likely to follow the recommended feeding practice in comparison to control groups over time. Optimal feeding practices were positively associated with maternal education and negatively associated with poor practice of traditional household food processing techniques and poor mother knowledge (Chapter 6).

Conclusion: This study found that the proportion of OCFP was low, and the rate of CIAF was high among children aged 6 to 23 months. After a year of BCC implementation for the intervention group, the prevalence of CIAF was decreased, while it remained unchanged in the comparison group. Over time, there was a significant improvement in the net effect of OCFP within the intervention group. This study suggested that long-term BCC interventions with WDAs could improve child feeding practice and nutritional status. Policymakers should support sustained interventions to improve children's optimal child feeding practices and nutritional status during the child initial first two years. Further research on the association of seasonal variation and child feeding practices is recommended. This study also recommended the importance of multisectoral approach to improve maternal education, family planning

services, and diversified agricultural production in improving OCFP.

Keywords: Agro-ecological area, Anthropometric failure, Behavioural change communication, Child feeding practice, Children aged 6-23 months, CRCT, Jimma zone, Mother knowledge, Optimal complementary feeding practice, Southwest Ethiopia, Women developmental army.

CHAPTER 1: GENERAL INTRODUCTION

1.1 Definition of undernutrition

Both inadequate and excess food consumption leads to the malnutrition, which affects human health, growth, and brain development on many levels, from the individual to the family, nation, and global scale. (1).

Inadequate intake of macro- and micronutrients results to undernutrition. Malnutrition is classified into undernutrition and overnutrition, with undernutrition further categorized to wasting, stunting, underweight and deficiency in vitamins and mineral. Children under the age of five are especially to undernutrition susceptible, more likely to get sick, and more likely to die than in other life cycles.

Wasted children under five reflects recent weight loss, often due to inadequate food intake, illness, or a combination of both (1). On the other hand stunting is a permanent condition resulting from long-term nutrient deficiency caused by poor socioeconomic conditions, inadequate maternal nutrition during pregnancy, infection, and insufficient feeding and care during childhood. It hinders children's cognitive and physical development, which reduces their potential for future economic success and affects the growth and productivity of a nation as a whole. However, underweight reflects both wasting and stunting (2-4).

The effects of undernutrition reach the nation's economic growth beyond the lives of people, families, and communities. The majority of damage caused by undernutrition happens before a child is two years old. Undernutrition has both immediate and long-term effects, such as impaired mental, emotional, and physical performance, decreased adult productivity, slower domestic growth, increased vulnerability to chronic illnesses, and an increased chance of developing chronic disease later in life (1, 2, 5, 6)

1.2 Anthropometric indexes

Based on the World Health Organization (WHO) growth standards reference z-scores below -2SD, conventional indices such as height for age (HAZ), weight for height (WHZ), and weight for age (WAZ) frequently serve as indexes to assess undernutrition in children(7).

These indices offer important insights into several biological processes and show the state of the three forms of undernutrition. For instance stunting which is failure in skeletal growth, and a sign of chronic malnutrition brought on by illnesses, insufficient food intake, and poor nutrient absorption. Secondly, wasting indicates an acute undernutrition brought on by a

recent food scarcity, which is characterized by a loss of tissue and fat mass. Lastly, underweight is a state that combines stunting and wasting. It is a reflection of stunting and wasting, but it cannot distinguish between the two indexes (8-10).

Moreover, different anthropometric indicators show varying levels of overlap. Conventional indexes often coexist with each other rather than being exclusive of one another. For example, while some stunted children may not be underweight, other underweight children may experience wasting and/or stunting. Furthermore, some children may go through all three stages of wasted, stunted, and underweight at the same time. As such, as a single index, these traditional indices are unable to give data on total undernutrition. Therefore, it is better to utilize the CIAF, which is a substitute metric made up of aggregate measures (8, 11-14).

Target 2.2 of the Sustainable Development Goals (SDGs) of the United Nations aims to eradicate malnutrition in all its manifestations by 2030, including wasting and stunting of children under five (15, 16). However, stunting and wasting are still very common, particularly in middle- and lower-income nations (15). Therefore, scholars emphasize the use of a variety of methodologies to evaluate the full range of undernutrition. In this regard, the CIAF is a helpful all-inclusive metric that offers precise insights about the general level of undernutrition in children as well as the direction and scope of changes over time. As a result, it draws attention to and has important ramifications for policymakers(8, 17). about the attainment of the SDG targets by 2030 by reducing undernutrition (16).

1.3 Global burden of undernutrition

According to the UNICEF global report on undernutrition, 149 million (22.3%) of children under five had stunting, with more than half of those instances occurring in Asia and two-fifths in Africa. Furthermore, it was estimated that 45 million children globally, or 6.8% of all children, were wasting; of those afflicted, 70% resided in Asia and more than 25% in Africa (18). Additionally, in nations with low and medium incomes, undernutrition is responsible for over half of all child deaths (2).

However, according to the global nutrition targets set by the World Health Assembly, not enough has been done to meet the 2025 target (16). Only around one-third of the countries are currently on pace to lower the percentage of stunted children by 2030. Besides, over 25% of countries are unable to assess progress. Thirty-nine million children would fall short of the 2030 objective if the current rate of development continues, with more than 80% of those

impacted living in Africa. Therefore, potential actions must be implemented in order to meet the global aim of lowering the proportion of undernourished children (18) (Figure 1.1).

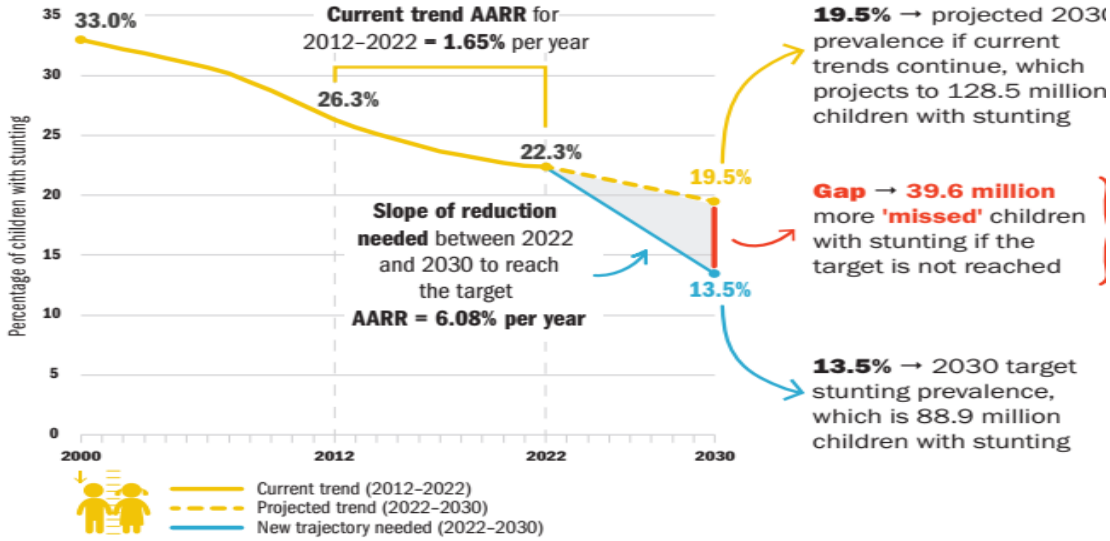


Figure 1.1 The Global burden of percentage of children with stunting 2020-2022, and projection to 2030
(Source: (18)) .

1.4 Optimal complementary feeding

The initial two years of child life are often regarded as the first critical period for promoting optimal growth and development in a child (19, 20). Research indicates that suboptimal child feeding practices for children between the ages of 6-23 months are a frequent and reliable indicator of malnutrition (21). Children below two years of age are at risk of malnutrition if they are not exclusively breastfed for the first six months of life and do not receive sufficient, frequent, and timely complementary foods afterward (1, 2, 22).

The WHO report highlights the issue of stunting and mortality among under five children, succinctly stating, "While more children are surviving, very few are thriving." This indicates the crucial period that establishes the framework for healthy physical growth and mental development throughout life, yet many children fail to thrive during this time, therefore; in later stages of childhood and adolescence (4).

The "1,000-day" is a period, which includes pregnancy and the first two years of childhood, is recognized as a crucial window period to prevent undernutrition and its long-term effects. The longest part of this time is the complementary feeding period (6-23 months) when

children transit from exclusive breastfeeding to eating a variety of foods alongside breast feeding (5, 23).

Breast milk is insufficient to cover a child's nutritional demands after six months, so complementary food must be introduced in addition to breastfeeding. It was recommended to begin the complementary feeding at the first half year and continue until 23 months. This period is recognized as a peak time for the shortage of micronutrients and growth failure (3, 20, 23).

1.5 Indicator of Optimal Child Feeding Practice

In order to comprehend the significance of optimal child feeding on the children's nutritional condition of under two years old, the WHO developed and validated a set of indicators, which include Minimum Dietary Diversity (MDD), Minimum Meal Frequency (MMF), Minimum Acceptable Diet (MAD), and timely initiation of complementary feeding (24). The term OCFP refers to an index that combines the four variables mentioned above. OCFP has the potential to save 6% of mortality among children under five each year and has been associated with a 17% reduction in the frequency of stunting at 24 months of age (25).

1.6 Global Magnitude of Optimal Child Feeding

The international nutrition goals set by the World Health Assembly in 2012 emphasize the need of ensuring that optimal complementary feeding reaches its maximum potential, in accordance with the SDG. It is planned to achieve these objectives by 2025. Among these goals is a forty percent decrease in stunting in children under five(1, 16, 18).

The WHO and UNICEF databases show that 48% of children do not receive the recommended number of meals per day, and almost one-third of infants between the ages of six and eight months do not start complementary feeding. Additionally, 29% of children eat a diversified diet, and almost half don't receive enough fruit and vegetables in their diet(18). Suboptimal feeding practices can result in inadequate nutrient intake and cause children to have long-term nutritional deficiencies. Children's complementary feeding programs have difficulties in a number of underdeveloped nations, including (19).

Based on original studies from Ethiopia and systematic reviews, meal frequency and insufficient dietary diversity are key causes of undernutrition (22, 26). Providing children with a meal rich in nutrients and suited for their age in terms of frequency and quantity is an

approach to reduce undernutrition in them (1). But in poorer nations like Ethiopia, children frequently switch from breast milk, which is high in nutrients, to meals consisting of unprocessed grains and legumes, which are low in vital elements because of their poor bio-availability. These foods' elevated phytate levels can impair nutrient absorption and lower their nutritional value (27-29).

The nutrient bioavailability and consistency of cereal-based complementary foods can be enhanced by using traditional home food processing techniques (THFP) like germination, roasting, and soaking when making gruel and porridge. Studies conducted in Southern Ethiopia in laboratory settings have shown that women do not understand the importance of adopting traditional food processing methods to make complementary meals with cereal-based ingredients (27, 28, 30-32).

1.7 Determinant factors of undernutrition and optimal complementary feeding practices

It has been demonstrated in earlier studies that socio-demographic, socioeconomic, and environmental factors are the main predictors of undernutrition in infant and young children in various countries (26, 33, 34) including Ethiopia (22, 35, 36).

Moreover, several studies and systematic review have revealed that socio-demographic, socio-economic, environmental factors, child illness, mothers or caregivers complementary feeding knowledge and agro-ecological production affect optimal child-feeding practices and nutritional status of children aged 6-23 months old(37-45).

1.7.1 Socio-demographic factors

Numerous findings have shown a correlation between socio-demographics, undernutrition, and, mother’s practice on complementary food. For instance, a systematic review conducted in Ethiopia reported the correlation between mothers' formal educational attainment and OCFP(46). Also, mother’s primary and secondary educational level were demonstrated to be positive predictors of OCFP in prior studies (37, 40, 42, 43, 47-49).

A study conducted in the northern region of Ethiopia found that children whose mothers attended formal schooling were less likely to be malnourished than children of illiterate mothers. It was also observed that the mothers and other caregivers in Ethiopia who have stunted children usually have lower educational status(50). Furthermore, a strong correlation

was discovered between the father's educational level and CIAF and complementary feeding practices (51).

The child's age has been found to be a predictor of the optimal feeding practice (52). In this older children were more likely to be protected against undernourishment than younger children (6–11 months) (53, 54). Besides, boys were more likely to suffer from undernutrition, possibly due to socio-cultural and biological differences (55-57).

In many developing nations, including Ethiopia, it has been observed that the larger the family size, the lower the likelihood of OCFP (48, 49). There is evidence that family size is a predictor of CIAF. It might be difficult for mothers or caregivers of large families giving their children the appropriate care and diet needed for healthy growth and development. This is due to constraint of time to prepare foods for the whole families and children separately and shortage of variety foods for preparation of complementary food (55).

The Bangladesh Demographic and Health Survey's secondary data indicates that 48.3% of children below the age of five suffered from undernutrition. Maternal age, living in rural areas, and having a low wealth index were factors that contributed to CIAF(58). Similar findings were obtained from a study done in Bogor, Indonesia, which showed that 42.1% of CIAF rate and its revealed relationship between with mother height, baby age, and improper child feeding habits (59). The above studies from Indonesia and Bangladesh focused on children below the age of five years old and employed cross-sectional design and secondary data analysis, respectively.

However, it is commonly recognized that a child's first two years of life are crucial for their development and growth, as well as offering a vital window of time to avert undernutrition (1, 20). Therefore, determining the overall undernutrition through the initial two years is important to set timely interventions into action.

1.7.2 Socio-economic factors

In developing nations, food insecurity is thought to be one of the main indicators of OCFP (41, 60-62). A study from South Africa has reported that household food insecurity is a major factor contributing to undernutrition in children and also influences the practice of complementary feeding. According to research conducted in South Africa, household food instability affects the practice of complementary feeding and it is a significant determinant in

children's undernutrition (63-65). Similarly, in Ethiopia, undernutrition is a major problem that primarily affects children, in food insecure households (66).

Mothers provide the majority of care for their children in many developing nations. As a result, their mother's ability to exercise control over and manage family resources may have an effect on their feeding practice and the nutritional status (67-69). One major obstacle that prevents mothers from feeding their children in accordance with WHO guidelines is the lack of resources (65, 70). Ethiopian research indicates that children are less likely to suffer from stunting when mothers have decision-making power (51). The study also showed that children from low-wealth families have a higher chance of developing CIAF (71, 72).

1.7.3 Mother knowledge on complementary feeding practice

Research conducted in Ethiopia had shown an association between poor maternal awareness of complementary feeding and its practice (39, 73, 74). Mothers' and caregivers' knowledge of the OCFP is essential for growth, development, and general wellbeing of the child (75). Moreover, parental knowledge and educational attainment are markers of the caregiver's ability to provide children with proper care (39, 76).

1.7.4 Agro-ecological production

There was insufficient evidence to demonstrate a definite relationship between OCFP and agro-ecological zone. Nonetheless, variations in agro-ecological zones can create significant challenges in food distribution, leading to disparities in nutrient availability and production levels across different areas. Moreover, differences in agro-ecological zones can pose serious problems for food distribution, resulting in variations in the availability of nutrients and levels of production in various areas (77). This intern has a negative effect on children' food intake, which can lead to undernutrition, suboptimal feeding practice, and a lack of variety in food intake (78).

As part of Sahara's monitoring system, a cross-sectional study in Nepal investigated the relationship between enhanced homestead food production and dietary diversity in women and children across two different agro-ecological zones: the Terrain and the mountains. When the study examined the seasonal fluctuations, it found a strong positive correlation between the beneficiary and non-beneficiary groups' dietary diversity. Nevertheless, the research did not establish a clear connection between DDS and agro-ecological zone, instead demonstrating that the strength of the relationships varied with season and agro-ecological

zone (79).

According to a study done in Kenya, there are differences in the characteristics pertaining to complementary feeding practices between agro-ecological zones in both high and low potential agricultural areas. Significant variations were found between high and low potential areas in the complementary feeding practice (44).

Similarly, studies conducted in the lowland and midland agro-ecological rural zones of Eastern and Northern Ethiopia revealed notable variations in the feeding practices of children between the ages of 6-23 months. In comparison to children in the midland zones, the findings show that children in the lowland regions typically have access to five or more food groups and MAD (80).

1.8 Behavioural change communication

Any intervention involving individuals, groups, or civilizations within a complete program is inherently a dynamic and brings participatory process of change in behaviour. Its core is the development of efficient communication plans intended to promote constructive behaviours appropriate for the circumstances in which they are used. However, altering one's behaviours takes time and needs taking into account the social and environmental influences on a person. Also, the willingness of individuals to accept behavioural change is essential to this process(81).

Evidence from throughout the globe indicates that BCC interventions are essential for promoting IYCF practices. In addition to creating a supportive environment, these interventions help mothers adopt and sustain healthy child-feeding practices (82-87). Ensuring successful complementary feeding requires addressing cultural beliefs and knowledge gaps through BCC. Thus, one of the most essential ways to lessen the effects of undernutrition is to investigate how provision of BCC improves mothers' knowledge and actions about complementary feeding practice(88).

Intervention can effectively alter mothers' complementary feeding practices and understanding when it is given in a well-organized, straightforward, and locally accessible food-based manner by volunteers such as community workers or WDAs. Researches on complementary feeding intervention has demonstrated that home-to-home food based BCC delivered by community workers is essential for enhancing feeding practice in children between the ages of 6-23 months (88, 89).

A systematic review conducted in low-income countries assessed the effects of nutrition education programs, either alone or in combination with other interventions, on children's nutritional status and other indices as assessed by conventional indices. After receiving educational intervention for six months, the study discovered that children in the intervention groups had a lower rate of stunting and wasting than their counterparts in the control groups. On the other hand, there were no noticeable impacts on the weight, underweight, or linear growth of the children. Additionally, the review demonstrated that educational interventions by alone had enhanced the frequency of food intake and consumption of a varied diet among children in the intervention group (90). The results of the study in LMICs suggest that mothers might not have gotten enough education throughout the six-month intervention, which had significant effects on the weight and linear growth of their children.

In a quasi-experimental study carried out in Ghana, mothers of pre-schoolers in the intervention groups received intervention over the course of a year through radio broadcasts. The researchers showed that increases in mothers' knowledge and improvement in children's DDS and MAD. Nevertheless, after the intervention, there were no appreciable gains in nutritional status (83). This study measured undernutrition in pre-school children using conventional indices. Furthermore, because there is no randomization in this quasi-experimental design, bias in participant allocation may be introduced, thus compromising internal validity of the finding.

In comparison to the comparison group, the intervention group had a larger percentage of children achieving DDS and MAD. However, growth indicators did not show any significant improvement (85). The impact of the intervention may have been hampered by the lack of house visits, practical demonstration, and message delivery that was restricted, even though BCC was provided for a period of eighteen months. This restriction may have an impact on mothers' knowledge and practices, which may result in a failure to improve feeding practices and a rise in the number of undernourished children.

1.9 Undernutrition, complementary feeding practice and its burden in Ethiopia

1.9.1 Ethiopian history of undernutrition and initiative

Ethiopia is a country that is both the second most populous and oldest autonomous nation in Sub-Saharan Africa. But it is known for having a higher prevalence in stunting (91).

Ethiopia has achieved significant progress in tackling malnutrition during the last decades, despite the fact that the condition is becoming more prevalent. Ethiopia is attempting to enhance nutrition through the following efforts : in order to lower the rate of nutritional deficiency and improve nutrition the Ethiopian government launched the National Nutrition Program (NNP I) in 2008 (92), and the second phase of NNPII (2011-2016) in 2016(93). Both programs aimed to involve many sectors in coordinated and integrated efforts. Additionally, Ethiopia launched its first Food and Nutrition Policy (FNP) in 2018 (94), and Food and Nutrition plans by 2021(95), by which time it had created a full FNP-based Food and Nutrition Strategy. The goal of this strategy is to improve food and nutrition security by stressing the significance of having a sufficient, varied diet available at a specific frequency.

Additionally, the Ethiopian government adopted the Seqota Declaration in 2015, which committed to ending child development impairment among children by 2030, in accordance with the SDG (96) . In addition, the Ethiopian government released a number of feeding guidelines for infants and young children in 2010 and food-based guidelines in 2021 with the goal of improving child feeding practices and moving the country closer to achieving SDG 2 by lowering undernutrition(97, 98).

However, in Ethiopia, for example, only 60% of children begin complementary fed at six months, while just 12%, 45%, and 7% meet the standards for MDD, MMF), and Minimum MAD respectively (99). Previous studies in Ethiopia show that the range of OCFP is 8.6% to 26.8%. Additionally, there are notable differences in child feeding practices among rural and urban setting, as well as across different agro-ecological zones (38, 41, 45).

Ethiopia remains far from achieving the World Health Organization's 2025 target for reducing undernutrition and continues to face challenges in meeting the 2030 goal. The percentages of children affected by, underweight, wasting, stunting, and CIAF have decreased slightly between 2005 and 2019, according to the EDHS report 2000-2019(99-101) (Figure 1.2).

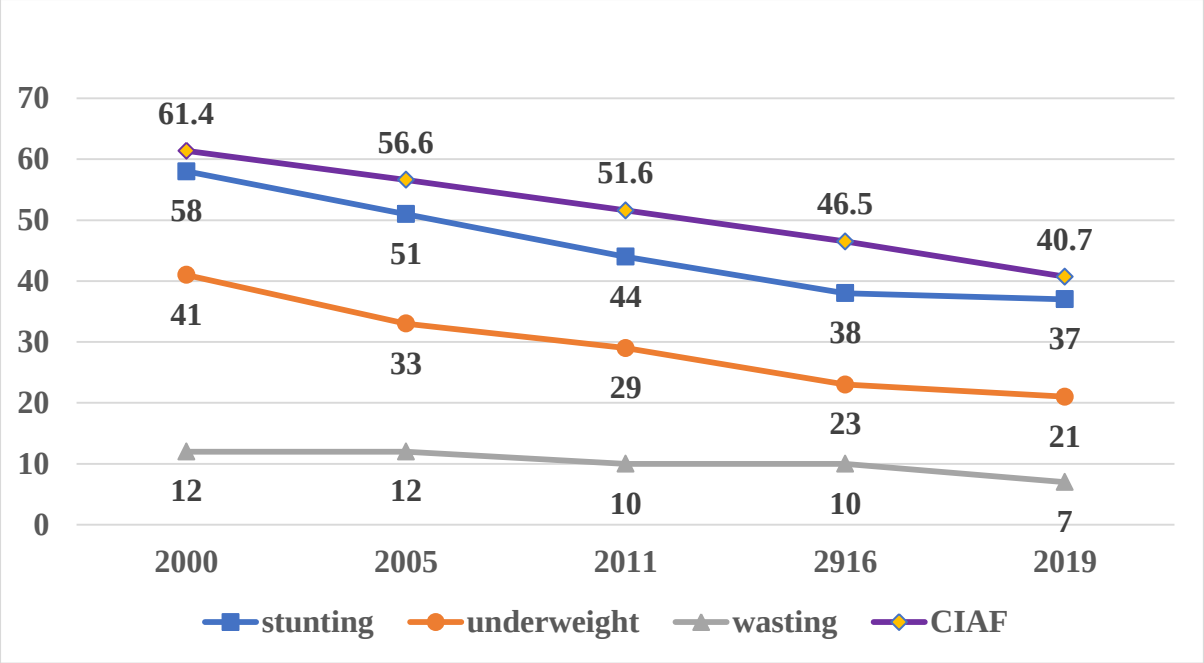


Figure 1.2 Trends of undernutrition by conventional index and CIAF from 2000-2019 among under five children
(source: (100, 101) .

Furthermore, earlier research revealed that the prevalence of undernutrition varied by region, with stunting rates ranging from 27.2% to 46.3%, underweight 15.8% and 33%, and wasting 6.3% and 15% (22, 80, 102). In addition, the rate of stunting is higher in rural areas (43%) compared to towns (29%), and the rate of wasting is higher in rural areas (12%) compared to urban (8%) According to a survey from the Jimma districts, the prevalence of underweight, wasting, and stunted children was 9.7%, 13.1%, and 25.4%, respectively (103). These numbers are lower than Ethiopian's national prevalence.

According to Africa's Hunger Cost report, the yearly cost of child undernutrition in Ethiopia amounts to ETB 55.5 billion or 16.5% of the country's GDP in 2009 (91). This shows an increased cost due to undernutrition in contrast to Uganda and Egypt. Based on the aforementioned analysis, Ethiopia may potentially save around 148 billion ETB birr by 2025 if she could decrease stunting among children aged 6 to 23 months by 10% and underweight by 5% (96).

So far, several studies examining underweight, stunting, and wasting in Ethiopian among infant and young children have been conducted using conventional indices. However, there is a visible gap in research regarding the assessment of overall undernutrition using a single index CIAF for this age group, especially within our specific study area.

According to Workie and Tesfaw's review of secondary data from Ethiopia, the country's overall undernutrition rate (CIAF) was 46.7% among under five children. Also, the CIAF was linked to place of residence, mother's education, wealth index, and child sex(71). In the other study, the prevalence of CIAF in children under five ranged from 46.2% to 53.5% Anthropometric failure was associated with risk factors such as birth order, low parental educational status, rural residency, low income index, and mother age(53, 104, 105).

1.9.2 Determinants of under nutrition and complementary feeding practice in Ethiopia

Numerous investigators have determined that undernutrition in Ethiopian children is caused by a variety factor including child age, disease, wealth index, inadequate feeding practice(91), parental education (43, 46), and mothers' capacity to make decisions about household resources (51, 68), family size (71, 106), maternal knowledge on child feeding practice, agro-ecological, production (38, 61, 74) and food insecurity(107).

1.9.3 Educational intervention to improve complementary feeding practice in Ethiopia

There was little information available in Ethiopia on the food-based BCC intervention that addressed feeding practice and nutritional status of children between the ages of 6-23 months (108). For example, few researchers were conducted on nutrition education intervention in southern Ethiopia, but their main focus was on particular foods like pulses and broad beans (84, 109).

In Sidama, a community-based CRCT was carried out to assess the impact of nutrition education on mother knowledge and the consumption of a variety of complementary foods among children aged 6—23 months. The intervention was administered by Health Extension Workers (HEWs) to child mothers in the intervention group over a nine-month period. The nutrition education which was provided by HEWs had considerably improved mothers' knowledge and practice of dietary diversity after nine months of implementation. Furthermore, a statistically significant distinction was noted in the rate of underweight, stunting, and wasting between the intervention and control group(84).

CRCT was carried out among infants in West Gojjam, Ethiopia, to evaluate the effect of BCC intervention on nutritional adequacy introduced by community-level actors. Generalized estimated equation statistics showed a substantial increase in the proportion of infants meeting MDD, MMF, and MAD in the intervention groups in comparison to the control groups (89). The same authors evaluated the impact of BCC on infant morbidity and growth

in rural West Gojjam areas in a follow-up study to the one stated above. According to this study, infants in the intervention group significantly increased in weight and height when compared to those in the control groups. Moreover, a decrease in the prevalence of stunting and underweight was noted in the intervention groups in contrast to the control group (108). The evaluation, which concentrated on the crucial 6 to 23m months of range, may offer distinct insights into how well intervention enhances nutrient adequacy, child growth and development. This supports the efforts of local stakeholders and policy makers to enhance child feeding practices by facilitating the delivery of BCC through community health workers.

1.9.4 The WDAs' involvement in promoting BCC to enhance complementary feeding practices

Ethiopia has successfully reduced the death rate of mothers and children by implementing the Health Extension Program (HEP) through HEWS. The sixteen health care packages that make up the HEP's components are categorized into four critical health needs: family health services, disease management and prevention, environmental health and hygiene, communication, and health education. However, because of the difficulties that the HEWs encounter like vast number of catchment areas with dispersed populations, rural areas still do not have access to sufficient health care coverage (110). In order to address this issue using community volunteers, a novel initiative known as Women Development Army (WDAs), also known as Health Development Army, was launched in 2010 in Ethiopia. The WDAs, selected from the "model household," contribute to the concept of creating a model household by guiding a network (one to five networks) comprising one woman leader and five neighbouring households toward improved health. Furthermore, WDA team leaders support HEWs by facilitating community organization, disseminating critical health information, encouraging healthy lifestyle choices, and gathering data on community members in need of medical care. The WDAs are therefore unpaid volunteers who serve as community representatives to improve public health activities(111). They are essential in mobilizing the population and promoting the primary health care program.

Previous research from Ethiopia, and other developing nation indicates that educational interventions provided by community health worker or WDA have improved mothers' knowledge and practices about feeding their children and improving their nutritional status (34, 108, 112). Moreover, because WDAs with the community share a common cultural

background, a common quality of living, and engage in unpaid and volunteer work, are trusted in the community and they have close relationships (111, 113). These facts may contribute to effectively conveying messages to mothers. WDAs are therefore ideal adapted to deliver the key BCC messages to mothers regarding child feeding knowledge and practice.

1.10 Why was this Ph.D. dissertation research necessitated? What was the gap that it attempted to fill?

Children start receiving solid and semi-liquid meals at six months of age. The dietary requirements of infants and young children increase in line with their rapid growth and development during critical window period (1, 19, 23).

Nevertheless, a lot of children don't follow the WHO's suggested child feeding guidelines (76, 114). UNICEF reports that 72% of children worldwide begin solid meals between the ages of six and eight months, only 50% receive the minimum meal frequency (MMF), and 47% of children eat meat, fish, or eggs. Furthermore, 31% were given a variety of foods according to standard(18). According to available data, children between the ages of 6-23 months have a low rate of OCFP in sub-Saharan African countries (21, 23, 49). For instance, the results of studies conducted in Ethiopia by Asrat *et al*. and Degfa *et al*. as well as a systematic review conducted across 52 LMICs by Alem *et al*. show that women who practice poor child feeding are more likely to have inadequate knowledge about feeding practices (74). The results of another study conducted in the Oromia region showed that 9.5% of IYCF practice were appropriate (106).

There is a little data available regarding the factors and prevalence of OCFP among infant and young children in the Jimma zone. According to a Jimma survey, just 16.1% of children satisfied the minimal requirements for nutritional diversification (103).

Nonetheless, there is discripancey in Ethiopian OCFP research findings. Prior studies have examined OCFP among children using one, two or three WHO complementary feeding indicators. Numerous prior studies conducted in Ethiopia employed indicators such as DDS and MMF only or DDS, MMF and MAD, or DDS and MMF and timely initiation of complementary food. But these studies lack generic information, hence OCFP needs to be defined (84, 89, 115-118). Because of this disparity, it is difficult to ascertain the exact overall percentage of complementary food and for local and national responsible agencies to develop a successful intervention plan.

The current study defines OCFP by taking into account WHO parameters such as MMF, MDD, timely initiation, and MAD. As a result, this study aims to close the gaps in the assessment and interpretation of these practices in addition to addressing the dearth of information on the percentage of OCFP among children in the study area and Ethiopia between the ages of 6-23 months.

In addition, Children from high-potential areas demonstrated a positive association with MMF, MDD, and MAD in contrast to children from low-potential resource areas. In addition research from Kenya reported that, there are differences throughout agro-ecological zones in terms of mothers' feeding practices and the quantity and quality of the nutrients they consume(44). Similarly, a study conducted in Ethiopia found that children who resided in lowlands had a lower likelihood of receiving DDS and MAD according to recommendations compared to highlands (80). Similar to this, distinct agro-ecological zones that produced various crops were found in the current research area. While the lowland area was well-known for its coffee plantations (cash crop) and the midland area was predominantly recognized for its agricultural production like cereals and legumes, the highland area was mostly focused on producing fruits and vegetables with little to no production of cereals. There is, however, a paucity of data on possible associations between child feeding habits and variation in agro-ecological areas among children between the ages of 6-23 months both in the study zone and region.

There is a shortage of research in Ethiopia on the cereal-based complementary food recipes using THFP and its impact in undernutrition There are also only a few data points, the majority of which focus only on the country's southern part(84). Moreover, our results show a strong correlation between THFP procedures and undernutrition in baseline evaluations. In response, our intervention placed a significant priority on this practice in order to enhance mothers' knowledge and skill with THFP.

We investigated variations on child feeding practice across agro-ecological zones in Chapter 3 (objective one). This study was identified districts with low OCFP for food-based BCC implementation with the help of our initial review.

Another concern, undernutrition is regarded as a significant public health problem, especially in relation to wasting and stunting (18). The majority of studies conducted on the nutritional status of Ethiopian children, concentrate on preschoolers and young children. Consequently,

there is only a few research conducted on undernutrition among children between the ages of 6-23 months (103).

A few studies that were done on children between the ages of 6-23 months measured undernutrition using a conventional index as stunting, wasting, and underweight. Nevertheless, the undernutrition percentage among children between the ages of between the ages 6-23 months cannot accurately be determined by these conventional indices, which have a tendency to overlap and miscalculate the number of undernourished children.

It is difficult for the policymakers to create inclusive interventions due to the absence of adequate data on the total rate of undernutrition in children between the ages of 6 to 23 months.

This dissertation, particularly study 2 and 3, address the observed methodological gap using CIAF to estimate the overall prevalence of undernutrition among children aged 6 to 23 months. Additionally, this dissertation tried to fill the information gap on undernutrition in the study area and Southwest Ethiopia.

The results of our first and second objectives indicated the need of food-based BCC. Indeed, no CRCT was conducted in the Oromia region as well as in the research area to evaluate the effects of complementary feeding BCC on OCFP and CIAF in children aged 6-23 months.

There is a shortage of data is available to evaluate the impact of educational intervention on undernutrition, appropriate complementary feeding practices, and knowledge among Ethiopian infant and young children aged. Despite the fact that the data that is currently available shows differences in the research participants, technique, design, and duration between the interventional studies conducted in the Amhara area and southern Ethiopia(119, 120).

In the Ethiopian interventional trial, BCC is usually administered for four to nine months and food-based strategies such as THFP procedures are frequently disregarded in these kinds of programs. Furthermore, the contribution of WDAs on mother knowledge and child feeding practice are often unnoticed. Thus, comprehensive and continuous efforts are required to improve child feeding practices and nutritional outcomes to close this difference. In order to close the aforementioned gap, our BCC intervention was implemented by using WDAs for duration of 12 months.

Table 1.1: Summary of previous educational intervention on undernutrition and complementary feeding practice in Ethiopia

Author-date **Study area**	**Participants age**	**Study design**	**1^0 outcome & measurement**	**Intervention**	**Limitation**
Teshome *et al*,2020 in Sidama zone	6-15	CRCT	DDS (7 food groups) Anthropometry -Conventional index	Mother in the intervention groups receive NE by HEWs for 9 months	Complementary feeding practice assessed by DDS only Anthropometry indicator using conventional Indexes NE delivered by HEWs may lack sustainability due to work load lacks community involvement
Muluye *et al*., 2020 Hawassa town (day care)	6-23	RCT	Appropriate complementary feeding practice components - DDS (7 food groups)	Four months NE by nutritionists Shorter duration	Conclude ACFP by assessing DDS only (7 food groups) exclude breast milk. NE may not reflect the true effect of the intervention on mothers' knowledge and practice in a shorter NE period. Design lacks cluster randomization NE by nutritionists may have create gaps in knowledge
Abiyu and Belachew, C 2020. Gojam (Rural) Abiyu and Belachew, 2020b Gojam (Rural)	Less than six months	CRCT	Undernutrition using conventional DDS, MMF& MAD	BCC by WDAs Nine months periods	Using conventional Indexes doesn't give the overall estimation of undernutrition

NE: *Nutrition education;* ***ACFP:*** *Appropriate complementary feeding practice;* ***WDA:*** *Women Development Army;* ***MAD****: Minimum Acceptable Diet;* ***DDS:*** *Dietary Diversity Score*

1.11 Significance of the study

This research finding provides valuable insights for policymakers and local stakeholders into the prevalence and variation of OCFP, identifying the extent and key factors that influence these practices in rural areas. To address the root causes of undernutrition, policymakers can utilize the aggregate metrics provided by the CIAF. The CIAF also offers comprehensive data that can inform strategies to reduce child mortality.

