

**EFFECTIVENESS OF A COMMUNITY-BASED
PARTICIPATORY NUTRITION PROMOTION PROGRAM TO
IMPROVE CHILD NUTRITIONAL STATUS IN EASTERN
RURAL ETHIOPIA: A CLUSTER RANDOMIZED TRIAL**

by
Yunhee Kang, MS.

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ABSTRACT

Background: Appropriate complementary feeding and hygiene may reduce child undernutrition. To improve child nutritional status and feeding and hygiene behaviors in rural Ethiopia, a community-based participatory nutrition promotion (CPNP) program was designed, adapting positive deviance theory and involving two-week group nutrition sessions. This program was implemented to complement the existing Essential Nutrition Action (ENA) and Community-based Management of Acute Malnutrition (CMAM) programs. The effectiveness of the CPNP program in improving child growth and caregiver feeding and hygiene practices was tested in a cluster randomized, controlled trial using the existing programs alone as the control group. To better understand how the CPNP achieved expected outcomes, we evaluated the following five key intervention components, using a program impact pathway (PIP) analysis approach: (1) quality of the CPNP implementation (2) participants' acceptance of the program, (3) participants' recall of delivered messages (4) child feeding practices and nutritional status at the community level, and (5) the influence of CPNP on participation in the existing ENA and CMAM programs.

Methods: The CPNP program was launched on August 2012 in Habro and Melka Bello districts of Oromia region of Ethiopia. The districts were divided into 12 clusters of which the CPNP was implemented in 6, while the ongoing programs of ENA and CMAM were carried out in all 12 clusters. Out of 2,064 (1,032 per group) child and mother pairs randomly selected from the locally prepared child rosters in Habro and Melka Bello districts, 1,790 children 6 to 12 months of age and their mothers, 914 and 876 pairs in the control and intervention areas, respectively, were enrolled in the study in November 2012, four months after the CPNP program had started. Enrolled children were followed over the next 12-months and measured for

length and weight every three months. At each visit the mothers were asked about the child's diet using 24-hour-based dietary recall questionnaire, and infant and young child feeding (IYCF) practices every month, whereas hand washing practices were elicited every six months. Length-for-age (LAZ), weight-for-length (WLZ), and weight-for-age (WAZ) z scores, and stunting (LAZ<-2), wasting (WLZ<-2), and underweight (WAZ<-2) status were calculated using the WHO reference population. Child feeding scores for current breastfeeding (range 0-7), meal frequency (range 0-15), dietary diversity (DDS, range 0-10), hand washing (range 0-6), and two composite feeding scores combining different variables were constructed to represent a 12-month feeding and hygiene practice pattern. For process evaluation, we reviewed attendance records for 3,299 participants and conducted group session observation checklists of 114 sessions and extracted data to construct process indicators such as dose delivered, dose received, and fidelity. Mothers were also asked every three months whether they were involved in the ENA and CMAM programs. A small survey of individuals who directly participated in the nutrition sessions (n = 197) was conducted to examine their own acceptance of the CPNP program and recall of messages provided in the nutrition sessions. Multilevel mixed-effects linear regression models using longitudinal data and Cox regression for recurrent event models for stunting, underweight, and wasting episodes were used.

Results: We conducted an intention-to-treat analysis. A total of 1,475 children—750 and 725 children in the control and intervention area who were measured at least two out of five times, respectively—were included in the analysis of child growth. After controlling for clustering effects and enrollment characteristics, children in the intervention area had a significantly greater LAZ/month of 0.021 (95% CI: 0.008, 0.034), WAZ/month of 0.015 (95% CI: 0.003, 0.026), length/month of 0.059 cm (95%

CI: 0.027, 0.092), and weight/month of 0.031kg (95% CI: 0.019, 0.042) compared to children in the control area. There was no difference in the risk of recurrent incidence of stunting [Hazard Ratio (HR) 1.01, 95% CI: 0.811], underweight (HR 0.826, 95% CI: 0.643, 1.061), or wasting (HR 1.048, 95% CI: 0.812, 1.354) between intervention and control areas. Prevalence of stunting was lower in the intervention area by 7.5% at the 9 month follow-up ($p = 0.037$) and by 7.3% at 12 month of follow-up (not significant). Of 1,199 mothers, those in the intervention area ($n = 570$) showed higher scores on meal frequency (diff: 1.02, 95% CI: 0.33, 1.70), and both composite feeding scores (type 1, diff: 1.30, 95% CI: 0.41, 2.19) (type 2, diff: 1.39, 95% CI: 0.48, 2.23) than mothers in the control area ($n = 629$), but there were no differences in scores of current breastfeeding (diff: -0.08, 95% CI: -0.22, 0.06), dietary diversity (diff: 0.38, 95% CI: -0.21, 0.98), or hand washing (diff: 0.41, 95% CI: -0.21, 1.02) between mothers in the two areas. The CPNP sessions were delivered at 81% of the expectation level; fidelity to intervention protocols varied between 68% and 92%. Out of 197 CPNP participants, 95% had ever contributed materials to a session and 90% showed positive perceptions of the session practices. For each of the session activities (e.g., food preparation), ~70% rated their participation level as active. The participants recalled 5.0 ± 2.0 (SD) out of the 8 messages (e.g., preparing nutritious complementary foods). We also observed improvements in feeding and hygiene, i.e., minimum dietary diversity (34.0% vs. 19.9%, $p < 0.05$) and mother's cleanliness (40.0% vs. 24.0%, $p < 0.05$) at an early stage of the CPNP, and a higher involvement of CPNP participants in the existing program (e.g., Essential Nutrition Action) over the project period compared to non-participants within the same intervention area (32.3% vs. 19.8%, $p < 0.001$).

Conclusions: A community-based participatory nutrition program approach adapting the positive deviance model was found to be effective in improving child feeding practices among caregivers and child growth in the rural Ethiopian context. Using a PIP analysis, our results suggest that the CPNP program was adequately implemented and well-accepted among participants. Program impact was seen in the early stages of the program implementation, although a true baseline was not available, giving the additional benefit of positively influencing the ongoing ENA program, and eventually resulting in improved child nutritional status.

DISSERTATION COMMITTEE

DISSERTATION COMMITTEE MEMBERS

Parul Christian (Advisor), DrPH, Professor, International Health

David Paige (Chair), MD, Professor, Population, Family and Reproductive Health

Keith P. West, DrPH, Professor, International Health

Elizabeth Colantuoni, PhD, Associate Scientist, Biostatistics

DISSERTATION COMMITTEE MEMBER ALTERNATES

Robert S. Lawrence, MD, Professor, Environmental Health

Kristen Hurley, PhD, Associate Professor, International Health

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ABBREVIATION

ADP	Area Development Programs
CMAM	Community-Based Management of Acute Malnutrition
CSB	Corn-Soy Blend
CPNP	Community-based Participatory Nutrition Promotion
DAC	Development Assistance Committee
DALY	Disability-Adjusted Life-Years
DHO	District Health Office
EDHS	Ethiopia Demographic and Health Survey
EIHNP	Ethiopia Integrated Health and Nutrition Project
ENA	Essential Nutrition Action
GEE	Generalized Estimating Equation
LAZ (HAZ)	Length (Height)-for-age z score
HEP	Health Extension Program
HEWs	Health Extension Workers
HFIAS	Household Food Insecurity Access Scale
ICC	Intra-cluster Correlation Coefficient
IYCF	Infant and Young Child Feeding
KOICA	Korea International Cooperation Agency
MCH	Maternal and Child Health
MDGs	Millennium Development Goals
MICS	Multiple Indicator Cluster Survey
MUAC	Mid-Upper Arm Circumference
NNP	National Nutrition Program
NNS	National Nutrition Strategies
ODA	Official Development Aid
ORHB	Oromia Regional Health Bureau
OTP	Outpatient Therapeutic Program
PD Hearth	Positive Deviant Hearth
RCT	Randomized Controlled Trial
RUTF	Ready to use Therapeutic Foods
SC	Stabilization Center
SFP	Supplementary Feeding Program
VCHWs	Volunteer Community Health Workers
WAZ	Weight-for-age z score
WHO	World Health Organization
WLZ (WHZ)	Weight-for-length (height) z score
WITH	Wholistic Interest Through Health
WVE	World Vision Ethiopia
WVK	World Vision Korea

CHAPTER 1. INTRODUCTION

1.1 PROBLEM STATEMENT

Child undernutrition accounts for more than one third of preventable deaths among children under five years of age in developing countries (1). Undernutrition begins at conception onwards, and failure to address undernutrition at an early life stage adversely affects later life stages by increasing the risk of childhood morbidity, poor academic performance at school, increased susceptibility to non-communicable diseases, and less economic productivity (2). Globally, 161.5 million (24.5%) children under five year of age were estimated to be stunted, 98.9 million (15.0%) were underweight, and 50.8 million (8%) were wasted (3).

The *Lancet* series in 2008 introduced 13 nutrition-specific interventions that had been shown to be effective in reducing child undernutrition (4). Recently the second *Lancet* series in 2013 further expanded on these interventions (5). Out of effective interventions, approaches to improve appropriate complementary feeding practices presented promising results in a few studies. Nutrition education about complementary feeding could lead to an increase in height-for-age z (HAZ) scores by 0.25 (95% CI, 0.01 to 0.49) in food-secure countries (6-8).

Most randomized controlled trials have presented primary outcomes of interest, but what and how such interventions were implemented, modified, and accepted remains unexamined or described in a limited way (9-11). Lack of understanding in the implementation process of community nutrition programs that are based on behavior change communication strategies is likely to hinder effective program development, implementation, and scaling up to other similar settings. In response to these questions, a theory-driven program impact pathways (PIP) analysis applying process evaluation has been proposed and utilized to open the “black box” of

programs (9-12). In a 2008 WHO/UNICEF meeting, the term *program impact pathway* (PIP) was defined as “the pathway from an intervention input through programmatic delivery, household and individual utilization to its desired impact” (13). A PIP analysis can reveal the various operational components of a program, identify successes and failures in the mechanisms by which programs are expected to impact outcomes. Until now, only a few implementation studies have examined the implementation processes of complementary feeding trials and conducted a PIP analysis, to demonstrate the adequacy and the feasibility of these interventions (14-20).

Ethiopia has a high burden of child undernutrition. In 2011 the Ethiopia Demographic and Health Survey (EDHS) reported the prevalence of stunting, wasting, and underweight among children under five years of age to be 44.4%, 9.7 %, and 28.7%, respectively (21). For decades, emergency nutrition programs have tackled the problems of undernutrition in Ethiopia, but recent study findings indicate that its causes have multifaceted features, and includes not only food insecurity (22), but poor maternal and child feeding and caring practices (23-25), prenatal influences (25, 26), poor access to and low utilization of community health services (27-29), and fundamentally deep-rooted poverty. To address such nutritionally vulnerability, the Ethiopian government has made efforts by launching National Nutrition Strategies (NNS)/Programs (NNP) which includes the Essential Nutrition Action (ENA) activity and the Community-Based Management of Acute Malnutrition (CMAM) program.

ENA is designed to deliver nutrition counseling to caregivers through community volunteers. The main messages of the ENA program are to promote optimal breastfeeding, appropriate complementary feeding, caring for sick children, and to prevent micronutrient deficiencies (30). Programs based on the ENA approach

in Ethiopia and Madagascar have shown to significantly improve breastfeeding and complementary practices (31). Although the ENA program has critical components to prevent child malnutrition, the current community health system in Ethiopia is unlikely to support the ENA service delivery. In this context, the ENA activity is largely about delivering brief nutrition messages to caregivers through Health Extension Workers (HEWs)/community volunteers. These HEWs are often overburdened with already huge service duties (32, 33). Community volunteers, whose work is to support the HEWs, and have been found to have inadequate knowledge about ENA key messages and have poor counseling skills in convincing mothers to keep recommended practices (32). In addition, the current community health system has an unclear supervision structure and no specific incentives for the community volunteers' activities, as identified in other settings where community health workers play key roles in delivering primary health services (34, 35).

The CMAM program aims to treat acutely malnourished children with therapeutic or supplementary foods (36), and has been shown to be effective in treating malnutrition cases in emergent and developing settings (37, 38), but the program depends entirely on external aid to purchase therapeutic and supplementary foods, without touching fundamental causes of child undernutrition (37). Subsequently, oftentimes the caregivers remain unaware of the ways to handle such cases without dependence on the therapeutic foods.

To compensate for these disadvantages of the CMAM and ENA programs, World Vision designed a community-based participatory nutrition promotion (CPNP) and incorporated the CPNP program into the existing context of ENA and CMAM programs. The CPNP, as a behavior change communication intervention, adapted the Positive Deviant Hearth (PD Hearth) program components, such as nutrition

rehabilitation sessions for two weeks, follow-up visits, and growth-monitoring activities (39). The PD Hearth approach identifies behaviors practiced and menus prepared by caretakers of well-nourished children, *positive deviants*, living in the poor community (40, 41). These culturally acceptable and affordable practices are shared with other caregivers with malnourished children in the Hearth sessions. Conversely, the CPNP—adapting a structured implementation process—prepares nutritionally balanced menus designed by World Vision nutrition specialists using locally affordable and available foods (42), and delivers universal complementary feeding guidelines without finding context-specific practices (43).

Adding the CPNP into the existing Ethiopian nutrition context was expected to compensate for the above-indicated defects of the ENA and CMAM programs as follows: (1) by rehabilitating malnourished children with menus prepared with locally available food ingredients rich in nutrients at CPNP sessions, (2) by promoting adequate feeding and hygiene practices, and sharing these practices with neighboring caregivers, and (3) by promoting increased participation in the ENA program.

The above-cited idea was crystallized and called the Ethiopia Integrated Nutrition Project (EINP), whereby CPNP, ENA, and CMAM programs were concurrently conducted by World Vision Korea (WVK) in collaboration with the World Vision Ethiopia (WVE), Wholistic Interest Through Health (WITH, a Korea-based NGO), and local health governments, funded by the Korea International Cooperation Agency (KOICA)^a. The main intervention components of the three programs are defined as follows:

CPNP: Through a two-week group nutrition session, the nutrient- dense

^a a government agency to maximize the effectiveness of Korea's grant aid programs for developing countries by implementing the government's grant aid and technical cooperation programs

complementary foods are prepared using locally available and affordable food ingredients, and nutrition education messages are delivered to caregivers with support of CPNP operators and supervisors. The nutrition messages are mainly about child feeding and hygiene practices based on WHO infant complementary feeding practices (44, 45).

ENA: Health Extension Workers (HEWs)/community volunteers are subject to provide monthly nutrition counseling to caregivers with children under two years of age on adequate breastfeeding and complementary feeding practices, and how to care for sick children (30).

CMAM: Acutely malnourished children—screened by mid-upper arm circumference (MUAC) measurements—are treated with therapeutic foods or supplementary foods (36). Procurement was managed by the project team and the CMAM program operation was conducted by district health offices.

With this program context, the overarching goal of the proposed study was to evaluate the effectiveness of the CPNP program added to the ENA and CMAM programs on child growth from 6 to 24 months of age and child feeding and hygiene among caregivers in rural Ethiopia compared to children in the control area, and to examine key implementation components by which the CPNP program impacts child nutritional status at the community level using program impact pathway (PIP) analysis.

To meet the overarching goal of this study, the present study has the following three specific aims:

Specific aim 1: To examine the effectiveness of the CPNP program added to the ENA and CMAM programs in improving length-for-age (LAZ), weight-for-age (WAZ),

and weight-for-length (WLZ) z scores and in reducing the risk of stunting, underweight, and wasting among children 6 to 24 months of age

Hypothesis 1a: Compared to children of the control area, the LAZ, WAZ, and WLZ in children of the intervention area will be significantly greater over the 12-month follow-up.

Hypothesis 1b: Compared to children of the control area, the risk of stunting, underweight, and wasting in children of the intervention area will be significantly lower over the 12-month follow-up.

Specific aim 2: To examine the effectiveness of the CPNP program added to the ENA and CMAM programs in improving child feeding and hygiene practices among mothers of children 6 to 24 months of age

Hypothesis 2a: Compared to mothers of the control area, child feeding and hygiene scores in mothers of the intervention area will be significantly higher over the 12-month follow-up. Child feeding and hygiene scores includes the following: (1) current breastfeeding score, (2) meal frequency score, (3) dietary diversity score, (4) hand washing score, and (5) composite feeding score_1 (involving currently breastfeeding, meal frequency and dietary diversity), and composite feeding score_2 (involving meal frequency and dietary diversity).

Specific aim 3: To evaluate the program impact pathway (PIP) through which the CPNP program improves child feeding and hygiene practice and child growth, through five key pathway components: (1) quality of implementation process of CPNP program, (2) CPNP participants' program acceptance, (3) CPNP participants'

message recall, (4) child feeding and hygiene practices, and (5) influence of CPNP program on the exposure to ENA and CMAM programs

Hypothesis 3a: Percentage dose delivered, percentage dose received, and percentage fidelity to the protocol will be greater than 70% of total expected level.

Hypothesis 3b: At least 70% of CPNP participants will show positive program acceptance (e.g., active participation at the sessions, material contributions, and favorable perceptions of the sessions).

Hypothesis 3c: CPNP participants will recall each discussion message and food ingredient at a 70% level.

Hypothesis 3d: Compared to the non-participants in the intervention area, child feeding and hygiene practices will be better among CPNP participants at the program initial stage.

Hypothesis 3e: Compared to the mothers in the control area, mothers in the intervention area will be more involved in the ENA program over the 12-month follow-up.

1.2 SUMMARY OF DISSERTATION CHAPTERS

This dissertation consists of seven chapters including this Introduction Chapter. The next chapter (Chapter 2) provides a comprehensive literature review on current situation analysis of child undernutrition in developing countries, research findings of complementary feeding trials and Positive Deviant Hearth programs, and process evaluation studies, including cases of program impact pathway studies for nutrition programs in underdeveloped settings. Lastly, the maternal and child nutrition situation and current information of CMAM and ENA programs are reviewed.

Chapter 3 describes the methods of this dissertation study in detail, including the study settings and population, randomization procedure, intervention, sampling strategy, data collection procedures and data management, Institutional Review Board process, and approaches of statistical analysis.

Chapter 4 (Paper 1) presents findings on the effectiveness of the CPNP intervention in improving child growth among children 6 to 24 months of age. The results show that the CPNP program significantly improved monthly LAZ, WAZ, and WLZ among children in the intervention area compared to the control area; however, no significant effect was found on reducing the risk of stunting, underweight, or wasting. The target journal for this last paper is the *American Journal of Clinical Nutrition*.

Chapter 5 (Paper 2) presents findings on the effectiveness of the CPNP intervention in improving child feeding and hygiene practices among caregivers. The results show that the CPNP program significantly improved meal frequency and composite feeding scores among mothers of children 6 to 24 months of age in the intervention area compared to mothers in the control area; however, there was no significant improvement in breastfeeding, dietary diversity, or hand washing. The target journal for this second paper is the *Journal of Nutrition*.

Chapter 6 (Paper 3) presents findings on the PIP analysis of the CPNP program. The program was implemented with adequate dose, receipt and fidelity compared to expectation at the design stage. Program contributions and perceptions among

participants was high, and discussion messages in the program were well-recalled. A positive influence of enhancing the ENA program was identified. The target journal for this paper is the *Journal of Nutrition*.

Chapter 7 concludes this dissertation by summarizing the main findings of the study and discussing program implications and further study areas, and strengths and limitations. This chapter also offers recommendations for future community-based nutrition interventions targeting young children for civil societies and Ethiopian government.

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CHAPTER 2. LITERATURE REVIEW

This chapter describes the following: the global situation of child undernutrition and its consequences, infant and young child feeding in low income countries (LIC), study results of complementary feeding trials related to nutrition education/counselling in LIC, and examples of process evaluation studies focusing on program impact pathway (PIP) analysis for nutrition interventions. Last, the child and maternal nutrition situation in Ethiopia and ongoing programs of Essential Nutrition Action (ENA) and Community-based Management of Acute Malnutrition (CMAM) in Ethiopia are described.