This study also incorporates THFP techniques in the BCC component, aiming to improve mothers' knowledge and use of these methods when preparing gruel and porridge from cereal-based foods. By promoting THFP practices, the study empowers mothers to protect their children from undernutrition. It underscores the importance of targeted interventions that enhance the delivery of complementary foods using locally sourced ingredients, offering valuable insights to both communities and policymakers.

The findings emphasize the need for targeted community-based initiatives and stronger nutrition policies to promote complementary feeding practices. Integrating THFP techniques with the support of WDA networks for message delivery is crucial. This research provides evidence to guide future researchers, policymakers, and program planners in designing sustainable, context-specific, food-based interventions.

To strengthen existing nutrition policies, it is essential to use comprehensive measures of undernutrition in children aged 6 to 23 months. The results from this CRCT will serve as a foundation for refining current policies and guiding future investigations to address undernutrition more effectively.

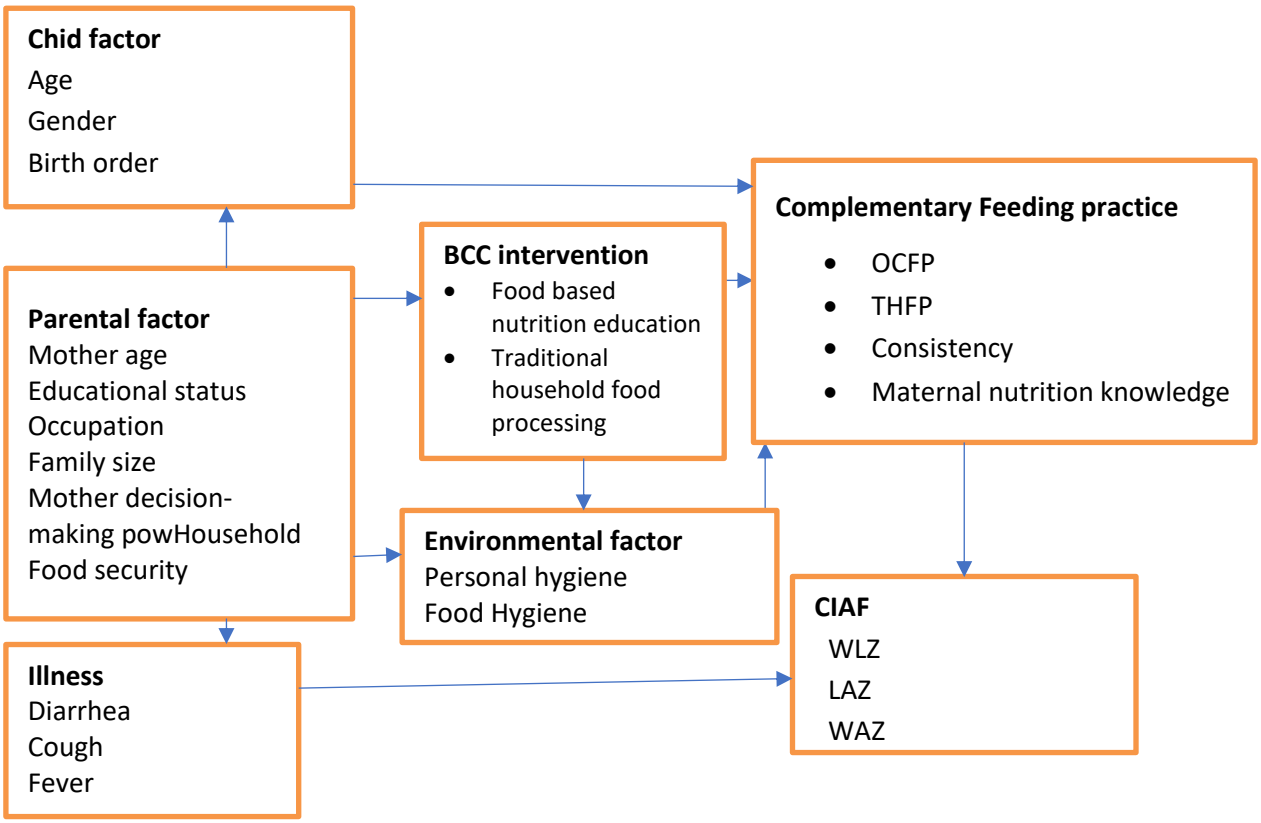


Figure 1.3: Schematic presentation of conceptual framework of interrelated factors of optimal complementary feeding practice and anthropometric failure, 2024.Adapted from different literature reviews
(5, 69, 121).

1.12 Objective of the study

This dissertation's general objective was to assess the effect of BCC on maternal optimal complementary feeding practice, complementary feeding knowledge, and overall undernutrition among children aged 6-23 months, in Kersa districts, Southwest Ethiopia.

- To determine the prevalence of OCFP and its associated factors among children aged 6–23 months in three agro-ecological rural districts (high, mid and lowland) in Jimma Zone Southwest Ethiopia.
- To assess the Anthropometric failure and its associated factors among children aged 6–23 months in Jimma Zone, Southwest Ethiopia.
- To assess the effect of BCC through women development army on CIAF among children aged 6-23 months in Southwest Ethiopia.
- To assess the effect of BCC through WDAs on OCFP among children aged 6-23 months in Jimma zone, Southwest Ethiopia.

1.13 Research questions

- What is the magnitude, trends and determinant factors of OCFP in the study areas?
- What are the magnitude and determinant factors of the CIAF in the study areas?
- Does the BCC through WDA improve OCFP of mothers/caregivers of infant and young children?
- Does the BCC through WDAs reduce overall prevalence of CIAF?

1.14 Research Hypothesis

- There is an improvement in OCFP between the ages of 6 and 23 months of children in those received BCC intervention for 12 months as compared to children who did not
- There is a difference in reduction of the overall undernutrition between the ages of 6 and 23 months of children in those who received BCC intervention for 12 months in comparison with children who didn't.

1.15 Outline of the dissertation

Chapter 1 gives a thorough review of the dissertation, encompassing definitions, indicators of undernutrition, OCFP. It investigates global and regional burdens and perspectives on risk factors, identifies gaps in previous research, presents the problem statement and the gap

analysis, explains the study's importance and develops the conceptual framework. Chapter 2 presents the methods part, discussing in detail the methodology and materials used in this study. The following four chapters are organized accordingly, with the initial two chapters having been published and the remaining chapters currently under review. Chapter 3 presents the prevalence and predictors of OCFP across three rural agro-ecological districts. Chapter 4 illustrates the evaluation of the frequency and predictors for anthropometric failure in children 6 to 23 months of age in Ethiopia. Chapter 5 demonstrates the effect of BCC through the WDAs on optimal complementary feeding practice. Chapter 6 portrays the effect of BCC through WDAs on optimal complementary feeding practice. Chapter 7 presents the theoretical and practical implication s of all findings, elucidating their potential implications for nutrition policy and practical applications in nutrition programming, and future research endeavors. Figure 1.4 illustrates the schematic presentation of the dissertation.

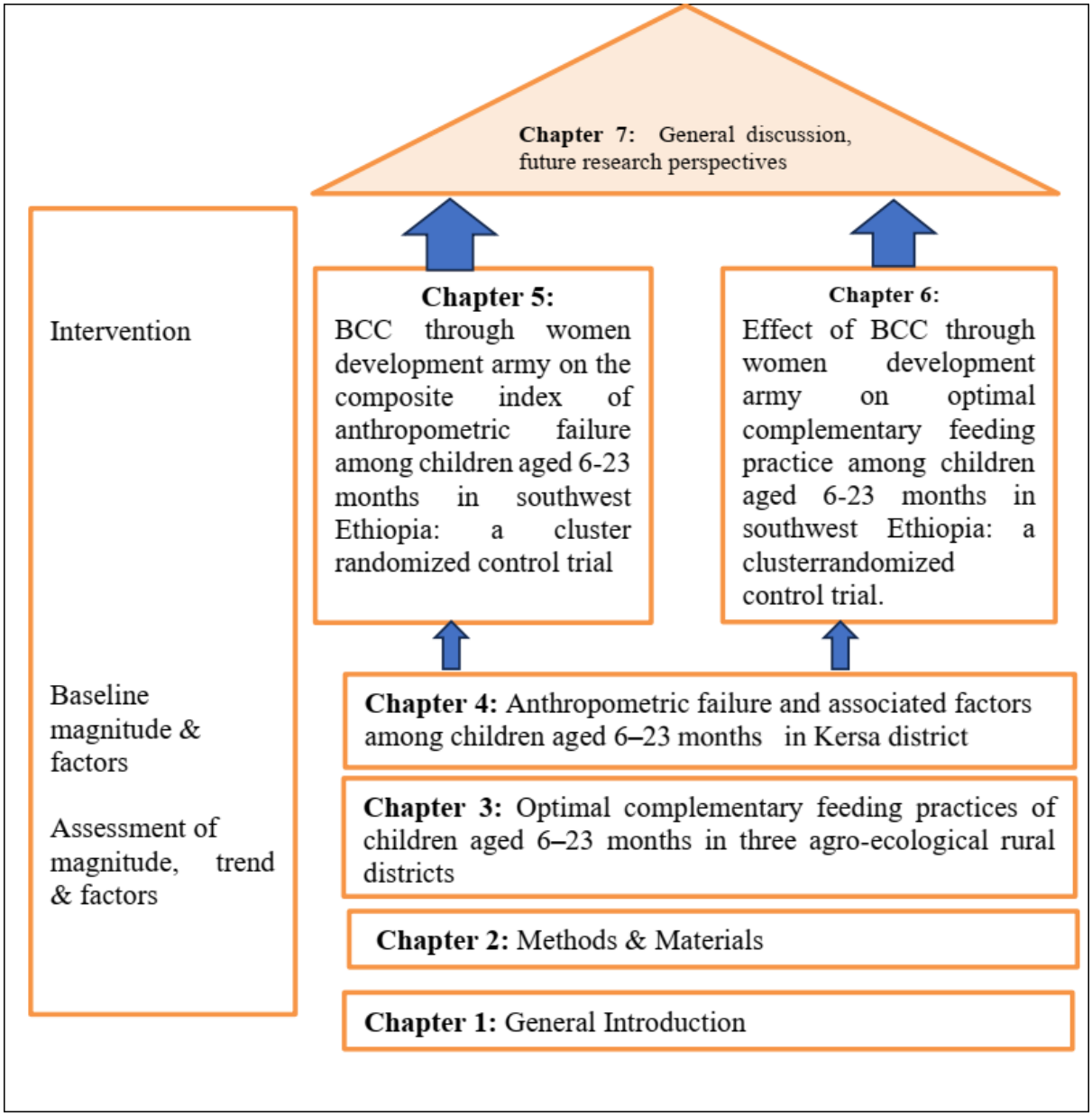


Figure 1.4 Schematic presentation of the PhD dissertation, 2024

CHAPTER 2: MATERIALS AND METHODS

2.1 Study area and period

The boundaries of Jimma zone are in the North East Welega Zone, in the Northeast West Showa Zone, in the Northwest by the Iluababbore Zone and in the South by South west region (Figure 2.1). The Jimma Zone, located between 7°15´ and 8°56´ n latitude and between 36°00´ and 38°38´ e longitude, is a moisture-reliable zone that is widely known for growing coffee and chat. Annual rainfall in the region is between 1,200 and 2,800 mm. per 59 annum, and in normal years the rainy season extends from February to November.

The zone is suitable for growing coffee (mainly), cereals, pulses, root and fruit and vegetables crops but the production varies accordingly. There are highlands (15%), midlands (67%), and lowlands (18%) in the agro-ecological context (122, 123). The three: Dedo, Mana and Kersa districts were selected deliberately based on their agro-ecological production. Dedo is known in the production of vegetables and tubers, and some cereal, and Mana is known in producing coffee (cash crop) area and Kersa is predominantly known in farming cereals (122). According to the health offices' report from 2018, there were an estimated 688 children in Mana, 914 in Dedo, and 1651 in Kersa.

Kersa district is bordered by Dedo to the south, Seka Chekorsa to the southwest, and Mana to the west. To the north, it borders Limmu Kosa, while Tiro Afeta lies to the northeast and Omo Nada to the southeast. The district is situated at a latitude between 7°35’-8°00’N and longitudes 36°46’ -37°14’ E, with an altitude ranging from 1740 to 2660 metres above sea level.

Its landscape comprises 10 percent highland and 90 percent midland, comprising diverse agro-ecologies. The Kersa district's total population was 165,391 as recorded during the national census of 2007. The district is located between latitudes. There were 81,812 women and 83,579 males in this population. Urban dwellers comprised 3.28% of the total population. Due to being identified as a midland area dependent on cereals and legumes, the Kersa district was purposefully chosen (122).

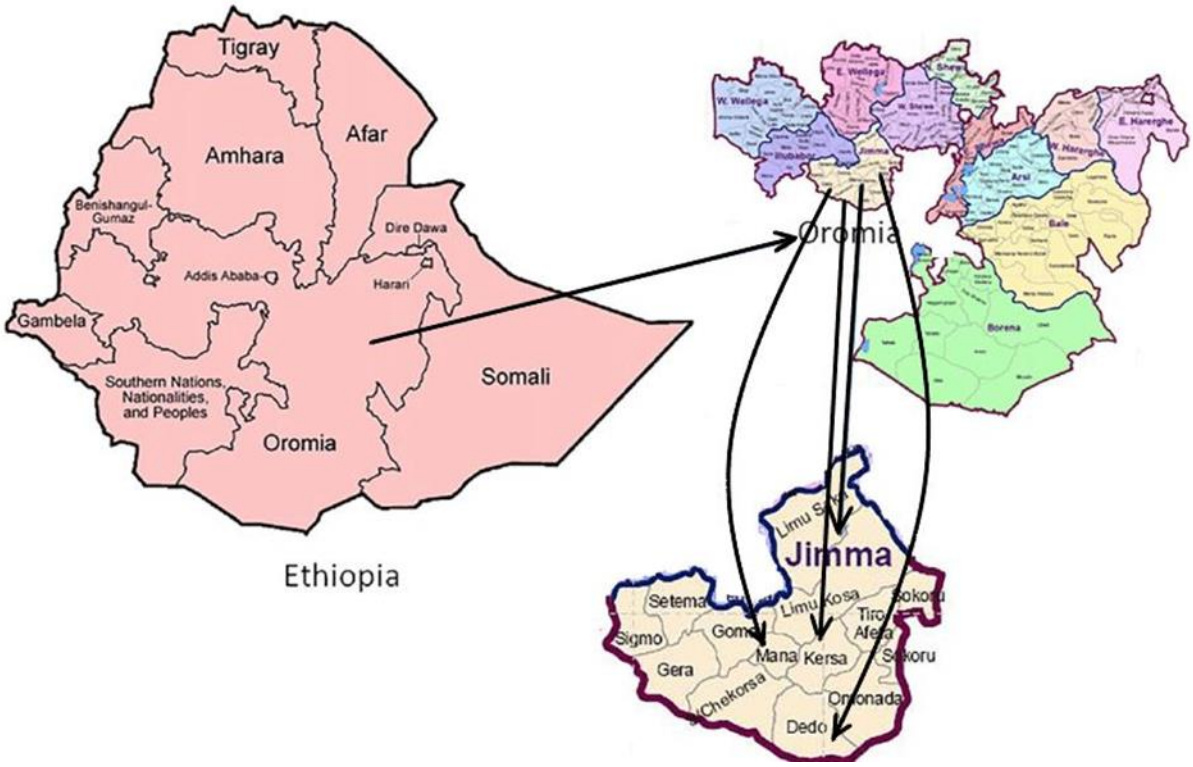


Figure 2.1 Map of Jimma-zone illustrate study area: Kersa, Mana and Dedo
(Source: https://en.wikipedia.org/wiki/Oromia)

2.2 Study design

For chapter 3, a community cross-sectional research was done across three agro-ecological zones between February and March 2020 in Dedo, Kersa, and Mana, districts, Jimma zone, Southwest Ethiopia. According to the health offices' report from 2018, there were an estimated 688 children in Mana, 914 in Dedo, and 1651 in Kersa.

For chapter 4, 5 &6, a cluster randomized control trial was conducted in rural Kersa district, Jimma zone, Southwest Ethiopia from January 2022 to December 2022. Kersa is predominantly known in farming cereals (122).

2.3 Participants recruitment and randomization

Participant Recruitment for all objectives

The study included children 6-23 months-old and their respective mothers from randomly selected kebeles. All mother-child pair who lived in the study area for six months and was available during the study period was eligible to participate. Children who have receiving supplementation as treatment for malnutrition were excluded. Because the supplementation,

which can cause a change in feeding habits, may obscure the observable effects of the intervention. Additionally, chid mothers/caregivers who were critically ill or unable to communicate were excluded from the study.

The study subjects for this research were drawn from Jimma zone. However, the number of samples and study area varied based on the objectives and research hypotheses. Specifically, the sample and area differed for the first objective (chapter three**)**. Districts with Dedo, Mana and Kersa, took part in cross-sectional research. Additionally, the second to fourth studies were carried out in the Kersa district, guided by the findings of low prevalence of OCFP from the first study (chapter 3) and considering the district's cereal-dominant production.

Sample size for chapter three: A single population percentage technique with a 95% confidence level and 5% precision was used to choose participants. This method was based on the conclusion from a prior study in two agro-ecological zone in rural Ethiopia that 50.5% of children satisfied the minimum meal frequency criteria(38). Taking into consideration two design effects and the non-response rate 10%, the final sample comprised 845 mother-child pairs. Utilizing a multi-stage sampling method, three districts in the Jimma zone were purposely selected based on primary agro-ecological features. Within each district, a specific number of kebeles were randomly chosen, with sample sizes determined by the proportions of children in the selected kebeles. Ultimately, the study sample was drawn from the HEW family folder in each kebeles using a method of systematic sampling. The final required sample was 431 children from Kersa (midland), 174 from Mana (lowland), and 240 from dedo (highland).

Participants and randomization for chapter 4, 5 & 6

The number of sample population required for interventional study was determined by G-POWER software, considering an effect size of 0.4 impact size in comparison to the control and intervention groups, a significance level of 5%, and an 80% power, resulting in an estimated sample of 100 mother-child pairs per group, with a total of 440 accounting for design effects and non-response rates.

For study 2, 3, and 4, multi-stage cluster sampling method was employed to select participants from 22 rural kebeles in Kersa, focusing on agricultural production. Four kebeles, consisting of 25 villages and 1,194 children aged 6 to 23 months, were initially selected, while the rest were excluded due to logistical constraints and geographical

considerations. Of the 25 villages, 18 were randomly selected by an independent statistician who was not involved in the study. The statistician used a computer-generated random number table to create the allocation sequence. Villages were randomly assigned numbers, with 1 to 9 designated one group and 10 to 18 for the other. To avoid potential contamination, four adjacent villages, including two from each group, were excluded to serve as a buffer zone. This left 14 villages in the study, with both the intervention and control groups receiving seven clusters each. This allocation aimed to ensure an equal proportion of clusters per group from each village, thereby neutralizing any potential variation effects. Finally, the sample population was proportionally distributed among the selected villages in both groups using systematic random sampling method (Figure 2.2).

2.4 BCC Intervention description

Recruitment and training of WDAs

WDAs were chosen by the communities' members, the Kebeles leaders and HEWs based on their willingness to help communities and trust as well as their work performance in assisting HEWs with public health activities. Then, 23 WDA members were recruited and given extensive training over seven days on the purpose and content of the package through lectures, discussions, and Question &Answer sessions led by a nutritionist. A trainer-of-trainees manual, leaflets, and posters were distributed to the WDA members. The training was further reinforced with demonstrations and re-demonstration in preparing complementary food recipes.

For the group that received interventions, three trained WDA members were allocated per cluster (one WDAs for 10 mother child pairs) to deliver key messages to the selected mother-child pairs between January 2021 and December 2022. These WDA members deliver key intervention messages to mothers and caregivers through various methods, including group discussions, flip charts, posters, child feeding guidelines, and practical demonstrations. They also distribute manuals and illustrated materials to mother-child pairs in the intervention wing. Home-to-home visits were conducted by the WDAs every two weeks for two days during the first three months, every month for two days during the second three months, and every two months for two days during the next six months.

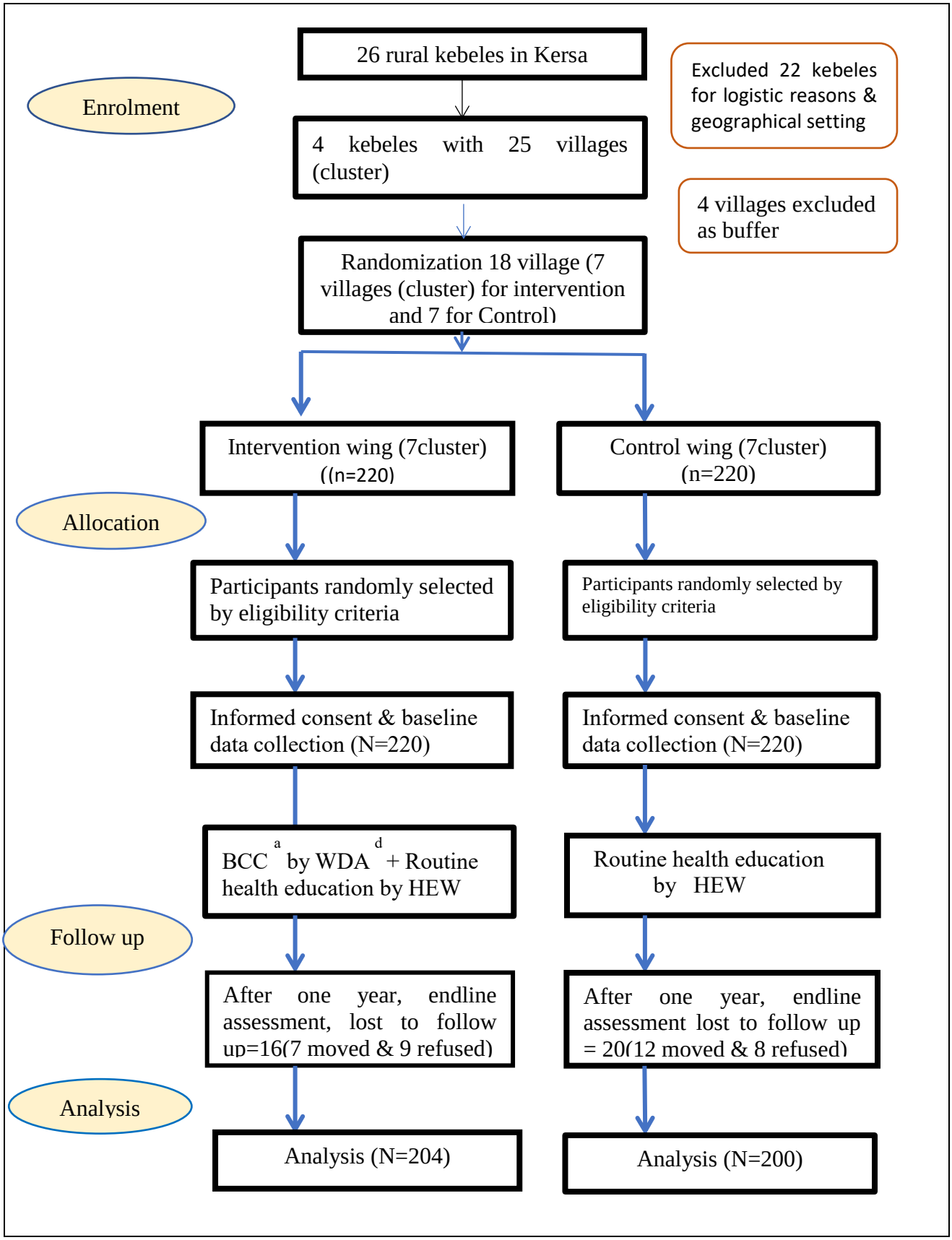


Figure 2.2 CONSORT flow diagram showing cluster randomized control trial, 2024

[a] *Behavioural change communication;* [b] *Women Developmental Army* [c] *Health Extension Workers* [d] *Endline*

During these visits, the WDAs and supervisors reinforced key messages and re-demonstrated food recipes skills that the participants had practiced. The control group did not get the BCC intervention and continued with the usual health education provided by the routine health services. Following the end of the second round of data collection for both groups, the control group received four hours of short BCC messages.

BCC Intervention

The WHO-UNICEF booklets "Key Messages Booklet on the Community Infant and Young Child Feeding Counseling Package" and "Complementary Feeding Training Handbook by Alive and Thrive in Ethiopia" served as the basis for our BCC intervention's modules(97, 124).The components of the intervention packages were breastfeeding continuation, when to introduce complementary foods and how to improve the, variety, diversity of complementary food from foods that are readily accessible locally, preparation of complementary food recipes using traditional food processing techniques, and hygiene.

BCC consisted of five sessions and door-to-door home visits to mothers in the intervention group. The BCC was reinforced through demonstrations and re-demonstrations. Home visits were employed every two weeks of each month for the first three months, monthly for the next three months, and every two months for the final six months. During visits, WDAs and supervisors reinforced the key messages and demonstrate food preparation including traditional household food processing techniques learned by practice. The BCC implementation is composed of five sessions, each addressing different aspects of infant and child feeding practice. Session 1, offers an introduction of malnutrition, emphasizing its causes and consequences, along with the benefits of sustained breastfeeding and timely introduction of complementary foods. In Session 2, the focus is on key messages regarding OCFP. This included continuing breastfeeding, introducing consistency of the complementary foods, and increasing feeding amounts gradually as the child grows older, with specific guidelines offered for various age ranges. Emphasis is also placed on including a diverse range of foods, such as animal-source foods, vegetables, and fruits, while promoting interactive feeding practices. Session 3stressed on how to make complementary food and explains how to make cereal-based flour and enriching it with variety of foods. Session 4 focused on feeding practices during illness and promoting good hygiene and food preparation habits. Lastly, Session 5 concentrates on THFP method, offering practical demonstrations and re-demonstrations for preparing legumes and cereal flour (Table 2.1).

Table 2.1: Section of Behavioural change communication key message for intervention group

Age	Recommendations		
when	Types of food	How often	How much
At 6 months 	Breastfeed on demand. Start with soft enriched porridge + Animal source food 	frequent breastfeed + 2 to 3 times	Start with 2 to 3 tablespoons and gradually increase the amount to three coffee cups
From 6 up to 12 months 	 + Enriched flour (3 parts cereal + 1 part legumes). 	2 to 3 meals + frequent breastfeeds 1 to 2 snacks may be offered	3 coffee cups  Thick of food
From 12up to 24 	+ Fruit and Vegetables 	3 to 4 meals + breastfeeds 1 to 2 snacks may be offered	4 coffee cups 

Preparation of complementary foods using soaking, germination, toasting, and grinding of cereal based foodingredients



Preparation of germinated flour

¼ legumes **¾ cereals** **enriched flour**



2.5 Instruments and outcome measure

We used a pre-tested, structured questionnaire, adapted from literature (24, 41, 43, 99, 125). Ten trained BSc nurses and two supervisors (nutritionists) were recruited to collected data for both cross-sectional and interventional studies on separate occasions. Different questionnaires were used for cross-sectional and interventional studies.

In the cross-sectional study, socio-demographic factors, complementary feeding practices, maternal knowledge, hygiene, and health-related characteristics were assessed. Baseline assessments for interventional studies (objectives 2, 3 & 4) were conducted in December 2021, encompassing socio-economic status, household food insecurity, and anthropometric measurements.

The endline survey, which was employed in December 2022 following a year of BCC implementation, employed the same measurements and questionnaires as the baseline.

Measurement

Using the OCFP indicator, the primary outcomes for study one and four were assessed, with a particular emphasis on the complementary feeding practice used by mothers. We adapted and employed the WHO/UNICEF 2010 and 2021 infant and child feeding guidelines. As outlined in the earlier WHO guidelines, children who received the recommended feeding over the past 24 hours were assigned a code of 1, whereas those who did not receive it were coded as 0. The MAD and DDS in the last 24-hour were used to create categories. The categories include vitamin A rich fruits, legumes, nuts, and tubers, roots, and grains; dairy products (milk, yoghurt, and cheese); meat foods (flesh meat, poultry, and organ meats); eggs and vegetables; other vegetable and fruits; and breast milk. DDS was generated by adding up the responses from mothers regarding these eight food groups. It was considered that a child had met the recommended MDD if they consumed five or more out among the eight dietary groups, categorized as "good diversity," while a score below five was considered "poor diversity." MMF was calculated using the frequency of feeding and breastfeeding status of children. MAD was considered as a combination of indicators as standards of minimum feeding and MDD. The guideline of WHO for initiation of complementary meals was satisfied by infant and young children who began semi-solid, solid, or liquid foods at six months. A child meeting all four indicators was categorized having OCFP, while even missing one was considered suboptimal (24, 39, 43, 45, 65, 99).

Anthropometry measurement

The outcome variable for studies 2 and 3 was an indicator of overall undernutrition measured using CIAF. Therefore, we derived and calculated the overall undernutrition from conventional indexes of wasting, being underweight, and stunting. For this purpose, we employed the following standard procedures.

Experienced and trained BSc nurses conducted measurements of wasting, being underweight, and stunting. Weight measurements were conducted using a UNICEF salter scale, up to 0.1 Kg in precision. For length measurements, children were placed in a recumbent position on a UNICEF portable length measuring board, with measurements recorded to the nearest 0.1 cm. Subsequently, the height board was positioned horizontally on a flat and leveled surface. Children were then positioned on the board, lying with feet together, knees straight, heels and buttocks in contact, shoulders relaxed, arms straight at the sides, and the shoulders in contact with the length board(7, 126). The anthropometric assessments were carried out following standard procedures, such as light clothing and instrument calibration. Weight scales were calibrated at zero level before weighing each child, and measurements were taken twice by different data collectors on the same subjects and the mean value was used for analysis to ensure validation and reliability (7, 127, 128).

The anthropometric measures: height and weight were converted to conventional indices using WHO Antro and then, assigned those children below the -2-standard deviation (SD) cut-off, as stunting, wasting and underweight based on the WHO guidelines(7). From the above classification of indictors of undernutrition, we calculated an aggregate estimate of the overall prevalence of undernutrition between children aged 6-23 months as one indicator using different categories of CIAF. According to Nandy's classification of anthropometric failure nutritional indicators were categorized into seven: (A) no failure; (B) wasting only; (C) wasting and underweight; (D) underweight, wasted, and stunted; (E) stunting and underweight; (F) stunting only; and (Y) underweight only. Therefore, a child is recognized as having undernourishment, as measured in CIAF, if he or she is suffering from any anthropometric failure (B-Y) (Table 2.1)(12, 129, 130).

Table 2.2 Classification of overall undernutrition using CIAF

Groups	**Description**	**wasted**	**stunted**	**Underweight**
Group A	No failure	No	No	No
Group B	Wasted only	Yes	No	No
Group C	Wasted and underweight	Yes	No	Yes
Group D	Stunting, wasting, and underweight	Yes	Yes	Yes
Group E	Stunting and underweight	No	Yes	Yes
Group F	Stunting only	No	Yes	No
Group Y	Underweight only	No	No	Yes

Source: Adapted from Kutti (130)

Mother/caretaker Knowledge

Additionally, there were nine questions concerning the mother's understanding of complementary feeding. Each "yes" response was coded as 1, while "no" was coded as 0. The total score of "yes" responses was then calculated, then the correct response was summed up, and the cut-off was decided based on a mean score 4(± 1.56), if it exceeded the four, it was considered as good knowledge; otherwise, it was regarded as poor knowledge (39, 131).

Wealth index

Household wealth was assessed by collecting data on the ownership of durable assets from mothers or fathers. The wealth index was constructed using Principal Components Analysis (PCA) on data related to household assets, utilities, and other relevant variables obtained from the EDHS. The presence of at least two variables with a correlation greater than 0.5, an overall sampling adequacy greater than 0.5, a statistically significant Bartlett's test of sphericity ($p < 0.05$), the adequacy of sample size and the ratio of cases to variables were taken into consideration before performing PCA. The resulting wealth scores were then categorized into five quintiles: lowest, second, middle, fourth, and highest(100).

Household Food Insecurity

The Household Food Insecurity Access Scale (HFIAS), a validated tool developed by FANTA for developing countries, was used to assess food insecurity in the household The HFIAS questionnaire is composed of two components: occurrence and frequency-of-occurrence questions. The occurrence section contains nine questions that have only one possible answer: 0 coded for "no" and 1 for "yes." If the subject gives a yes response, they proceed to the frequency-of-occurrence questions. Here, respondents are asked about how frequently the condition occurred in the past four weeks, using a likert scale response: 1 for "rarely" (once or twice in the previous 30 days), 2 for "sometimes" (3-10 times in the last 30 days), and 3 for "often" (more than 10 times preceding 30 days). This scale reflects intensity of food insecurity experienced over the preceding four weeks. Mothers or caregivers are expected to answer these questions on behalf of the entire household. The cumulative score of the nine items ranges from 0 to 27. Next, we allocated according to the four HFIAS score levels as severe, moderate, mild and food secured (132, 133).

Health and related variables

The child was categorized as morbidity if the mother stated that her child had suffered from any of the three common diseases: fever, coughing, or diarrhoea. in the two weeks preceding the survey(106).

2.6 Data quality control

The questionnaires were translated into the local language, Oromiffa, and then back into English to keep its consistency. Researchers provided three days of intensive training to data collectors and supervisors with the necessary skills in administering questionnaires, conducting anthropometric measurements, and understanding the objectives of the study.

Five per cent of the population participated in a pre-test to ensure the questions were understandable to mothers, responses were accurate, the time required for data collection was estimated, and the question flow was smooth. This included 43 individuals for chapter one from Seka-Chekorsa (Geruke kebeles) and 22 mother-child pairs from Kersa (excluding Ketemble kebeles, which were not part of the study) for chapter 2, 3, &4. Any necessary modifications, such as correcting and using simple words of the questionnaire to make understandable to mothers and other modifications were made based on the pre-test results.

Additionally, two separate data entry clerks matched and checked records to maintain data quality. Upon ending each and every day, supervisors, researchers, and data collectors met to review their work and address any issues that arose. Before analysis, the data underwent cleaning through descriptive statistics analysis. The trial was stopped according to the pre-specified time frame.

Process Evaluation for BCC implementation

The study team regularly monitored WDA activities to ensure adherence to the intervention protocol. WDAs distributed leaflets and posters to mothers after each session. The research team evaluated intervention implementation using a checklist with various criteria, such as the number of mothers who attended BCC in each session, the number of training materials provided for mothers, the number of trained WDAs who delivered messages, and the frequency of home visits performed by WDA.

2.7 Data analysis

For cross sectional studies (Chapter 3&4)

The data was exported into SPSS version 20 0 for analysis after being into Epidata version 1 4 4 0. Then, the data were summarized using descriptive analysis, and the findings were displayed using frequency, tables, and figures. The relation between agro-ecological districts and dietary variables was displayed using chi-square ($\chi 2$) (chapter3). Histograms were used to verify if continuous variables were normal. To develop nutritional indexes, anthropometric

data were exported from SPSS to WHO Anthro software version 3.2.2 (chapter4). Analysis of bivariate logistic regression was utilized to identify the candidate variables for multivariable analysis. Then all variables having a *p* value less than 0.25 entered into multivariable logistic regression to manage the possible confounders and identify the predictors at a p-value of <0.05. Multicollinearity was checked by using a standard error less than 2.0 and model fitness by the Hosmer- Lemeshow test.

For CRCT studies (chapter 5&6)

The data was fed to the Epi-Data manager and then exported to Stata Version17.0 for analyses. Continuous variables were checked for normality by Kolmogorov test and histograms (Chapter 5). Descriptive statistics was performed and the results were presented using proportion, figures and tables. A chi-square (X2) test was employed to evaluate the association of socio-demographic variables with the control and intervention groups. The difference-in-differences (DID) model was used to determine the effect of the intervention on primary outcome and secondary outcome over time, comparing the intervention and comparison groups. In the Generalized Estimating Equation (GEE), a binomial family, logit link function, and independent correlation structure were considered to examine the effect of BCC on undernutrition in the intervention groups over time, and to identify predictors of the outcomes. Univariable GEE models were fitted for each independent predictor variable. Those variables with a p-value < 0.25 were selected for multivariable GEE. The intervention's effect was assessed through the interaction term “intervention*time". The GEE model also explores the relationship between outcome and explanatory variables.