2.1 CHILD UNDERNUTRITION: GLOBAL PERSPECTIVES

In 2013, globally, 161.5 million (24.5 %) children under five year of age were estimated to be stunted [height-for-age z score (HAZ) < -2], 98.9 million (15.0%) were underweight [weight-for-age z score (WAZ) < -2], and 50.8 million (8%) were wasted [weight-for-height z score (WHZ) < -2] (1). Stunting, underweight, and wasting frequently are found together (2), and most countries experience some combination of under-five undernutrition (3).

Childhood undernutrition is multifactorial but inadequate dietary intake and/or infectious diseases are the immediate causes (4). A lack of sustainable access to safe foods with sufficient quality and quantity, inappropriate health systems and unhealthy environment, and inadequate maternal and child care as underlying causes adversely affect dietary intake and infection conditions. Fundamentally, social and political structures at national and societal levels are distal factors that lead to undernutrition at national and societal levels (4).

Child undernutrition is estimated to be responsible for 35% of child deaths and

11% of the total global disease burden in children under five years of age (5). Stunting, severe wasting, and intrauterine growth retardation account for 2.2 million deaths; combined, they accounted for 21% of global disability-adjusted life-years (DALYs) of preschool children (6). Micronutrient deficiencies of vitamin A, zinc, and iodine are unacceptably high in developing countries as well. Vitamin A and zinc deficiencies were associated with 0.6 million and 0.4 million deaths, respectively, and together account for 9% of lost DALYs in childhood (6).

The most rapid physical growth in life occurs from conception through 24 months of age (7). Sub-optimal feeding practices, morbidity resulting from persistent infections, and enteropathic conditions lead to increased risk of growth faltering and micronutrient deficiencies (8, 9). Mortality in children who were stunted and underweight was more than three times greater than mortality among well-nourished children [Hazard Ratio (HR) 3.4, 95% CI: 2.6, 4.3]. This risk increases more than 12-fold (HR 12.3, 95% CI: 7.7, 19.6) among children who were stunted, underweight, and wasted (2). Populations born with low birth weight and those undernourished in childhood have a higher risk of lifelong disadvantages such as developing chronic diseases including cardiovascular diseases, mental illnesses, and may suffer deficiencies in cognitive development, reproductive performance, intellectual ability, and future economic productivity (10). There is inequality in stunting prevalence based on socioeconomic status. In a study, stunting prevalence in the poorest quintile was 2.47 (range 1.00 to 7.64) times higher than in the richest quintile (9).

The period of 1,000 days from conception to 24 months of age is recognized as the most effective intervention period to mitigate the adverse effects of undernutrition; thus, evidence-based nutrition-specific interventions have been delivered with a focus on this period (11). The 2013 *Lancet* child and maternal under-

nutrition series identified a set of 13 evidence-based cost-effective interventions shown to be efficacious in small-scale trials (11). It was estimated that if collective implementation of these interventions were conducted on a large scale and with wide coverage in the 36 countries presenting high prevalence of growth faltering, the impact would turn out as a reduction of stunting by 36% at age 36 months, mortality by 25% between birth and 36 months, and DALYs related to stunting, severe wasting, intrauterine growth restriction, and micronutrient deficiencies by about 25% (12). As a global commitment to tackle this public health issue, the World Health Assembly targets to reduce by 40% the number of under-five stunted children from 171 million in 2010 to 100 million in 2025, and to reduce wasting to less than 5% (13).

Until now the underlying mechanisms of linear growth failure and its stunting-prevention interventions are not thoroughly defined (14). Growth failure appears across the life course, starting from the moment of conception. Approximately 20% of stunting is attributed to utero origins (15). Globally, almost 3 million infants were born preterm and small-for-gestational age. Using data from 19 birth cohorts, the risk of postnatal stunting increased markedly among infants born preterm (OR 1.93, 95% CI: 1.71, 2.18), SGA (OR 2.43, 95% CI: 2.22, 2.66) and SGA-preterm (OR 4.51, 95% CI: 3.42, 5.93), compared to infants born appropriate for gestational age and at term (15). Maternal height is associated with size at birth, child stunting at 24 months, and offspring height at all ages (correlations ranging from 0.15 to 0.55, $p < 0.001$) (16).

In developing countries, the average length-for-age z scores indicate approximately -0.5 among newborns after birth, and from 6 months of age presents a steep decline to around -2.0 by 18 to 24 months of age (17). Growth velocity of healthy infants is maximal between birth and 6 months of age (18).

There is a bidirectional interaction between infectious diseases, such as

diarrhea and pneumonia, and malnutrition (19). Frequent diarrhea episodes increased the risk of having pneumonia among undernourished child populations by a factor of 1.08 (95% CI: 1.00-1.15) (20, 21). Using data from two randomized controlled trials of vitamin A supplementation in Ghana and Brazil, differences in diarrhea episodes in the study groups showed strong linear association with differences in WAZ (21). Undernourished conditions may in part be related to reduced efficacy of oral rotavirus vaccines, and pneumonia immunization of children or immunization of pregnant women against influenza may offer benefits of improving child growth and reducing intrauterine growth retardation (19, 22, 23). In a study of seven infant cohorts, cumulative diarrhea resulted in a smaller but measurable decrease in linear growth. The average diarrhea burden (equivalent to 23 days per year) resulted in decrease of 0.38 cm (95% CI: -0.59, -0.17) in length at 2 years of age (24).

Environmental enteric dysfunction (EED) is characterized by villous atrophy and stimulated chronic inflammation (8, 25, 26). This subclinical condition results in reduced nutrient absorption and increased intestinal permeability, followed by endotoxin translocation into the systematic circulation in the body, stimulating chronic inflammation of the small intestine mucosa and IGF-1 suppression. EED may lead to growth faltering among those at the first 24 months of life, when the EED occurs concurrently in the marginal dietary intake environment of developing countries and high growth demand at this range of age.

Growth faltering starts from conception and dramatically increase until 24 months (17). Until now, the appropriate intervention period to address child stunting is considered as -9 to 24 months as a window of opportunity, with slight increase after 24 months of age and without recovery until ≥ 5 years of age (17). However, a recent study proposed the possibility of catch-up growth beyond 24 months and mid-

childhood, using longitudinal data from collaboration of the Consortium of Health Oriented Research in Transitioning (Brazil, Guatemala, India, Philippines, and South Africa), and data from rural Gambia (27). Another study, using longitudinal data in the Young Lives study, showed significant reduction from stunting prevalence at early age in four mid- and low-income countries; this growth recovery and failure was associated with household and community attributes (28, 29).

2.2 INFANT AND YOUNG CHILD FEEDING IN DEVELOPING COUNTRIES

Infancy and childhood is a period of continuing growth and development. The FAO/WHO/UNU recommendations for total energy requirements and energy requirements from complementary foods during infancy are based on longitudinal measurements of total energy expenditure from 76 US children (30); for infants at 6-8 months, 9-11 months, and 12-23 months of age, energy requirements were estimated to be ~600, ~700, and ~900 kcal per day, respectively (30). Given that energy intake from breast milk is 413, 379, and 346 kcal per day for each age group, the energy intakes required from complementary foods for each age group are 202, 307, and 548 kcal per day, respectively (Table 1). Assuming that meals are prepared with a minimum energy density of 1.0 kcal/g, children in all age groups would need at least three meals per day to have enough energy from complementary foods (Table 2); however, specific guidelines are needed regarding the effect of energy density and feeding frequencies of complementary foods on breast milk consumption. Increasing energy density in complementary foods is likely to decrease feeding frequencies of foods and breast milk consumption (31).

Table 2.1 Energy requirements according to age group, as presented in the WHO/UNICEF 1998 publication and in recent longitudinal studies of US children (30)

Age group (mo)	Recommended feeding frequency of complementary foods		Total energy requirement (kcal/day)*	Energy intake from breast milk (kcal/day)	Energy required from complementary foods (kcal/day)
	no. of meals per day	no. of snacks per day			
6-8	2-3	1-2	615 (~600)	413	202 (~200)
9-11	3-4	1-2	686 (~700)	379	307 (~300)
12-23	3-4	1-2	894 (~900)	346	548 (~550)

*US longitudinal data

Table 2.2 Minimum daily number of meals required to attain the level of energy needed from complementary foods with various mean energy densities for children with low level of breast milk energy intake, per age group (30)^b

Energy density (kcal/g)	No. of meals		
	6-8 mo	9-11 mo	12-23 mo
0.6	3.7	4.1	5.0
0.8	2.8	3.1	3.7
1.0	2.2	2.5	3.0

Adequate infant and young child feeding (IYCF) practices are important as child growth is determined by an interaction between the individual's genetic potential, hormonal milieu, and the environment. Optimal breastfeeding and complementary feeding practices can save the lives of 1.5 million children under five years of age every year (6). WHO guidelines for infant and young child feeding practices include early initiation of breastfeeding within one hour of birth, exclusive breastfeeding for the first six months of life, and the introduction of nutritionally

^b Estimated total energy requirement is based on new US longitudinal data averages plus 25% (2SD). Assumed functional gastric capacity (30g/kg reference body weight) is 249g/meal at 6-8 months, 285g/meal at 9-11 months, and 345g/meal at 12-23 months.

adequate and safe complementary foods at six months, together with continued breastfeeding up to two years, and appropriate feeding practices in children 6 to 23 months of age such as measures of dietary diversity, feeding frequency, and the consumption of iron-rich or iron-fortified foods (Appendix 2.1) (32).

The global coverage of IYCF indicators was reported in two studies. A study using Demographic and Health Survey data of 46 developing countries pointed out that the coverage of many IYCF indicators is by and large poor, and requires effective nutrition strategies to promote recommended practices (5). On average about 36% of infants 0 to 6 months of age were exclusively breastfed, and about 60% of children received age-appropriate breastfeeding. Less than a third of children received nutritionally adequate and safe complementary foods with adequate dietary diversity. Half of children received the minimum number of meals that meet the feeding frequency criteria (5). While more than 70% of children in Latin America and Caribbean countries consumed at least 4 food groups on the day before the survey, only about 30% of children in Asia and African countries could meet this standard. The proportion of breastfed children 6 to 23 month of age consuming a minimally acceptable diet, defined as receiving at least the minimum dietary diversity and the minimum meal frequency during the previous day, was only 21% in 41 developing countries, particularly fewer children (~15%) in countries of the African region met the minimum criteria. As such, global strategies to promote IYCF practices that are grounded on the specific context are called for in developing countries.