2.8 Ethical consideration

We obtained ethical clearance for our study from the Institutional Review Board (IRB) of Jimma University, Institute of Health, and Faculty of Public Health, under approval number HRPGC/536/2015. Additionally, we secured a letter of support from the Regional Health Office of Oromia and Jimma Health Office. Before they involve in the study, verbal consent was obtained from the mothers, ensuring they were fully informed about the study's purpose. We assured all participating mothers/caregivers of confidentiality and their right to stop the interview at any time. If a participant decides to cancel his/her permission to take part in the trial at any point, and cannot be reached for follow-up assessments or missing scheduled appointments (from BCC sessions) was typically discontinued. Upon the completion of data collection for the endline survey, key BCC messages were given to the control group for four

hours for ethical reasons. Our study was registered on the Pan African Clinical Trials Registry as PACTR202106621156513, although registration occurred after the participant enrollment.

CHAPTER 3: OPTIMAL COMPLEMENTARY FEEDING PRACTICES OF CHILDREN AGED 6–23 MONTHS IN THREE AGRO-ECOLOGICAL RURAL DISTRICTS



Retrieved from: Gebretsadik MT, Adugna DT, Aliyu AD, Belachew T. ***Optimal complementary feeding practices of children aged 6–23 months in three agro-ecological rural districts of Jimma zones of southwest Ethiopia****. Journal of Nutritional Science. 2023;12:e40*doi:10.1017/jns.2023.26

Abstract

Despite the critical importance of complementary feeding, large proportions of children in developing countries are sub-optimally fed during 6-23 months of age. In Ethiopia, even though the government has been rolling out infant and young child feeding guidelines, the proportion of mothers adhering to the recommended optimal practices and its associated factors have not been assessed in different agro-ecological areas. To this end, this study aimed to determine OCFP and associated factors in three agro-ecological rural districts (high, mid, and low land) of Southwest Ethiopia. A community-based cross-sectional study was carried out among 845 mothers-index young children 6-23 months Jimma zone. Multistage sampling was employed to select the study participants. Structured questionnaires were used to collect data. The data were analysed using SPSS version 20. The Binary and multivariable logistic regressions were used to identify factors associated with optimal child-feeding practices. The significance of the association was declared at P < 0.05.It was found that the overall proportion of optimal complementary feeding practice was 9.4% at 95% CI (7.19, 11.08). The timely initiation of complementary feeding, MMF, MDD, and MAD was 52.2%, 64.1%, 17.2%, and 12.2% respectively. The multivariable logistic regression showed that being in the highland districts, having good maternal knowledge, and mothers attaining primary level education, having a family size of less than six were positively associated with OCFP. The findings showed that prevalence of optimal complementary feeding practice was low, especially in the midland agro-ecological districts.

Keywords: Agro-ecological area: Children aged 6-23 months: Optimal complementary feeding: Southwest Ethiopia.

3.1 Introduction

Pregnancy through to two years of life is the critical window of opportunity to prevent malnutrition among children. The widest part of the critical period was covered by complementary feeding (4). Even though exclusive breastfeeding is ideal nutrition for optimal growth and development in the first six months, complementary food is mandatory to meet the need for energy and micronutrients for the child after six months to fill the gap. Hence, optimal complementary feeding practice during 6-23 months plays a crucial role in physical growth, cognitive development, intellectual ability, and strengthening immunity (2, 134, 135).

Sub-optimal complementary feeding practice is a vital factor contributing to inadequate nutrient intake among infants and young children (4, 136). Different researchers showed factors that influence optimal complementary feeding practice are socioeconomic status, educational status, child age, maternal knowledge, and family size (43, 44, 135-137).

Globally, few children received nutritionally adequate, diversified, age-appropriate frequency and timely initiation of complementary food. In the world, evidence showed that 73% of children aged 6-23 months received solid, semi-solid, or soft foods at 6-8 months, 52% of mothers fed their children with MMF, and only 29% of children have a diversified diet (4). In Ethiopia, 55% of children consumed a minimum number of times appropriate for their age. Although Ethiopia established infant and young child feeding practice guidelines , only 14% of the children received minimum dietary diversity, and 11 % of them received MAD in Ethiopia(99).

The WHO developed a core indicator to assess OCFP practices by integrating breastfeeding and complementary foods to improve the nutritional status of children less than two years. The suggested components for OCFP include MMF, MDD, and the MAD, together with the timely introduction of complementary food between 6 and 8 months. The MMF is defined as the children 6-23 months of age who received solid, semi-solid, or soft foods at least the minimum number of times or more during the previous day. A MAD is a composite indicator of both MDD along with MMF used to ensure optimal growth and development (24, 138). Dietary diversity is a proxy for adequate micronutrient density of foods and a potentially helpful indicator of quality complementary food. Higher dietary diversity was associated with increased nutrient intake or better child nutritional status in developing countries (136).

The complementary feeding practice of mothers on the attainment of the diversified diet and frequency of meals appropriate to age contributes to improving the optimal child feeding practice (87). Some evidence in the Eastern part of Ethiopia and Kenya shows the variation of MMF and MDD in highland and midland agro-ecological areas (38, 44, 80).

Therefore, it is crucial to understand different agro-ecological areas may affect the practice of optimal complementary feeding. So, besides a better understanding of the magnitude and associated factors of OCFP, this study could provide evidence to improve practice in diversified production in the different agro-ecological areas. Furthermore, it may help the National Nutrition Program to design new interventions.

A few studies were conducted on OCFP across two agro-ecological districts (Highland and midland) in some parts of Ethiopia. However, Jimma Zone is one of the areas known for farming cereal, fruit and vegetables, coffee and chat (Catha Edulis) as the Zone has high, mid and low agro-ecology. Despite that, there is no evidence in Zone and the Oromia region concerning OCFP different agro-ecological rural districts. In Ethiopia, previous studies have used one or two indicators, but the findings inconsistent to conclude optimum complementary feeding practice. Hence, we used four indicators to obtain better information on optimum complementary feeding practices. Therefore, this study aimed to determine the optimal feeding practices and associated factors among children aged 6 to 23 months in three agro-ecological rural districts (high, mid, and lowland) of Jimma Zone, Ethiopia.

3.2 Methods and materials

Sample

This cross-sectional study was conducted among 845 children aged 6-23 months and their mothers in different three agro-ecological rural districts of Jimma zone in 2020. The detailed description of the study area, sample size and technique are presented in Chapter 2.

Measurement

We used OCFP as an outcome measure and socio-demographic, maternal, knowledge, and health and health related factors as predictor variables for this study (study one). We expected child age, agro-ecological region, maternal education level, family size, and maternal knowledge of complementary feeding are influence OCFP. In particular, we assessed variations on mother child pair's practice of optimal complementary feeding across highland, midland, and lowland agro-ecological zones.

Dietary data was gathered using 24-hour recall method, where mothers/caretakers recalled all foods given to their child in the preceding day. MDD, MMF, MAD, and timely initiation of complementary foods were calculated according to WHO 2021 guidelines (24, 45, 138). Then optimal complementary feeding practice were calculated by considering the above four indicators and other indicators such as and Knowledge index were assessed based on predetermined criteria (39). Illness status of the child was determined based on reported common morbidities in the preceding two weeks. Details about measurement were discussed briefly in Chapter 2.

Data analysis

The data were entered into Epi Data Manager and entry version 1.4.4.0 and exported to SPSS version 20.0 for analyses. Descriptive statistics were used to summarise the data, and chi-square(X2) was used to show the association between food groups and the agro-ecological districts. The crude association between each independent variable and the outcome variable was examined using bivariate logistic regression analysis. Then, all variables with a p-value less than 0.25 entered into a multivariable logistic regression to control the possible confounders and identify the predictors at a P-value of < 0.05. Multicollinearity was checked by using a standard error of less than 2.0 and model fitness by the Hosmer Lemshow test (*P*=0.781).

3.3 Results

Socio-demographic characteristics

Of 845 mother-child pairs, 843 (99.3%) respondents gave complete responses. The mean age of children was 13 (± 4.7) months and 44.5% of participants were in 6-11 months. The majority of children were males (52 %). The mean age of mothers was 26.8 (± 5), and the majority (54.2%) of them were 25 to 30 years old. The majority of caretakers (92.5%) were married. Nearly all participants were Oromo (95.8%) and Muslim (96.6%). More than half of mothers/caregivers (63%) and fathers (48.6%) were unable to write and read, and almost all mothers were housewives (91.9%). The average family size of study participants was six. One-third (33.1%) of participants reported that their husbands exclusively decided on the household's economy (Table 3.1)

Table 3.1 Socio-demographic and health characteristics of the participants in Jimma zone, southwest Ethiopia, 2020

Variables	Frequency(n)	Percentage (%)
Age of child		
6-11	375	44.5
12-17	303	35.9
18-23	165	19.6
Sex		
Male	438	52.0
Female	405	48.0
Age of mothers (Years)		
<20	122	14.5
20-24	117	13.9
25-30	457	54.2
>30	147	17.4
Marital status		
Single	45	5.3
Married	780	92.5

Widowed	10	1.2
Separated	8	0.9
Ethnicity		
Oromo	808	95.8
Amhara	17	2.01
Tigre	12	1.49
Dawero	5	0.59
Kaffa	1	0.11
Religion		
Muslim	814	96.6
Orthodox	18	2.1
Protestant	10	1.2
Wakefata	1	0.1
Mother educational status		
Unable to write and read	531	63
Write read	59	7.0
Primary (1-8)	231	27.4
Secondary and above	22	2.6
Father educational status		
Unable to write and read	410	48.6
Write read	88	10.4
Primary (1-8)	264	31.3
Secondary and above	81	9.6
Maternal occupation		
Housewife	775	91.9
Farmer	23	2.7
Government employee	17	2.0
Private	25	3.3
Father occupation		
Farmer	739	87.7
Government employee	32	3.8
Private	65	7.7
Daily Labourer	7	0.8
Household size		
1-3	145	17.2
4-6	306	36.3
>6	392	46.5
Decision-making power		
Mother and father Jointly	222	26.3
Father	279	33.1
Mother	95	11.3
Family	135	16.0
Neighbours	112	13.3

Health and related characteristics

More than half (52.4%) of the mothers/ caregivers delivered their last child at home. Regarding birth order, more than half of the children (63.7%) were third and above children of their parents. Regarding comorbidity, (42.6%) of children were exposed to illness in the

last two weeks preceding the survey. More than one-third (36.8 %) of mothers provided an extra meal for their children during sickness (Table 3.2).

Table 3.2 Health and related characteristics of participants in Jimma zone, southwest Ethiopia, 2020

Variables	Frequency(n)	Percentage (%)
Delivery place		
Home	442	52.4
Health Facilities	401	47.6
Birth order		
First	164	19.5
Second	142	16.8
Third and above	537	63.7
Morbidity report		
Yes	359	42.6
No	484	57.4
Type of morbidity(N=359)		
Diarrhoea	124	34..5
Cough	128	35.7
Intestinal parasites	92	25.6
Fever, tonsillitis	15	4.2
Feeding during illness (N=359)		
As usual	227	65.2
Additional meals	132	36.8

Infant and young child feeding practices by agro-ecology

The mothers/caregivers (88.7%) had practised breastfeeding, and 64.7% continued breastfeeding until 12-23 months of the child's age. The overall prevalence of children who started complementary food at six months was 65.7%. There is no statistical difference between agro-ecological production and timely initiation of complementary feeding at six months (P=0.148). In the highland, the highest practice of MDD was observed (23.5%). However, only 8.4 % of mothers fed their children based on the recommended MDD in the midland. One hundred forty-six (61.3%), 128 (73.6%), and 266 (61.7%) mothers achieved the minimum meal frequency among high, low, and midland districts, respectively. The overall rate of MAD was 11.4%, however, only 6.3 % of mothers met the MAD in midland. Regarding the OCFP, only 9.4 % of children met the optimum feeding practice, among these; a low proportion of children (4.4 %) received optimal child feeding practice in the midland districts. There are statistically significant differences between the agro-ecological areas and the children ever breastfed, continued breastfeeding and minimum meal frequency ($p<0.005$), minimum dietary diversity, minimum acceptable diet, and OCFP ($p<0.0001$) (Table 3.3).

Table 3.3 Child feeding practice across agro-ecology in Jimma zone, Southwest Ethiopia, 2020

variables	Overall N (%)	High land N (%)	Low land n (%)	Mid land n (%)	*P*
Ever Breastfeed					
Yes	748(88.7)	204(85.7)	164(94.3)	380(88.2)	< 0.05*
No	95(11.3)	34(14.3)	10(5.7)	51(11.8)	
Continued BF					
Yes	545(64.7)	132(55.5)	118(67.8)	295(68.4)	< 0.05*
No	298(35.3)	106(44.5)	56(32.2)	136(31.6)	
Introduction of CF					
Yes	440(52.2)	150(63)	87(50.0)	203(47.1)	0.148
No	403((47.8)	88(37)	87(50.0)	228(52.9)	
MDD					
Yes	128(15.2)	56(23.5)	36(20.7)	36(8.4)	<0.001**
No	715(84.8)	182(76.5)	138(79.3)	395(91.6)	
MMF					
Yes	540(64.1)	146(61.3)	128(73.6)	266(61.7)	< 0.05*
No	303(35.9)	92(38.7)	46(26.4)	165(38.3)	
MAD					
Yes	96(11.4)	41(17.2)	28(16.1)	27(6.3)	<0.001**
No	747(88.6)	197(82.8)	146(83.9)	404(93.7)	
OCFP					
Yes	79(9.4)	38(16.0)	22(12.6)	19(4.4)	<0.001**
No	764(90.6)	200(84.0)	152(87.4)	412(95.6)	

*OCFP,optimal complementary feeding practice; MAD, minimum acceptable diet; MDD, minimum dietary diversity;MMF, minimum meal frequency; BF, breastfeeding. Continued BF, refers to children 12–23 months of age who were fed breast milk during the previous day; Timely initiation refers to infants 6 - 23 months of age who received solid, semi-solid, or soft foods at 6 months*significant. **highly significant*

Consumption of food items by children across agro-ecological districts, in Jimma zone, 2019

Overall, grain, root, and tubers (92.5 %) were the most common food items consumed by children, and the least (14%) were flesh foods in the 24 hours preceding the survey. Cereals were the most commonly consumed in the highland (90.3%), lowland (88.5%), and midland (95.4%) among three agro-ecological areas. The highest intake of legumes & nuts by children was (67.8%) in lowland and highland (58.0%). Flesh food consumption was higher in the lowland (35.1%)(p<0.001). The intake of vitamin A containing FV and other FV among all participants was 27.5 % and 20.8 %, respectively. However, the proportion of children who ate Vitamin A containing FV 39.9% (P<0.001) and other fruit and vegetables 28.2% was higher in the highland (P<0.05) There was no difference in consumption of eggs (P=0.408) and dairy products (P=0.828) (Figure 3. 1).

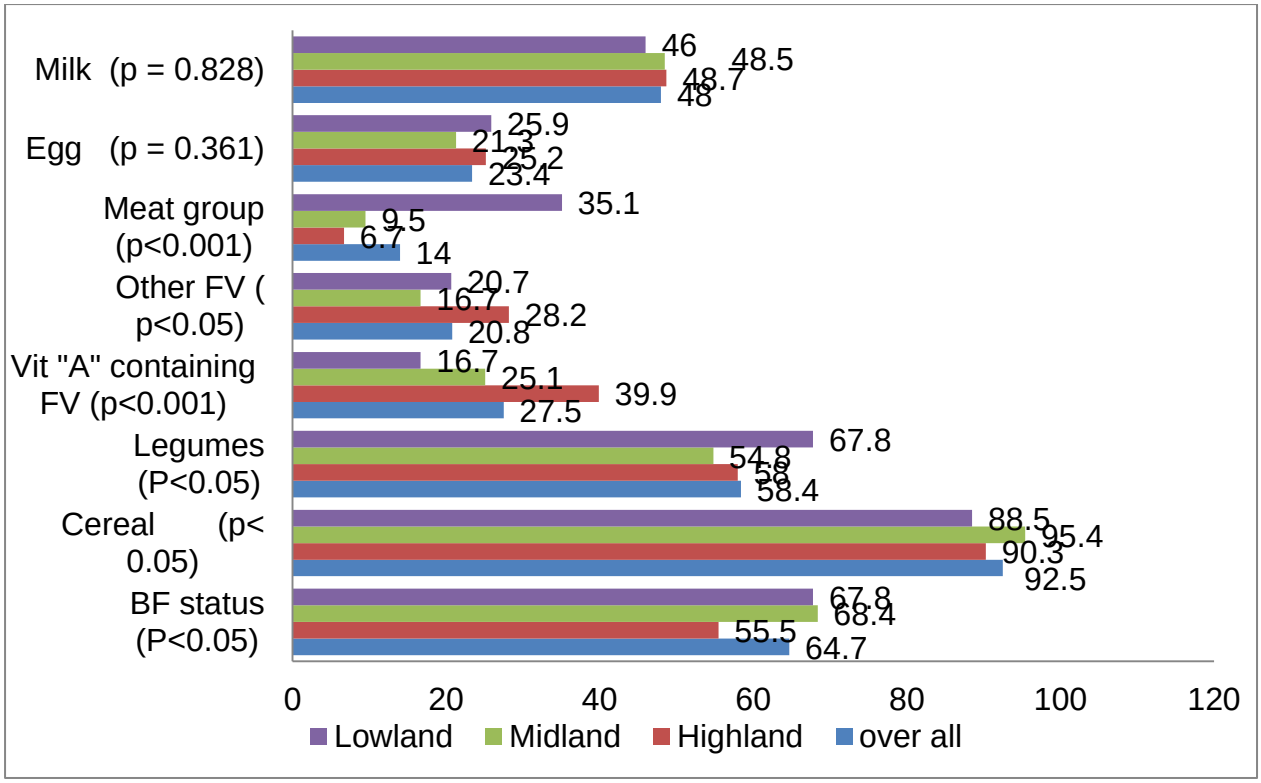


Figure 3.1 Types of food groups given to children aged 6-23 months across agro-ecological areas in Jimma zone, Southwest Ethiopia, 2020.

Maternal knowledge of optimal complementary feeding practice

Overall, 535(42.7%) mothers had good knowledge about complementary feeding practices. Of 535 mothers, the majority (72.4 %) were from the lowland, whereas the rest were from the high (37.4 %) and midland (33.6 %) (Table 3.4).

Table 3.4 Knowledge of mothers on IYCF in Jimma zone, Southwest Ethiopia, 2020

Complementary Feeding knowledge on	**Had knowledge**	**Percent (%)**
When to start CF feeding	535	63.5
Importance of CF	202	24 .0
Consistency of CF	276	32.7
Local HH traditional food processing method	72	8.5
Frequency of feeding young children	493	58.5
Additional foods during illness	180	21.4
Risk of bottle feeding	488	57.9
How to prepare diversified complementary foods	185	21.9
Hand washing before food preparation	739	87.7

knowledge score(good)

Overall	High land	Low land	Mid land	X^2	*p*
360(42.7%)	89(37.4%)	126(72.4%)	145(33.6%)	79.975	<0.001

Factors associated with optimal complementary feeding practice

In the bivariate regression analysis, factors such as agro-ecological area, maternal knowledge, child age, maternal education, paternal education, and household size were significantly associated with OCFP. After controlling for the potential confounding agro-ecological area, maternal knowledge, maternal education, and family size were significantly associated with optimal complementary feeding practice. However, the age group and father's education were not associated with optimal complementary feeding practice. Mothers /caretakers who lived in the midland area were 77% less likely to give optimal complementary feeding to their children compared to mothers who lived in the highland [AOR=0.23, 95% CI: (0.12, 0.45)]. In addition, mothers or caretakers living in lowland district were 59% less likely to provide optimal complementary feeding to their children compared to those living in highland areas. [AOR=0.41, 95% CI: (0.21, 0.80)]. Children from a household where the mother has good knowledge about OCFP were 3.95 times more likely to practice OCFP than those mothers who had poor knowledge [AOR=3.95, 95% CI: (2.12, 7.36)]. Mothers who attended primary school and above were two times more likely to practice optimal complementary feeding [AOR=2.81,95% CI:(1.51,5.5.23] than mothers unable to read and write. Those households having 1-3 persons were 3.6 times [AOR=3.64, 95% (CI: 2.11, 6.29)] more likely to practice optimal complementary feeding compared with those households having greater than 4 and above persons (Table 3.5).

Table 3.5 Bivariate and multivariable logistic regression model predicting the likelihood of optimal complementary feeding practice among children aged 6-23 months in South West Ethiopia, 2020

Variable	**Complementary feeding practice**		**COR with 95% CI**	**AOR with 95% CI**
	Appropriate n (%)	**Inappropriate n (%)**		
Agro-ecology				
Highland	38(16)	200(84.0)	1	1
Midland	19(4.4)	412(95.6)	0.24(0.13, 0.43)**	0.23(0.124, 0.45)**
Lowland	22(12.6)	152(87.4)	0.761(0.432, 1.34)	0.412(0.21,0.80)*
Maternal Knowledge				
Good	62(17.2)	298(82.8)	5.70(3.27,9.94) **	3.95(2.12,7.36) **
Poor	17(3.5)	466(96.5)	1	1
Age group				
6-11	27(7.2)	348(92.8)	1	1
12-17	31(10.2)	272(89.8)	1.46(0.85,2.52)	1.06(0.581,1.943)
18-23	21(12.7)	144(87.3)	1.88(1.02,3.43) *	1. 256(0.63,2.49)
Mother education				

Unable to read &write	26(4.9)	505(95.1)	1	1
Read &write	3(5.1)	56(94.9(	1.04(0.30,3.54)	0.39(0.10,1.51)
Primary	50(19.8	203(80.2)	4.78(2.89,7.89) **	2.81(1.51,5.23) *
Father education				
Unable to read &write	25(6.1)	385(93.9)	1	1
Read &write	9(10.2)	79(89.8)	1.75(0.78,3.90)	1.52(0.59,3.93)
Primary &above	45(13.0)	300(87.**0**)	2.31(1.38,3.85) *	1.09(0.58,2.01)
Family size				
1-3	41(28.3)	104(71.7)	6.80(4.20,11.14) **	3.64(2.11,6.29) **
≥ 4	38(54.4)	660(94.6)	1	1

COR, crude odd ratio, AOR: adjusted odd ratio, CI: confidence interval
*** Significant at P <0.001, *significant at P <0.05*

3.4 Discussion

The finding of the current study revealed that the prevalence of optimal complementary feeding practice was 9.4%. This finding is in agreement with the study finding from secondary data analysis of 2019 mini-EDHS (9.7%), Horo district (9.91%), and Sidama (8.6%)(41, 43, 45). However, this study is much lower than the studies conducted in Ghana (15.7%), (30%) in Shashemene and Amhara region (26.8%) (60, 139, 140). This discrepancy from previous Ethiopian studies might be the studies conducted in urban and adjacent to urban areas, mothers might have relatively better access to information about appropriate complementary feeding practices from different mass media compared with the current study of the urban area. The variation in finding from Ghana might be because the study was conducted during the post-harvest season. Moreover, in the current study, the practice of optimal complementary feeding practice varied among agricultural diversification of foods. Children are at high risk of under nutrition in the first 2 years of life when there are limitations in the quality and quantity of their diets. Moreover, children aged 6-23 months are recurrently prone to infectious diseases like diarrhoea and upper respiratory infection due to common micronutrient deficiencies. Therefore, optimal complementary feeding practices are essential to ensure children receive the necessary energy and nutrients for healthy growth and development. In the present study, 52.2% of infants were introduced to solid, semi-solid, or soft foods at six months, with almost similar findings across agro-ecological areas. The current figure is nearly in-line with the studies from Ethiopia (60.4% - 83.2%) (43, 45, 140, 141), South Asia (57.4%) and Indonesia (50%) (142, 143).

Complementary foods for children should be varied and nutrient-dense in at least five food groups(24). However, in the current study, only 15.2% of children met the minimum requirement of five or more from the eight food groups, and the highest prevalence was in high land (26.9%), low land (23%), and midland (9.5%). The overall MDD is similar to the review of mini EDHS 2019 (45), studies in Horo(43) , and Sidama(41) in Ethiopia. This finding is much lower than the review in Southern Ethiopia from 6-9 surveys(144) and Ghana(139). In the case of Southern Ethiopia, different projects are working on the awareness creation of child feeding practices, particularly on the inclusion of pulses and animal-source food in the diet of children. It might help mothers to look into legumes and animal products, hence it might increase the number of food groups consumed by children. The variation of the current finding from the Ghana study could be the study period. Thus, seasonality may have contributed to increasing the intake of a diversified diet and available foods for better MDD in the case of the Ghana study.

Even though FV and ASF are known sources of Vitamin A, protein, and zinc, the most common foods used to feed infants are cereal-based gruels produced from traditionally refined cereal grains or tubers with minimal intake of FV, and ASF in developing countries (29, 145, 146). The current study similarly found that the majority of children received primarily cereal (92.5%), legumes (58%), and milk (48%) with a low intake of meat (14%), vitamin A containing FV(27.5%), and other FV(20.8%) which is almost similar to the review conducted in southern Ethiopia(144). Regarding consumption of food items across agro-ecological districts, the low proportion of children who consumed vitamin A containing FV in lowland compared to highland counterparts. This difference might be because the highland farmers were growing vitamin A-containing FV for consumption for household use in addition to cereal and legumes, while the lowland farmers were primarily growing cash crops such as coffee in addition to cereal production. Contrary, only a few children received fleshy meat with low prevalence in high and midland compared to low-land counterparts. A similar finding was reported by Roba KT(80). A possible reason for the higher consumption of meat in the lowland could be that the cash crop is sold to the market and obtains adequate money to buy stuff that can cover the high cost of meat. Low consumption of fleshy meat and vitamin A-containing FV might contribute to poor DDS. In turn, it might compromise proper growth, development, and immunity (24, 147). It showed that the more production diversity at the household level, the more children meet the requirements for MDD. Thus, agricultural production diversity is needed to improve the complementary foods diversity(148, 149).

In our study, the proportion of children (64.1%) who met MMF was high. This finding is consistent with the review EDHs, Horo, Shasehmene (43, 45, 140). Moreover, the current study reported a higher rate of MMF in lowland areas (73.6%). This finding is consistent with studies in Kenya (44) and Ethiopia (38). The reason for the higher prevalence of MMF in the lowland could be the agricultural fieldwork (coffee plantation) handled by the husband or employed person, thereby mothers have adequate time and stay at home to feed their children frequently, Whereas, in the high and midland, the majority of mothers participated in extraneous agricultural activities and they do not have time to feed their children per recommendation(148).

The overall finding of MAD in this study is comparable with the results from developing countries: Ethiopia and Nigeria (41, 43, 60, 149). However, it was low compared with studies in Shashemene, Aceh, and Congo (140, 143, 150). This might be due to the difference in health care services, the residential area (urban versus rural), and the maternal illiteracy rate. The low MAD clearly shows that the majority of the children have failed to meet the required nutrient and energy density as a MAD is the composite indicator of MDDS and MMF.

The current study confirmed that 42.7% of the mothers were knowledgeable about complementary feeding practices. Findings from Adea, Ethiopia (51%) (39), were similar to the present study. But, it is lower than the study conducted (68%) in Ghana and (68.4%) in an urban area of Northwest Ethiopia (73, 131). The discrepancy could be because the mothers who lived in urban areas may have been accessing information through mass media compared to mothers who lived in the current study's rural area. Another explanation for the difference might be the present study used mean value as a cut-off to measure the mother's nutritional knowledge and classified it as poor and good. In Northwest Ethiopia, studies employed Principal component analysis to assess mothers' knowledge through tertiles, then assigned as lowest, medium, and highest. Thus, the classification in northwest Ethiopia might allocate much proportion of mothers as having good knowledge.

Maternal education attainment of primary schooling was significantly associated with optimal child feeding practice. This finding is consistent with the study from western Ethiopia and the review of mini-EDHS 2019, Nigeria and Congo (45, 149, 150). The possible reason could be mothers who attended primary and above school have more exposure to media for

information on feeding practices. Hence, mothers could have better information to practice optimal complementary feeding.

Additionally, mothers who have good knowledge of complementary feeding practices were three times more likely to practice optimal complementary feeding compared to women who have poor knowledge. Studies conducted in Sidama, Adea and Pakistan supported this study (39, 41, 151).

Mothers with smaller family sizes (1-3 people) are more practised optimum complementary feeding with mothers having ≥ 4 persons in the household. The finding is consistent with a review of EDHS 2019 and Sidama in Ethiopia (41, 45). The possible explanation is that mothers with bigger family sizes might not offer a nutrient-dense diet and enough food for their children. Moreover, mothers may not have adequate time to prepare and feed their children according to the IYCF recommendation beyond the family dish.

This study reported that those children from the midland areas were 77 % less likely to meet the optimal feeding practice compared to their highland area counterparts. Moreover, children living in midland areas were 59% less likely to receive optimal complementary foods. This finding is similar to the study conducted by Kedir T et al in Ethiopia.(80). Other studies from four Anglophone West African countries and Kenya showed the variation of complementary feeding practices across regions (37, 44). In Ethiopia, farmers predominantly grow cereals because the staple food is 'Injera' made up of cereal crops. However, midland farmers' dependence on monotonous agricultural production, whereas farmers in the highland areas cultivate a variety of crops, including vegetables, fruits, cereals, and tubers. A possible explanation for children in lowland areas less likely receiving optimal feeding practices may be the focus on cash crop (coffee) farming. This focus often limits land available for diverse food crops, increases dependency on markets, and reduces access to a variety of nutritious foods due to economic and awareness constraints. This implies that, poor dietary diversity might contribute to poor optimal child-feeding practices for those children in the mid and lowland.

Limitations

A single 24-hour recall used in this study may not reflect the usual dietary practices of children. Moreover, the study did not gather data across all seasons and may not consider what is going on in different seasons, which should be considered in future studies.

Conclusion

The overall findings of this study showed a low prevalence of optimal complementary feeding practice, particularly in the midland area. Maternal educational status, family size, agro-ecological residence, and knowledge were significant predictors of optimal complementary feeding practice. The findings imply the need for multi-sectoral collaboration to strengthen maternal education, family planning service, and the promotion of diversified agricultural production to improve OCFP. Further research on the association of seasonal variation and child feeding practice should be recommended.

CHAPTER 4: ANTHROPOMETRIC FAILURE AND ASSOCIATED FACTORS AMONG CHILDREN AGED 6–23 MONTHS IN ETHIOPIA

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Abstract

Undernutrition in childhood is a crucial public health issue in Ethiopia. Yet, more than an assessment of undernutrition using conventional index is needed to conclude the overall prevalence of undernutrition among children aged 6-23 months. Therefore, this study was conducted with the major objective to assess the prevalence of undernutrition using CIAF and its associated factors among children aged 6 to 23 months in Southwest Ethiopia. To achieve this ,a community-based cross-sectional study was employed among 440 mother-child pairs selected using a two-stage cluster sampling technique in the rural Kersa district, Jimma Zone, Southwest Ethiopia. A pretested structured questionnaire was used to collect data. Multivariable logistic regression analysis was employed to identify factors associated with undernutrition. Variables with a P-value of <0.05 were considered statistically significant. The result indicated that the proportion of undernutrition using (CIAF) was 57.3% among children aged 6-23 months. Being male [AOR=1.55;95%CI (1.01,2.37)], not meeting MAD[AOR=2.104;95%CI (1.05,4.21)], larger family size [AOR=1.69; 95%CI(1.079 ,1.67)], having comorbidity [AOR=3.31;95%CI(2.06,5.32)], and being from food insecurity household [AOR=3.12; 95% CI (2.00,4.86)] were more likely to be in anthropometric failure whereas born to a mother who attended higher and above education level[AOR=0.24;95%CI (0.09,0.64)] were less likely to be in anthropometric failure. In conclusion, more than half of 6-23 months children were experienced anthropometric failure. Being a boy child, not achieving the MAD, larger family size, presence of comorbidities, living in a food-insecure household, and having a mother with higher education level were identified as predictors of anthropometric failure.

Keywords: Anthropometric failure, Children aged 6–23 months, Ethiopia

4.1 Introduction

Despite social and economic progress, there are still many people suffering from undernutrition worldwide(6, 152). All age groups are affected by undernutrition, but children under the age of two are the most at risk because of their need for more nutrients for rapid growth and development. According to a UNICEF report, there are 144 million stunted and 47 million wasting children under the age of five in the world(153).

Nutritional status in early childhood is crucial for long-term health, strength, and mental development. It significantly impacts their overall wellbeing, including their financial

stability in their later life (20, 154, 155). The consequences of undernutrition ranged from short-term mortality to long-term disability and adulthood chronic diseases. Most of the damage associated with undernutrition occurs before children reach their second birthday(16).

Even though Ethiopia has one of the world's fastest-growing economies with a poverty line rate that declined from 55.5% to 26.7% (107, 156)undernutrition and poor child-feeding practices remain an immense challenge among children under five years in the country. Based on the Ethiopia National Demographic Health Survey, the magnitude of stunting, wasting, and underweight was 37%, 7% and 21%. There is also a higher regional difference in the prevalence of undernutrition(99).

The separate analysis of child stunting, wasting, and underweight indexes cannot provide an accurate overall assessment of undernutrition burden in a population. Additionally, using reference information that does not accurately reflect the real problem contributes to the high prevalence of undernutrition. This is because comprehensive actions to tackle the issue have not been effectively implemented(59).

The CIAF was developed by Svedberg p in 2000 and modified by Nandy S. in 2005 (11) to give a single measure to estimate the overall prevalence of undernutrition.

In Ethiopia, earlier research on the prevalence of child undernutrition is excessively constrained, and they lack current data. In the past, some studies have evaluated child undernutrition using the conventional traditional three indexes, and others have evaluated undernutrition using just one index (CIAF) indicator. Conventional indexes may overlap when a single child exhibits two or more of them at once. Therefore, it is not enough to draw a conclusion on the prevalence of undernutrition in children. Additionally, no study establishes the relationship between CIAF and a composite index (MAD) of complementary feeding practices in Ethiopia and the study area. Therefore, this study aimed to determine the prevalence of undernutrition and its associated factors using a CIAF among children aged 6 to 23 months in the rural Jimma zone, Southwest Ethiopia. The current study findings will help to strengthen the delivery of interventions to improve child nutrition status.

4.2 Materials and Methods

Sample

This cross-sectional study was part of a baseline survey in a cluster-randomized controlled trial, aiming to assess overall undernutrition using the CIAF and identify its predictors. The sample size was determined for interventional study using G-POWER software with a total of 440 accounting for design effects and non-response rates. Initially, 440 children aged 6-23 months and their mothers/caregivers were recruited, but after excluding 2 ineligible children, 438 pairs remained at baseline. The study area, sampling technique and procedure were thoroughly discussed in Chapter 2.

Data collection and procedures

To achieve the objectives outlined in Chapter 2, socio-demographic data, child feeding practices, anthropometric measurements, food insecurity status, health, and related characteristics were collected. Questionnaires were adapted from various literature sources (24, 65, 99).

Child weight and height were measured using standard procedures, including instrument calibration and minimizing clothing, with measurements taken by two individuals and averaged for accuracy. The coefficient of variation was calculated, yielding values less than 0.3 to ensure reliability(7, 127). The study's outcome variable, overall undernutrition, was determined through CIAF, which was calculated from conventional indexes of stunting, wasting, and underweight, to provide an aggregate estimate of undernutrition prevalence among children aged 6-23 months. These measurements were categorized into seven groups based on Nandy's classification of anthropometric failure nutritional indicators(12, 130).

Dietary information was collected using 24 hours recall method to generate MDD, MMF and MAD. The full description of data collection and procedure were discussed in chapter 2.