Exclusively breastfeeding for the first six months after birth is not associated with improved height-for-age z scores (33). Another study examining 7 IYCF practices in 28 countries using the Multiple Indicator Cluster Survey 3 (MICS3) pointed out that not only are feeding practices varied across developing countries, but

improved conditions of development or education in countries have also not been translated to improved feeding practices (34, 35).

IYCF indicators showed an association with child anthropometry in a few studies. In a study with pooled data from 14 low-income countries to assess the overall average effect of the WHO IYCF indicators on child anthropometry, consumption four or more diverse food groups reduced risk of stunting (OR 0.79, 95% CI: 0.72, 0.86) and underweight (OR 0.78, 95% CI: 0.71, 0.86) (35). Moreover, timely solid food introduction at 6 to 8 months was associated with reduced underweight (OR 0.52, 95% CI: 0.44, 0.62) and stunting (OR 0.50, 95% CI: 0.41, 0.60), and iron-fortified food consumption showed association with both stunting (OR 0.82, 95% CI: 0.76, 0.89) and underweight (OR 0.83, 95% CI: 0.77, 0.90) (35).

In eight studies—using recent Demographic and Health Surveys data from a total of 9 countries in sub-Saharan Africa, Asia, and the Caribbean—diet diversity and overall diet quality indicators showed positive association with HAZ in Bangladesh, Ethiopia, India, and Zambia ($p < 0.05$). In Bangladesh and Zambia, complementary feeding indicators were not associated with WHZ, but exclusive breastfeeding for the first 6 months after birth was associated with greater WHZ ($p < 0.05$) (36).

2.3 CHILD FEEDING INDEX

Child feeding indices (CFIs) using data related to infant and young child feeding indicators were first proposed by Ruel and Menon (37). A few indices of child feeding were designed according to the existing holistic feeding practices, and the associations between the child feeding indices with child growth and energy and micronutrient intake were examined in a few African and Asian countries including Ethiopia (37-41). As a whole, child feeding indices showed positive association with

height-for-age and weight-for-age z scores, but the association with weight-for-height z score was not clear. In general, five types of indicators—breastfeeding, dietary diversity based on 7-8 food groups in the past 24 hour, meal frequency, bottle feeding, and foods group frequency in the past week—were used to construct CFIs (37). Based on the contexts, Ma et al. used food consistency as an indicator to construct a summary index instead of bottle feeding. Sawadogo et al. used the number of foods consumed in the past 24 hours instead of food group frequency in the past 7 days (38, 39). For the food group frequency in the past, it was reasonable that dietary diversity scores based on 24-hour recall examined five times, once every three months, could replace the contribution from food group diversity based on 7-day recall because this indicator is considered an indication of a relatively long period of food consumption. In a previous study examining CFIs in Ethiopia, the viability of using dietary diversity based on 24-hour recall instead of 7-day recall was mentioned (42). Another study using CFIs in Ethiopia evaluated feeding practices for HIV-exposed infants; the CFI showed weak correlation between current breastfeeding status and bottle feeding (40). While most studies were based on rural and urban settings, a CFI study was conducted in a metropolitan area in China (43). Notably few longitudinal CFI studies were available, and all studies were adapted with Moursi et al.'s method to construct a longitudinal index (43, 44).

2.4 COMPLEMENTARY FEEDING TRIALS

A few studies examining the impact of various behavior change communication (BCC) strategies on child nutritional status and caregivers' feeding practices contributed to increasing the coverage of IYCF indicators as well as the understanding

of facilitating and impeding factors in implementing interventions in various contexts (45-47).

Those BCC strategies deliver interventions involving multicomponent, contextualized nutrition messages, and communication channels (47, 48); main target groups are mostly caregivers with children 6 to 24 months of age. The nutrition services were delivered by the following: mentor/peer mothers, community health workers, doctors, health care providers, and influential family members. Interventions included individual counseling through home visits or health center visits, group education, food preparation and demonstration, messages delivery with or without food supplements, and mass media. The intervention periods and frequencies varied by study. Some interventions were entirely embedded in the existing health system, as a consequence, potentially strengthened local health capacity (49, 50). Nutrition messages were specifically grounded on IYCF guidelines but contextualized to be culturally acceptable and applicable to caregivers in a few studies as appropriate. Their impact on outcomes were largely encouraging, which resulted in better accomplishment in changes in caregivers' knowledge and practices and child growth (47). Shi et al. suggest that effective educational interventions should include designing culturally appropriate educational messages, training effective communication skills of health providers, involving various community and household members as providers as well as beneficiaries, and making use of existing health-providing services or social groups (47).

Caulfield et al. reviewed complementary feeding trials and programs published between 1970 and 1997 (45). Of those, five efficacy trials and four programs showed an increase in total energy intake: 65 to 399 kcal per day and 71 to 164 kcal per day, respectively. Improvement in child growth rates was between 0.1

and 0.5SD. A systematic review with 17 studies by Imdad et al. showed that the provision of appropriate complementary foods with or without nutritional counseling led to an extra gain of 0.25 kg (\pm 0.18) in weight and 0.54 cm (\pm 0.38) in height in children aged 6 to 12 months, whereas education about complementary feeding resulted in an extra gain of 0.30 kg (\pm 0.26) in weight and of 0.49 cm (\pm 0.50) in height (46).

The previous studies showed promising effects of interventions to promote complementary feeding through various behavior change communication channels on HAZ and WAZ (46, 51). Education on complementary feeding only (fortified or unfortified, but not micronutrients alone) resulted in significant increases in HAZ [standard mean difference (SMD) 0.23, 95% CI: 0.09, 0.36] and WAZ (SMD 0.16, 95% CI: 0.05, 0.27) (46, 51). For the studies in food insecure conditions, only education on CF resulted in improvement of HAZ (SMD 0.25, 95% CI: 0.09, 0.42, 1 study) (52) and WAZ scores (SMD 0.26, 95% CI: 0.12, 0.41, 2 studies) (52, 53), and reduced the rates of stunting [Relative Risk (RR) 0.68, 95% CI: 0.60, 0.76, 1 study] (52).

Interventions, implemented in food secure populations in Peru, Brazil, and China, produced improved dietary intake, feeding frequency, and better weight gain or height gain (49, 50, 54). One of the outstanding aspects in common in these studies was the introduction of weaning food recipes and providing information about use of locally available animal food sources. Environments with variable food choices were likely to favor the approach of promoting the use of nutrient-dense complementary foods. The study in Peru strengthened the nutrition advice provided by health centers and emphasized affordable nutrition messages about the use of specific foods and responsive feeding to children (49). Nutrient-dense thick foods were found to be

utilized greater in intervention children than in children in control communities (31% vs. 20%, $p = 0.03$), and the prevalence of stunting was lower in intervention communities than in control communities (16% vs. 5%, AOR 3.04). Children in the intervention area had more energy intake from complementary foods, consumed more animal foods, iron, and zinc; however, there was no significant difference in 24-hour recall-based feeding practices by the two groups.

In a group educational study in China, healthcare providers led the group sessions, emphasizing animal foods use through food preparation and demonstrated weaning foods (50). The intervention improved the percentage of consumption of meats or organ meats (96.9% vs. 58.2%, $p < 0.001$), beans (92.1% vs. 67.2%, $p < 0.001$), yellow and orange foods (97.2% vs. 76.7%, $p < 0.001$), and the number of more meals over the year of follow-up. Intervention children consumed significantly more meals at 6, 9, and 12 months than the control group, but had small changes in weight gain. In the Brazil study, trained doctors in health centers administered nutrition counseling to mothers about nutritional values of animal protein, micronutrient rich foods, and recipes to increase nutrient density in complementary foods (54). The doctors' intercommunication skills and knowledge were favored by community caregivers, and mothers in the intervention reported superior knowledge and recall of recommended guidelines than mothers in the control group.

On the other hand, in the food insecure settings, strategies attempting to improve caregivers' behaviors—especially with regards to complementary feeding practices—had moderately encouraging results. In a study in India improving health workers' communication skills and performance, the energy intake from complementary foods was higher in the intervention children at 18 months of age (3807 ± 1527 vs. 2577 ± 1058 kJ; $p < 0.001$) than in the control children (55). In other

randomized controlled trials in India, feeding education improved the mean daily feeding frequency (e.g., being fed solids at least four times a day) (OR 4.35, 95% CI: 1.96, 10.00) (53) or increased the receiving diet with diverse foods (OR 3.23, 95% CI: 1.28, 7.69) (56).

In a study in Pakistan, which examined the effect of the Integrated Management of Childhood Illness (IMCI) module—'Counsel the mother'—by trained health workers, the intervention children were given more eggs ($p = 0.043$) and more frequently thick *kitchuri* ($p = 0.044$), and show better HAZ scores ($p = 0.012$), compared to non-intervened children (57). A study in Bangladesh compared the effect of three months Intensive Nutrition Education (INE) and the INE plus SF (supplement foods with 300 kcal energy intake and 8-9g protein in addition to INE) on the rehabilitation of malnourished children (56); a higher proportion of recovered children and improved WAZ scores during follow-up periods were found in the intervention groups than in the control groups ($p < 0.001$). The *Philani* program, a paraprofessional home visit program in South Africa, which involved mentoring mothers in their own community, showed a significantly greater proportion of rehabilitated children in the intervention group than in the control group by three months (43% vs. 31%; $p < 0.01$) (58). In a study in Iran, family members were instructed together with caregivers about food preparation and cooking practices, which resulted in significant improvement in child nutritional status ($p < 0.05$) (59). Studies that enhanced responsive feeding practices led to optimistic results. A few trials in Bangladesh showed overall positive consequences on child language and developmental indicators as well as on weight and height gain (60-62).