We assessed household food insecurity status using FANTA classification the HFIAS for developing countries. Using a Likert scale, nine items gauged food insecurity severity over the past four weeks. The HFIAS questionnaire consists of two components: occurrence and frequency-of-occurrence questions. The occurrence section comprises nine questions with binary responses: 0 for "no" and 1 for "yes." If the mothers responded affirmatively, they proceed to the frequency-of-occurrence questions ranged from "rarely" to "often." The cumulative scores ranged from 0 to 27, then categorizing households into four levels: food

secure, mild, moderate, and severe food insecurity(132). Our study found a Cronbach's alpha of 0.840, indicating high scale reliability.

The wealth index was calculated through principal components analysis, and scores were then divided into five quintiles: lowest, second, medium, fourth, and highest wealth based on the classification of wealth index of the Ethiopian Demographic and Health Survey(99). A brief description of the data collection and procedure is provided in Chapter 2.

Data analysis

Epi Data Manager Version 4.6 was used to enter the data, which was then exported to SPSS Version 25 for analysis. The data were summarized using descriptive statistics, and the findings were displayed using frequency, tables, texts and figures. Histograms were used to verify if continuous variables were normal. To develop nutritional indexes, anthropometric data was exported from SPSS to WHO Anthro software version 3.2.2. Bivariate logistic regression analysis was utilized to identify the candidate variables for multivariable analysis and variables with a p-value less than 0.25 were added to a multivariable logistic regression. The significance and strength of association were determined using p-value of $\leq$ 0.05, and adjusted odds ratio (AOR) with 95% confidence interval (CI) respectively. The Variance Inflation Factor (VIF) values for each variable were less than 1.0, indicating that multicollinearity was not a problem in the model. The Hosmer Lemeshow test was used to assess the goodness of fit of the model (P-value: 0.782).

4.3 Results

Socio demographic characteristics of the study participants

In this study, 438 child-mother pairs participated with a response rate of 99.4%. Females made up more than half of the children (52.7%). Only 171 (39.5%) mothers or caregivers had a formal education, and 400 (92.2%) of the mothers were housewives. Mothers were overwhelmingly Muslim (99.3%) and Oromo (98.4%) by ethnicity. Almost half of the participants (49.3%) had more than five family members, and 424 of the participants (96.8%) were married. Nearly half of the household's resources (41.1%) were under the authority of other family members, followed by child fathers (26.0%) and mothers alone (14.2%). Only 18.7% of women and fathers, however, controlled the household's resources. In terms of food security, 66.0% of households were food insecure, while 6.4 % were severely food insecure. The second and fourth wealth index quintiles were represented by 122 (27.9%) and 101 (23.1%) of the respondents, respectively (Table 4.1).

Feeding practice and health related characteristics

In the previous 24 hours, nearly all mothers (98.4%) breastfed their children. Almost half of mothers and caregivers (47.9%) began complementary feeding at six months, and 46.1% bottle-fed their children. In terms of nutritional diversity and meal frequency, 14.4% and 64.8% of children received the recommended amounts. However, only 46 children (10.7%) met the recommended MAD. Two hundred eighty-seven (65.5%) children were born in hospitals. In terms of illness, 34.5% of children had been sick in the previous 15 days. Coughing was experienced by nearly half of the children (47.7%), followed by diarrhoea (43.7%). Only 5.7% of mothers prepared cereal-based complementary foods using traditional household food processing techniques (THHFP). Nearly half (52%) of the 25 (5.7%) mothers acquired information about THHFP from their mother-in-law and neighbours (28%) (Table 4.2).

Table 4.1 Socio-demographic characteristics of the mothers/caretakers and their children in rural of Jimma zone, south west Ethiopia, 2021 (N = 438)

Variables N=440	**Category**	**Frequency**	**Percent**
Child age in month	6-11	303	69.2
	12-17	121	27.6
	18-23	14	3.2
Sex of child	Male	207	47.3
	Female	231	52.7
Mother Age in years	< 25	232	53.0
	25-34	154	35.1
	>35	52	11.9
Mother education	Informal education	267	61.0
	Primary school	146	33.3
	Secondary & above	25	5.7
Mother Occupation	House wife	404	92.2
	Farmer	16	3.7
	Governmental employee	4	0.9
	Others[†]	14	3.2
Religion	Muslim	435	99.3
	Orthodox	2	0.5
	Protestant	1	0.2
Ethnicity	Oromo	431	98.4
	Others[‡]	7	1.6
Marital status	Single	5	1.1
	Married	424	96.8
	Widowed	5	1.1
	Separated	4	1.0
Decision making on household resource	Jointly[§]	82	18.7
	Mother only	62	14.2
	Father Only	114	26.0
	Family[¶]	180	41.1

Family size	>5	222	50.7
	<5	236	49.3
Wealth index	Lowest	79	18.0
	Second	122	27.9
	Middle	50	11.4
	Fourth	101	23.1
	Highest	86	19.6
Food insecurity	Food secured	149	34.0
	Mild FI	189	43.2
	Moderate food insecurity	72	16.4
	Severe food insecurity	28	6.4

† Merchant, private; ‡Amhara, Dawero, Kaffa, § both mothers &fathers; ¶Mother-in-law, other both spouse family

Table 4.2 Feeding practice and health related characteristics among 6-23 months of children in rural Jimma zone, south west Ethiopia, 2021 (N = 438)

Variable	Category	Frequency	Per cent
Ever breast fed (N=438)	Yes	431	98.4
	No	7	.6
Ever bottle fed (N=438)	Yes	202	46.1
	No	236	53.9
Initiation of Complementary foods	Not started	7	1.6
	<6 month	119	27.2
	At 6 months	210	47.9
	>6 month	102	23.3
MDD	met	63	14.4
	Not met	375	85.6
MMF	met	284	64.8
	Not met	154	35.2
MAD	met	47	10.7
	Not met	391	89.3
Place of delivery	Health facility	287	65.5
	Home	151	34.5
Practice of THHFP† technique	Yes	25	5.7
	No	413	94.3
Information about THHFP technique	Mothers-in-law	13	52.0
	Neighbours	7	28.0
	Health workers	3	12.0
	Mass media	2	8.0
Illness	Yes	151	34.5
	No	287	65.5
Type of illness(N=159)	Diarrhoea	66	43.7
	Cough	72	47.7
	intestinal parasite	11	7.3
	Others ‡	2	1.3

†Traditional household food processing

Assessment of under nutrition using conventional and CIAF

Table 4.3 presented the prevalence of undernutrition based on CIAF classification by age and sex among children aged 6-23 months. The overall proportion of anthropometric failure was

57.3%. Anthropometric failures were observed in various categories: wasted only (6.6%), wasted and underweight (8.7%), stunted, wasted, and underweight (8.9%), stunting and underweight (10%), stunted only (22.6%), and underweight only (0.5%). Among children aged 6-12 months, stunting only was the most prevalent at 23% within the subgroups of CIAF. Conversely, underweight only was the least prevalent at 0.6%. In contrast, for children aged 13-23 months, wasted and stunted, and underweight was the most prevalent at 20.5%, while none experienced underweight only (Table 4.3).

Table 4.3 Prevalence of undernutrition based on the CIAF classification by age and sex among 6-23 months of children in rural areas of Jimma Zone, Southwest Ethiopia, 2021 (N = 438)

Categories of CIAF [a]	Age group in months		Sex		**Total**
	6-12	**13-23**	**Male**	**Female**	
No Failure (A)	155(43.7)	32(38.6)	76(36.7)	111(48.1)	187(42.7)
Wasting only (B)	27(7.6)	2(2.4)	13(6.3)	16(6.9)	29(6.6)
wasting & underweight (C)	33(9.3)	5(6.0)	22(10.6)	16(6.9)	38(8.7)
Wasting, stunting & underweight (D)	22(6.2)	17(20.5)	24(11.6)	15(6.5)	39(8.9)
stunting & underweight (E)	32(9.0)	12(14.5)	27(13.0)	17(7.4)	44(10.0)
stunting only (F)	84(23.7)	15(18.1)	43(20.8)	56(24.2)	99(22.6)
Underweight only (Y)	2(0.6)	0(0.0)	2(1.0)	0(0.0)	2(0.5)
†CIAF= B+C+D+E+F+Y	200(56.3)	51(61.4)	131(63.3)	120(51.9)	251(57.3)

[a] *Composite Index of Anthropometric Failure*

The prevalence of conventional indexes by age and gender is shown in Table 4.4. It is observed that for all three measures of malnutrition, the prevalence decreases as the child gets older. The proportion of wasting is higher (28.9%) in children 12-23 months compared to children aged 6-12 months. The prevalence of stunting is higher in children aged 13-24 months (53.0%) compared to children aged 6-12 months (38.9%). As the same, prevalence of underweight is higher among children aged 13-24 months (41 %) compared to children aged 6-12 months. Specifically, the percentage of wasted, stunted, and underweight males is higher than that of females. The prevalence of wasting is higher in males (28.5%) compared to females (20.3%). Similarly, in stunting, males having a higher prevalence (45.4%) compared to females (38.1%). In underweight, males have a higher prevalence (36.2%) compared to females (20.8%). In comparison, conventional measures of wasting, stunting, and underweight were 24.2%, 41.6%, and 28.1%, respectively, all of which were lower than the CIAF (Table 4.4).

Table 4.4 Prevalence of undernutrition using conventional indexes by age and sex among 6-23 months of children, 2021

Conventional indexes	Child age in months		Sex		Total
	6-12	13-23	Male	Female	
Wasted (Weight for Height)	82(23.1)	24(28.9)	59(28.5)	47(20.3)	106(24.2)
Stunted (Height for Age)	138(38.9)	44(53.0)	94(45.4)	88(38.1)	182(41.6)
Underweight (Weight for age)	89(25.1)	34(41.0)	75(36.2)	48(20.8)	123(28.1)

Factors associated with CIAF among children 6-23 months in rural Jimma zone, south west Ethiopia, 2019

On bivariate analysis, the factors found to be significantly associated with the overall prevalence of undernutrition using CIAF (Anthropometric failure) were the sex of the child, mother's education, MAD, birth order, family size, illness within two weeks and HH food security status.

After controlling the potential confounders, in the final multivariable logistic regression, male children had 1.5 times higher odds of CIAF (AOR=1.55, 95% CI: 1.01-2.37) as compared to female children. Those children whose mothers attained secondary and above schooling were 75% less likely (AOR=0.24, 95% CI: 0.09-0.64) to be undernourished compared to children whose mothers had formal education. A child who did not meet MAD was 2.0 times more likely malnourished than those who had met the recommended MAD (AOR=2.14, 95% CI: 1.06-4.30). Children who lived in a family of more than five members were 1.6 times more likely to have an anthropometric failure than children with less than five family members (AOR=1.699, 95%CI: 1.07-1.67). Children who experienced illness in the past two weeks were 3.3 times more likely (AOR=3.31, 95%CI: 2.06-5.32) to have anthropometric failure than those who did not have the disease. Children from food-insecure households were 3.12 times more likely to have an anthropometric failure (AOR=3.2, 95%CI: 2.00-4.86) compared to food-secure household counterparts (Table 4.5).

Table 4.5 Multivariable logistic regression of factors associated with CIAF among children aged 6-23 months in rural Jimma zone, south west Ethiopia, 2021 (N = 438)

Variables (n=438)	CIAF		COR (95% CI)	AOR (95% CI)
	Failure	No Failure		
Child sex				
Male	131(63.3)	76(36.7)	1.59(1.08-2.33) *	1.55(1.01-2.37) *
Female	120(51.9)	111(48.1)	Ref.	Ref.

Mother education				
[a]Informal	168(62.9)	99(37.1)	Ref.	Ref.
Primary	75(51.4)	71(48.6)	0.62(0.41-0.33)	0.70(0.44-1.12)
≥Secondary	8(32.0)	17(68.0)	0.27(0.11-0.66) *	0.24(0.09-0.64) *
MAD[b]				
Met	18(38.3)	29(61.7)	Ref.	Ref.
Not met	233(59.6)	158(40.4)	2.37(1.27-4.42) *	2.10(1.05-4.21) *
Birth order				
1	31(50.9)	30(49.2)	Ref.	Ref.
2-4	122(52.6)	110(47.40	1.073(0.61-1.88)	0.95(0.50-1.81)
>5	99 (67.6)	47(32.4)	2.01(1.09-3.71) *	1.65(0.80-3.38)
Family size				
<5	111(50.0)	111(50.0)	Ref.	Ref.
≥5	140(64.8)	76(35.2)	1.84(1.25-2.70) *	1.69(1.079-1.67) *
Illness [c]				
Yes	111(44.2	40(21.4)	2.91(1.89-4.47) *	3.31(2.06-5.32) **
No	140(55.8)	147(78.6)	Ref.	Ref.
Food security status				
Secured	58(38.9)	91(61.1)	Ref.	Ref.
Not secured	193(66.6)	96(33.2)	3.15(2,09-4,75) **	3.12(2.0-4.86) **

*** p -value<0.001; *p-value<0.05; [a] Informal; unable to read and write and read and write only; [b] Minimum Acceptable Diet: [c] cough, diarrhoea, fever; Ref. indicates for the reference category of variables; Hosmer and Lemeshow test=0.782*

4.4 Discussion

In the current study, a single index (CIAF) was computed from the three conventional anthropometric indexes (wasting, stunting, and underweight), as conventional indexes cannot determine an aggregate estimate of undernutrition among infants and young children. Thus, the current finding revealed that the prevalence of CIAF was (57.3%), and it was higher than the conventional index of wasting (24.2%), stunting (41.6%), and underweight (28.1%). The current study's findings on conventional indexes of wasting, stunting and underweight were higher than those of the Ethiopian national demographic health survey(99).

Children who are older and being a male are more affected by undernutrition in both conventional and composite indexes, which is consistent with prior studies in Ethiopia(99, 101, 157). This could be due to the male children's higher dietary requirements for growth and development at this age due biological difference, as well as increased exposure to infection. Furthermore, males had higher odds of undernutrition than girls, which could be attributed to increased energy requirements, social and cultural norms favouring female children, and limited access to healthcare and resources. More than half of the children in this study (57.3%) had CIAF, which was substantially similar to Pakistan's. (52.2%) and, India findings (54.4%) (17, 155, 158).

However, several researchers found that the prevalence of undernutrition (CIAF) was lower in Ethiopia from 46.2% to 50.8%(55, 101, 104, 159), in Malawi (50.6%)(160), Indonesia (42.1%) (59) and Bangladesh (48.3%)(58). This disparity could be attributed to differences in study duration, feeding practices, information gaps, and socioeconomic and cultural factors. Furthermore, the majority of the preceding research was conducted on various age groups: children under the age of five and preschool children. The higher prevalence of CIAF found in this study could be attributed to the fact that children in their first two years are more vulnerable to undernutrition than toddlers or preschool children due to the high demand for nutrients to support their rapid growth and development, poor child feeding practices, and infection. Furthermore, the current research area's population is reliant on cereal and grain cultivation. These factors may result in a lack of variety in a child's diet, putting children at risk of undernutrition.

However, the proportion of CIAF was lower than the finding from Yemen (70 %)(126) (Al-Sadeeq *et al*., 2018) and India 62%(161). This discrepancy could be attributed to a difference in the study period, which was conducted earlier than to the current study.

According to this study, mother higher education was associated to CIAF. Children whose mothers had completed secondary school or above were less likely to have CIAF than children whose mothers had never completed formal education. It is consistent with prior research from Ethiopia(53, 101, 104), Pakistan(158), Bangladesh(162) and Bengal(155)which found that when mothers' educational status improves, the probability of their children failing to anthropometric failure decreases. These clearly emphasize that, depending on their educational level, educated women may receive direct information about their child's diet and nutritional status.

This study found a significant association between CIAF and larger family size, which is consistent with research done in Ethiopia(55). The reason could be that large families are more likely to have financial difficulties and are therefore unable to give their children balanced and nutritious food that would support normal growth and development. The current study found that illness in the previous two weeks (cough, fever, and intestinal parasites) is a predictor of CIAF. Likewise, research from Ethiopia and India consistently found an association between CIAF and illness(55, 101, 159, 163). This resemblance could be explained by the vicious cycle of illness and nutrition. Infection can cause a loss of appetite,

poor digestion, nutrient malabsorption, and a weaker immune system. As a result, it may jeopardize children's nutritional status(164).

Male children were 1.5 times more likely than females to experience anthropometric failure, according to our findings. This outcome is consistent with previous research from Ethiopia and India (55, 101, 159). One possible explanation for the higher risk of undernutrition among male children compared to females is the influence of both socio-cultural and biological factors. Culturally, certain practices may favour girls over boys in terms of care and nutrition. Biologically, male children tend to have a larger surface area-to-volume ratio, which increases their nutrient requirements during early childhood(165).

To the best of my knowledge, this is the first study in Ethiopia that has determined the association of a MAD with CIAF. In the current study, children aged 6-23 months who did not receive the recommended MAD were more likely to experience CIAF than children who did. We were unable to compare our findings to other studies since no studies determining the association of MAD with CIAF were found. However, Our findings are comparable to research in Nigeria that used conventional measures to quantify undernutrition and showed association between MAD and underweight and stunting but not wasting (160). This could be due to insufficient nutritional intake, and the quality of supplemental foods raises the risk of chronic malnutrition. Dietary diversity and MMF index, respectively, are predictors of child linear growth and proxies for energy intake. As a result, MAD is a composite index of dietary diversity and minimal meal frequency used to capture multiple dimensions of feeding in order to promote optimal growth and development of children, and it may play a role in undernutrition(166).

This finding showed that children who lived in food-insecure households were three times more likely to be exposed to anthropometric failure compared to their counterparts of children in food-secure households. The finding is similar to India and Rwanda studies(64, 65). It could be due to the low consumption and monotonous diet in food insecure households that may deprive adequate intake of essential nutrients and can affect the nutritional status of children. The South Africa study reported that household food insecurity is the primary contributor to undernutrition among children (63).

Strength of the study

This study considered MAD as a predictor variable. A MAD is a combined index and a proxy for the quality of complementary food, and its effect may reflect on a child's nutritional status. Thus, this study showed the association between MAD and CIAF.

Limitation

The possible limitations of this study might be recalling bias and social desirability bias as the data relies on self-report. The nature of the cross-sectional study limits the ability to conclude the cause-and-effect relationship between CIAF and independent variables.

Conclusion

In conclusion, more than half of the children aged 6-23 months in the study area were found to have anthropometric failure, as measured by the CIAF. The study found that being male, having a mother with higher education, not having a MAD, having a larger family size, having comorbidities, and experiencing food insecurity were all predictors of anthropometric failure. CIAF is a composite measure that considers all types of undernutrition to provide a comprehensive assessment. These findings provide better evidence that CIAF is an effective tool for identifying undernutrition in children aged 6-23 months. The results of this study can be used to develop targeted interventions to reduce undernutrition. Policymakers and researchers are also urged to utilize CIAF to accurately assess children's nutritional status in future studies and policy-making decisions.

CHAPTER 5: EFFECT OF BEHAVIOURAL CHANGE COMMUNICATION ON ANTHROPOMETRIC FAILURE AMONG CHILDREN AGED 6-23 MONTHS IN SOUTHWEST ETHIOPIA: A CLUSTER RANDOMIZED CONTROLLED TRIAL

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Abstract

The high prevalence of CIAF among children remains a significant public health threat. Therefore, this study aimed to assess the effect of BCC through WDA reducing CIAF among children aged 6-23 months in Jimma zone, Ethiopia. For this, a cluster randomized control trial was conducted in rural Kersa districts, Southwest Ethiopia. Fourteen villages were randomly selected, and a total of 440 mother-child pairs participated, with 220 assigned to the intervention group and received BCC through the women developmental army for 12 months, while the control group received routine health education. Data were collected using structured questionnaires, anthropometric measurements, and 24-hour dietary recall. The difference in socio-demographic status was assessed using the chi-square test. The effect of the intervention was evaluated by using the difference-in-differences and generalized estimating equation. The finding of this study showed that composite index of anthropometric failure reduced significantly by 18.5 % (DID: 18.5 percentage points, p<0.007) in the intervention group compared to control group. The BCC (AOR=0.07, 95% CI: 0.02, 0.22), child age (AOR=1.17, 95% CI: 1.09, 1.26), decision-making power by parent-in-law (AOR=3.10,95%CI:1.35, 7.10), maternal formal education (AOR=0.28, 95% CI: 0.19, 0.42), paternal primary education (AOR=0.65, 95% CI: 0.43, 0.99), food insecurity (AOR=2.14,95%CI:1.42,3.22),family size greater than six (AOR=3.27, 95% CI: 1.93, 5.37), and met MAD (AOR=0.44, 95% CI:0.28, 0.72) were significantly associated with the overall CIAF among children aged 6-23 months. The study found that the intervention significantly reduced the proportion of anthropometric failure in children aged 6-23 months over time. It is recommended that policymakers support long-term BCC with nutrition-sensitive interventions and promote the involvement of women developmental armies as messengers of BCC. The study was registered in Pan African Clinical Trials Registry as PACTR202106621156513.The trial was registered after enrolment of the study.

Keywords: Anthropometric failure, Behaviour change communication, Children, Cluster randomized controlled trial, aged 6-23 months

5.1 Introduction

Malnutrition is one of the causes of morbidity and mortality in children under the age of five around the world. Undernutrition is responsible for around 45% of all deaths among children under the age of five (152). According to a UNICEF report, 148 million children under the age of five (22.3%) suffer from stunting, while 45 million (6.8%) suffer from wasting worldwide. This indicates that two out of every five children under the age of five are stunted, and approximately 27% of African children are wasted(18).

Over the last two decades, Ethiopia has drastically reduced malnutrition by strengthening and expanding health care service, with stunted falling from 42.1% in 2012 to 34.4% in 2022 wasted dropped from 10% in 2011 to 7% in 2019, underweight falling from 29% in 2011 to

21 % in 2019. The CIAF declined from 51.0% in 2011 to 46.2% in 2016(53, 99). However, there is still a slow change in rate of undernutrition and it remains a high public health issue in the country.

Poor quality, insufficient quantity of food, poor maternal knowledge, infection, food insecurity, mother education, father education, family size, environmental sanitation are a major cause of under nutrition and developmental outcome in developing countries including Ethiopia(2, 5, 83, 120, 167).

WHO developed a growth standard to determine children's growth by using indexes such as height for age (LAZ), weight for height (WLZ), and weight for age (WAZ)(7). These indexes indicate: stunting is a chronic undernutrition with deprivation of food, nutrient intake and infection, and wasting is an acute undernutrition resulting from a recent shortage of foods and recent weight loss; while underweight is a composite index of both acute and chronic undernutrition. Various studies have used conventional indexes to assess the nutritional status of children. However, it does not provide an overall estimate of undernutrition among children aged 6 to 23 months. One child may exhibit one or more signs simultaneously, resulting in an under or overestimation of undernutrition. By merging wasting, stunting and underweight indexes into one, the CIAF provides the overall prevalence of undernutrition The CIAF was developed for the first time by Svedberg as a new composite indicator that incorporates stunting, wasting, and underweight and revised by Bose and Nandy (12, 130).

The first "1,000 days" is a critical window period for preventing malnutrition, particularly for children aged 6-23 months, who often experience growth faltering and nutrient deficiencies (1, 5). Unfortunately, infants and young children in developing countries, especially in Eastern and South Africa, struggle to obtain optimal diets during this critical window. For instance, in Ethiopia, only 12%, 45%, and 7%(99) of children received the MDD, MMF, and MAD, respectively. Deficiencies in nutrients during critical periods can have irreversible effects such as faltering growth, impaired development, lower intelligence, increased vulnerability to infections, reduced work capacity, and hindered economic productivity in adulthood (152, 168-170).

Several studies have demonstrated that more emphasis on BCC on complementary feeding is required to enhance eating practice during the key period of 6-23 months, which is a peak period for linear growth and development particularly, in developing countries(85, 120). The BCC is "an interactive process with communities as integrated with an overall program to

develop tailored messages and approaches using a variety of communication channels to develop positive behaviours, promote and sustain individual, community, and societal Behaviour change, and maintain appropriate behaviours"(171). BCC is a proven strategy for increasing the use of diverse and varied foods in local affordable diets to alleviate the burden of undernutrition. According to the Bangladesh cluster randomized trial; the information gained through 12 months of intensive BCC, mothers may have adequate time for exposure to information, resulting in change in mother's child feeding knowledge and practice. As a result, if appropriate time and follow-up are provided, BCC can be a useful technique for changing nutritional knowledge and infant feeding practices and results for reduction in prevalence of undernutrition. Face-to-face individual and group implementation of BCC has been shown to have positive effects n mother knowledge and child care practice.

Ethiopian government has been given training for HEWs as a front line to promote IYCF practice and other health issues. However, the HEW's are responsible for raising awareness on various topics; the time that is spent covering IYCF in households is limited. As a result, Ethiopia Government assigned a cadre of volunteers called WDA, to focus on more intensively on sparking local behaviour change in the household during home visit by linking with HEW's (34, 108). So, to provide an effective message to mothers, BCC needs to be given by the Women's Developmental Army.

The current study addresses the lack of cluster randomized control (CRCT) trials evaluating the effectiveness of BCC on overall undernutrition (CIAF) and highlights the potential of using WDAs as effective messengers for promoting optimal child feeding practice. To the best knowledge of the researcher, there is no study that determines the effect of intervention on CIAF among 6-23 months in study area. Therefore, this study aims to assess the effect of BCC through WDA on reducing undernutrition among children aged 6-23 months in Jimma zone, Ethiopia.

The primary objective of the intervention trial was to evaluate the effect of BCC intervention on the CIAF through the WDAs. The evaluation is based on changes in weight-for-length, length-for-age, and weight-for-age measurements after a 12-month intervention period for both the intervention and control groups. The secondary objectives are to examine the influence of the intervention on maternal complementary feeding knowledge and dietary practices.

The trial hypothesized that the CIAF among children aged 6-23 months would be reduced by change in the z-score of WLZ, LAZ and WAZ in those who received BCC than in those who had not received.

5.2 Materials and Methods

Sample

This cRCT aimed to assess the impact of BCC on overall undernutrition among children 6-23 months between two groups: intervention and control. The intervention group received food-based BCC on complementary feeding practices, nutritional knowledge, and preparation of local cereal-based complementary foods through traditional techniques by trained WDA. The control group received standard health education from HEWs. The BCC implementation continued for a year after recruitment of participants.

Based on a previous study in SSNP, which showed an expected change in intervention on child feeding practice of 0.4, the assumptions considered were: an effect size of 0.4 between intervention and control groups, a significance level of 5% ($\alpha = 0.05$; $Z\alpha/2)=1.96$; two-tailed tests), and a power of 80% ($Z_\beta = 0.84$) by G-POWER software. . This yielded an estimated sample size of 100 mother-child pairs per group. Factoring in design effects of 2 and a 10% non-response rate, the total sample size was 440, with 220 pairs allocated to both intervention and control groups in a 1:1 ratio. For Study 5, we employed a two-stage cluster sampling method to select participants. Using cluster randomization, we randomly chose four out of 22 rural kebeles based on agricultural production, totalling 25 villages with 1194 children aged 6-23 months. Villages were considered as clusters for participant selection. We excluded four adjacent villages between the intervention and control groups as a buffer zone. Then, 14 out of the remaining 21 villages were randomly selected. A statistician not involved in the study generated a randomized allocation sequence. Both arms consisted of seven clusters, with sample sizes distributed proportionally based on the total number of eligible children in each village. Initially, we recruited 440 mother-child pairs, but after excluding two ineligible children, 438 pairs remained at baseline. During the endline data collection, there were 200 pairs in the control group and 204 in the intervention group due to lose to follow up. The trial was conducted based on the CONSORT Guidelines.

Interventions Description

We adopt and made some modification on modules from WHO-UNICEF publications "Key Messages Booklet on the Community Infant and Young Child Feeding Counselling Package"

and "Complementary Feeding Training Handbook by Alive and Thrive in Ethiopia"(97, 124) for a BCC intervention aimed at improving child feeding practices.

The BCC key message was delivered in five sessions, each lasting three days. The first session focused on the overview of malnutrition on the causes and consequences of It is important to gradually increase the serving size from 2 to 3 tablespoons at six months to a half of a 250 ml cup by 9-12 months. The food should have a thick consistency that can be fed by hand. Furthermore, enriching the baby's porridge with animal-source foods, finely chopped vegetables, and mashed fruits is recommended to ensure a well-rounded diet. Mothers should engage with their child during mealtime through responsive feeding. Foods should be provided during illness and additional meals may be necessary to meet the child's nutritional needs.

The third session discussed how mothers/caregivers feed their children during illness. It was emphasized that mothers should continue breastfeeding and increases their child's feeding during and after the child's illness. Additionally, mothers were advised to be aware of hygienic practices when handling food and to practice proper hand washing techniques while preparing and feeding complementary foods.

In the fourth session, the focus is on preparing nutritious foods using locally available cereals and traditional food processing methods such as germination, soaking, and pounding. The mothers were taught how to make cereal-based flour using traditional household techniques and learn how to prepare recipes for enriching cereal, legume, or root-based complementary foods by combining different ingredients with recommended proportion for preparing porridge and gruel(three parts soaked, germinated, and pounded cereal and one part legumes If possible, mothers were encouraged to use milk instead of water for preparing porridges and to add butter/oil to make the porridge easier to consume. They were also advised to include finely chopped meat, fish, or eggs, as well as vegetables. Finally, the mothers were instructed to add iodized salt while preparing complementary food. The fifth session focuses on practical demonstrations and re-demonstrations on preparation of recipes by mixing a variety of fruits, vegetables, and animal source foods, and traditional food processing methods for preparing legumes and cereal flour. These methods include germination, soaking, and pounding. Additionally, there will be demonstrations and re-demonstrations on preparing complementary food recipes

After providing seven-day training for WDAs, they conveyed BCC messages to mothers for duration of 12 months for the intervention group. Three trained WDAs were assigned per cluster to deliver messages to selected mother-child pairs. Then the WDAs delivered the intervention to child mothers/caregivers from January 2022 to December 2022. Details on why we selected WDAs as messengers, recruitment, training, and delivery methods can be found in Chapter 2.

Data collection and procedures

For the present study, we gathered data using structured questionnaires to evaluate socio-demographics, dietary practices, knowledge, food security status, wealth status, and illness within both the intervention and control groups. The primary outcome variable for this study was anthropometric failure. We used CIAF to assess the aggregate single measurement of overall undernutrition among children aged 6-23 months (Table 5.1). Similar questionnaires, same data collectors were utilized for both the baseline and endline surveys. These questionnaires were adapted from various sources (7, 32, 99, 127, 133). Chapter 2 provides a concise discussion of data collection and procedures.

Data management and analysis

The data was entered to Epi-Data manager and was exported to SPSS version 20.0 and then exported to Stata Version17.0 for analyses. Based on 2006 WHO child growth standards, LAZ, WAZ and WLZ indexes, was created by using WHO Anthro software version 3.2.2. Continuous variables were checked for normality by Kolmogorov test and histograms. Descriptive statistics was performed and the results were presented using proportion, figures and tables. A chi-square (X^2) test was employed to evaluate the association of socio-demographic variables with the intervention and control groups. The difference-in-differences (DID) model was used to determine the effect of the intervention on anthropometric indices and knowledge over time, comparing the intervention and control groups. In the Generalized Estimating Equation (GEE), a binomial family, logit link function, and independent correlation structure were considered to examine BCC effect on undernutrition between intervention and control groups over time, and to identify predictors of CIAF. GEE univariable models were fitted for each independent predictor variables. Those variables with a p-value < 0.25 were selected for multivariable GEE. The intervention's effect was assessed through the interaction term “intervention*time". The GEE model also explores the relationship between CIAF and explanatory variables.

5.3 Results

Socio demographics and economic characteristics of participants

A total of 440 participants were enrolled in the study during baseline assessment: 220 for the intervention group and 220 for the control group, with a response rate of 91.8%. Eight percent of participants from the two groups lost follow-up during the follow-up period due to refusal to participate or moving to another location. Table 2 summarizes the socio-demographic and economic characteristics of the participants at baseline and the end of the study for two distinct groups (Table 5.1).

Table 5.1 Descriptive characteristics with the test of association among children aged 6-23 months old in the Kersa district, Southwest Ethiopia, 2022.

	Baseline n (%)			**Endline n (%)**		
Variables	Control	Intervention	*P*	Control	Intervention	*P*
Sex						
Female	99(49.5)	108(52.94)	0.489	99(49.5)	108(52.94)	0.489
Male	101(50.5)	96(47.06)		101(50.5)	96(47.06)	
Mother age						
<24 years	61(30.5)	58(28.43)	0.605	57(28.5)	54(26.47)	0.709
24-35 years	130(65.0)	140(68.63)		118(59.0)	119(58.33)	
> 35 years	9(4.5)	6(2.94)		25(12.5)	31(15.2).	
Mother education						
Informal	113(56.5)	121(59.31)	0.567	104(52.0)	110(53.92)	0.699
Formal	87(43.50)	83(40.69)		96(48.00)	94(46.08)	
Father education						
Informal	123(61.5)	133(65.2)	0.366	123(61.5)	133(65.2)	0.366
Primary	70(35.0)	60(29.41)		70(35.00)	60(29.41)	
Secondary& above	7(3.5)	11(5.39)		7(3.5)	11(5.39)	
Place of delivery						
Home						
Health facility	126(63.0)	139(68.14)	0.277	126(63.0)	139(68.14)	0.277
	74(37.0)	65(31.86)		74(37.00)	65(31.84)	
Family size						
< 4	66(33.00)	77(37.75)	0.277	67(33.50	78(38.24)	0.154
4 -6	72(36.00)	78(38.24)		72(36.00)	81(39.70)	
>6	62(31.00)	49(24.01)		61(30.5))	45(22.06)	
Food insecurity						
No	64(32.0)	75(36.76)	0.313	68(34.0)	88(43.14)	0.039
yes	136(68.0)	129(63.24)		132(66.0)	116(56.86)	
Wealth index						
Lowest	33(16.5)	40(19.61)	0.238)	33(16.50)	38(18.63)	0.200
Second	62(31.0)	50(24.51)		64(32.00)	51(25.00)	
Middle	24(12.0)	20(9.80)		26(13.00)	27(13.24)	

Fourth	39(19.5)	56(27.45)		37(18.5)	55(26.95)	
Highest	42(21.0)	38(19.63)		40(20.00)	33(16.18)	
MAD [a]						
No	169(84.5)	178(87.25)	0.426	163(81.5)	73(35.78)	0.000**
Yes	31(15.5)	26(12.75)		37(18.5)	131(64.22)	

****p<0.01; **p<0.05; The P-value is obtained from Chi-square test; [a] Minimum Acceptable Diet*

Conventional indexes in the intervention and control groups over time

This study revealed that there were no significant differences in the proportion of wasting, stunting, underweight in the intervention and control groups at baseline (*P*>0.05) by Pearson chi-square test. In an endline survey, the proportion of wasting and underweight in the intervention group showed a significant difference between two groups (*P*<0.05). However, there was no significant difference observed in the proportion of stunting between the intervention and the control group at the end line survey (Table 5.2).

Table 5.2 Conventional indexes in the intervention and control groups over time among children aged 6-23 months in Kersa district, Southwest Ethiopia.2022.

Indicators	**Baseline**		**P-value**	**Endline**		**P-value**
	CG [a]	**IG [b]**		**CG**	**IG**	
Wasted	50(25.00)	49(24.02)	0.819	45(22.5)	25(12.3)	0.007*
Stunted	88(44.0)	88(43.1)	0.861	79(39.50)	62(30.39)	0.055
Underweight	59(29.5)	60(29.4)	0.984	43(21.5)	28(13.73)	0.043*

****** p<0.01; ** p<0.05; [a] Control Group; [b] Intervention Group;*** *the P-value is obtained from Chi-square test*

Comparison of changes in children nutritional indexes and mother knowledge by Difference-in-difference (DID) estimator

The study compared the average weight and height differences between the intervention and control groups at baseline, showing no significant distinction (0.114 kg and 0.796 cm, respectively). However, at the endline, a significant increase in weight difference was observed 1.18 kg, and height difference increased by 2.51 cm (p<0.001), between the intervention and control groups. Notably, the intervention group displayed a highly significant difference, with an average net effect of 1.06 kg (DID 1.6 kg, p<0.001) and 1.71 cm (DID, p<0.05) on weight and height of children. Initially, there was no notable difference in weight-for-length z-score (WLZ) and weight-for-age z-score (WAZ) between the groups. However, over time, there was an overall increase in the intervention group, with an average difference of 0.763 in WLZ (DID 0.763, p<0.001) and 0.740 in WAZ (DID 0.740, p<0.001) compared to the control group. At baseline, the average difference in length-for-age z-score (LAZ) between the groups did not exhibit significant variation. The net effect in LAZ among the intervention group increased by 0.476 (DID 0.476, p=0.076) over time. However, no

significant difference was found in the average length-for-age between the intervention and control groups at the endline (Table 5.3). Additionally, Figure 2 clearly depicts the impact of the intervention on the change in nutritional indices of WLZ, LAZ, and WAZ between the intervention and control groups (Figure 5.1).