Meanwhile, nutrition educational strategies proven to be efficacious may not necessarily translate to positive outcomes in programmed settings. The Community

Nutrition Project (CNP) in Senegal indicated instead that the control zone had a greater decrease of 5.1% in child wasting, compared to a 0.5% decrease in the intervention zone ($p < 0.05$) (63, 64). In the absence of an appropriate control group, nutrition program settings, engaging multi-intervention components, may have limitations in interpreting program effects.

2.5 POSITIVE DEVIANT HEARTH PROGRAMS

The Positive Deviant (PD) Hearth approach uses an intensive behavioral change intervention, targeting families of children with malnutrition to introduce the locally-discovered PD practices as well as to promote other practices essential to child health. The PD Hearth approach is based on the premise that there are individuals who share the same poor socioeconomic characteristics as their community members but manage to find ways to overcome barriers and actually practice positive behaviors without external interventions (65). In 1976, Wishik described an approach that identified deviant behaviors, which are affordable, acceptable, and sustainable, practiced by the caretakers of well-nourished children from poor families and suggested transferring such positive practices to other community members in the community with malnourished children (66). The term ‘Positive Deviance (PD)’ was first used by Zeitlin in 1990 (67). Hearth programs were originally modified versions of the Nutrition Demonstration Foyer (NDF) program that originally evolved from Mothercraft Centers in Haiti, where volunteer mothers prepared and fed meals to malnourished children in outdoor kitchens. In the 1990s, the concept of PD was combined with Hearth sessions—called PD Hearth programs—and were implemented in Haiti, Bangladesh, and Vietnam (68).

Since then, PD Hearth approaches have been implemented by international NGOs and governments in developing countries and have shown overall positive impact on child nutritional status (65, 69). The Nutrition Working Group, Child Survival Collaborations and Resources Group [CORE] produced the PD Hearth approach manual that includes critical steps in program implementation (70): The manual grouped PD behaviors/practices into four categories: child feeding, child caring, hygienic and health-care seeking practices. PD foods investigated are used to rehabilitate underweight children by encouraging mothers to prepare complementary foods.

A systematic review of the PD Hearth approach represents the largely positive influences of PD Hearth with mixed results of program effectiveness in reducing child malnutrition (69). The PD Hearth approach sustained and was able to prevent malnutrition cases among younger siblings of participating children. The program sensitized the communities to child undernutrition and helped the communities build the capacity to secure the well-being of children using affordable and available resources (71).

A randomized trial in Vietnam, prospectively following up to 120 children each in comparison and intervention groups for 12 months (72, 73); however, during the follow-up, children who were younger (<15 months) and more malnourished at baseline indicated on average far less drop of WAZ scores in the intervention group than counterpart children in the control group. The intervention children consumed a greater amount of foods (409.8g vs. 340.3g; $p < 0.01$), showed higher meal frequency (4.4 vs. 4.9; $p < 0.05$), and had more energy intake (826.9 kcal vs. 718.4 kcal; $p < 0.05$) than control children at the 12-month follow-up (74).

Sibling studies suggested a sustainable impact of interventions using the PD

Hearth approach. In Vietnam, after 3 to 4 years of cessation of the Community Empowerment and Nutrition Project (CENP), younger siblings of participants were significantly better nourished than those in the comparison group, with better WAZ scores (1.82 vs. 2.45; $p = 0.007$), WHZ scores (0.71 vs. 1.45; $p < 0.001$), and HAZ scores (2.11 vs. 2.37; $p = 0.4$) (71).

In another sibling study in Indonesia, low underweight prevalence was observed among younger siblings of children who were intervened in a previous program than comparison sibling children (22% vs. 43%, p value not reported) (75); however, a study of the impact on younger siblings' nutritional status in Rwanda had no significant difference (76).

In non-randomized trials, one study in Haiti reported no significant differences in nutritional status between study groups (77), but in another study in Haiti, intervened children continued catch-up growth through month two and six (40% and 60%, respectively) (78).

In a study with 100 family in India, some identified factors associated with determinants of positive deviants were maternal autonomy in decision (OR 7.3, 95% CI: 2.1, 25.5), family happiness on child birth (OR 2.8, 95% CI: 0.9, 9.9), psychosocial care, and home environment (OR 2.8, 95% CI: 0.8, 10.8), and mothers keen to learn new things (OR 2.9, 95% CI: 0.9, 9.4) (79). This result indicates that family support and mothers' efficacies are very important determinants of growing well-nourished children even in poor communities.

PD Hearth interventions are likely to have a promising impact on improving child feeding and caring behaviors among mothers, ensuring child nutrition in households and at community levels, and mobilizing community resources to combat child undernutrition, but comprehensive and rigorous studies are still needed. Bullen

suggested a need for studies using a robust study design with larger sample size, examining the extent of community participation specifically (69). Studies will also be needed to identify factors that may facilitate or impede program sustainability, track changes in the intervened community over the longer period regarding women's empowerment, and other health outcomes, considering the connectivity with other development programs.

2.6 PROCESS EVALUATIONS IN NUTRITION INTERVENTIONS

Process evaluation in randomized controlled trials is commonly conducted in health promotion programs, but implementation data often remain descriptive and lack of systematic data collection methods without appropriate guidelines. Despite promising findings of nutrition interventions in improving child growth and healthy practices of caregivers, what and to what extent interventions were implemented, modified, and accepted remains unexamined in most community-based programs. Lack of understanding in the implementation process may result in considerable trial and error of implementing parties, especially government health departments and civil societies, in scaling up nutrition schemes of behavioral change to other similar settings. Process evaluation of the complex programs at scale is particularly important to open the “black box” of programs, to understand how programs are operationalized, and how success and failure of their impact and mechanisms are involved (80-82). Until now, only a few process evaluation studies have examined the implementation processes of complementary feeding trials based on BCC strategies, demonstrating the adequacy and feasibility of these interventions (83-85). The Alive & Thrive project targeted to improve infant and young child feeding practices (IYCF) in Bangladesh, Ethiopia, and Vietnam described detailed mechanisms of theory-driven process evaluation,

which provide useful information for future process evaluation in large-scale nutrition programs. Mixed methods involving quantitative and qualitative methods were used, and data collection was simultaneously carried out in control and intervention groups.

Program impact pathways (PIP) were examined in Vietnam and Bangladesh (86, 87). Program impact pathway (PIP) analysis one of methodological approaches to carry out process evaluation (88). In a 2008 WHO/UNICEF meeting, the term *program impact pathway* (PIP) was defined as “the pathway from an intervention input through programmatic delivery, household and individual utilization to its desired impact” (89). PIP analysis focuses on the causal mechanisms of programs and the intention to move beyond static input-out program models. Sparse documentation and use of program theories are available in nutrition intervention programs; however, there is growing interest and greater awareness of the need to understand causal mechanisms and pathways of intervention programs. Cases of PIP analysis highlight the importance of designing a program theory framework and assessing the components that lie along the primary program impact pathways to optimize program service delivery and utilization. This study underscores the importance of including process evaluation that will lead to the development and implementation of more effective nutrition interventions. The PIP model of Conditional Cash Transfer (CCT) was developed and evidence was synthesized regarding child nutrition. They found gaps in knowledge about the mechanism of improving nutrition by CCT programs (90). The Alive & Thrive project evaluated program process using program impact pathways. A BCC intervention implemented in Bangladesh attempted to improve infant and young child feeding (IYCF) practices. A PIP analysis showed the capacity of the implementation staff and the extent of fidelity to the intervention; facilitating factors such as family support and barriers including lack of resource were described

(86). The Alive & Thrive (A&T) social franchise model that attempted to improve infant and young child feeding (IYCF) practices in Vietnam indicated its effective management of the franchise system and challenges in service utilization (87). In an RCT study in Peru, where health personnel delivered the multicomponent intervention as part of usual care in the government health centers, using process indicators such as the extent of delivery dose, fidelity to intervention protocol, barriers to implementation and context were assessed; they quantified the extent of program implementation and quality. The process evaluation demonstrated additional benefits to existing government programs by the intended interventions (91). In the same context, they conducted a pathway analysis and found significant determinants to the improvement outcomes such as health center implementation, caregiver exposure, and caregiver message recall (83). Using a program theory framework, the Homestead Food Production program in Cambodia did a PIP analysis and found program components delivered as planned and utilized, and identified program gaps in the pathway to reduce program impact and, based on the process results, suggested increasing some intervention components to improve impact (92).

2.7 NUTRITION SITUATION ANALYSIS IN ETHIOPIA

2.7.1 Child and maternal undernutrition in Ethiopia

In 2009 more than six million Ethiopian children under five years of age suffered from growth retardation, accounting for 3.5% of the total stunted children in the developing world (93). Prevalence of stunting, wasting, and underweight was estimated to be 44.4%, 9.7 %, and 28.7% in preschool children, respectively (94). In Ethiopia, causes for the 321,000 deaths of children under five years of age were attributed to neonatal deaths (33%), pneumonia (22%), diarrhea (17%), malaria (6%),

and HIV/AIDS (4%), which accounts for one third of under-five deaths in Ethiopia (95). The under-five child mortality in Ethiopia has been reduced from 184 deaths per 1,000 births in 1,990 to 106 deaths in 2,010 at a 6.6% yearly reduction rate. The overall prevalence of stunting and wasting has gradually declined, but inequality in providing health programs has resulted in disproportionate malnutrition prevalence between slum urban and rural areas, and between male and female children (95).

According to data from the Ethiopia Demographic Health Survey (EDHS) 2011, the increase in undernutrition begins in the first 4 to 6 months after birth. HAZ scores of children at birth were close to the mean value of the reference population. Later, the trajectory of HAZ scores decreased sharply at 4 to 6 months of age until 24 months of age, so it eventually reached two standard deviations below the mean of the reference population, which is in line with the period that exclusive breastfeeding ends and the transition to complementary feeding begins (94).

Determinants of undernutrition in Ethiopia have been found to have the following multifaceted features, ranging not only from household food shortages caused by droughts (96), but also from complex causes: suboptimal child feeding and caring practices (97-99), nutritionally inadequate diets including micronutrient-absorption inhibitors (99), maternal poor nutritional status (100), not completing immunization (101), poor access to and utilization of community health services (102-104), non-availability of latrine and unprotected water sources (105), poor housing conditions (105), malaria (106), seasonal variation (107), and low socioeconomic backgrounds (96, 108).

Maternal mortality decreased from 950 deaths in 100,000 live births in 1990 to 350 deaths in 2010 in Ethiopia (95). Approximately 22,000 Ethiopian women lost their lives in 2005 due to hemorrhage (34%), sepsis/infection including AIDS (16%),

and hypertensive disorders (9%). Statistical data indicate that poor access to health services, low utilization of postnatal care and lack of trained health work forces resulted in deteriorating maternal health outcomes (98). Only 28% of mothers could get access to antenatal care by skilled health providers at least once during pregnancy, and only 6% of deliveries were attended by skilled health providers, and 89% of pregnant women did not take iron supplements during pregnancy period (95). Women of child bearing age experienced chronic shortage of macro- and micronutrient deficiencies including iron, zinc, vitamin A, vitamin B12, and folate (109, 110). Besides, the underlying causes for women's poor nutrition status may include low socioeconomic status because the majority of them were engaged in subsistence farming and grain-based diets deficient in animal food sources (111).

Vitamin A, iron, zinc, and iodine deficiencies and their clinical signs are widespread in Ethiopian children and women of reproductive ages. Despite the inconsistent statistical data, vitamin A deficiency among children and women is apparent. One report indicated that nationally 1.7 % of the children had Bitot's spots and 37.7 % of the children had deficient serum retinol levels (95% CI: 35.6, 39.9) (112). Approximately 62 % of the 6,762,000 children were vitamin A deficient (defined by serum retinol $<0.70 \mu\text{mol/L}$), and 4.8% of the children (530,000) had xerophthalmia, which is the highest prevalence in the world (113). Inadequate dietary consumption of vitamin A and/or suboptimal use of the nutrient in the body mainly contribute to causes of vitamin A deficiencies. Clinical vitamin A deficiency was significantly associated with male-child, older age, or rural residence ($p < 0.05$) (112). High subclinical vitamin A deficiency was also associated with low levels of maternal awareness of vitamin A deficiency, and not receiving vitamin A supplement over the year (114). Alongside, the coverage of pneumonia treatment coverage rate by

appropriate healthcare providers was only 19%, and the proportion of children treated with oral rehydration salts has declined from 38% in 2000 to 15% in 2005 (115). The vitamin A supplementation coverage rate was only 58% in 2005, which increased from 16% in early 2000. Anemia was prevalent among 54% of the preschool children and 71% of children under two years of age (94).

Micronutrient deficiencies in Ethiopia were associated with consumption of indigenous plants. Grain-based monotonous diets with high phytate prevent children from consuming enough micronutrients for balanced growth. On the other hand, some staples help children not to become micronutrient deficient. A survey in 1996 indicated that people consuming Enset (*Ensete ventricosum*) had the lowest occurrence of Bitot's spot and night blindness, followed by grain-croppers, cash-croppers, and those living in pastoral areas (101). Teff (*Eragrosis teff*), high iron, and zinc-containing grain, is generally used as a staple food in Southern Ethiopia where zinc and iron deficiencies are reported to be low (116). Across the country, the percentage of households consuming adequately iodized salt is estimated to be 15%; 13% in rural households and 23% in urban households (94). Besides, anemia is found to be associated with poor human waste management, lack of safe drinking water, and lower women's educational status (117). Zinc deficiency is prevalent in Ethiopia. Zinc is provided to infants during the first 6 months through exclusive breastfeeding (118). Afterward, an amount of only one-sixth of the zinc requirement is met through breast milk; as a result, additional zinc needs to be obtained primarily through complementary foods. Low serum zinc concentration adversely affects the cognition of pregnant mothers in South Ethiopia (119). In a randomized controlled study of zinc supplementation, stunted children showed significantly more increase in length

(mean±SE: 7.0 ± 1.1 cm, $p < 0.001$) than stunted children in the placebo group (2.8 ± 0.9 cm) (120).

2.7.2 Infant and young child feeding practices in Ethiopia

In Ethiopia, the proportion of exclusively breastfeeding for the first 6 months after birth was 52% in 2011(94). Fortunately, the exclusive breastfeeding rate for the first 6 months after birth is higher compared to other African countries with similar under-five child mortality (93). At 6 to 9 months of age, only half of the children received complementary foods. The proportion of minimum acceptable diet for breastfed children was only 21%, and only 5% of children 6 to 23 months of age fulfilled minimum standards with respect to food diversity (94). The environment, where available food resources are few, used to impose constraints on preparing diversified and enough amounts of food for infants and young children. Responsive feeding is commonly practiced by the caregivers in some districts (121). Pre-lacteal feeding, a complementary diet started at 12 months of age or beyond, bottle-feeding, and maternal illiteracy were reported as major risk factors that increase the occurrence of stunting (97, 122). The fact that stunted preschool children were observed even in food surplus areas underscored the importance of adequate feeding practices (100).

Ethiopian mothers' knowledge and beliefs towards breastfeeding and complementary foods are not well known. Nevertheless, few studies have pointed out current barriers in promoting infant and young child feeding and caring practices. Colostrum was often discarded as it was considered to cause abdominal problems, and ritual pre-lacteal feeding was often reported (122-124). In some districts, caregivers recognized colostrum (inger) and breast milk (yetut wotet) as different substances (122). While maternal knowledge about the nutritional value of human milk and

breastfeeding duration was overall sound, the majority of mothers preferred not to breastfeed during illness of mother or child (123). Some mothers began the introduction of weaning food at the child's age of 4-6 months, mainly because the mothers believed that the reduction of the amount of breast milk and the child's age would be adequate to start weaning food (124). As such, potentially harmful beliefs, which could lead to the detrimental health outcomes, should be well-addressed through culturally tailored and context-specific behavior change communication strategies that promote immediate colostrum feeding and discourage pre-lacteal feeding.

2.7.3 Essential Nutrition Action (ENA) and Community-based Management of Acute Malnutrition (CMAM) programs in Ethiopia

The ENA framework was initiated by the USAID-funded BASICS project in 1997, and was implemented in developing countries including Madagascar and Ethiopia under the USAID-funded LINKAGES Project of the Academy for Educational Development (AED)(125, 126). The ENA operational framework uses an integrated package of preventive nutrition actions including IYCF, micronutrients, and women's nutrition. Delivering strategies included interpersonal counseling, community mobilization, and mass media at variable contact points such as antenatal and postnatal care, immunization sessions, and healthcare service during child illnesses (126). A peer reviewed ENA framework study in Madagascar reported collectively positive impacts (127). After five years of implementation, the rate of exclusive breastfeeding in the first 6 months after birth increased from 42% to 70% ($p < 0.001$), and the rate of feeding children the minimum recommended number of meals per day at 6 to 23 months increased from 87% to 93% ($p < 0.001$). But behaviors such as

dietary diversity of complementary foods or appropriate feeding during child illnesses had non-significant changes. In 2008, the Ethiopian government launched its first-ever National Nutrition Strategy (NNS), primarily focusing on improvement of maternal and child nutritional status (128). As one of the key nutrition activities of the NNS/NNP, the Essential Nutrition Actions (ENA) program was expected to promote and support the prioritized nutrition behaviors (128). Messages delivered through the ENA program included optimal breastfeeding, appropriate complementary feeding, care of sick children, importance of women's nutrition, control of vitamin A deficiency and anemia, and iodine deficiency disorders (129). In Ethiopia, the Volunteer Community Health Workers (VCHWs) supported by Health Extension Workers (HEWs) were the main deliverers of the ENA program at the Kebele^c level (130). In addition, the VCHWs were involved in other relevant health activities including antenatal care, preparation before delivery and prenatal care, family planning, immunization, and growth monitoring. The ENA program achieved significant improvement in breastfeeding practices, maternal diet, and vitamin A supplementation, but barely promoted complementary foods and hygiene practices in some districts in Ethiopia (125).

In 2011, the prevalence of severely acute malnourished children under five years of age was 2.8%, and the prevalence of moderately malnourished children was 6.9% (94). The population covered by the CMAM program was more than 40 million (131). The CMAM program was piloted in the year 2000 as part of a research program in Malawi, Ethiopia, and South Sudan, and a large-scale program was launched in response to the drought in 2003. National protocols for severely acute malnutrition case management are currently available (132). A total of 315 districts

^cThe smallest administration unit under district level in Ethiopia.

have either inpatient wards or Out-patient Therapeutic Programs (OTPs). Since 2002, the national capacity of the CMAM program has been expanded from treatment of 18,000 to treatment of 230,000 severely malnourished patients, and has reached 59% of health facility coverage (133). HEWs and VCHWs are trained for screening and referring acutely malnourished children. Government ownership and commitment was considered as the key to CMAM scaling up; however, systems are still needed to monitor and improve quality of service (131, 133).

Appendix 2.1 Infant and young child feeding (IYCF) indicators

Core indicators

Category	Indicators	Definition
Breastfeeding initiation	Early initiation of breastfeeding	Proportion of children born in the last 24 months who were put to the breast within one hour of birth
Exclusive breastfeeding	Exclusive breastfeeding under 6 months	Proportion of infants 0–5 months of age who are fed exclusively with breast milk
Continued breastfeeding	Continued breastfeeding at 1 year	Proportion of children 12–15 months of age who are fed breast milk
Introduction of complementary foods	Introduction of solid, semi-solid or soft foods	Proportion of infants 6–8 months of age who receive solid, semi-solid or soft foods
Dietary diversity	Minimum dietary diversity	Proportion of children 6–23 months of age who receive foods from 4 or more food groups
Meal frequency	Minimum meal frequency	Proportion of breastfed and non-breastfed children 6–23 months of age who receive solid, semi-solid, or soft foods (but also including milk feeds for non-breastfed children) the minimum number of times or more.
Summary infant and young child feeding indicator	Minimum acceptable diet	Proportion of children 6–23 months of age who receive a minimum acceptable diet (apart from breast milk).
Consumption of iron-rich or iron-fortified foods	Consumption of iron-rich or iron-fortified foods	Proportion of children 6–23 months of age who receive an iron-rich food or iron-fortified food that is specially designed for infants and young children, or that is fortified in the home.