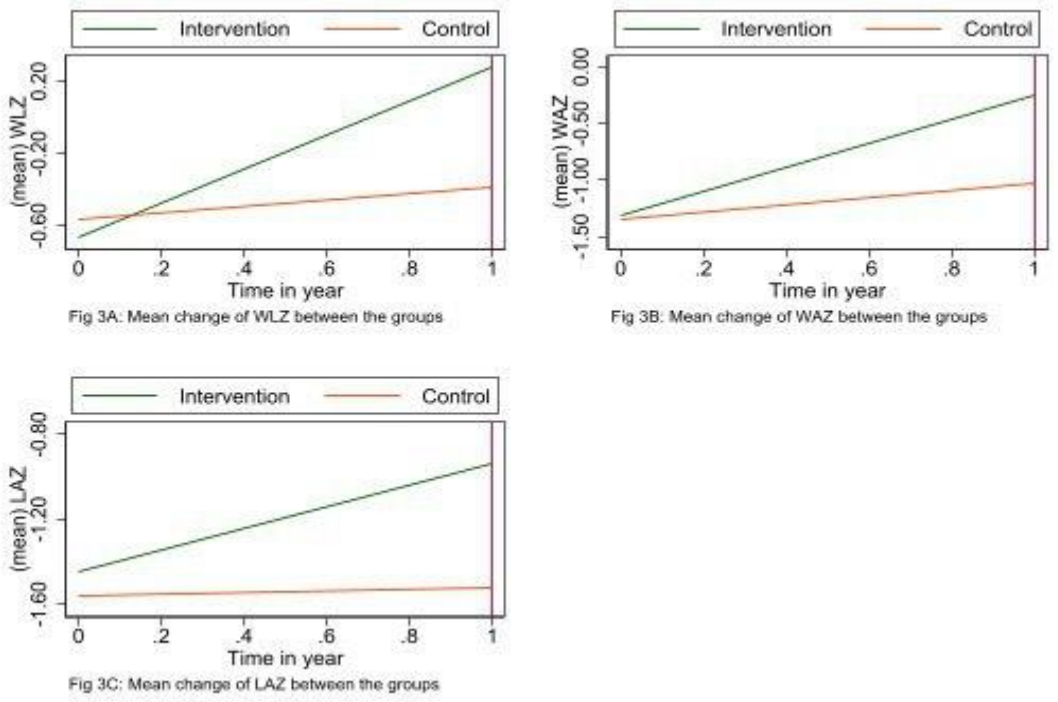


Figure 5.1 Comparison of mean WLZ, LAZ and WAZ between the intervention and control group, 2022

Similarly, the mean difference in mothers' nutrition knowledge at baseline between the intervention and control groups was -0.086, which lacked statistical significance (P=0.575). The intervention group showed a significant improvement in average knowledge score compared to the control group, with an increase of 1.65 ($p < 0.001$) over time (Table 5.3).

Table 5.3 Effect of the intervention on nutritional status indexes and knowledge by DID analysis, 2022

Variables	Time	Groups	Mean value	p
Weight	Baseline	Control Intervention Diff(I-C) [a]	7.514 7.628 0.114 (±0.128)	0.378
	Endline	Control Intervention Diff(I-C)	9.955 11.136 1.182 (±0.129)	< 0.001***
		Diff-in-Diff[b]	1.068 (±0.183)	< 0.001***
Height	Baseline	Control Intervention Diff(I-C)	68.129 68.925 0.796 (±0.460)	0.084
	Endline	Control Intervention Diff(I-C)	79.375 81.885 2.510 (±0.460)	< 0.001***
		Diff-in-Diff	1.714 (±0.651)	< 0.001**
WLZ	Baseline	Control Intervention Diff (T-C)	-0.570 -0.661 -0.091(±0.145)	0.529
	Endline	Control Intervention Diff (T-C)	-0.391 0.280 0.671(±0.145)	< 0.001***
		Diff-in-Diff	0.763(±0.205)	< 0.05***
LAZ	Baseline	Control Intervention Diff (T-C)	-1.560 -1.450 0.110(±0.189)	0.560
	Endline	Control Intervention Diff (I-C)	-1.519 -0.933 0.586(±0.189)	< 0.001***
		Diff-in-Diff	0.476(±0.268)	0.076*
WAZ	Baseline	Control Intervention Diff (I-C)	-1.346 -1.317 0.029(±0.132)	0.828
	Endline	control Intervention Diff(T-C)	-1.024 -0.255 0.768(0.132)	< 0.001***
		Diff-in-Diff	0.740(±0.186)	< 0.001***
knowledge	Baseline	Control Intervention Diff(I-C)	4.120 4.034 -0.086(±0.153)	0.575
	Endline	Control Intervention Diff(I-C)	4.410 5.975 1.565 (±0.153)	< 0.001***
		Diff-in-Diff	1.651 (±0.216)	< 0.001***

**** p<0.01; ** p<0.05 [a] difference between Intervention (I) and Control (C); [b] the difference between the baseline and endline time*

Comparison of changes in the proportion of children on the CIAF between control and intervention groups over time

At baseline, there was no significant difference in the proportion of children on the CIAF between the intervention and control groups (p = 0.514). However, the proportion of CIAF in the intervention group dramatically declined by 18.5% from the baseline of 58.8% to 35.8%, while in the control group, it slightly decreased from 62% to 57.5%. A highly significant difference was observed between the intervention and control groups (DID: 18.5 percentage points (p<0.001) over time (Figure 5.2).

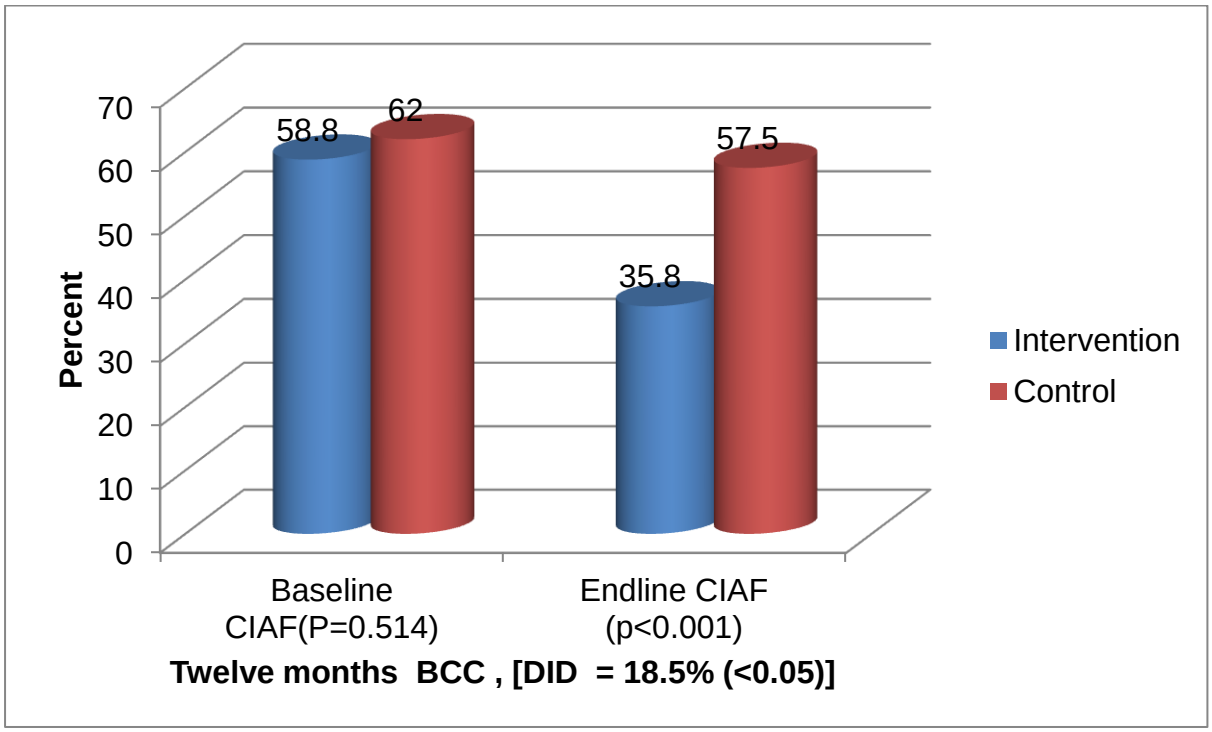


Figure 5.2 Comparison of CIAF in children aged 6-23 months between intervention and control groups, 2022.

Generalized estimated equation analysis on anthropometric failure among children aged 6-23 months in Kersa district, Southwest Ethiopia, 2022

In the GEE univariable analysis, child age, sex, decision on household assets, mother education, father education, HH food insecurity, illness in the past two weeks, family size, MAD and mother/caretaker knowledge were significantly associated with CIAF. However, after controlling the possible confounders, multivariable GEE analysis showed that interaction term (intervention*time), child age, mother education, father education, HH food insecurity, mother/caretaker knowledge and MAD remained statistically significant with the overall undernutrition. An intervention (intervention * time) had a significant effect on the CIAF at the end line in the intervention group. (AOR=0.07, 95%CI 1:(0.026 -0.22)). For a

one-month increase in the age of the child, the odds of CIAF were increased by 17% (AOR=1.17 95% CI: (1.09 -1.26)). Children in households with influence over household resources held by their parents-in-law were three times (AOR=3.10, 95% CI (1.35-7.10)) more likely to develop CIAF than children in households with resources controlled jointly by their mother and father. Regarding family educational status, child mothers who had a formal education were 72 % (AOR=0.28, 95% CI (0.19 -0.42)) less likely to have undernutrition compared to child mothers with no formal education. Children whose fathers had a primary education had a 34% (AOR=0.65, 95% CI (0.43- 0.99) lower risk of having CIAF than those whose fathers had no formal education. Children who lived in food insecure houses were 2 times (AOR=2.14, 95% CI (1.42- 3.22)) more likely exposed to CIAF compared children in food secure houses. Children living in families with more than six family members were three times (AOR=3.2, 95% CI (1.93, 5.37)) more likely to develop CIAF than children living in households with one to three family members. Mothers who did respond to less than five complementary feeding practice-related knowledge questions were eleven times (AOR=11.38, 95% CI (2.01-17.20)) more likely to have CIAF compared to mothers who responded to more than five questions. Children who received MAD according to the standard were 55% (AOR=0.44, 95% (CI 0.28- 0.70)) less likely to have CIAF compared to children who did not receive (Table 5.4).

Table 5.4 Generalized estimating equation model on Anthropometric failure among children aged 6-23 months in Kersa district, Southwest Ethiopia.2022

Anthropometric Failure (CIAF)	**Coefficient**	**SE**	**P-value**	**AOR**	**95% CI**
BCC					
Time	-1.6280	0.46	0.000	0.19	0.07-0.49**
Group	-0.5233	0.30	0.084	0.59	0.32- 1.07
Time*group	-2.5547	0.54	0.000	0.07	0.02 -0.22**
Child age	0.1634	0.03	0.000	1.17	1.09 -1.26
Sex (Ref. female)					
Male	0.2561	0.19	0.193	1.29	0.87- 1.90
Decision power on HH asset (Ref. Jointly [a])					
Father	0.7055	0.41	0.092	2.02	0.89 -4.60
Parents-in-law [b]	1.1326	0.42	0.007	3.10	1.35 -7.10*
Maternal education (Ref. Informal)					
Formal education	-1.2565	0.20	0.000	0.28	0.19-0.42*
Paternal education (Ref. In					

formal)					
Primary	-0.4188	0.20	0.046	0.65	0.43- 0.99*
Secondary & above	-0.7710	0.44	0.084	0.46	0.19 - 1.10
Food Insecurity (Ref. No)					
Yes	0.7613	0.20	0.000	2.14	1.42- 3.22**
Illness in 2 weeks (Ref. Yes)					
No	-0.2344	0.20	0.261	0.79	0.52- 1.19
Household size (Ref. 1-3)					
4-6	0.4208	0.22	0.063	1.52	0.97 -2.37
>6	1.1863	0.26	0.000	3.27	1.93 -5.53**
MAD [c] (Ref. No)					
Met DDS	-0.8122	0.23	0.001	0.44	0.28- 0.70*
Maternal Knowledge (Ref, Yes)					
No	2.4322	0.21	0.000	11.38	2.01-17.20**

**** p<0.01; ** p<0.05; [a] mothers and father; [b] a parent of one's husband or wife; [c] Minimum acceptable Diet*

5.4 Discussion

This cluster randomized controlled trial aimed to investigate the effect of BCC provided by trained WDA on CIAF among children's aged 6-23 months. Following a year of BCC implementation for the intervention group, the prevalence of the CIAF decreased by 18.5% in the intervention group while remaining unchanged in the control group over time. There have been no RCTs investigating the impact of BCC on the CIAF among children aged 6-23 months in the study area. However, a quasi-experimental study conducted in Ethiopia among preschool children reported similar findings (172).

The significant reduction in CIAF after intervention might have different points. Primarily, the prolonged duration of the intervention (12 months) might have provided time for mothers to translate their knowledge about complementary feeding into practice leading to improvements in child feeding practices thereby resulting in reduction in the overall undernutrition. Second explanation could be that our intervention program was conducted in the community through face-to-face communication, and home visits accompanied by demonstration of complementary food recipe preparation including THFP using locally available ingredients. This THFP has the potential advantages in improving absorption of nutrients by reducing phytate from cereal based foods and also enhances the nutritional value by increasing the viscosity of complementary foods (30, 173). This aspect may have contributed to the reduction of CIAF among children aged 6-23 months. Thirdly, a possible explanation for these promising outcomes of the current findings could be the involvement of

WDA in facilitating the transformation of participants' nutrition knowledge into action. For effective BCC, the way of the message disseminated is crucial. Evidence suggested that local individuals, especially women serving as agents of BCC and nutrition educators have been shown to have a significant impact on child feeding practice and child nutritional status(174).These individuals are familiar with their communities, living among them and sensitive to the contextual realities, thereby the community accepts them. Therefore, they imparted culturally appropriate messages to mothers which can lead to significant improvements in combating CIAF, and may have input in sustainability of the program (111).

To strengthen the above findings, our current study also found that the mother nutritional knowledge score is improved in the endline period with a net average difference by 1.65 in the intervention group compared to control groups over time. This finding is consistent with the studies in developing countries(83, 120). Addressing knowledge gaps through BCC is essential for ensuring adequate in amount, frequency, and variety of complementary feeding practices and improvement in child nutritional status (25). This might be due to the frequency of BCC sessions and duration may result in further retention of information and enhances awareness. The other explanation might be due to home-to-home visits and the WDA. As the WDA is the member of the community and has a friendly relationship with mothers, therefore, the mothers may easily receive the intervention from WDA during home-to-home visits and may contribute to improve mother's child feeding knowledge. Our finding suggests that after 12 months complementary feeding intervention, there is a significant improvement in the practice of MAD among children in the intervention group over time. This finding is consistent with the study conducted in southern Ethiopia(84), Ghana(83), India(175). The mother's complementary feeding knowledge and practice is closely linked with undernutrition (61,74). When the mother's knowledge improves through food-based intervention, the mothers may provide diversified, nutrient dense, and frequency of complementary foods for their children based on their child age from locally available foods. This practice enhances the MAD as it is the composite index of MDD and MMF. Therefore, BCC plays a crucial role in enhancing knowledge and improving feeding practices, which indirectly helps reduce the prevalence of CIAF.

To analyse the effect of intervention, the DID approach was used for WLZ, LAZ, and WAZ. The net average difference in weight and height showed a significant difference between the intervention and control groups over time, in the intervention group exceeding by 1.06 kg in weight and 1.71 cm in height. This disparity can be related to the 12-month food-based

intervention response. These findings are consistent with a randomized controlled experiment done in Northern and Karnataka India, and systematic review in developing countries(90, 175, 176).

The current study found that the net average difference in WLZ was increased by 0.763 in the intervention groups as compared to control groups over time. The results of an RCT study conducted among preschool children in Southern Ethiopia and a systematic review(90) revealed similar findings as the current study. However, in contrast to the current trial, a quasi-experimental study conducted in Ghana found no significant change between the intervention and comparison groups after 12 months of BCC on WLZ(83). The disparity could be the variation in study methodology, the study participant age ranging from 23 to 36 months, and the BCC contents.

The control group experienced a slight decline in the average LAZ, while the intervention group showed a notable decrease in the average LAZ at the endline. However, there was no significant difference observed in the net average LAZ score in the intervention groups compared to control group overtime, which is consistent with a previous study conducted in Ghana, Indonesia and systematic review (83, 85, 109). A systematic review conducted in low and middle-income countries (LMIC)(90) also showed an increase in the mean HAZ in the intervention groups. However, this review reported a significant difference between the intervention and endline points after 18 months of nutrition education, which contrasts with the present study where no significant effect on linear growth was observed. The variation in results could potentially be attributed to socioeconomic disparities and differences in study duration. The enhancement in linear growth might not manifest within one year of educational interventions. As it is known the linear growth faltering begins in the mother womb, complementary feeding BCC alone might not improve the linear growth. BCC focuses on 1000 days which begin during the pregnancy period to prevent the faltering linear growth (1, 96). Thus, the future researcher should focus on BCC which involve the pregnancy, breastfeeding and complementary feeding period to reduce stunting in Ethiopia.

The current study reported that there was an increase in the mean WAZ by 0.768 in the intervention group compared to the control group over time with a highly significant difference. This finding is in line with the studies in India and Bangladesh(177, 178).

After controlling for potential confounders, multivariable GEE analysis revealed that, the odds of being suffering in CIAF among children were 93.0% lower in the intervention group compared to the control group overtime. There has been limited RCT study on the effect of BCC on overall undernutrition (CIAF) among children aged 6-23 months to compare the findings. The findings of quasi-experimental study among preschool children in Southwest Ethiopia (55) revealed that the BCC has a considerable influence on CIAF. Our current findings confirm a significant effect of intervention within the intervention groups compared to control over time, attributing the 93.0% reduction of CIAF to the responses of intervention.

The current study found that as the child age increases their risk of CIAF increases due to the greater nutritional requirements(101, 179). Paternal formal and primary schooling appears to reduce the correlates with the CIAF, possibly by improving understanding on appropriate feeding and might increase the involvement of fathers in caring practice (101, 159). Children in food insecure areas are more vulnerable to CIAF due to insufficient and poor quality and quantity of complementary foods, as well as a low socioeconomic status within the household (35, 66).

The study identifies factors influencing CIAF among infant and young children, including family size and decision-making authority. At household level, children living in households with more than six family members are more likely to experience CIAF. This finding is in line with studies conducted in Ethiopia (172, 179). Moreover, when parents-in-law control household resources, children are three times more likely having CIAF compared to households where both parents share authority. This significant finding was consistent with similar studies conducted in Ethiopia and the Congo(70, 180). Poor maternal nutrition knowledge is strongly associated with CIAF, highlighting the importance of education in improving child nutrition which was consistent with the studies in developing countries in Ethiopia and Ghana(39, 83). Mothers with better knowledge may have practiced optimal feeding results in improved child growth and development (181). Additionally, those mothers who MAD standards significantly reduce the likelihood of CIAF Although evidence on this association is scarce, utilizing food-based interventions can potentially enhance child feeding practices and nutritional outcomes (172, 182).

This study has several strengths such as using cluster random control trials to reduce variability and maintain group homogeneity, making our findings more casual. We also utilized WDAs to deliver messages to mothers who share the same language, culture, and

living standards, offering child mothers a positive opportunity to receive key messages. Additionally, we employed the composite index MAD to assess child feeding practices.

Limitations

We gathered dietary information using the 24-hour recall method, which may lead to recall bias. In addition, data collection only took place at two time points(baseline and endline). If the data collection time were increased, further analysis could be conducted and the result might show the clear interventional effects.

Conclusion

This study shows that BCC through WDA contributes to reducing the prevalence of CIAF. Additionally, significant improvements in mothers' knowledge and practice of MAD were observed, potentially impacting CIAF rates. It is recommended that policymakers support the provision of long-term BCC to enhance the nutritional status of children. They should promote the participation of the WDAs in the implementation intervention to ensure the sustainability of OCFP. Additionally, to address determinants of undernutrition, we recommend that future researchers integrate BCC with nutrition-sensitive interventions.

CHAPTER 6: EFFECT OF BEHAVIOURAL CHANGE COMMUNICATION THROUGH WOMEN DEVELOPMENT ARMY ON OPTIMAL COMPLEMENTARY FEEDING PRACTICE AMONG CHILDREN AGED 6-23 MONTHS IN SOUTHWEST ETHIOPIA: A CLUSTER RANDOMIZED CONTROLLED TRIAL

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Abstract

The first two years of life are critical for ensuring appropriate growth and development through optimal feeding. Due to insufficient food intake and a lack of knowledge on the appropriate quantity, frequency, and diversity of complementary feeding, poor nutritional status in infant and young children is common in Ethiopia. Promoting optimal complementary feeding is a global health priority, but the impact of BCC on these practices in Ethiopia remains unclear, particularly due to the scarcity of cluster randomized controlled trials evaluating BCC's effectiveness among children aged 6 to 23 months in Southwest Ethiopia. Therefore, this study design to evaluate the effects of BCC using women developmental army on OCFP among children aged 6–23 months. To this end a CRCT was conducted in rural Kersa districts, Jimma Zone, Southwest Ethiopia, with 14 randomly selected villages and 440 mother-child pairs. 220 children in the intervention group received intervention through the WDAs for 12 months, while the control group received routine health education. Data were collected using structured questionnaires and 24-hour dietary recall at baseline and endline. The difference in socio-demographic status was assessed using the chi-square test, and the intervention's effect was evaluated using the difference-in-differences method. The Generalized estimating equation was used to examine the effect of BCC on OCFP between the groups over time and identify predictors. An intervention group showed a 28.4% (DID: 28.4%, 95% CI: 18.1 to 38.6) improvement in optimal complementary feeding practices compared to the control group ($p<0.001$). Factors associated with optimal complementary feeding practices included BCC (AOR=5.00, 95% CI: 1.78-14.05), maternal education (AOR=2.00, 95% CI: 1.33-3.01), not using traditional food processing methods (AOR=0.34, 95% CI: 0.21-0.54), and maternal knowledge (AOR=0.65, 95% CI: 0.43-0.99). BCC through the WDA significantly improved complementary feeding knowledge and practices. Policymakers should support long-term BCC interventions and adopt a multi-sectoral approach to address the factors influencing child feeding practices.

Keywords: Behavioral change Communication, Children aged 6-23 months, Cluster randomized controlled Trial, Optimal complementary feeding practice, Southwest Ethiopia

6.1 Introduction

The first two years of life provide a critical window of opportunity for ensuring children's appropriate growth and development through optimal feeding. The nutritional need for growth and development at 6 to 23 months is great than at any other time in life (170). However, infants and young children in developing countries face greater challenges in obtaining proper nutrition, particularly in Eastern and Southern Africa. Children aged 6-23 months often consume a poorly diversified diet that does not meet the recommendations set by the WHO (24, 99). Evidence suggests that the percentage of mothers practicing optimal complementary feeding ranges from 8.6% to 26.8% in Ethiopia. Moreover, there are variations in child feeding practices between urban and rural areas, as well as different agro-ecological production regions (41, 45, 80).

Ethiopia is one of the countries demonstrating that undernutrition is a critical public health issue, with a large proportion of under the age of five children suffering from 34.4% stunting, 21% underweight, and 6.8% wasting in the country(99).

Several studies have demonstrated that emphasis BCC on OCFP to enhance feeding practice during the critical window of under two children, which is a peak period for linear growth and development of children(86, 183).

BCC is a proven strategy for increasing the use of diverse and affordable foods in local diets by leveraging indigenous knowledge of traditional food processing techniques to combat undernutrition in developing countries. Improvements in infant and young child feeding practices and growth can be achieved by raising caregivers' awareness of childhood nutritional problems and enhancing their confidence and skills to act (82, 184). Therefore, BCC can effectively change nutritional knowledge and infant feeding practices through face-to-face interactions and group implementations, provided there is adequate time and follow-up(183, 185).

In developing countries like Ethiopia, children often transition from nutrient-rich breast milk to a household diet that lacks sufficient nutrients due to poor bioavailability. Factors such as high phytate levels that inhibit nutrient absorption and the high fibers content of bulky gruel and porridge further contribute to reduced nutritional benefits, ultimately impacting irreversible outcomes. Thus, THFP complementary diet formulations like: germination, roasting and pounding have great potential for improving nutrient bioavailability,

consistency, and palatability of complementary foods, thereby improving nutritional status among infants and young children (29, 30, 186, 187).

In Ethiopia, HEWs are responsible for raising awareness on various topics, and the time spent to cover infant and child feeding promotion in the house is limited. Thus, the government assigned a cadre of volunteers called the Women's Development Army (WDA) to focus more intensively on sparking local behaviour change in the household during home visits collaboration with HEWs(111, 113, 185, 188). So, the women's development armies are essential to delivering effective complementary feeding BCC to children's mothers.

The current study addresses the lack of CRCT evaluating the effectiveness of BCC on opt OCFP in Southwest Ethiopia and highlights the potential of using WDAs as effective messengers for promoting OCFP. In Ethiopia, there is a significant issue of poor nutritional status among infants and young children, even in areas with abundant resources, which can be attributed to a lack of awareness and knowledge regarding the appropriate amount, frequency, and variety of complementary feeding. Promoting optimal complementary feeding is a global health priority, and behaviour change interventions are seen as vital in achieving this goal. However, it remains unclear whether behaviour change communication has an impact on the OCFP of children in this age group in Ethiopia. Therefore, this study aims to assess the effect of BCC through WDA on OCFP among children aged 6-23 months in Jimma Zone, Ethiopia.

The primary objective of the intervention trial was to evaluate the effect of BCC intervention on OCFP by change in mean DDS, MMF and MAD. The secondary objectives were mother knowledge and practice of THFP technique. The trial hypothesised that BCC would improve OCFP, mothers' complementary knowledge and practice of THFP technique.

6.2 Materials and Method

Sample

A cluster randomized controlled trial was conducted among children aged 6-23 months in a rural community of Kersa districts from January 2021 to December 2022. The intervention aim was to assess the effect of BCC on OCFP over time in two groups with two measurements taken at baseline and endline. The study participants were randomly assigned to either the intervention or control group in allocation of 1:1 ratio, 220 mother child pairs for each group. WDAs delivered BCC to the intervention group, while the control group received

routine health education from HEWs. Baseline data collection took place from December 1, 2021, to December 15, 2021. The intervention began on December 2, 2021, and continued for 12 months until November 1, 2022 for mothers in the intervention group. After twelve months, the same questionnaires were administered for both the intervention and control groups by the same data collectors as part of the endline survey.

Measurement

Ten trained graduate nurses' data collectors and two nutritionist supervisors were participated in baseline and endline surveys to the intervention and control group. Based on the WHO guidelines, we used 24 hr. recall method to assess the outcome variable (OCFP)(24). The predictor variables including socio-demographic, socio-economic, mother knowledge, traditional household food technique, and history of morbidity measurement were collected (39, 45).

Data Management and Analysis

The data was entered to Epi Data manager version 4.0 and was exported to Stata MP Version 17.0 for analyses. Descriptive statistics was performed and the results were presented using proportion, figures and tables. A chi-square (X^2) test was employed for categorical variables to determine the association between socio-demographic variables and the outcome variables in both intervention and control groups at baseline and endline measurements. The difference-in-differences (DID) model was used to determine the effect of the intervention on child feeding practice, knowledge and food processing method over time. Generalized Estimating Equation (GEE), were usd to examine the effect of BCC on OCFP between intervention and control groups over time, and to identify predictors of OCFP. Those variables with a p-value< 0.25 in GEE univariable model, were selected for multivariable GEE. The intervention's effect was assessed through the interaction term "intervention*time". The GEE model also explores the relationship between OCFP and explanatory variables. We discussed details of participant recruitment, sample size determination and procedure, randomization, intervention allocation, intervention description, evaluation process and data collection procedures in chapter 2.

6.3 Results

Since we used the same sample size and population for chapters 5 and 6, the socio-demographic characteristics are similar. Therefore, you can refer to Table 5.1 in Chapter 5.

Comparisons of food group's distribution on practice of mothers on complementary food and preparation between control and intervention groups

Cereal was the most frequently consumed food by children, while meat was the least consumed in the study area. There was no difference among children in the consumption of cereal, other fruits and vegetables, eggs, legumes, and milk and milk products between the intervention and control groups at baseline. However, a highly significant difference was observed in the consumption of Vitamin A-containing fruits and vegetables, other fruits and vegetables, eggs, legumes, milk, and milk products (<0.0001) and cereal (<0.05) in the intervention group compared to the control group over time. Mothers who reported children's consumption of meat in the intervention group, increased from 7.84% at baseline to 15.2% at endline. In the control group, it changes from 9.0% at baseline to 9.5% at the end of the study. However, no significant difference was observed between the two groups over time (p=0.082) (Table 6.1).

Table 6.1 Comparisons of food group's distribution and complementary food preparation for children (6–23 months) between control and intervention groups, 2022

	Baseline (n=404)			Endline (n=404)		
Food group	CG	IG	*P*	CG	IG	*P*
Cereal	181(90.0)	193(94.61)	0.115	190(95.0)	203(99.51)	0.005*
Vitamin A FV	40(20.0)	62(30.39)	0.016	60(30.00	158(77.45)	0.000**
Other FV	22(11)	19(9.31)	0.575	58(29.00)	132(64.71)	0.000**
Meat	18(9.0)	16(7.84)	0.675	19(9.5)	31(15.20)	0.082
Eggs	50(25.0)	54(26.47)	0.735	60(30.00)	104(50.98)	0.000**
Legumes	119(59.5)	109(53.43)	0.219	125(62.5)	180(88.24)	0.000**
Milk	126(63.0)	117(57.35)	0.246	145(72.5)	93(45.59)	0.000**
Breast milk	193(96.5)	200(8.04)	0.42	191(95.5)	198(97.50)	0.407

***CG**: Control group; **IG**: Intervention group; **FV**: Fruits & vegetables; * and ** indicate for moderately or highly significant association from Chi-square*

Comparison of complementary foods preparation, feeding during illness and hand washing practice between intervention and control groups over time

Table 6.2 shows a summary of the trend of complementary foods preparation, feeding during illness and hand washing practice at baseline and endline survey between intervention and control groups. Concerning history of illness in the past two weeks prior to survey, the proportion of children who had illnesses was 36.75% in the intervention group and 43.0% in the control group at baseline (p=0.072). However, in the intervention group, the proportion of

children suffering from illness decreased from 36.75% to 27.94% compared to the control group (43.00% to 40.5%), showing a significant difference (P<0.05) over time (Table 6.2).

Table 6.2 Complementary foods preparation and feeding during illness in the past 2 weeks, 2022

	Baseline (n=404)			**Endline (n=404)**		
Variable	**CG**	**IG**	**P**	**CG**	**IG**	**P**
Practice of THFP						
Yes	12(6.0)	10(4.9)	0.38	24(12.0)	92(45.1)	<0.0001**
No	188(94.0)	194		176(88.0)	112(54.9)	
Type of THFP						
Germination	8(4.00)	3(1.47)	0.40	9(4.50)	27(13.24)	<0.0001**
Soaking	2(1.00)	4(1.96)		14(7.00)	17(8.33)	
Pounding	2(1.00)	2(1.00)		1(0.50)	6(2.94)	
Combining	0(0.00)	1(0.49)		0(0.00)	42(20.59)	
Consistency of CF [a]						
Thick	30(15.0)	38(18.63)	0.08	47(23.50)	139(68.1)	<0.0001**
Thin	168(84.0)	157(76.96)		151(75.5)	58(28.43)	
Others	2(1.0)	9(4.41)		2(1.0)	7(3.43)	
Illness 2 weeks						
Yes	76(38.0)	75(36.8)	0.79	81(40.5)	57(27.94)	<0.005*
No	124(57.0)	129(63.2)		119(59.5)	147(72.06)	
Feeding during illness (N=151)						
As usual	61(79.2)	53(71.62)	0.52	53(65.43)	22(38.6)	<0.005*
Extra meal	15(19.5)	19(25.7)		28(34.57)	33(57.9)	
Others	1(1.1)	2(2.70)		0(0.00)	2(3.51)	
Hand washing practice						
Yes	192(96.0)	193(94.6)	0.50	195(97.5)	198(97.06)	0.785
No	8(4.0)	11(5.4)		5(2.50)	6(2.94)	
Hand washing						
Before preparation	14(7.29)	15(7.77)	0.24	13(6.7)	16(8.08)	<0.0001*
Before feeding	50(26.04)	51(26.42)		26(13.31)	52(26.26)	
Both	41(21.35)	58(30.05)		9(4.61)	82(41.42)	
After toilet	87(45.32)	69(35.76)		147(75.38)	48(24.24)	

***CG**: Control group; **IG**: Intervention group; **THFP**: Traditional Household food processing; **CF**: Cereal based Complementary food; others: mixed with other food items**;** * and ** indicate for moderately or highly significant association from Chi-square*

Effect of BCC on practice of traditional house food processing technique among mothers of children between interventions a control group overtime

Regarding the practice of mothers in preparing complementary foods using the THFP technique, it was found that 6% in the control group and 4.9% in the intervention group followed this practice at baseline. There was no significant difference between the two groups (DID -1.1, $P = 0.745$). After implementing food-based BCC the intervention group showed a highly significant difference, with a net effect of 34.2% on THFP practice (DID 34.2%, $P < 0.001$) (Figure 6.1).

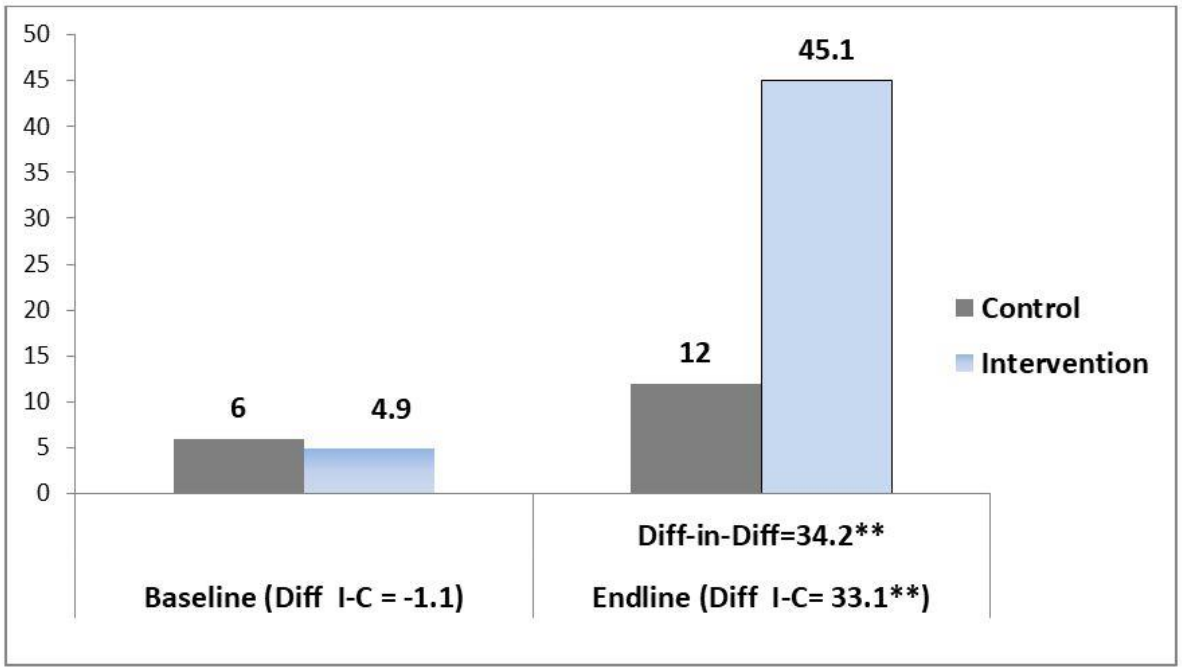


Figure 6.1 Comparison of traditional household food processing technique intervention and control groups over time by DID estimator, 2022

Diff I-C: *Difference between intervention and control;* ***Diff-in-Diff:*** *difference between intervention and control overtime*

Effect of the BCC on Child Feeding Practice and knowledge among child mothers by DID Estimator

Following the implementation of BCC, the intervention group showed improvement in feeding practice compared to the control group. The proportion of MDDS increased by 45.4% (DID 45.4%, $P<0.001$), MMF increased by 13.6% (DID 13.6%, $P<0.0001$), and MAD increased by 48.5% (DID 48.5%, $P<0.0001$) in the intervention group. These differences were highly significant at the endline point. Out of the 12 nutrition-related knowledge questionnaires, the percentage of correct knowledge responses from mothers in the

intervention group improved from 31.4% to 59.3%, while in the control group, the proportion increased from 35.5% to 47.5%. There was a significant 15.9% difference in the proportion of correct knowledge responses between the intervention and control groups (DID 15.9%, *P*<0.001) (Table 6.3).