Appendix 2.1 Infant and young child feeding (IYCF) indicators (continued)

Optional Indicators

Category	Indicators	Definition
Breastfeeding	Children ever breastfed	Proportion of children born in the last 24 months who were ever breastfed
	Continued breastfeeding at 2 years	Proportion of children 20–23 months of age who are fed breast milk
	Age-appropriate breastfeeding	Proportion of children 0–23 months of age who are appropriately breastfed
	Predominant breastfeeding under 6 months	Proportion of infants 0–5 months of age who are predominantly breastfed
Duration of breastfeeding	Duration of breastfeeding	Median duration of breastfeeding among children less than 36 months of age
Bottle feeding of infants	Bottle feeding	Proportion of children 0–23 months of age who are fed with a bottle
Milk feeding frequency for non-breastfed children	Milk feeding frequency for non-breastfed children	Proportion of non-breastfed children 6–23 months of age who receive at least 2 milk feedings

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CHAPTER 3. STUDY DESIGN AND METHODS

This chapter describes the study design and data collection methods of the effectiveness and process evaluation of a community-based participatory nutrition promotion (CPNP) program, which was added to the Essential Nutrition Action (ENA) and Community-based Management of Acute Malnutrition (CMAM) programs in rural Ethiopia. The following components are described: study setting and population, randomization procedure, study subjects, intervention, data collection instruments and schedule, data collection and statistical analysis.

3.1 OVERVIEW

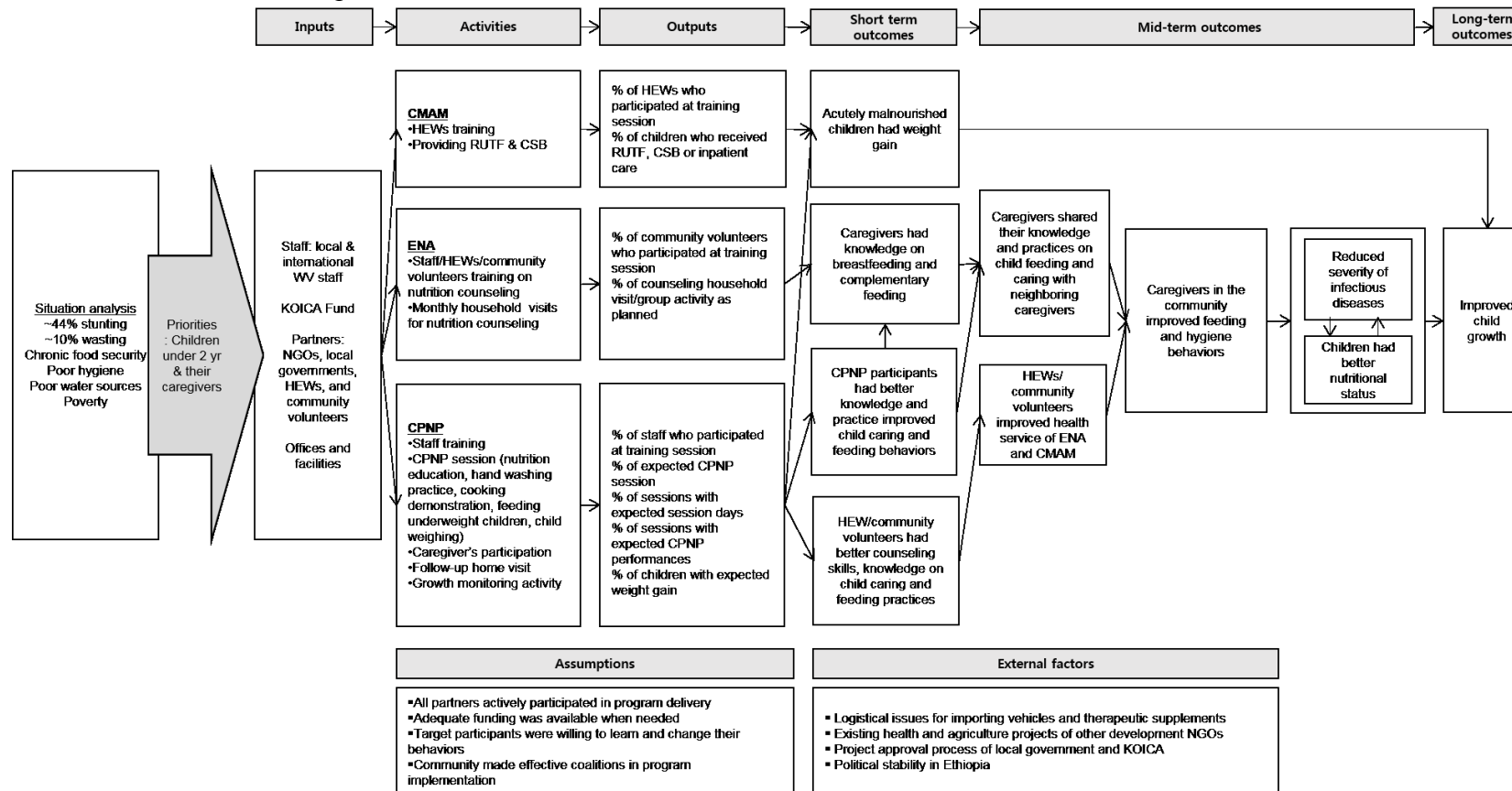
Appropriate complementary feeding and hygiene practices reduce the high burden of child stunting in developing countries (1, 2). A community-based Participatory Nutrition Promotion (CPNP) program using a two-week group nutrition session was designed to promote child feeding and hygiene and improve child nutritional status. We adapted CPNP program components from previous Positive Deviance Health interventions in developing countries (3). The CPNP program was added to the existing programs of the ENA and CMAM in two rural districts in Ethiopia.

The logic framework for the CPNP program is provided in Figure 3.1. The overarching goal of the proposed study was to evaluate the effectiveness of the CPNP program on child growth in children 6 to 24 months of age and child feeding and hygiene practices among caregivers in rural Ethiopia. In addition to the effectiveness evaluation, a program impact pathway (PIP) analysis of the CPNP program, was done by assessing: (1) quality of implementation process, (2) participants' program acceptance, (3) participants' message recall, (4) child feeding and hygiene practices

and child growth, and (5) influence on participation in the ENA and CMAM programs.

We conducted a randomized controlled trial in 12 community clusters in two rural districts – Habro and Melka Belo in Ethiopia; ENA and CMAM programs were implemented in 6 control clusters, and CPNP, ENA, and CMAM programs were carried out in their matched 6 intervention clusters. Out of the 2,064 child and mother pairs—randomly selected from a roster of children in the community aged 6 to 12 months of age—who were visited, 1,790 child and mother pairs, 914 in the control area and 876 in the intervention area, were enrolled in this study after obtaining informed consent. Every three months, children’s length and weight were measured, and the mothers were asked about their child feeding and hygiene practices using infant and young child feeding (IYCF) indicators (4). Every six months, the mothers were also asked about hand washing with soap. For process evaluation, we reviewed project records of 3,299 CPNP participants and checklist of activities used during 114 group session observations. In connection with the effectiveness evaluation, we also conducted a household survey every three(5) months of 914 and 876 mothers in the control and intervention areas, respectively, to ask about subjects’ exposure to the CMAM and ENA programs, including recall of messages provided during the counseling sessions among direct CPNP participants (n = 197).

Figure 3.1 Program logic model to describe expected input, activities, outputs, and outcomes of CPNP, ENA and CMAM programs, Habro and Melka Bello districts, Ethiopia



WV (World Vision); WITH (Wholistic Interest Through Health); KOICA (Korea International Cooperation Agency); ENA (Essential Nutrition Action); CMAM (Community-based Management of Acute Malnutrition); CPNP (Community-based Participatory Nutrition Promotion); RUTF (Ready-to-use Therapeutic Foods); CSB (Corn-Soy Blend); HEWs (Health Extension Workers)

3.2 STUDY DESIGN AND POPULATION

3.2.1 Ethiopia Integrated Nutrition Project (EINP) and the present effectiveness trial

The proposed study and involved nutrition programs were implemented under the Ethiopia Integrated Nutrition Project (EINP). The EINP was a 20-month-long project (January 2012 to August 2013) conducted by World Vision Korea, in collaboration with World Vision Ethiopia, Wholistic Interest Through Health (WITH, a Korean NGO) and the Ethiopian local governments, funded by ‘Air-ticket Solidarity Levy’^d (USD 13,000,000) from the Korea International Cooperation Agency (KOICA). Before launching the EINP in Habro and Melka Belo districts, the ENA and CMAM programs had been in part implemented through the Health Extension Program (HEP), supervised by district health offices, and financially and technically supported by Goal Ethiopia^e.

The weakness of the existing programs of Essential Nutrition Action (ENA) and Community-based Management of Acute Malnutrition (CMAM) was pointed out by World Vision staff; especially the absence of a prevention component in the CMAM program (6) and disorganized and poor nutrition counseling services by the community volunteers (7). It was suggested that the CPNP program, added to the existing program context of CMAM and ENA, would address some of the weaknesses of the existing programs and help promote caregivers’ complementary feeding and hygiene and eventually child nutritional status. The EINP was finally approved by the

^dIntroduced on September 30, 2007, the levy imposes a contribution of 1000 Korean won (approx. 1 USD) for each passenger departing from Korea. It is expected to raise annual revenue of around 20 million USD for Korea’s Official Development Assistance (ODA). KOICA uses this fund for various disease eradication and control initiatives, including contributions to the UNITAID (an international drug purchase facility), mainly in the African region.

^eInternational NGO which had worked in the Habro and Melka Bello districts. Since the launching of EINP, Goal Ethiopia handed over the role of supporting ENA and CMAM program to the EINP team.

Ethiopian Finance and Economic Development Ministry and Regional Health Bureau in April 2012 and phased out in August 2013 (Appendix B).

The current study was prepared by a Memorandum of Understanding (MOU) among World Vision Korea, WITH, and World Vision Ethiopia (Appendix A). Ms. Yunhee Kang led this study as a primary investigator with other investigators from World Vision Korea, World Vision Ethiopia, and WITH. The present trial was funded by World Vision Korea (USD 100,000, project number E197814).