Table 6.3 Effect of BCC on the proportion of complementary feeding indicators and mother knowledge by DID Estimator, 2022

Variables	**Baseline(n=404)**			**Endline(n=404)**			**Difference-in-Difference**
	CG	**IG**	**Diff (I-C)[c]**	**CG**	**IG**	**Diff (I-C)**	
OCFP	11.5	9.3	-2.2	14.5	40.7	26.2***	28.4***
MDDS	20.5	18.1	-2.4	32.0	75.0	43.0***	45.4***
MMF	59.5	63.7	-4.2	68.0	85.8	17.8***	13.6**
MAD	15.5	12.7	-2.8	18.5	64.2	45.7***	48.5***
Initiation CF	68.5	65.2	-3.3	68.0	65.2	-2.8	0.05*
Knowledge	35.5	31.4	-4.1	47.5	59.3	11.8**	15.9**

***CG**: Control group; **IG**: Intervention group; **Diff**: Difference between Intervention and Control; **OCFP**: Optimal Complementary Feeding Practice; **MDD**: Minimum Dietary Diversity; **MMF**: Minimum Meal Frequency; MAD: Minimum Acceptable Diet; **CF**; Complementary Feeding; * and ** indicate for moderately or highly significant coefficients*

Effect of BCC intervention on mean optimal complementary feeding practice among mothers of children aged 6-23 months in Southwest Ethiopia

In the intervention group, the average difference in OCFP between groups did not show significant variation at baseline. However, the mean of OCFP increased from 1.59 to 2.91 whereas in the control group, there was only a minimal improvement from 1.64 to 1.89. The net effect in OCFP in the intervention groups improved by 1.064 with a highly significant difference over time (DID 1.064, *P*<0.0001) (Figure 6. 2).

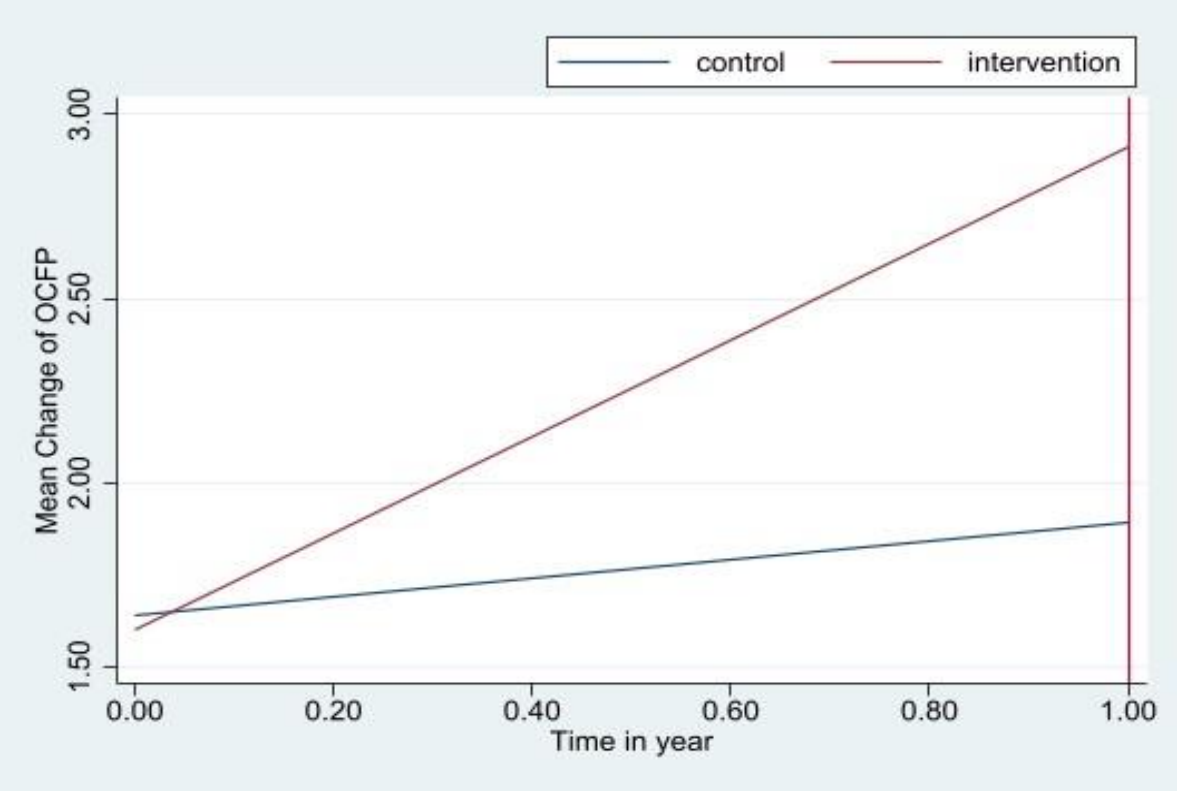


Figure 6.2 the mean change of OCFP over time using the Difference-in-Differences estimator, 2022

Generalized estimating equation model on optimal child feeding practice (OCFP) among children aged 6-23 months in Kersa district, Southwest Ethiopia, 2022

In a multivariable GEE analysis, the intervention (BCC), mother's educational status, THFP, and mother's nutrition knowledge were identified as independent predictors of optimal child feeding practices. After adjusting for potential confounders, the study showed that child mothers who received BCC in the intervention group were five times (AOR = 5.00; 95% CI: (1.78-14.05) more likely to follow the recommended OCFP compared to mothers in the control group who did not receive. Additionally, child mothers with a formal education were twice as likely to provide optimal complementary food for their children compared to mothers who did not attend school (AOR=2.00; 95% CI: 1.33-3.00). Furthermore, mothers who did not use the THFP method to prepare complementary foods were 65.4% less likely to provide optimal complementary food for their children compared to mothers who did use THFP (AOR = 0.34; 95% CI: 0.21-0.54). Child mothers who had poor nutrition knowledge were 35.1% less likely to feed their children based on the recommended optimal complementary food (AOR = 0.64; 95% CI: 0.42-0.98) compared to mothers who had good knowledge (Table 6.4).

Table 6.4 Generalized estimating equation model on optimal child feeding practice (OCFP) among children aged 6-23 months in Kersa district, Southwest Ethiopia, 2022 (N=808)

Optimal child feeding practice	Coefficient	SE.	AOR	*P-value*	95% CI
BCC (Ref. Control *Baseline)					
Time (Endline)	-0.1609	0.3425	0.85	0.638	0.43 - 1.66
Group (Intervention)	0.4251	0.4779	1.52	0.374	0.59 - 3.90
Time*group	1.6102	0.5269	5.00	0.002*	1.78- 14.05
Child age(in months)	-0.0297	0.0365	0.97	0.416	0.90 - 1.04
Consistency (Ref. Thick)					
Thin	0.1179	0.2435	1.12	0.628	0.69 - 1.81
Others	-1.3877	1.0728	0.24	0.196	0.03 - 2.04
Mother education (Ref. Informal)					
Formal	0.6945	0.2078	2.00	0.001*	1.33- 3.00
Practice of THFP (Ref. Yes)					
No	-1.0590	0.2347	0.34	0.001**	0.21 - 0.54
Illness 2weeks (Ref. Yes)					
no	0.2746	0.2282	1.31	0.229	0.84 - 2.05
Family size (Ref. 1-3)					
4-6	-0.1940	0.2278	0.82	0.395	0.52 - 1.28
> 6	-0.2385	0.2607	0.78	0.360	0.47 - 1.31
Knowledge (Ref. Good knowledge)					
Poor knowledge	-0.4316	0.2130	0.64	0.04 *	0.42 - 0.98

AOR: Adjusted Odds ratio**; BCC:** *Behavioural change communication;* ***Ref:*** *reference group;* **THFP:** *Traditional Household food processing;* * and ** indicate for moderately or highly significant coefficients

6.4 Discussion

The complementary feeding period, from 6 to 23 months of age, is recognized as one of the most challenging stages in meeting children's nutrient demands (5). Thus, BCC is a primary approach aimed at improving optimal child feeding practices (UNICEF, 2020). Our study shows that WDAs delivering BCC for 12 months effectively changed mothers' knowledge and optimal complementary feeding practices.

The proportions of OCFP increased from 9.3% to 40.7%, whereas in the control group, there was only a minimal improvement from 11.5% to 14.5%. The difference in the net effect of the percentage point of OCFP was 28.4% (DID) in the intervention group at the end of the survey. The percentage of mothers who had good knowledge on optimal complementary feeding practice was increased in the intervention compared to the control group. A significant difference was observed in the net effect of percentage point on good knowledge

by 15.9% in the intervention group overtime. In agreement with the current study, a study in India showed that giving nutrition education through home visits improved mothers' knowledge(189). Similar findings were observed in studies conducted in Indonesia and Bangladesh (34, 85), where BCC programs lasting one year resulted in improved knowledge and complementary feeding practices among mother-child pairs. However, our study, which lasted for 12 months, differed from a previous study conducted in Hawassa (120), which provided BCC for only four months and still showed improvement in child feeding practices. This discrepancy could be attributed to variations in study area and design compared to our own study. The fact that urban mothers, who have better access to information, experienced changes in knowledge within a shorter duration (four months) of the BCC implementation might have contributed to these differences. The effectiveness of the intervention in our study might be due to our twelve-month intervention consisting of five sessions which involved home-to-home visits and BCC delivered by WDAs through one-to-five connections with mothers/caregivers. This approach provided ample opportunities and time for interactions and education, resulting in enhanced knowledge and practice (111).

According to this study, it was found that the percentage point of DDS, MMF, and MAD were notably higher among mothers in the intervention group compared to the control group. This finding aligns with similar studies conducted in Kenya and Ethiopia, where nutrition education interventions effectively improved DDS among infants and young children (84, 109, 112). Additionally, a recent study in India indicates that employing BCC through Self-Help Groups (SHG) in the community can enhance mothers' knowledge of dietary diversity and their practices(190), which is similar to the current study approach that WDAs deliver BCC to mothers in the community . Furthermore, our findings regarding MMF and MAD align with a study conducted in Ethiopia and Ghana (83, 167).

Our study showed no significant difference in consumption of food variety between the two groups at baseline. After receiving BCC, more children in the intervention group consumed a diversified food compared to the control group. This increase included cereal, legumes, nuts, vitamin A-rich fruits and vegetables, other fruits and vegetables, eggs, and milk products, which agree with findings from a similar study conducted in Bangladesh, Uganda and Ethiopia (84, 183, 191). However, despite the change in mothers' knowledge, there was no significant difference in meat consumption between the intervention and control groups over time in the current study. In contrast to our study, a cluster randomized control trial in China reported that consumption of all food groups increased in the intervention group than the

control group after 12 months of behavioral education (192). The Chinese study differs from the current study in meat consumption, might be due to the difference in the study period and socio-economic status to the current study. This could be attributed to the limited availability of meat in the household and the high cost in the market in the current study area, suggesting the need for alternative approaches like poultry breeding to enhance meat consumption for children. Because, increasing the consumption of animal source foods in a diversified diet is expected to have a positive impact on children's nutritional status and provide essential micronutrients.

In the current study, one of the components of BCC was promotion of THFP technique for preparing cereal-based complementary food. During the baseline survey, it was observed that only a few mothers/caretakers practiced THFP, and there were no significant differences between the intervention and control groups. However, after implementing the intervention, there was a net percentage point difference was 34.2% of practicing THFP in the intervention group overtime. This finding aligns with the results obtained from a randomized controlled trial conducted in Sidama zone, Uganda and in systematic review (84, 184, 187).

After adjusting for potential confounders, a GEE multivariable analysis revealed that mothers/caregivers in intervention groups who had received nutrition education in the last 12 months were five times more likely to practice OCFP compared to mothers/caregivers who had not received education in the control group. Our findings are similar with those reported in an interventional trial conducted in developing countries in Bangladesh, western Gojam and Hawassa(34, 89, 120). The current study suggests that the longer period of community-based BCC through WDA, with home visits as a central component, can promote OCFP among mothers/caregivers of young children. However, the effectiveness of WDAs may be affected by a lack of motivation, including incentives and non-financial support. Therefore, addressing the motivation issues of WDAs is crucial for maintaining the sustainability of improvements in OCFP and child nutritional status(56, 193).

The study revealed a significant association between OCFP and the educational status of mothers. The finding agrees with previous research conducted in Western Ethiopia, Indonesia, Ghana, and Pakistan (37, 40, 42, 43). Educated mothers have a higher likelihood of employment opportunities or running their businesses, which allows them to exert control over resources and make decisions regarding household assets. Consequently, this leads to positive changes in how they feed and care for their children. Another possible explanation is

that educational interventions on complementary feeding catalyse altering the feeding behaviour of educated mothers.

Mothers or caregivers who did not used traditional house food processing techniques less likely to practice optimal complementary feeding compared to those who did, as supported by a studies in Malawi and Ethiopia(27, 84). A laboratory-based evidences from Ethiopia showed that all complementary foods samples predominantly given to children lacked essential nutrients and also, they showed that the germinated and roasted cereal and legumes flour have better in nutrients contents than of non-germinated and non-roasted flour (29, 194). Thus, THFP technique is important to improve the quality of complementary foods and the quantity of diversified complementary foods from different items to complement each other.

The current study showed that the mother /caretakers with limited knowledge on complementary feeding practices were 35% less likely to practice OCFP. This finding aligns with research conducted in North Shewa, Bensa district in Ethiopia, Bangladesh and in somewhere systematic review (41, 49, 181, 183). This discrepancy could be attributed to the year-long intervention implementation, consisting of five sessions and home visits through WDAs, which effectively changed mother's behaviour in the current study.

Strength and Limitations

The study used Cluster random control trials to reduce variability and maintain group homogeneity. The WDAs to deliver BCC messages to mothers who share the same culture, language and living standards offers mothers' positive opportunity to receive messages. The current study provided BCC for twelve months duration. Furthermore, our study used a composite index of OCFP to assess child feeding practice. We also want to acknowledge the limitations of our study. The dietary information was collected using the 24-hour recall method, which may introduce recall bias even though the data collectors used probes and visual aids. Furthermore, data collection occurred only at baseline and endline, at two time points. Increasing the frequency of data collection would allow for more in-depth analysis to be conducted. Therefore, we recommend that future researchers conducting BCC interventions incorporate repeated measurements beyond just baseline and endline, and consider analysing the data using various statistical models.

Conclusion

In the current study, it was found that the proportion of mothers practicing OCFP increased significantly through the implementation of BCC in the intervention group over time. The introduction of BCC brought notable changes in the percentage point of MDDS, MMF, MAD, and mothers/caretakers' knowledge. It was identified that mothers/caretakers with formal education, practicing THFP, and possessing maternal knowledge were predictors of OCFP. The provision of BCC through WDAs over a twelve-month period proved successful in enhancing complementary child feeding practices, maternal knowledge, and promoting THFP techniques. Regarding policy implications, the study highlights the effectiveness ofintervention in achieving optimum complementary feeding practices facilitated by WDAs. We suggest that the effectiveness of WDAs may be influenced by a lack of motivation, including incentives and non-financial support. Therefore, addressing motivation issues among WDAs is crucial for sustaining improvements in OCFP and the nutritional status of children during the critical window period.

CHAPTER 7: GENERAL DISCUSSION, FUTURE RESEARCH PERSPECTIVES

7.1 Introduction

This is a PhD dissertation on the effects of BCC on child feeding practices, knowledge, and undernutrition in children aged 6-23 months, and the findings are summarized.

Adequate nutrients intake during the early stages of life are crucial for growth and development. To ensure this, complementary foods should be introduced at six months, and should be provided in adequate amounts and quality. Undernutrition affects not only individuals but also families, communities, and entire countries by hindering economic development. Today, undernutrition remains an important public health issue globally, as well as in SSA, including Ethiopia (18, 99). Although some countries have made strides towards achieving SDGs related to nutrition, others remain significantly off-track (16).

Ethiopia has implemented various nutritional programs, policies, strategies, and guidelines over the past decades (93, 94, 98). Despite these efforts, children continue to suffer from suboptimal complementary feeding and undernutrition. Studies in Ethiopia have shown a strong association between poor maternal knowledge of complementary feeding suboptimal feeding practices and undernutrition (39, 41, 151).

Alarmingly, the consequences of undernutrition, such as permanent functional deficits, are challenging to reverse after the first two years of life. The complementary foods in developing countries often lack adequate quality and quantity, further exacerbating the risks associated with undernutrition. For instance, complementary foods in Ethiopia are often thin cereal-based porridges and gruels with low nutritional and calorie density. This suboptimal practice poses a significant threat to the survival of children across Africa (75, 84, 120). Both food availability and maternal knowledge and feeding practices influence the variety and the frequency of complementary feeding. Therefore, improving mothers' knowledge and practices on complementary feeding is essential to reduce the prevalence and devastating effects of undernutrition among children (1).

As a result, numerous studies have highlighted the need for educational interventions to improve child feeding practices in the Ethiopia (106, 107, 140). These recommendations are based on findings that reveal the prevalence of undernutrition and various contributing factors related to child feeding practices in the country. However, these factors vary significantly across the country due to different methodological approaches. Researchers' attention has been on assessing undernutrition using conventional methods such as measuring wasting,

underweight, and stunting separately. Additionally, many studies in Ethiopia predominantly focus on urban areas, with fewer addressing rural contexts and even fewer considering the impact of agro-ecological variations across different zones. Though some research has evaluated the influence of BCC on OCFP in children between the ages of 6 and 23 months, a CRCT looking at BCC's effect on the CIAF in Ethiopia is notably absent. These studies vary in methodology, the age of study participants, duration, and methods of delivering BCC. These limitations could potentially lead to discrepancies in decision-making for interventions by policymakers.

Considering these limitations, this PhD research evaluated the trends and prevalence of OCFP across different agro-ecological zones, evaluate the magnitude and predictors of overall undernutrition using the CIAF, and determine the effect of complementary feeding BCC on knowledge, OCFP, and CIAF between the ages of 6 to23 months.

Very few CRCTs assessed the impact of BCC on the OCFP for children, and none take into account the CIAF in southwest Ethiopian children between the ages of 6 to 23 months. Despite the significance of the child age (6-23 months old) for growth of children, most randomized controlled trials had focused on the child feeding practice and undernutrition among under five and preschool children (55, 109).

Additionally, there are no studies that use the CIAF index to determine undernutrition in children aged 6-23 months in study area and region. Some research also emphasizes the significance of using WDAs as effective messengers for promoting OCFP (89, 188).

7.2 Summary of the main finding

The main result of this PhD dissertation includes a baseline survey for a CRCT (Chapter 4), a cluster-randomized controlled trial on CIAF and OCFP (Chapters 5 and 6), and a cross-sectional study carried out in different agro-ecological areas (Chapter 3).

Chapter 3 discussed the rate and predictors of OCFP across three different agro-ecological areas. The findings demonstrated that children in the studied area, especially those in the midland districts did not get OCFP in accordance to with the recommendation. Additionally, mothers in these regions have low knowledge about complementary feeding. In Ethiopia, the staple food is "Injera " made from cereals and grains (29). Those farmers residing in the midland agro-ecological area often rely on farming cereals and legumes and mostly they used for preparation of "Injera ", which limits their ability to grow a diverse range of foods.

Consequently, children from the midland have a reduced chance of consuming a variety of foods. Since variety of foods is the main component of OCFP, children in the midland may not meet the recommended OCFP.

Furthermore, mothers with primary education, good knowledge of complementary feeding, and families with fewer than five members were identified as positive predictors for OCFP. This suggests that poor maternal knowledge about complementary feeding may contribute to the low OCFP observed in the study area. Additionally, agro-ecological variations may also contribute to the low OCFP in the midland region. Therefore, the results indicate that BCC interventions and the promotion of diversified food production through a multisectoral approach are needed to address the current problem (Chapter 3). As shown in Chapters 5 and 6, food-based BCC interventions on complementary feeding were provided to mothers of children in the midland areas. As discussed in Chapter 4, Ethiopia is among the SSA countries with a high prevalence of wasted, being underweight, and stunted.

Despite undernutrition being a widespread public health problem, there is a scarcity of studies that assess undernutrition through one aggregate measure. Therefore, this PhD research assessed undernutrition using CIAF from baseline data of cluster randomized controlled trials. The results of this research reported that an increased frequency of CIAF, similar to studies in local and developing countries (104, 154, 155, 158, 195). This research identified that male children, comorbidities, and food insecurity were a positive predictor of anthropometric failure. Conversely, mothers who had completed their elementary and secondary educations acted as a protection against CIAF.

This assessment can be used to develop targeted interventions to address undernutrition (Chapter 4). As part of the intervention, complementary feeding BCC was implemented for mothers by trained community health volunteers, known as the WDA, over twelve months. The findings from CRCT revealed a reduction in the proportion of CIAF among children in the intervention group over time.

The results agree with another research carried out in Ethiopia among preschool children (55). The result also revealed that when children become older, the chance of having CIAF increases. Furthermore, factors such as decision-making power held by parents, food insecurity, and larger family sizes (greater than six) were identified as positive predictors for CIAF. However, parental education at the primary school or above was identified as a protective factor against undernutrition (Chapter 5).

Chapter 6 showed the effect of BCC on OCFP, and the practice improved significantly over time in the intervention group, while there was no difference in mean OCFP in the control groups over time. We couldn't find adequate research that focused on educational interventions for OCFP (composite index) in order to contrast and compare our findings. However, there were studies on BCC and individual indices such as DDS, MMF, or MAD. Our findings also showed a notable improvement in maternal knowledge and an increase in the proportion of mothers who practiced THFP among those who received BCC for a year. This aligns with results from RCT, and systematic reviews conducted in Sidama Zone, Uganda, Indonesia, and Bangladesh (34, 84, 85, 187)(Chapter 6).

Our study found that OCFP was poor in the research area, consistent with findings from the 2019 EDHS survey data in Ethiopia (45). While various predictors were identified, agro-ecological areas and maternal knowledge significantly contributed to OCFP. Additionally, the study showed variations in OCFP prevalence across different agro-ecological zones.

The study revealed that more than half study participants were affected by undernutrition. It identified that MAD, comorbidities, and food insecurity significantly increased the likelihood of children experiencing CIAF. The improper practice of complementary foods is a major factor to undernutrition, as inadequate dietary diversity and frequency of meal fails to meet children's nutritional needs. When households face food insecurity, mothers are often unable to provide balanced and nutritious foods, exacerbating undernutrition. Additionally, illness is a predictor of undernutrition, as it generates a vicious loop of inadequate nutrient intake and poor health (2).

The findings highlight the necessity of complementary feeding BCC to improve maternal knowledge and practices. By enhancing the diversity of complementary foods, we can improve optimal child feeding practices and reduce undernutrition among children aged 6-12 months. The interventional study showed a fourfold improvement in OCFP after mothers received 12 months of complementary feeding BCC. Moreover, the average net effect of the intervention on the prevalence of CIAF reduced by 18.5% after the intervention.

Overall, these results emphasize the importance of targeted interventions to improve complementary feeding practices, addressing food insecurity and illness, and ultimately reducing undernutrition in young children (108, 164).

Overall finding

- OCFP among children aged 6 to 23 months of children is low.
- There is variation in OCFP among agro-ecological area, being particularly lower in the midland area compared to the highland area.
- Factors negatively associated with OCFP included living in midland and lowland districts. In contrast, good maternal knowledge, mothers with a primary education level, and a family size of three members in the household were positively associated with OCFP.
- More than half of children aged 6-23 months are experiencing anthropometric failure.
- Being boy, having a mother with higher education, not consuming the standard MAD, having a larger family size, comorbidities, and living in a food-insecure household were factors that predicted anthropometric failure.
- The food-based BCC intervention significantly reduced the proportion of anthropometric failure in infant and young children over time in the intervention groups.
- The average weight and height of the children in the treatment group showed a statistically significant improvement over time.
- Mothers had a significant improvement in average knowledge scores in comparison to the control group over time after receiving BCC
- The net effect of the intervention on OCFP in the intervention groups improved with a highly significant difference over time.
- The rate of mothers practicing THFP techniques in the preparation of cereal-based complementary food increased in those mothers who received BCC.
- Based on the GEE model, factors associated with OCFP were children in the intervention group at endline, maternal formal education, not using traditional household food processing techniques, and poor maternal knowledge .

7.3 Implication of the findings

7.3.1 Implication of the findings on child feeding practices

If children in the critical first window period do not receive the recommended complementary foods, it hinders their capacity to grow and their intellectual ability throughout the life. Despite WHO developing several indicators to assess OCFP(24), many studies in Ethiopia have assessed OCFP using only one or two indicators, such as the most common DDS and MMF(84, 116, 118-120). As previously discussed in depth in chapter 3,

this study offers valuable insights for researchers and policymakers on the prevalence and predictors of OCFP using a single index that combines four indicators.

The results of this research have significant implications for understanding OCFP among children aged 6-23 months among agro-ecological rural districts. This research provides new insights into the prevalence and variation of OCFP, to address the extent and factors that determined OCFP in these areas. Particularly, it found low OCFP in midland areas, which was similar to 2019 EDHS survey data in Ethiopia (45). Additionally, mothers' knowledge, agro-ecological areas, maternal education, and family size were identified as predictors of OCFP. Nearly half of mothers lacked enough understanding about the practice of child feeding, a finding consistent with studies conducted in Ghana and Ethiopia (32, 52, 106). Poor maternal knowledge about feeding practices has been recognized as a significant predictor of suboptimal child feeding practices. Mothers often do not use available resources due to insufficient knowledge about optimal feeding behaviors and practices regarding complementary feeding (19, 61, 74).

This suggests the need to promote diversified agricultural production and consider different agro-ecological zones to minimize dependency on a single crop for production and consumption. The highland farmers, who cultivate a different type of vegetables and fruits along with cereals and tubers, may help children to have a higher likelihood of consuming five or greater food groups in comparison to those in lowland, cereal-dependent areas.

This finding underscores the importance of promoting diversified agricultural production and taking agro-ecological differences into account to reduce reliance on a single crop. By encouraging varied crop cultivation, we can improve children's nutrition and overall health outcomes in different zones.

7.3.2 Implication of the findings on undernutrition (CIAF)

The study findings provide important insights into the CIAF. By examining the prevalence and determinants of CIAF in Kersa district, it highlights the association between anthropometric failure and poor practices of MAD, larger family sizes, illness, and food insecurity. Conversely, there was a negative association between CIAF and maternal education at the primary level or above. This result is in agreement with other studies conducted in underdeveloped nations (53, 104, 158), suggesting that better educational status significantly decreases the possibility of children experiencing CIAF.

Insufficient complementary feeding in terms of variety, frequency, and quality may result in undernutrition among children, particularly in the context of food insecurity, where mothers are unable to provide balanced and nutritious foods. This association is supported by studies in developing countries (63, 64). Additionally, illness is a predictor of undernutrition, setting a vicious cycle of inadequate nutrient intake and poor health. The early childhood and infancy period are a critical window for maintaining normal growth and development, requiring OCFP to meet nutrient needs. However, in our current study, the aforementioned factors significantly influenced children's nutrient needs during this critical period, affecting their rapid growth and development.

The CIAF is a comprehensive measure that considers stunting, being underweight and wasting indicators. This study's findings can be used to create focused interventions that alleviate undernutrition. Our findings support the use of CIAF as a useful method for determining undernutrition in children between the ages of 6-23 months. These implications may assist the NNP and policymakers in achieving our country's NNP aims and SDG by 2030.

As stated in Global Nutrition Report, Ethiopia has made achievements towards global objectives, which may be monitored using indicators like wasting, stunting, and practices of child feeding. Ethiopia is also carrying out a number of initiatives, such as the NNP and, EFBG to combat undernutrition (93, 94, 98). However, the country still faces numerous underlying causes related to childhood malnutrition. Therefore, interventions that provide BCC to mothers and caregivers on the timely introduction, adequate quality (variety), frequency, and preparation of complementary feeding, along with improved hygienic and caring practices, can be crucial. By improving maternal knowledge, these interventions may effectively tackle undernutrition among children aged 6-23 months.

Overall, these results highlight the necessity of focused interventional approaches to improve maternal knowledge, diversify agricultural production, and address the specific challenges among agro-ecological zones to enhance OCFP and reduce undernutrition among young children. Furthermore, the current study result has significant implications for understanding and applying the effects of BCC on complementary feeding practices, knowledge, and undernutrition between children aged 6-23 months in the Jimma zone, Ethiopia.

The findings of this study indicate that BCC effectively improves maternal knowledge, child feeding practices, and anthropometric failure. The finding also implies that the provision of

BCC through WDAs over a twelve-month period proved successful in enhancing maternal knowledge, improving OCFP, and reducing overall undernutrition. Mothers are considered important targets for behavioral change programs, which can enhance feeding practice by promoting behavioral change, such as improved food quality(variety), frequency, better food preparation skills and inclusion of local available foods along improved hygienic and caring practice, may effectively tackle undernutrition among children aged 6-23 months (82, 85, 87).

This improvement has significant implications for reducing national healthcare expenses. Therefore, promoting optimal child feeding practices is a crucial measure to decrease the prevalence of undernutrition (CIAF). Consequently, reducing undernutrition lowers family healthcare costs and results in more productive adults during adulthood, further boosting the country's GDP.

The finding highlight that the BCC delivered through the WDA contributed to enhancing complementary feeding knowledge, reducing the prevalence of CIAF, and improving OCFP. Therefore, the provision of BCC through WDAs over a twelve-month period proved successful in enhancing maternal knowledge, improving OCFP, and reducing overall undernutrition. This research provides valuable insights for policymakers. By understanding the variation in agro-ecological areas on OCFP and the high burden of the CIAF, National Nutrition Programs, and policies can promote diversified agricultural production, including homesteading and THFP techniques. For example, THFP techniques can reduce the bioavailability of nutrients, especially in cereal-based complementary foods like porridge and gruel (30, 84, 120). Furthermore, these techniques are vital for enhancing the nutrient content and nutritional value of complementary food by increasing the viscosity of porridge and gruel, thereby contributing to the reduction of undernutrition in the individual child, families and country as a whole.

7.3.3 Implications of the findings on Policy and Program planning

Even though there are initiatives like NNP, NNS, FBG, MCN and child feeding guidelines, the current findings showed that only 9.4% of children aged 6-23 months receive optimal complementary feeding among three agro-ecological areas. There is also variation in OCFP across agro-ecological area, being particularly lower (4.4%) in the midland area compared to the highland area. Furthermore, 5.7% of mothers prepared cereal-based complementary foods using traditional household food processing techniques (THHFP). Only 42.7% of mothers had good knowledge on optimal complementary feeding practice. More than half (57%) of

children were affected by CIAF. By using these findings to inform policy makers, planner and stakeholders can create more targeted, effective, and sustainable interventions to improve complementary feeding practices and reduce undernutrition.

Furthermore, the finding showed that only 9.4% of children aged between 6-23 months receive optimal complementary feeding provide a clear, quantifiable measure of the current state of child nutrition in Southwest Ethiopia. This evidence implies that the need for integrated and enhanced programs and policies aimed at enhancing complementary feeding practice. Furthermore, the variation in the prevalence of OCFP across different agro-ecological areas, particularly the low rate of 4.4% in midland areas, emphasizes the need for agro-ecological-specific interventions. Policymakers can use this information to allocate resources more effectively and design effective strategies that address the unique challenges of each region. Therefore, the findings of this study direct policymakers toward promoting diversified food production instead of relying on one or two crops, providing a clear direction for agricultural policy adjustments

Besides, the findings showed that only 5.7% of mothers use THFP, which indicates a significant area for improvement. Policymakers may develop programs that promote these techniques; ensuring mothers are educated on enhancing the nutritional value of complementary foods. While there was an existing initiative on THFP in Ethiopia, a lack of THFP knowledge among child mothers persists. This drives the need to strengthen existing policies by fostering BCC and ensuring consistent follow-up for effective implementation.

In addition, with 42.7% of mothers having good knowledge of complementary feeding practices, there is still a significant portion that lacks adequate knowledge. This finding can drive policies focused on increasing awareness and education among mothers, ensuring they have the information needed to practice optimal complementary feeding.

Furthermore, the effectiveness of BCC provided by the WDA in enhancing complementary feeding practices demonstrates the significance of locally based approaches. Thus, policymakers can support and expand the role of the WDA, ensuring they have the resources and training needed to continue their impactful work.

The finding showed more than half (57%) of children are affected by CIAF. This suggests that a majority of infants and young children are susceptible to the immediate and long-term effects of undernutrition. This finding aligns with research conducted in Ethiopia, which

examined secondary data from the EDHS, children under five had a prevalence of CIAF ranging from 46.2 % to 53.5 % (36, 53, 104, 105). These effects extend into later adulthood, posing a significant public health problem in the country. The damage affects the national GDP as well as household budgets. This finding emphasizes the urgent need for focused nutritional interventions in this age range Therefore, more attention is needed from researchers, nutrition policymakers, and planners to reduce the overall prevalence and address its predictors among children aged 6-23 months.

CIAF was used in this study to measure undernutrition as it encompasses all types of anthropometric failure. This approach is more sensitive and inclusive, providing a more accurate estimate of undernutrition prevalence. It identifies children experiencing any combination of wasting, underweight and wasting, offering a holistic measure that highlights the overlaps. This comprehensive view is invaluable for understanding the full burden of undernutrition and also save resource by addressing one index rather three. Although CIAF is more complex to interpret, it is far more useful for comprehensive policy-making and intervention planning (8, 12).

However, most previous studies assess undernutrition using conventional indices, and policymakers and planners also base their nutritional interventions on these indices: underweight stunting, and wasting as they are simpler to target specific issues. However, conventional indices might not fully capture the true prevalence of undernutrition because they often miss children who suffer from multiple forms simultaneously. Each index addresses a specific aspect of undernutrition, leading to fragmented data where overlaps are not explicitly shown. Moreover, conventional indices provide information on predictors separately for each of the three indices, leading policymakers to design interventions separately for each, unlike CIAF, which offers inclusive and holistic predictors. Therefore, it is better to strengthen the existing policy by integrating conventional and the CIAF indices for assessing undernutrition. By using both indices together, policy planners can develop more effective, and inclusive and efficient strategies to reduce overall undernutrition.

By making this modification and strengthening targeted approaches, Ethiopia can better address the complex nature of undernutrition, ultimately enhancing the health and well-being of children, particularly those in the critical age window of infant and young child.

7.4 Perspective for future child feeding practice and nutritional status In Ethiopia

What is the problem?

Globally, one in three individuals is impacted by a single or multiple types of malnutrition. Women and children are particularly at risk due to increased nutrient needs required to support child growth. Nutritional deficiencies during the initial period of two years hindered development and growth leading to poor school performance, reduced productivity, and led to a lower income in later life (19, 170).

Despite notable advancements over two decades, Ethiopia still has a high rate of undernutrition. In Ethiopia, children frequently begin complementary feedings early before six or beyond six months, consume less than the recommended five food groups and frequency of meals than recommended. Therefore, achieving optimal complementary feeding is crucial for meeting the global nutrition targets set for 2025 and the SDG to reduce undernutrition among children.

What is missing?

This dissertation finding provided valuable information on the extent of anthropometric failure and OCFP in the study area. The current researches were assessed the implications of BCC on undernutrition and child feeding practice and knowledge in children between the ages of 6-23 months. In addition to the limitations mentioned in each chapter, there are a few more to consider.

Seasonal Variations: This study did not consider seasonal variations while assessed the variation of agro-ecological on OCFP (Chapter 3). Complementary feeding practice can significantly vary with seasonal changes; the absence of this data might lead to an incomplete understanding of mothers on child feeding practice. Future studies should ensure data collection throughout different seasons to capture a more comprehensive picture of dietary intake.

Frequency of Data Collection: Data was only collected at two time points: baseline and endline. This limited frequency restricts the ability to use further analysis over time. More in-depth analysis would be feasible if the data were collected at three or more different time periods.

Expanding the Research from conception to child second birthday: our BCC intervention targets undernutrition among children aged 6-23 months. However, starting at the day of

conception till the second day of a child's birth is globally recognized as a critical window for future health and productivity. By extending the study to include the time during pregnancy and child's initial two years, researchers can build upon the current study's findings and gain a more comprehensive understanding of the intervention's impact on long-term child health outcomes.

What is the way forward?

Multisectoral Approach: A multisectoral approach is necessary to address the factors associated with OCFP and CIAF. Integrate complementary feeding BCC with the different sectors to enhance optimal feeding practices.

Enhance collaboration of agricultural sectors: to promote diversified agricultural production including homesteading and diversified food in contextual basis in different agro ecological areas. This condition also supports the mother's financial resources.

Addressing food Insecurity: Ethiopia continues to experience significant poverty and food insecurity despite economic progress. Household food insecurity compromises children's dietary intake, and leading to undernutrition. Strengthen linkages between agricultural sectors and nutritional stakeholders in rural areas needed to enhance household food security.

Family planning promotion: Promote family planning services to reduce family size in the long term, thereby improving maternal and child nutrition outcomes.

Enhancing women developmental Armies: Ethiopia's HEWs have made changes in the health of mothers and children's well-being. However, there are challenges in rural areas, such as large catchment areas, hindering efforts of HEWs to improve maternal nutrition knowledge (111). Therefore, strengthen the role of WDA members is needed to enhance child feeding practices and combat undernutrition.

In conclusion, adopting a multisectoral approach, integrating BCC with education, promoting family planning, addressing food insecurity, and empowering local health workers are critical steps toward improving child nutrition and reducing undernutrition in Ethiopia. These efforts not only address immediate nutritional needs but also contribute to long-term health and development outcomes for Ethiopian children and families.

7.5 Methodological consideration

In addition to the limitations mentioned in each chapter, there are a few more to consider. This dissertation evaluated the impact of BCC on mothers' awareness and practice of complementary feeding, as well as CIAF in children between the ages of 6-23 months. This dissertation finding provided valuable information on the burden of anthropometric failure and OCFP in the study area. Despite the data collectors' use of probes and visual aids, the 24-hour dietary recall technique was used to gather the dietary information, which may create recall bias. Mothers might forget or misreport their children's dietary intake. Additionally, only the baseline and endline time points were used for data collection. Due to the nature of the BBC intervention, this study did not perform blinding of data collectors, supervisors, and WDAs. In this study, BCC was provided to mothers through WDAs within the group that received intervention, leading to improvements in OCFP, increased maternal knowledge, and a reduction in the prevalence of overall undernutrition among children in the study area. However, the sustainability of these findings in the study area remains questionable, particularly concerning the role of messengers.

7.6 Conclusion

In conclusion, there was low prevalence (9.4%) and a notable variation in OCFP over three distinct agro-ecological districts, with higher rates observed in lowland areas compared to highland areas. The findings revealed that more than half (57.3%) of children between the age of 6-23 months experienced anthropometric failure. After 12 months intervention, maternal knowledge, OCFP, and CIAF in the intervention group had significantly improved. Overall, these results emphasize agro-ecological variation in feeding practice, the importance of targeted interventions to improve complementary feeding practices, addressing food insecurity and illness, and ultimately reducing undernutrition in young children (108, 164).

7.7 Recommendations and Further Research Perspectives

7.7.1 Recommendations for policy actions

This evaluation will help to improve future intervention strategies. A dedicated effort from all sectors and policy makers is needed to increase attention to considerably reduce undernutrition among children aged 6-23 months, as it is a problem of widespread public concern. Implementing these recommendations will contribute to enhancing child feeding practice, reducing undernutrition, and improving overall nutritional outcomes in Ethiopia.

Therefore, in light of our findings, we forwarded the following recommendations:

For policy actions

- Integrate research findings with policy strategies to address the predictors effectively and accelerate the reduction of anthropometric failure among children.
- Integrate education, family health, enhance paternal education, promote family planning services, and improve hygiene practices.
- Strengthening collaboration of agricultural sectors is essential. Policy makers should foster collaboration among agricultural sectors to promote diversified agricultural production, including homesteading and diverse food options tailored to different agro ecological areas.
- Support the provision of long-term BCC interventions as a routine in the health sectors and wider to community level, and maintain its sustainability.
- Promote the involvement of WDA members as messengers to enhance mother's child feeding knowledge and practice. This approach ensures a sustained flow of information and enhances mothers' and caretakers' knowledge about optimal child-feeding practices.
- Address motivation issues among WDAs by providing incentives and non-financial support. This approach aims to sustain improvements in OCFP and the children's nutritional status during the critical window period.
- Develop strategies to evaluate the effectiveness and sustainability of educational interventions based on contextual factors.

7.7.2 Recommendations for future researchers

Future researchers

By addressing the following research priorities, future studies can contribute valuable insights into improving child nutrition status and guiding effective policy interventions in Ethiopia and beyond.

- Further research is needed to explore the association between seasonal variation and child feeding practices. Understanding how seasonal changes impact on feeding behaviours can inform targeted interventions to improve child nutrition.
- Researchers are encouraged to use the CIAF to accurately assess children's nutritional status in future studies and policy-making decisions. Using CAF's single, unified index of full nutritional status evaluation, decision-makers may reduce the rate of undernutrition more effectively than assessed separately, the three indices of wasting

underweight and stunting. This efficient method simplifies the identification of overall predictors, making it easier to implement effective interventions.

- Future studies should prioritize investigating the impact of BCC interventions during the critical "1000 days" period from pregnancy to a child's second birthday-on child nutritional status. This period is crucial for establishing the framework for lifelong development, growth and health of children.

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9. Annex

9.1 Curriculum Vitae

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Work experiences

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Conferences attended

April 2017 Systematic review and Meta-analysis by NORHED funded SACCAD from Oslo University and Jimma university.
Jan 2017 Longitudinal data Analysis using R software by UNISA, south Africa and Jimma University, jimma
Nov 2015 research ethics Part I & II organized by NORHED funded SACCAD from Oslo university and Jimma university.
Nov 2015 Effective teaching skills by Jhpiego with save children, Hawassa, Ethiopia.
Apr 2015 Technical update course on dietetics by Jhpiego with save children, Hawassa, Ethiopia.
Aug 2014 Technical update course on nutrition Operational research by Jhpiego / USAID/ENGINE, Adama, Ethiopia.
July 2014 Skill Lab Management by Jhpiego with save children, Hawassa, Ethiopia
DEC 2013 Instructional design workshop organized by Jhpiego with save children Ethiopia, Bahir Dar. Ethiopia.
Aug 2010 Technical update course in EPI organized by WHO with Ministry of health .

Research Conducted

1. **Gebretsadik, M.T**., Sisay, A.L., Tamiru, D. and Belachew, T., 2024. *Anthropometric failure and associated factors among children aged 6–23 months in Ethiopia.* Food Science & Nutrition, 12(3), pp.1581-1591.
2. **Gebretsadik, M.T**., Adugna, D.T., Aliyu, A.D. and Belachew, T., 2023. *Optimal complementary feeding practices of children aged 6–23 months in three agro-ecological rural districts of Jimma zones of southwest Ethiopia.* Journal of Nutritional Science, 12, p.e40.
3. Worku, B.T., Abdulahi, M., Tsega, M., Edilu, B., Ali, R., Habte, M.B., Awel, S., Getnet, M., Melaku, Y., Kidane, R. and Taye, A., **Tamrat, M** 2023. *Complication experience during pregnancy and place of delivery among pregnant women: a cross-sectional study.* BMC Pregnancy and Childbirth, 23(1), p.161.
4. Abebe, T., Mezgebu, G.S., Feleke, F.W. and **Tamrat, M**., 2023. *Dietary diversity and associated factors among adolescent girls in Nifas Silk Laphto sub city, Addis Ababa, Ethiopia, 2021*. BMC nutrition, 9(1), p.39.
5. Kera, A.M., Zewdie, A., Akafu, W., Kidane, R. and **Tamirat, M**., 2023. *Formula feeding and associated factors among mothers with infants 0–6 months old in Mettu Town, Southwest Ethiopia. Food Science & Nutrition*, *11*(7), pp.4136-4145.
6. Wondie, S.G., Zinab, B., Gizaw, G. and **Tamrat, M**., 2022. *Time to recovery and its predictors among children aged 6–59 months with severe acute malnutrition admitted to outpatient therapeutic program in Southwest Ethiopia: retrospective cohort study*. *BMC pediatrics*, *22*(1), p.157.
7. Kotiso, G.B., Abame, D.E., Belachew, T., **Tamrat, M**. and Mekango, D.E., 2020. *Disparities in antenatal care service utilization among food secure and food insecure women in Gombora District, Hadiya zone, south Ethiopia. Pan African Medical Journal*, *37*(1).
8. Tesema, D., **Tamirat, M**. and Tadele, A., 2020. *Sexual behaviors and its association with life skills among school adolescents of Mettu town, South West Ethiopia: A school-based cross-sectional study*. *SAGE Open Medicine*, *8*, p.2050312120940545.
9. Chaimiso, A.N., Lodebo, T.M., **Gebretsadik, M.T**. and Sadore, A.A., 2017. *Compliance to National infant and young child feeding recommendation and associated factor among mothers of children 6-23 months-of-age in Gombora District, Southern Ethiopia: community based cross sectional study*. *Int J Clin Experiment Med Sci*, *3*(1), p.5.
10. Laelago, T., Belachew, T. and Tamrat, M., 2017. *Effect of intimate partner violence on birth outcomes. African health sciences*, *17*(3), pp.681-689.
11. Gali, N., Tamiru, D. and **Tamrat, M**., 2017. *The emerging nutritional problems of school adolescents: overweight/obesity and associated factors in Jimma town, Ethiopia.* Journal of pediatric nursing, 35, pp.98-104
12. Tamiru, D. and **Tamrat, M**., 2015. *Constraints to the optimal breastfeeding practices of breastfeeding mothers in the rural communities of Arba Minch Zuria Woreda, Ethiopia: a community-based, cross-sectional study*. South African Journal of Clinical Nutrition, 28(3), pp.134-139.
13. Laelago, T., Belachew, T. and **Tamrat, M**., 2014. *Prevalence and associated factors of intimate partner violence during pregnancy among recently delivered women in*

public health facilities of Hossana town, Hadiya zone, southern Ethiopia. Open Access Libr J, 1(07), p.1.

Conference Presentation

Meseret Tamrat, Tefera Belachew, Tafesse Bosha. *Effect of Nutrition Education on Nutritional Status of Adolescents in Kersa Woreda School, Jimma, South West Ethiopia.* presented at the Annual Research Conference, of food and nutrition society of Ethiopia, February,2014(Oral presentation).

Gebretsadik, M.T., Sisay, A.L., Tamiru, D. and Belachew, T., 2024. *Anthropometric failure and associated factors among children aged 6–23 months in Ethiopia*. Presented on (Oral presentation).

Personal skills and competences

Self assessment of Amharic and English

English	Listening	Reading	Speaking	Writing
Amharic	Excellent	Excellent	Excellent	Excellent

STATEMENT

I certify that the above statement is correct to the best of my knowledge.

Name; - Meseret Tamrat Date: 24.04.2024

REFERENCE

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Tel : + (251) 0912373397 ; E-Mail: dessalegn97@gmail.com

9.2 Questionaries'

English version for cross-sectional study

PART I Socio demographic status of child and mother		
Socio demographic	Response	
Kebele ----------HHno. __ __		
Child characterstics		
1. Age of baby___	---------- months	
2. Sex of baby	1. Male 2. Female	
3. Place of delivery	Home ---------- Institutional Delivery----------	
4. Birth order		
Family characterstics		
5. Mother age	_____years	
6. Religion	1. Muslim 2. Orthodox 3. Protestan 4. Catholic 5. Other(specify	
7. Ethnicity	1. Oromo 2. Amhara 3. Dawero 4. Keffa 5. Other(specify	
8. Marital status	1. Single 2. Married 3. Widowed 4. Separated	
9. Educational level of mother?	1. Unable to write, read 2. Write, read 3. Primary (1-8) 4. Secondary(9-12) 5. College and above	
10. Educational level of father?	1. Unable to write, read 2. Write, read 3. Primary (1-8) 4. Secondary(9-12) 5. College and above	

11. Mother occupation level?	1. House wife 2. Farmer 3. Gov't employee 4. Private 5. Merchant 6. Daily laboror 7. Others	
12. Father occupation l level?	1. Farmer 2. Gov't employee 3. Private 4. Merchant 5. Daily laboror 6. Others	
13. Household size	----------	
14. Who usually decides on family income that is used for home expense?	1. Husband/Partner 2. Wife/mother 3. Any other (specify	
15. Has fathers role in feeding practice of baby	1. Yes 2. No	
16. If Yes Q.15 , How?		
17. If No Q 15 , why?		
18. How is food obtained in the family?	1. Farming 2. Buying 3. Food aid/donation 4. Any other	
Child morbidity in the last two weeks		
19. Has the child been sick in the past 2 weeks?	1. Yes 2. No	
20. If yes, which one? *(possible more than one response)*	1. Diarrhoea 2. Vomiting 3. Malaria 4. Cough 5. Intestinal parasites 6. Measles 7. Others	
21. How do you feed your baby during sickness	1. As usual 2. Additional extra meal 3. Others	
22. At what occasions do you wash your hands? (Multiple answers possible)	1. After defecation 2. After handling child/adult feces or cleaning child's bottom 3. After cleaning the environment 4. Before preparing food	

	5. Before feeding child	
PART II. Child feeding practice		
23. Did you ever breastfeed	1. Yes 2. No	
24. If No, why?	No milk Did not want to breast feed Traditional beliefs Other (Specify	
25. Are you still breastfeeding	1. Yes 2. No	
26. If No how old was the child when you stopped breastfeeding	At ----------month	
27. At what month start complementary diet	1. At birth 2. _____ months .	
28. How many times the child ate	_____times	
29. What kind of food you gave for children while starting complementary diet	1. Porridge 2. Gruel 3. Familly food 4. Others, specify	
30. How is it its consistency	1. Thick 2. Thin 3. Others 4. Not started	
31. Why?------		
32. What is the ingredients you used for preparation of complemntary foods	1. Grains 2. Legumes 3. Fruits 4. Vegetable 5. Milk and milk products 6. Meat 7. Oils and Fat	
33. If Grains or/and Legumes for Q 32, How do you prepared to make gruels and porridge?	_____	
34. Do you use local HHprocess of germination ,soaking and pounding of cereals and legumes while preparing complementary food	1. Yes 2. No	
35. If, yes ? Which one?	1. Germination 2. Soaking 3. Pounding 4. Roasting 5. Combined of either	

	6. Others	
36. Where did you get information about this method?	1. Mothers in Law 2. Neighbours 3. Health workers 4. Massmedia (TV,Radio)	
37. If Yes Q 34 ,Why do you choice this method ?	----------	
38. If Yes Q 34 , how Prepared it ?	----------	
39. What is its advantage of using such kind of methods ?	----------	
40. If No Q.34 ,Why?	----------	
PART III Knoweldge Question		
41. Do you know about malnutrition	1. Yes 2. No	
42. Do you know the importance of CF	1. Yes 2. No	
43. Do you know at what age should babies start eating foods ?	----------months	
44. Do you know which type of food start as CF	1. Yes 2. No	
45. Do you know the right consisitencey of CF?	1. Yes 2. No	
46. Do you know how many times the child should ate	1. Yes 2. No	
47. Do yo know the advantage of diversified food ?	1. Yes 2. No	
48. Does bottle feeding have benefit for baby?	1. Yes 2. No	
49. Do you know the need of extra meal during and after child illness	1. Yes 2. No	
50. Do you know how to improve the good complementary food ?	1. Yes 2. No	
51. Do you know the local HH traditional food processing method ?	1. Yes 2. No	
52. Do you know the five critical point for hand washing	1. Yes 2. NO	

English version for baseline and endline survey for interventional study

PART I Socio demographic status of child and mother		
Socio demographic	Response	
District..... Kebele --------- HHno. __ __		
Child characterstics		
1. 1. Age of baby___	---------- months	
2. Sex of baby	1. Male 2. Female	
3. Place of delivery	Home ---------- Institutional Delivery----------	
4. Birth order		
Family characterstics		
5. Mother age	_____years	
6. Religion	1. Muslim 2. Orthodox 3. Protestan 4. Catholic 5. Other(specify	
7. Ethnicity	1. Oromo 2. Amhara 3. Dawero 4. Keffa 5. Other(specify	
8. Marital status	1. Single 2. Married 3. Widowed 4. Separated	
9. Educational level of mother?	1. Unable to write, read 2. Write, read 3. Primary (1-8) 4. Secondary(9-12) 5. College and above	
10. Educational level of father?	1. Unable to write, read 2. Write, read 3. Primary (1-8) 4. Secondary(9-12) 5. College and above	
11. Mother occupation level?	1. House wife	

	2. Farmer 3. Gov't employee 4. Private 5. Merchant 6. Daily laboror 7. Others	
12. Father occupation l level?	1. Farmer 2. Gov't employee 3. Private 4. Merchant 5. Daily laboror 6. Others	
13. Household size	----------	
14. Who usually decides on family income that is used for home expense?	1. Husband/Partner 2. Wife/mother 3. Any other (specify	
15. Has fathers role in feeding practice of baby	1. Yes 2. No	
16. If Yes Q.15 , How?		
17. If No Q 15 , why?		
18. How is food obtained in the family?	1. Farming 2. Buying 3. Food aid/donation 4. Any other	
Child morbidity in the last two weeks		
19. Has the child been sick in the past 2 weeks?	1. Yes 2. No	
20. If yes, which one? *(possible more than one response)*	1. Diarrhoea 2. Vomiting 3. Malaria 4. Cough 5. Intestinal parasites 6. Measles 7. Others	
21. How do you feed your baby during sickness	1. As usual 2. Additional extra meal 3. Others	
22. At what occasions do you wash your hands? (Multiple answers possible)	1. After defecation 2. After handling child/adult feces or cleaning child's bottom 3. After cleaning the environment 4. Before preparing food 5. Before feeding child	

PART II. Child feeding practice		
23. Did you ever breastfeed	1. Yes 2. No	
24. If No, why?	1. No milk 2. Did not want to breast feed 3. Traditional beliefs 4. Other (Specify	
25. Are you still breastfeeding	1. Yes 2. No	
26. If No how old was the child when you stopped breastfeeding	At ----------month	
27. At what month start complementary diet	1. At birth 2. _____ months .	
28. How many times the child ate	_____times	
29. What kind of food you gave for children while starting complementary diet	1. Porridge 2. Gruel 3. Familly food 4. Others, specify	
30. How is it its consistency	1. Thick 2. Thin 3. Others 4. Not started	
31. Why?------		
32. What is the ingredients you used for preparation of complemntary foods	1. Grains 2. Legumes 3. Fruits 4. Vegetable 5. Milk and milk products 6. Meat 7. Oils and Fat	
33. If Grains or/and Legumes for Q 32, How do you prepared to make gruels and porridge?	_____	
34. Do you use local HHprocess of germination ,soaking and pounding of cereals and legumes while preparing complementary food	1. Yes 2. No	
35. If, yes ? Which one?	1. Germination 2. Soaking 3. Pounding 4. Roasting 5. Combined of either	
36. Where did you get information about this	1. Mothers in Law	

method?	2. Neighbours 3. Health workers 4. Massmedia (TV,Radio)	
37. If Yes Q 34 ,Why do you choice this method ?	----------	
38. If Yes Q 34 , how Prepared it ?	----------	
39. What is its advantage of using such kind of methods ?	----------	
40. If No Q.34 ,Why?	----------	
PART III Knoweldge Question		
41. Do you know about malnutrition	1. Yes 2. No	
42. Do you know the importance of CF	1. Yes 2. No	
43. Do you know at what age should babies start eating foods ?	----------months	
44. Do you know which type of food start as CF	1. Yes 2. No	
45. Do you know the right consisitencey of CF?	1. Yes 2. No	
46. Do you know how many times the child should ate	1. Yes 2. No	
47. Do yo know the advantage of diversified food ?	1. Yes 2. No	
48. Does bottle feeding have benefit for baby?	1. Yes 2. No	
49. Do you know the need of extra meal during and after child illness	1. Yes 2. No	
50. Do you know how to improve the good complementary food ?	1. Yes 2. No	
51. Do you know the local HH traditional food processing method ?	1. Yes 2. No	
52. Do you know the five critical point for hand washing	1. Yes 2. NO	

Part IV: Household Food Insecurity Access Scale (HFIAS) questionnaires		
No.		Response
1	In the past four weeks, did you worry that your household would not have enough food?	0 = No (skip to Q2) 1=Yes
1.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks)

		2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)
2.	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	0 = No (skip to Q3) 1=Yes
2.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)
3.	In the past four weeks, didyou or any household member have to eat a limited variety of foods due to a lack of resources?	0 = No (skip to Q4) 1 = Yes
3.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)
4.	In the past four weeks, didyou or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food	0 = No (skip to Q5) 1 = Yes
4.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)
5.	In the past four weeks, didyou or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0 = No (skip to Q6) 1 = Yes
5.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)

6.	In the past four weeks, didyou or any other household member have to eat fewer meals in a day because there was not enough food?	0 = No (skip to Q7) 1 = Yes
6.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)
7.	In the past four weeks, wasthere ever no food to eat of any kind in your household because of lack of resources to get food?	0 = No (skip to Q8)1 = Yes
7.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)
8.	In the past four weeks, didyou or any household member go to sleep at night hungry because there was not enough food?	0 = No (skip to Q9) 1 = Yes
8.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)
9.	In the past four weeks, didyou or any household member go a whole day and night without eating anything because there was not enough food?	0 = No (questionnaire is finished) 1 = Yes
9.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)

Part V: Household Characteristics for Wealth Index		
No.	Variable	Response
1.	Does your household have Electricitty	1. Yes 2. No

2.	Does your Household have electric mitad	1. Yes 2. No
3.	Does your household have functional Television	1. Yes 2. No
4.	Does your household have stove	1. Yes 2. No
5.	Does your household have watch oclock	1. Yes 2. No
6.	Does your household have refigrator	1. Yes 2. No
7.	Does your household have radio	1. Yes 2. No
8.	Does your household have non mobile phone	1. Yes 2. No
9.	Does your household have table	1. Yes 2. No
10.	Does your household have chair	1. Yes 2. No
11.	Does your household have bed with cotton sponge/ spring	1. Yes 2. No
12.	Does your household have a kerosene lamp	1. Yes 2. No
13.	Do you have a separate room which is used as a kitchen?	1. Yes 2. No
14.	Does any member of this household own mobile phone	1. Yes 2. No
15.	Does any member of this household own bicycle	1. Yes 2. No
16.	Does any member of this household own motorcycle	1. Yes 2. No
17.	Does any member of this household own animal drawn cart	1. Yes 2. No
18.	Does any member of this household have a bank account or microfinance savings account?	1. Yes 2. No
19.	Does any member of this household own any agricultural land?	1. Yes 2. No
20.	Do you have toilet facility	1. Yes 2. No
21.	Does this household own oxen	1. Yes 2. No
22.	Does this household own cows	1. Yes 2. No
23.	Does this household own horse/mules	1. Yes

		2. No
24.	Does this household own goat /and sheep	1. Yes 2. No
25.	Does this household own chicken	1. Yes 2. No
26.	Does this household own donkey	1. Yes 2. No

Part VI: Twenty four hour's dietary intake of 6-23 months of children

ID_____ Food eaten/drunk eaten(probe for more	
Food eaten/drunk eaten(probe for more)	Portion size consumed
1.	
2.	
3.	

PART VI. NUTRITIONAL STATUS
Anthropometric survey data form

kebele: _____ Date: _____

Children Identification number ----------

child ser.no.	Name (optional)	Sex (f/m)	Age in Year and month	Weight (kg) ±100g	Height (cm) ±0.1cm	Edma (y/n)	% W/H	Remarks

Gaaffiilee': Oromiffa versionii qorannoo qaxxaamuraaf

KUTAA I Haala hawaas demoogiraafii daa'imaa fi haadha		
Deebii hawaas-dimoogiraafii		
Kebele ----------HHno		
Amala daa'imaa		
1. Umurii daa'ima	ji'oota	
2. Saala daa'imaa 1.	1. Dhiira 2. Dubartii	
3. Bakka itti geejjibsiifamu	1. Mana ---------- 2. Dhaabbata fayyaa----------	
4. Tartiiba dhalootaa	----------	
Amala maatii		
5. Umuriin haadha _____	_____waggaa	
6. Amantii	1. Muslima 2. Ortodoksi 3. Pirootestaantii 4. Kaatoliki 5. Kan biraa(ibsi	
7. Saba	1. Oromo 2. Amaaraa 3. Daaweroo 4. Keffaa 5. Kan biraa(ibsi	
8. Haala gaa'elaa	1. Qophaa'e 2. Fuudhaa fi heeruma 3. Dubartii abbaan manaa irraa du'e 4. Addaan bahuu	
9. Sadarkaa barnootaa haadha?	1. Barreessuu, dubbisuu dadhabuu 2. Barreessuu, dubbisuu 3. Sadarkaa tokkoffaa (1-8) 4. Sadarkaa Lammaffaa(9-12) 5. Kolleejjii fi isaa ol	
10. Sadarkaa barnoota abbaa?	1. Barreessuu, dubbisuu dadhabuu 2. Barreessuu, dubbisuu 3. Sadarkaa tokkoffaa (1-8) 4. Sadarkaa Lammaffaa(9-12) 5. Kolleejjii fi isaa ol	

11. Sadarkaa hojii haadha?	1. Haadha manaa manaa 2. Qonnaan bulaa 3. Hojjetaa Mootummaa 4. Kan dhuunfaa 5. Daldalaa 6. Hojjetaa guyyaa guyyaa 7. Kanneen biroo	
12. Sadarkaa Sadarkaa hojii abbaa?	1. Qonnaan bulaa Farmer 2. Hojjetaa Mootummaa 3. Kan dhuunfaa 4. Merchent Daldalaa 5. Hojjetaa guyyaa guyyaa 6. Kanneen biroo	
13. Baay'ina manaa	----------	
14. Yeroo baay'ee galii maatii baasii manaaf oolu eenyutu murteessa?	1. Abbaa manaa/Hiriyaa 2. Haadha manaa/haadha 3. Kan biraa kamiyyuu (ibsi)	
15. Shaakala nyaachisuu daa'imaa keessatti gahee abbootii qaba	1. Eeyyee 2. Lakki	
16. Yoo Eeyyee G.15, Akkamitti?		
17. Yoo Lakki G 15, maaliif?		
18. Nyaanni maatii keessatti kan argamu akkamitti?	1. Qonna 2. Bituu 3. Gargaarsa nyaataa/arjooma 4. Kan biraa kamiyyu	
Dhukkubbii daa'immanii torban lamaan darban keessatti		
19. Torban 2 darban keessa daa'imni dhukkubsatee jiraa?	1. Eeyyee 2. Lakki	
20. Yoo eeyyee ta'e isa kam? (deebii tokkoo ol ta'uu danda'a)	1. Garaa kaasaa 2. Dhukkuba garaachaa 3. Dhukkuba busaa tingne 4. Qufaa 5. Paraasitii garaachaa 6. Dhukkuba busaa 7. Kanneen biroo	
21. Yeroo dhukkuba daa'ima kee akkamitti nyaachifta	1. Akkuma barame 2. Nyaata dabalataa dabalataa 3. Kanneen biroo	
22. Yeroo akkamii harka dhiqattu? (Deebiin dachaa ta'uu danda'a)	1. Erga fincaan baafatanii booda 2. Manca'aa daa'imaa/ga'eessotaa erga	

	qabannee booda ykn jala daa'imaa erga qulqulleessinee booda 3. Naannoo erga qulqulleessinee booda 4. Nyaata qopheessuu dura 5. Daa'ima nyaachisuun dura	
KUTAA II. Shaakala nyaata daa'immanii		
23. Harma hoosistee beektaa	1. Eeyyee 2. Lakki	
24. Lakki yoo ta'e maaliif?	1. Annan hin qabu 2. Harma hoosisuu 3. Hibarbaanne Amantaa aadaa 4. Kan biroo (Ibsi Other (Specify)	
25. Ammallee harma hoosisaa jirtaa	1. Eeyyee 2. Lakki	
26. Yoo Lakki yeroo ati harma hoosisuu dhiiftu daa'imni umriin isaa meeqa ture	Ji'a ---------- tti	
27. Ji'a kamitti nyaata dabalataa jalqabuu	1. Yeroo dhalatan 2. _____ ji'oota	
28. Mucaan yeroo meeqa yeroo _____	_____ nyaate	
29. Nyaata akkamii daa'immaniif yeroo nyaata dabalataa eegaltan kennitan.	1. Daakuu 2. Muki 3. Nyaata maatii 4. Kanneen biroo, ibsi	
30. Akkamitti walsimannaa isaa	1. Fulbaana 2. Haphi 3. Kanneen biroo 4. Hin jalqabne	
31. Maaliif?	------ .	
32. Wantoonni nyaata dabalataa qopheessuuf itti fayyadamtan maali	1. Midhaan 2. Baala mukaa 3. Fuduraalee 4. Kuduraa fi muduraa 5. Aannanii fi oomishaalee aannani 6. Foon 7. Zayitii fi Cooma	
33. Yoo Midhaan yookiin/fi Midhaan Q 32, Gruels fi daabboo hojjechuuf akkamitti	_____	

qophooftan?		
34. Nyaata dabalataa yeroo qopheessitu adeemsa biqiluu ,midhaanii fi baala jiidhuu fi dha'uu HH naannoo fayyadamtaa	1. Eeyyee 2. Lakki	
35. Yoo, eeyyee? Kam?	1. Biqiluu 2. Jiidhina 3. Dha'uu 4. Bishaan bilcheessuu 5. Lamaan keessaa tokko 6. Kanneen biroo	
36. Waa'ee mala kanaa odeeffannoo eessaa argatte? 1.	1. Haadholii Haadholii 2. Ollaa 3. Hojjetoota fayyaa 4. Massmedia (TV,Raadiyoo	
37. Yoo Eeyyee G 34 ,Maaliif mala kana filatta ?	----------	
38. Yoo Eeyyee G 34 , akkamitti Qopheesse ?	----------	
39. Faayidaan mala akkanaa fayyadamuu maali ??	----------	
40. Yoo Lakki G.34 ,Maaliif?	----------	
KUTAA III Gaaffii Beekumsaa		
41. Waa'ee hanqina nyaataa beektaa?	1. Eeyyee 2. Lakki	
42. Barbaachisummaa CF ni beektaa?	1. Eeyyee 2. Lakki	
43. Daa'imman umrii meeqatti nyaata nyaachuu jalqabuu akka qaban beektu ?	1. ----------months	
44. Gosti nyaataa kam akka CF	1. Eeyyee 2. Lakki	
45. Consisitencey sirrii CF beektaa? 1. 2.	1. Eeyyee 2. Lakki	
46. Mucaan yeroo meeqa nyaachuu akka qabu beektaa	1. Eeyyee 2. Lakki	
47. Faayidaa nyaata adda addaa beektaa ? 3. 4.	1. Eeyyee 2. Lakki	
48. Nyaachisuun qaruuraa daa'imaaf faayidaa qabaa? 1. 2.	1. Eeyyee 2. Lakki	
49. Yeroo dhukkuba daa'immanii fi booda nyaata dabalataa barbaachisuu ni beektaa	1. Eeyyee 2. Lakki	
50. Nyaata dabalataa gaarii akkamitti akka fooyyessuu beektaa ?	1. Eeyyee 2. Lakki	

51. Mala aadaa nyaata qopheessuu HH naannoo sanaa beektu ?	1. Eeyyee 2. Lakki	
52. Qabxiilee murteessoo shanan harka dhiqachuuf ni beektaa	1. Yes 2. Lakki	

Gaaffiilee': Oromiffa versionii qorannoo bu'uuraa fi xumuraa qorannoo gidduu-galummaaf

KUTAA I Haala hawaas demoogiraafii daa'imaa fi haadha		
Deebii hawaas-dimoogiraafii		
Kebele ----------HHno		
Amala daa'imaa		
1. Umurii daa'ima	ji'oota	
2. Saala daa'imaa	1. Dhiira 2. Dubartii	
3. Bakka itti geejjibsiifamu	1. Mana ---------- 2. Dhaabbata fayyaa----------	
4. Tartiiba dhalootaa	----------	
Amala maatii		
5. Umuriin haadha _____	_____waggaa	
6. Amantii	1. Muslima 2. Ortodoksi 3. Pirootestaantii 4. Kaatoliki 5. Kan biraa(ibsi	
7. Saba	1. Oromo 2. Amaaraa 3. Daaweroo 4. Keffaa 5. Kan biraa(ibsi	
8. Haala gaa'elaa	1. Qophaa'e 2. Fuudhaa fi heeruma 3. Dubartii abbaan manaa irraa du'e 4. Addaan bahuu	
9. Sadarkaa barnootaa haadha?	1. Barreessuu, dubbisuu dadhabuu 2. Barreessuu, dubbisuu 3. Sadarkaa tokkoffaa (1-8) 4. Sadarkaa Lammaffaa(9-12) 5. Kolleejjii fi isaa ol	
10. Sadarkaa barnoota abbaa?	1. Barreessuu, dubbisuu dadhabuu 2. Barreessuu, dubbisuu 3. Sadarkaa tokkoffaa (1-8) 4. Sadarkaa Lammaffaa(9-12) 5. Kolleejjii fi isaa ol	

11. Sadarkaa hojii haadha?	1. Haadha manaa manaa 2. Qonnaan bulaa 3. Hojjetaa Mootummaa 4. Kan dhuunfaa 5. Daldalaa 6. Hojjetaa guyyaa guyyaa 7. Kanneen biroo	
12. Sadarkaa Sadarkaa hojii abbaa?	1. Qonnaan bulaa Farmer 2. Hojjetaa Mootummaa 3. Kan dhuunfaa 4. Merchent Daldalaa 5. Hojjetaa guyyaa guyyaa 6. Kanneen biroo	
13. Baay'ina manaa	----------	
14. Yeroo baay'ee galii maatii baasii manaaf oolu eenyutu murteessa?	1. Abbaa manaa/Hiriyaa 2. Haadha manaa/haadha 3. Kan biraa kamiyyuu (ibsi)	
15. Shaakala nyaachisuu daa'imaa keessatti gahee abbootii qaba	1. Eeyyee 2. Lakki	
16. Yoo Eeyyee G.15, Akkamitti?		
17. Yoo Lakki G 15, maaliif?		
18. Nyaanni maatii keessatti kan argamu akkamitti?	1. Qonna 2. Bituu 3. Gargaarsa nyaataa/arjooma 4. Kan biraa kamiyyu	
Dhukkubbii daa'immanii torban lamaan darban keessatti		
19. Torban 2 darban keessa daa'imni dhukkubsatee jiraa?	1. Eeyyee 2. Lakki	
20. Yoo eeyyee ta'e isa kam? (deebii tokkoo ol ta'uu danda'a)	1. Garaa kaasaa 2. Dhukkuba garaachaa 3. Dhukkuba busaa tingne 4. Qufaa 5. Paraasitii garaachaa 6. Dhukkuba busaa 7. Kanneen biroo	
21. Yeroo dhukkuba daa'ima kee akkamitti nyaachifta	1. Akkuma barame 2. Nyaata dabalataa dabalataa 3. Kanneen biroo	
22. Yeroo akkamii harka dhiqattu? (Deebiin dachaa ta'uu danda'a)	1. Erga fincaan baafatanii booda 2. Manca'aa daa'imaa/ga'eessotaa erga	

	qabannee booda ykn jala daa'imaa erga qulqulleessinee booda 3. Naannoo erga qulqulleessinee booda 4. Nyaata qopheessuu dura 5. Daa'ima nyaachisuun dura	
KUTAA II. Shaakala nyaata daa'immanii		
23. Harma hoosistee beektaa	1. Eeyyee 2. Lakki	
24. Lakki yoo ta'e maaliif?	1. Annan hin qabu 2. Harma hoosisuu 3. Hibarbaanne Amantaa aadaa 4. Kan biroo (Ibsi Other (Specify)	
25. Ammallee harma hoosisaa jirtaa	1. Eeyyee 2. Lakki	
26. Yoo Lakki yeroo ati harma hoosisuu dhiiftu daa'imni umriin isaa meeqa ture	Ji'a ---------- tti	
27. Ji'a kamitti nyaata dabalataa jalqabuu	1. Yeroo dhalatan 2. _____ ji'oota	
28. Mucaan yeroo meeqa yeroo _____	_____ nyaate	
29. Nyaata akkamii daa'immaniif yeroo nyaata dabalataa eegaltan kennitan 1.	1. Daakuu 2. Muki 3. Nyaata maatii 4. Kanneen biroo, ibsi	
30. Akkamitti walsimannaa isaa	1. Fulbaana 2. Haphi 3. Kanneen biroo 4. Hin jalqabne	
31. Maaliif?	------ .	
32. Wantoonni nyaata dabalataa qopheessuuf itti fayyadamtan maali	1. Midhaan 2. Baala mukaa 3. Fuduraalee 4. Kuduraa fi muduraa 5. Aannanii fi oomishaalee aannani 6. Foon 7. Zayitii fi Cooma	
33. Yoo Midhaan yookiin/fi Midhaan Q 32, Gruels fi daabboo hojjechuuf akkamitti	_____	

qophooftan?		
34. Nyaata dabalataa yeroo qopheessitu adeemsa biqiluu ,midhaanii fi baala jiidhuu fi dha'uu HH naannoo fayyadamtaa	1. Eeyyee 2. Lakki	
35. Yoo, eeyyee? Kam?	1. Biqiluu 2. Jiidhina 3. Dha'uu 4. Bishaan bilcheessuu 5. Lamaan keessaa tokko	
36. Waa'ee mala kanaa odeeffannoo eessaa argatte? 1.	1. Haadholii Haadholii 2. Ollaa 3. Hojjetoota fayyaa 4. Massmedia (TV,Raadiyoo	
37. Yoo Eeyyee G 34 ,Maaliif mala kana filatta ?	----------	
38. Yoo Eeyyee G 34 , akkamitti Qopheesse ?	----------	
39. Faayidaan mala akkanaa fayyadamuu maali ??	----------	
40. Yoo Lakki G.34 ,Maaliif?	----------	
KUTAA III Gaaffii Beekumsaa		
41. Waa'ee hanqina nyaataa beektaa?	1. Eeyyee 2. Lakki	
42. Barbaachisummaa CF ni beektaa?	1. Eeyyee 2. Lakki	
43. Daa'imman umrii meeqatti nyaata nyaachuu jalqabuu akka qaban beektu ?	1. ----------months	
44. Gosti nyaataa kam akka CF	1. Eeyyee 2. Lakki	
45. Consisitencey sirrii CF beektaa? 1. 2.	1. Eeyyee 2. Lakki	
46. Mucaan yeroo meeqa nyaachuu akka qabu beektaa	1. Eeyyee 2. Lakki	
47. Faayidaa nyaata adda addaa beektaa ? 3. 4.	1. Eeyyee 2. Lakki	
48. Nyaachisuun qaruuraa daa'imaaf faayidaa qabaa? 1. 2.	1. Eeyyee 2. Lakki	
49. Yeroo dhukkuba daa'immanii fi booda nyaata dabalataa barbaachisuu ni beektaa	1. Eeyyee 2. Lakki	
50. Nyaata dabalataa gaarii akkamitti akka fooyyessuu beektaa ?	1. Eeyyee 2. Lakki	
51. Mala aadaa nyaata qopheessuu HH	1. Eeyyee	

naannoo sanaa beektu ?	2. Lakki	
52. Qabxiilee murteessoo shanan harka dhiqachuuf ni beektaa	1. Yes 2. Lakki	

Kutaa IV Gaaffiilee Iskeelii Dhaqqabummaa Wabii Nyaataa Manaa (HFIAS).		
No.		Response
1	Torban afran darban keessa, manni keessan nyaata gahaa akka hin qabaanne yaadda'aa turtanii?	0 = Lakki (gara Q2) 1=eeyyee
1.a	Kun yeroo meeqa ta'e?	1. Yeroo muraasa (torban afran darban keessatti al tokko ykn lama) 2. yeroo tokko tokko (torban afran darban keessatti yeroo sadii hanga kudhanii) 3. yeroo baay'ee (torban afran darban keessatti yeroo kudhan ol)
2.	Torban afran darban keessa, ati ykn miseensi maatii kamiyyuu sababa hanqina qabeenyatiin gosa nyaata filatte nyaachuu hin dandeenyee	0. Lakki (gara Q3) 1. eeyyee
2.a	0 = Lakki (gara Q3) 1= Kun yeroo meeqa ta'e?	1. Yeroo muraasa (torban afran darban keessatti al tokko ykn lama) 2. yeroo tokko tokko (torban afran darban keessatti yeroo sadii hanga kudhanii) 3. yeroo baay'ee (torban afran darban keessatti yeroo kudhan ol)
3.	Torban afran darban keessa ati ykn miseensi maatii kamiyyuu sababa hanqina qabeenyaatiin nyaata adda addaa daangeffame nyaachuu qabdaa?	0. Lakki (gara Q4) 1. eeyyee
3.a	Kun yeroo meeqa ta'e?	1. Yeroo muraasa (torban afran darban keessatti al tokko ykn lama) 2. yeroo tokko tokko (torban afran darban keessatti yeroo sadii hanga kudhanii) 3. yeroo baay'ee (torban afran darban keessatti yeroo kudhan ol)
4.	Torban afran darban keessatti, Didyou ykn miseensi maatii kamiyyuu nyaata gosa nyaataa biroo argachuuf dhuguma nyaachuu hin barbaanne nyaachuu qabda dhuguma nyaachuu hin barbaanne .	0. Lakki (gara Q5) 1. eeyyee
4.a		1. Yeroo muraasa (torban afran darban keessatti al tokko ykn lama) 2. yeroo tokko tokko (torban afran darban keessatti yeroo sadii hanga kudhanii) 3. yeroo baay'ee (torban afran darban keessatti

		yeroo kudhan ol)
5.	Torban afran Kun yeroo meeqa ta’e?darban keessa, nyaanni gahaan waan hin jirreef, ati ykn miseensi manaa kamiyyuu nyaata si barbaachisu sitti dhaga’ame caalaa xiqqaa ta’e nyaachuu qabdaa?	0. Lakki (gara Q6) 1. eeyyee
5.a	Kun yeroo meeqa ta’e?	1. Yeroo muraasa (torban afran darban keessatti al tokko ykn lama) 2. yeroo tokko tokko (torban afran darban keessatti yeroo sadii hanga kudhanii) 3. baay'ee (torban afran darban keessatti yeroo kudhan ol)
6.	Torban afran darban keessa nyaanni gahaan waan hin jirreef isin ykn miseensonni maatii biroo guyyaa tokkotti nyaata xiqqaa nyaachuu qabduu?	0. Lakki (gara Q7) 1. eeyyee
6.a	Kun yeroo meeqa ta’e?	1. Yeroo muraasa (torban afran darban keessatti al tokko ykn lama) 2. yeroo tokko tokko (torban afran darban keessatti yeroo sadii hanga kudhanii) 3. baay'ee (torban afran darban keessatti yeroo kudhan ol)
7.	Torban afran darban keessa sababa hanqina qabeenya nyaata argachuuf mana keessan keessatti nyaanni gosa kamiyyuu nyaachuu hin turree?	0. Lakki (gara Q8) 1. eeyyee
7.a	Kun yeroo meeqa ta’e?	1. Yeroo muraasa (torban afran darban keessatti al tokko ykn lama) 2. yeroo tokko tokko (torban afran darban keessatti yeroo sadii hanga kudhanii) 3. baay'ee (torban afran darban keessatti yeroo kudhan ol)
8.	Torban afran darban keessa, nyaanni gahaan waan hin jirreef halkan beela'ee halkan rafu ati ykn miseensonni maatii kamiyyuu?	0. Lakki (gara Q9) 1. eeyyee
8.a	Kun yeroo meeqa ta’e?	1. Yeroo muraasa (torban afran darban keessatti al tokko ykn lama) 2. yeroo tokko tokko (torban afran darban keessatti yeroo sadii hanga kudhanii) 3. baay'ee (torban afran darban keessatti yeroo kudhan ol)
9.	Torban afran darban keessa ati ykn miseensi manaa kamiyyuu nyaata gahaa waan hin jirreef halkan guutuu osoo homaa hin nyaatin deemtee?	0. Lakki (gaaffiin xumurame) 1. Eeyyee

9.a	Kun yeroo meeqa ta’e?	1. Yeroo muraasa (torban afran darban keessatti al tokko ykn lama) 2. yeroo tokko tokko (torban afran darban keessatti yeroo sadii hanga kudhanii) 3. baay'ee (torban afran darban keessatti yeroo kudhan ol)

Kutaa V Amaloota Maatii Indeeksii Qabeenyaaf

	Jijjiiramaa	Deebii
1.	Elektirikii qabaa	1. Eeyyee 2. Lakki
2.	Manni keessan mitad elektirikii qabaa	1. Eeyyee 2. Lakki
3.	Manni keessan Televijiinii hojiirra oolu qabaa	1. Eeyyee 2. Lakki
4.	Manni keessan iddoo ibiddaa qabaa	1. Eeyyee 2. Lakki
5.	sa'aatii qabaa	1. Eeyyee 2. Lakki
6.	refigrator qabaa	1. Eeyyee 2. Lakki
7.	Manni keessan raadiyoo qabaa	1. Eeyyee 2. Lakki
8.	Manni keessan bilbila harkaa hin qabne qabaa	1. Eeyyee 2. Lakki
9.	Manni keessan minjaala qabaa	1. Eeyyee 2. Lakki
10.	Manni keessan teessoo qabaa	1. Eeyyee 2. Lakki
11.	Manni keessan siree ispoonjii/ birraa suufii qabu qabaa	1. Eeyyee 2. Lakki
12.	Manni keessan ibsaa keeroosiinii qabaa	1. Eeyyee 2. Lakki
13.	kushiinaatti itti fayyadamtu qabduu ?	1. Eeyyee 2. Lakki
14.	Miseensi mana kanaa kamiyyuu bilbila harkaa qabaa	1. Eeyyee 2. Lakki
15.	Miseensi mana kanaa kamiyyuu biskileetii qabaa	1. Eeyyee 2. Lakki
16.	Miseensi mana kanaa kamiyyuu motora qabaa	1. Eeyyee 2. Lakki
17.	Miseensi mana kanaa kamiyyuu gaarii Beeylada harkifamu	1. Eeyyee 2. Lakki

	qabaa	
18.	Miseensi maatii kanaa herrega baankii ykn herrega qusannaa faayinaansii maayikiroo qabaa?	1. Eeyyee 2. Lakki
19.	Miseensi maatii kanaa lafa qonnaa kamiyyuu qabaa?	1. Eeyyee 2. Lakki
20.	Bakka mana fincaanii qabduu	1. Eeyyee 2. Lakki
21.	Manni kun re'ee qabaa	1. Eeyyee 2. Lakki
22.	Manni kun re'ee qabaa	1. Eeyyee 2. Lakki
23.	Manni kun farda/gaala qabaa	1. Eeyyee 2. Lakki
24.	Manni kun re'ee /fi hoolaa qabaa	1. Eeyyee 2. Lakki
25.	Manni kun qamadii qabaa	1. Eeyyee 2. Lakki
26.	Manni kun harree qabaa	1. Eeyyee 2. Lakki

Kutaa VI Gosa Nyaataa Daa'imni sa'a 24 darbe Keessatti Nyaate

Gosa nyaataa daa'imni umuriin isaa ji'a 6-23 ta'u sa'a 24 darbe keessatti nyaate

ID_____

Nyaata nyaatame/dhugame nyaatame (qorannoo dabalataaf).	Guddina qooda fudhatame
1.	

PART VII. HAALA NYAATAA

Unka daataa qorannoo antiroopoomeetrikii

kebele : _____ Guyyaa: _____

Ijoollee Lakkoofsa Eenyummaa

Daa'ima ser.lakk.	Maqaa (dirqama)	Walqunnamtii saalaa (Dhi/Dhu)	Umurii keessa Waggaa fi ji'a	Ulfaatina (kg) ±100g ta'a	Olka'iinsa (cm) ±0.1cm ta'a	Edmaa (Eyee/Lakkin)	Yaada
1.							
2.							

9.3 Information Sheet

Amharic version for study one

Good morning/afternoon, W/O/W/T…….. We are from jimma university. We are working on a project "**Optimal complementary feeding practices of children aged 6–23 months in three agro-ecological rural districts"** in selected districts of the Jimma zone, including yours The interview will take about one hour. All the information we obtain will remain strictly confidential and your answers and name will never be revealed. Also, you are not obligated to answer any question you do not want to, and you may stop the interview at any I would like you to answer questions honestly, telling me about what you know, how you feel, and the way you feed your child. Feel free to answer questions.

Do you agree to participate in this interview?
Yes ___ No ___ If yes, continue to the next question; if no, stop the interview.
Do you have any question before we start? (Answer questions).
Data Collector _____ Signature_____
Supervisor _____ Signature_____

Amharic version for study 2, 3 4

Hello, my name is _____, and I am from Jimma University. We are conducting a study on the title of "Effect of behavioural change communication on mother knowledge, child feeding practice and anthropometric failure among children aged 6-23 months in Southwest Ethiopia: a cluster randomized controlled trial" in selected districts of the Jimma Region, including yours. The purpose of this study is to assess child feeding knowledge and practices to help improve nutrition and health in the community. I will be asking you a series of questions, which should take about one hour to complete. Please know that your responses, including your name, will be kept completely confidential and used only for research purposes. Your participation is entirely voluntary, and you may choose to withdraw at any time without any obligation or consequence. I kindly ask that you share openly and honestly about how you are feeding your child, as your insights are invaluable to this study. Thank you for considering participating and for helping us work toward better health outcomes for children in our Zone.

Do you agree to participate in this interview?
Yes ___ No ___ If yes, continue to the next question; if no, stop the interview.
Do you have any question before we start? (Answer questions).
Data Collector _____ Signature_____
Supervisor _____ Signature_____

.

Waraqaa Odeeffannoo : Afaan Oromiffa qo'annoo o tokkoof

Nagaa ganama/waaree, W/O/W/T..... Nuti yuunivarsiitii jimmaa irraa dhufne. Kan keessan dabalatee aanaalee filatamoo zoonii Jimmaa keessatti pirojektii "**Optimal complementary feeding practices of children aged 6–23 months in three agro-ecological**" jedhu hojjechaa jirra Af-gaaffiin kun gara sa'aatii tokkoo ni fudhata. Odeeffannoon nuti argannu hundi iccitii cimaa ta'ee kan turu yoo ta'u, deebii fi maqaan keessan gonkumaa hin mul'atu. Akkasumas, gaaffii hin barbaanne kamiyyuu deebisuuf dirqama hin qabdu, akkasumas gaaffii fi deebii sana dhaabuu dandeessa ani gaaffii dhugaadhaan akka deebistu nan barbaada, waa'ee waan beektu, miira sitti dhaga'amuu fi akkaataa ati kee nyaachiftu natti himtee daa'ima. Gaaffii yoo qabaattan bilisaan deebisaa.

Gaaffii fi deebii kana irratti hirmaachuuf walii galtuu?

Eeyyee ___ Lakki ___ Yoo eeyyee ta'e gara gaaffii itti aanutti itti fufi; yoo lakki ta'e interview dhaabi.

Osoo hin jalqabiin dura gaaffii qabduu? (Gaaffilee deebisaa).

Walitti qabaa Odeeffannoo _____ Mallattoo_____ .

Suppervaayizara _____ Mallattoo_____ .

Waraqaa Odeeffannoo, oromiffa version: Qorannoo 2, 3 4 .

Akkam jirtu, maqaan koo _____, ani immoo Yunivarsiitii Jimmaa irraati. Mata duree "**Dhiibbaa qunnamtiin jijjiirama amala beekumsa haadha, shaakala nyaata daa'immanii fi kufaatii anthropometric daa'imman umuriin isaanii ji'a 6-23 ta'e irratti qabu Kibba Lixa Itiyoophiyaa: yaaliin to'annoo tasaa kilaastara**" jedhu irratti aanaalee filatamoo Naannoo Jimmaa, kan keessan dabalatee. Kaayyoon qorannoo kanaa beekumsaa fi gochaalee nyaata daa'immanii madaaluun sooratаa fi fayyaa hawaasa keessatti fooyyessuuf gargaara. Gaaffiiwwan walduraa duubaan isin gaafachaa jira, kunis xumuruuf gara sa'aatii tokkoo fudhachuu qaba. Maqaa keessan dabalatee deebii keessan guutummaatti iccitii akka ta'ee fi qorannoo qofaaf akka oolu beekaa. Hirmaannaan kee guutummaatti fedhii keetiin kan raawwatamu yoo ta'u, yeroo barbaaddetti dirqama ykn bu'aa tokko malee ofirraa baasuu filachuu dandeessa. Hubannoon keessan qorannoo kanaaf gatii guddaa waan qabuuf, akkaataa daa'ima keessan nyaachisaa jirtu ifatti fi amanamummaadhaan akka qooddan kabajaan isin gaafadha. Hirmaachuu yaaduu keessanii fi bu'aa fayyaa fooyya'aa daa'imman Zoonii keenya keessa jiraniif akka hojjennu waan nu gargaartaniif galatoomaa.

Gaaffii fi deebii kana irratti hirmaachuuf walii galtuu?
Eeyyee ___ Lakki ___ Yoo eeyyee ta'e gara gaaffii itti aanutti itti fufi; yoo lakki ta'e interview dhaabi.
Osoo hin jalqabiin dura gaaffii qabduu? (Gaaffilee deebisaa).
Walitti qabaa Odeeffannoo _____ Mallattoo_____ .
Suppervaayizara _____ Mallattoo_____ .

9.4 Participant consent form

Consent form: English version

This permission form's contents have been read to me, or I had someone read it to me. I am aware of the study's goals, methods, possible drawbacks, and rewards. Time to think on whether or not to participate was provided to me. I was able to ask questions and was given good responses. I am aware that I can leave the study at any moment, for any reason, and that doing so won't have an impact on any advantages I may receive in the future. I authorize this form to be used and shared for the research objective, using my anonymous personal health information. I know that signing this does not release me of any legal obligations.

1. Do you agree to participate in this interview?
   Yes ___ No ___ If yes, continue to the next question; if no, stop the interview.
2. Interviewer signature certifying that informed consent has been given verbally by the respondent.
3. Do you have any question before we start? (Answer questions).
4. Signature……Date……

Adress

Meseret Tamrat (PhD student in Jimma University)

Jimma University faculty of Public health Department of Nutrition and Dietetics

Mobile +251-09 17 80 43 61

E-mail: mesetamrat@yahoo.com

Unka hayyama hirmaataa: Afaan Oromoo version

Qabiyyeen unka hayyamaa kanaa naaf dubbifameera, ykn namni tokko akka naaf dubbisu godheera. Galma qorannichaa, mala, hanqina qabaachuu danda'uu fi badhaasa qorannichaa nan beeka. Hirmaachuu fi dhiisuu koo yeroon itti yaadu naaf kenname. Gaaffii gaafachuu danda'eera, deebii gaariin naaf kennameera. Yeroo barbaadetti, sababa kamiinuu qo'annoo sana gadhiisuu akkan danda'u, kana gochuun koos faayidaa gara fuulduraatti argachuu danda'u kamiyyuu irratti dhiibbaa akka hin qabne nan beeka. Unkaan kun odeeffannoo fayyaa dhuunfaa koo maqaa hin beekamne fayyadamuun, kaayyoo qorannoof akka itti fayyadamuu fi qoodamu nan hayyama. Kana mallatteessuun dirqama seeraa kamirraayyuu akka na hin baafne nan beeka.

1. Gaaffii fi deebii kana irratti hirmaachuuf walii galtuu?

Eeyyee ___ Lakki ___ Yoo eeyyee ta'e gara gaaffii itti aanutti itti fufi; yoo lakki ta'e interview dhaabi.

2. Mallattoo af-gaaffii hayyamni beekumsa qabu deebii kennaan afaaniin akka kenname mirkaneessu.

3. Osoo hin jalqabiin dura gaaffii qabduu? (Gaaffilee deebisaa).

4. Mallattoo.

Teessoo

Meseret Tamrat (barattuu PhD Yuunivarsiitii Jimmaa)
Yuunivarsiitii Jimmaa faakiultii Fayyaa Hawaasaa Kutaa Nyaataa fi Nyaata
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9.5. Educational (BCC) training and Material

Schedule of WDAs training for seven days

Session	content	Duration
1	**Welcome ceremony** **Overview of malnutrition** The cause and consequence of malnutrition and the benefit of continuation of breast feeding and complementary foods.	2hrs for1 day
2	**key message on optimal complementary feeding practice:** • At six months, the mother or the caregivers must introduce soft, appropriate foods and continuing breast feeding on demand. • Feeding your child with the right food consistency only when child is 6 months of age. • Increase the amount a of feeding with age o Amount of food per meal: Begin with 2 to 3 tablespoons at 6 months of age. 2 to 3 tables spoonful's; and increase gradually to half (½) 250 ml cup at 6–9 months. Half (½) of 250 ml cup at 9–12 months. Three quarters to 1 of 250 ml cup at 12–24 months. • 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. • Variety of food: Enrich baby's porridge by adding one or more ingredients from animal-source foods (milk, egg, and dried meat powder), finely chopped vegetables (kale, carrot, cabbage, tomato, potato) and mashed fruits (avocado, papaya, mango, banana and pumpkin) in each meal and ensure complementary food should be thick enough to be fed by hand • Feed animal-source foods (e.g. eggs, beef, pork, chicken, liver and fish) at least 3 times per week. Feed your child a fruit (e.g. ripe banana, mango, orange, papaya and avocado) after a meal at least once per day. • Interact with the child during feeding .Continue breastfeed and feed your child simple foods and provide extra meal during illness	10hrs for 3 days
3	**Feeding during illness and hygienic practices** • Increase feeding during and after illness Practice good hygiene and food preparation **Five moments are considered critical times to wash hands**	2hr. for 1 day

	• after defecation • after handling child/adult feces or cleaning child's bottom • after cleaning the environment • before preparing food • before eating food	
4	**key message on preparation of complementary foods** • How to Prepared cereal based flour using traditional household food processing technique. o Prepare complementary food recipe like porridge and gruel in proportion of three parts of soaked, germinated and pounded, cereal and one parts legumes and enrich with variety of food items (Figure 2). **Enriched cereal, legumes or root based complementary foods**	3hr for 1 day
5.	Demonestration and redemonstration on preparation of complementary food reciepe	4hr for 1 day
	Total	21 hrs

Schedule of WDAs deliver key message to Mothers of childen

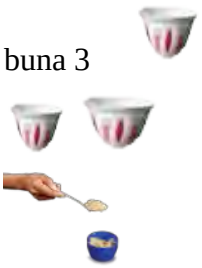
Session	content	Duration
1	**Welocome and introduce each other** **Overview of malnutrition** The cause and consequence of malnutrition and the benefit of continuation of breast feeding and complementary foods.	2hrs for 1 day
2	**key message on optimal complementary feeding practice:** • At six months, the mother or the caregivers must introduce soft, appropriate foods and continuing breast feeding on demand. • Feeding your child with the right food consistency only when child is 6 months of age. • Increase the amount a of feeding with age o Amount of food per meal: Begin with 2 to 3 tablespoons at 6 months of age. 2 to 3 tables spoonful's; and increase gradually to half (½) 250 ml cup at 6–9 months. Half (½) of 250 ml cup at 9–12 months. Three quarters to 1 of 250 ml cup at 12–24 months. • 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. • Variety of food: Enrich baby's porridge by adding one or more ingredients from animal-source foods (milk, egg, and	2 hrs for consecutive 5 days

	dried meat powder), finely chopped vegetables (kale, carrot, cabbage, tomato, potato) and mashed fruits (avocado, papaya, mango, banana and pumpkin) in each meal and ensure complementary food should be thick enough to be fed by hand • Feed animal-source foods (e.g. eggs, beef, pork, chicken, liver and fish) at least 3 times per week. Feed your child a fruit (e.g. ripe banana, mango, orange, papaya and avocado) after a meal at least once per day. • Interact with the child during feeding	
3	**Feeding during illness and hygienic practices** • Increase feeding during and after illness • Continue breastfeed and feed your child simple foods and provide extra meal during illness Practice good hygiene and food preparation Five moments are considered critical times to wash hands • after defecation • after handling child/adult feces or cleaning child's bottom • after cleaning the environment • before preparing food • before eating food	2hrs for 2 days
4	**key message on preparation of complementary foods** • How to Prepared cereal based flour using traditional household food processing technique. o Prepare complementary food recipe like porridge and gruel in proportion of three part of soaked, germinated and pounded, cereal and one parts legumes and enrich with variety of food items (Figure 2). **Enriched cereal, legumes or root based complementary foods**	2 hr for 1 day
5.	Demonestration and redemonstration on preparation of complementary food reciepe	2hr in differen for 4 days
	Total	26 hrs

BCC materials (Broacher)

Oromiffa version: kutaa BCC ergaa furtuu haadholii

<table>
<tr><th colspan="4">dhiyaateKutaa Ergaa furtuu qunnamtii jijjiirama amala garee gidduu seensaa keessatti</th></tr>
<tr><td colspan="4">Kutaa 2ffaa fi 3ffaa: Ergaawwan ijoo nyaata dabalataa, gocha nyaataa yeroo dhukkubaa fi booda, fi gochaalee qulqullinaa irratti</td></tr>
<tr><td>Umurii</td><td colspan="3">Yaada kennaman</td></tr>
<tr><td>Yerro</td><td>Gosoota</td><td>nyaataa Yeroo</td><td>Meeqa Meeqa</td></tr>
<tr><td>Ji'a 6tti
</td><td>Gaaffii irratti harma hoosi.
Ganfoo lallaafaa badhaadhina qabuun jalqabi +
Nyaata madda bineensotaa
</td><td>baayisuu’ee harmaa hoos
+
Yerro 2 - 3</td><td>Kanastaa 2 hanga 3 irraa jalqabdee suuta suutaan hamma buna sadiitti guddisu</td></tr>
<tr><td>Ji'a 6 hanga 12tti
</td><td>

+
Daakuu badhaadhina qabu (midhaanii kutaa 3 + loomii kutaa 1). 
+
Fuduraalee fi muduraalee
</td><td>Nyaata 2 hanga 3 nyaachu
+
yeroo baay’ee harma hoosisuun nyaata salphaa 1 hanga 2 kennamuu danda’a</td><td>buna 3

Walsimannaa furdaa nyaataa</td></tr>
<tr><td>12hanga 24tti
</td><td></td><td>Nyaata 3 hanga 4
+
harma hoosisuuf nyaata salphaa 1 hanga 2 kennamuu danda’a</td><td>Buna 4
</td></tr>
</table>

Nyaata dabalataa qopheessuu, jiidhuu, biqiluu, toostii, fi qamadii midhaan irratti hundaa'e fayyadamuun



Qophii daakuu biqilee

¼ legumes	¾ midhaan	Daakuu badhaadhina qabu



yaatni dabalataa harma hoosisuu itti fufuu bira darbee garee nyaataa adda addaa irraa qophaa'uu qaba

	• Midhaan (staples) . Midhaan :- boqqolloo, qamadii, Karaa, ruuzii, midhaanii fi midhaanii fi hidda fi qamadii kan akka boqqolloo ,godere
	• Legumes: jedhamuun beekama :- baaqelaa, qamadii, baaqelaa, boqqolloo , baaqelaa bal'aa
	• Fuduraalee :- maangoo, paapaayaa, burtukaana, baala magariisa dukkanaa'aa, kaarotaa, boqqolloo keelloo fi paampii fi fuduraalee biroo
	• Kuduraalee :- muuzii, aanaanii, avokaadoo, timaatima, eggplant fi kaabaaji
	• Nyaata Madda Beeyladaa :- nyaata foon kan akka foon, hanqaaquu, qurxummii, kalee fi hanqaaquu fi bu'aa aannanii fi aannani
 Daa'immaniif guyyaatti walakkaa kanastaa hin caalle	• Zayitii fi cooma :- sanyii zayitaa fi dhadhaa kuduraalee fi nyaata birootti dabalamuun xuuxamuu vitaaminoota tokko tokko fooyyessuu fi humna dabalataa ni kenna.

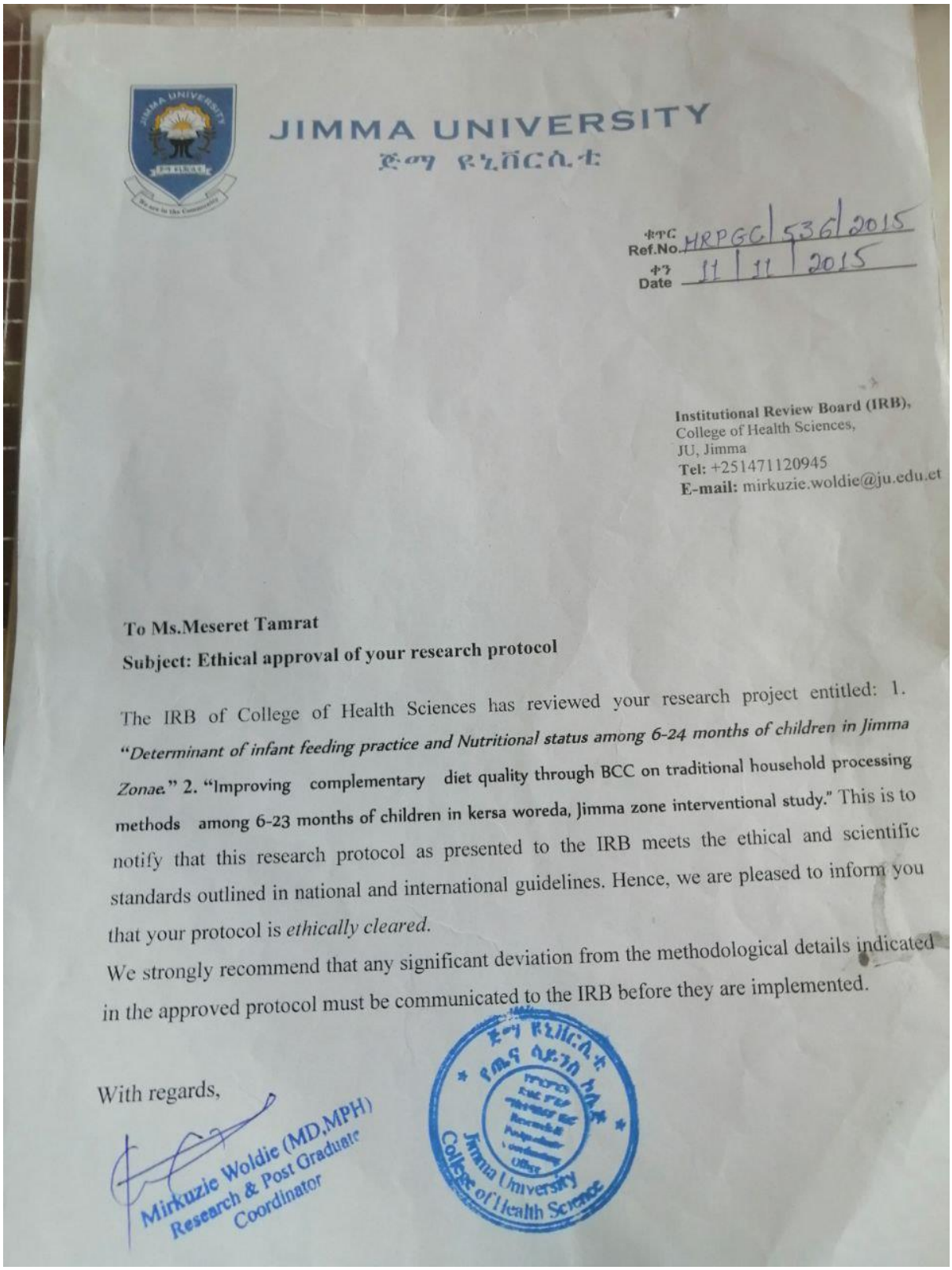
	• Harma hoosisuu itti fufuu
Kutaa 4 ffaa: shaakala nyaata yeroo dhukkubaa fi qulqullina gaarii fi amala qophii nyaataa guddisu	
   Shaakala harka dhiqachuu	• Nyaatni dabalataa yeroo dhiyootti akka dhihaatuuf baay'ee xiqqaadhaan qophaa'uu qaba • Haadholiin yeroo hunda nyaata qopheessuun duras ta'e daa'ima nyaachisuun dura harka isaanii bishaanii fi saamunaadhaan dhiqachuu qabu
	• **Nyaanni risaa fi raammoo biroo irraa eeguuf haguugamuu qaba**

Process evaluation on complementary feeding Behavioural change communication

Component of process evaluation	**Process Indicators**	**Percent**	**Source**	**Aim**
Reach	The proportion of the intended target audience over time	100%	Log book	To assess the target audience during BBC session
Dose delivered	No. of selected WDAs No. of trained WDAs No. of home visit carried out by WDAs	23 23 24hr	Attendance Check list	To asset effort of the intervention providers
Dose received	No. of selected child mother pairs for the study No. of mothers trained No. of mothers participated in the home visit (100% attended) Absent from home visits	220 220 204 16	Check list	To assess the rate of engagement of participants with the intervention

Fidelity	No. of training session for WDA No of training session by WDA No of Training manual distributed for WDA(handout)	5 5 220	Log book	To assess the intervention will be carried out as planned

9.6 Ethical clearance



JIMMA UNIVERSITY
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Ref.No. HRPGC/536/2015
Date 11/11/2015

Institutional Review Board (IRB),
College of Health Sciences,
JU, Jimma
Tel: +251471120945
E-mail: mirkuzie.woldie@ju.edu.et

To Ms.Meseret Tamrat

Subject: Ethical approval of your research protocol

The IRB of College of Health Sciences has reviewed your research project entitled: 1. *"Determinant of infant feeding practice and Nutritional status among 6-24 months of children in Jimma Zonae."* 2. **"Improving complementary diet quality through BCC on traditional household processing methods among 6-23 months of children in kersa woreda, Jimma zone interventional study."** This is to notify that this research protocol as presented to the IRB meets the ethical and scientific standards outlined in national and international guidelines. Hence, we are pleased to inform you that your protocol is *ethically cleared.*

We strongly recommend that any significant deviation from the methodological details indicated in the approved protocol must be communicated to the IRB before they are implemented.

With regards,

Mirkuzie Woldie (MD,MPH)
Research & Post Graduate
Coordinator

Jimma University
College of Health Science