3.2.2 Study area

This study was conducted in Habro and Melka Bello districts, Oromia Regional State in Ethiopia (Figure 3.2). The two districts are 150-180 km or more apart from each other. Both districts were selected for the EINP because these areas experienced food insecurity and had a high burden of child malnutrition and both ENA, and CMAM programs were being implemented here.

Habro district is located in the West Harargie zone of Oromia Regional State, 396 km from Addis Ababa (8). The district is an agrarian site of 722 km², consisting of 28 rural Kebeles and three towns. Agro-ecologically, it is divided into three categories: Low-land 22%, mid high-land 61% and high-land 17%. The district has an estimated total population of 191,546. The majority are Muslims (85%), followed by Orthodox Christian (14%) and other religious groups. Oromo is the dominant ethnic group consisting of 75% of the total population, with the remaining 25% being the Amara and others. Cultivable land is about 38% out of the total land, with 13% degraded/unproductive land, 43% bush and grass land, 6% forest. Immunization coverage reaches 58% and potable water coverage is 24.5%. The average distance to the nearest potable water source for the households is ~2.5 km. Melka Bello district is

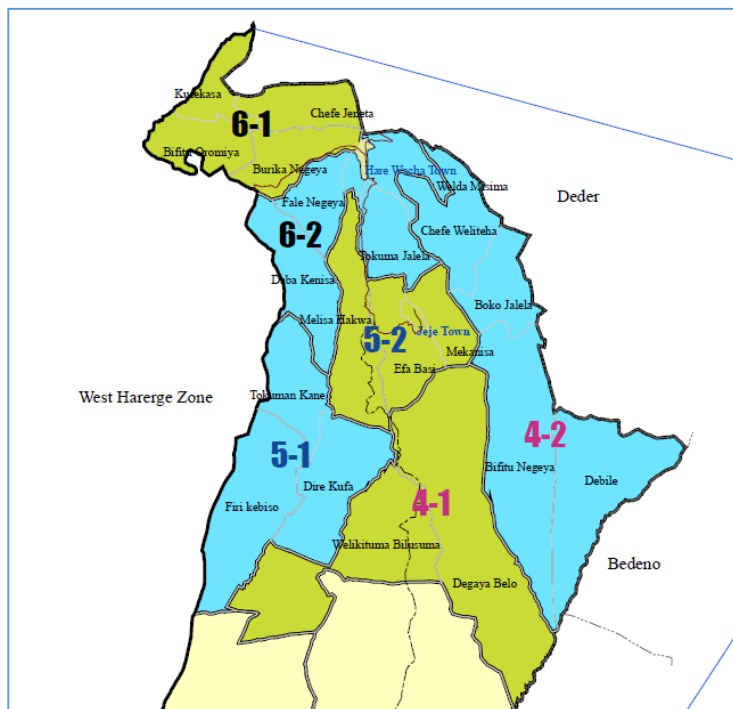
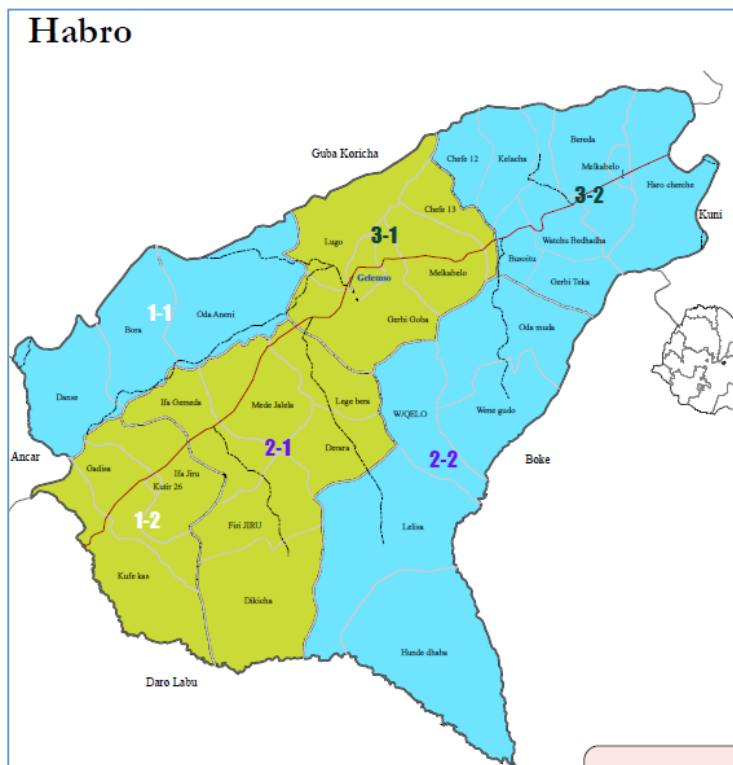
located in the East Hararghe zone, 488 km from Addis Ababa (9). The area size is 1147 km², segmented into 22 rural Kebeles and two towns. Agro-ecologically, it is divided into three categories: Low-land 41%, mid high-land 39% and high land 20%. The estimated total population in 2007 was 176,813. The majority of residents are Muslims (95%); Oromo is the dominant group, accounting for 98% of the population. Cultivable land is about 38% out of total land, followed by 14% degraded/unproductive land, 5.3% bush and grassland, and 24% forest covered land. Immunization coverage reaches 86% and potable water coverage is only 5%. The average distance to the nearest potable water source from the households is ~12.5 km.

Both areas have similar agricultural practices. Mixed agriculture of crop production and livestock rearing together is the predominant source of livelihood for the majority of the population. Major cereals grown in the district are maize, sorghum, teff, finger millet, and wheat. The district also has a practice of producing legumes and pulses, root crops, vegetables, fruits, and other cash crops (predominantly “chat”). It is highly dependent on human labor and oxen-driven following traditional methods. Diversified local community-based organizations support each other for their social and economic activities. “Afosha,” “Ekub,” Cooperatives, youth associations, women associations and farmers associations are such community organizations in the two districts. The availability and level of activities of these voluntary local self-help groups and associations vary from village to village even within the same Kebele, for instance.

Since 2007, World Vision Ethiopia has operated large-scale development programs in both districts, with close ties with the communities. All Kebeles and towns in both districts were accessible to all three nutrition programs, whereas only 28 rural Kebeles in the Habro district and 20 rural Kebeles in the Melka Bello district

were included in the study site. The town areas in these two districts and two large remote Kebeles in Melka Bello district were excluded from the study because of the quite different environments between town and rural areas and logistical difficulties in gaining access to remote areas.

Figure 3.2 Clusters and intervention allocation of Habro and Melka Bello districts¹



¹Six clusters in Habro district were numbered from 1-1 to 3-2, and another 6 clusters in Melka Bello district were numbered 4-1 to 6-2. Matched cluster pairs were labeled with the same number in the first place. The green-colored area received the CMAM and ENA interventions only; the blue-colored area received the CPNP program in addition to the other two programs. For example, 1-1 and 1-2 in Habro district were matched pairs, for which 1-1 cluster had an intervention area (CPNP, ENA, and CMAM programs) and 1-2 clusters had a control area (ENA and CMAM programs).

3.2.3 Study Design

We conducted a randomized effectiveness trial. A total of 12 clusters were created prior to the beginning of randomization of interventions. The number of 12 clusters was based on intervention logistics of the EINP project team. The Geographic Information System (GIS) unit of World Vision Ethiopia kindly provided maps of Habro and Melka Bello districts with spatial information on geographical distribution of Kebeles, including major landmark indicators. The GIS resource enabled us to create clustering of the study site and visible allocation of control and intervention groups.

The procedure of creating geographical clusters was as follows. First, all 28 Kebeles in the Habro district and 20 Kebeles in the Melka Bello district were ranked according to its food security level, e.g. high, middle and low, based on the qualitative information offered by the agriculture program officer of World Vision Ethiopia and government agriculture officers. Next, two to six nearby Kebeles in the similar food insecure environment were grouped together so that study site was divided into 12 clusters, 6 clusters per district (Figure 3.2). For the intervention randomization, each cluster was paired with another cluster selected to be similar in their food security condition. Pair-matching to reduce variation between clusters enabled us to have six pairs assumed to have similar food security and population size.

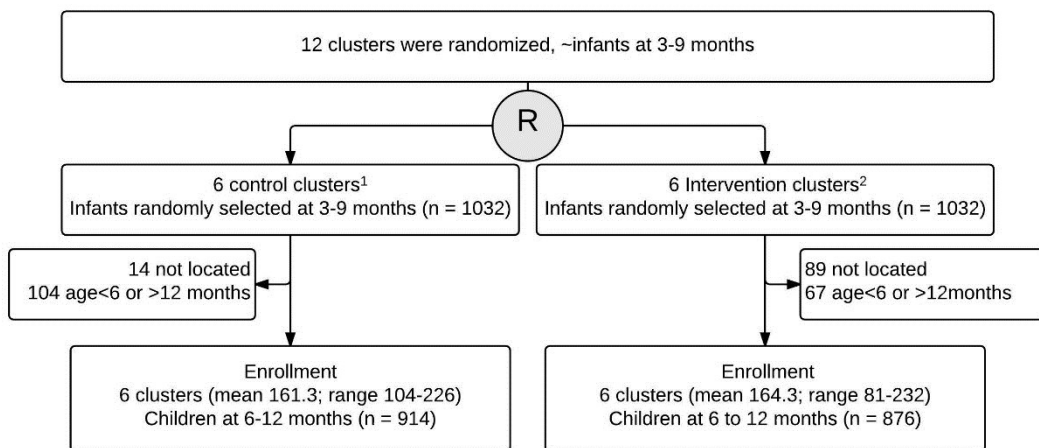
3.2.4 Randomization

Randomization of intervention and control clusters was accomplished with a coin toss in the presence of the local health officers and community leaders to have mutual agreement and impartiality in random allocation of interventions. One study investigator explained the rule of random allocation of intervention, obtained

agreement among the local health officers and community leaders, and carried out tossing a coin. If one cluster of each pair was randomly assigned to the intervention group, the other one automatically was assigned to control group.

The agreement document for the intervention allocation, including the signatures of local health officers and authorities, was obtained. As a result, 6 control clusters and 6 intervention clusters were created. Specifically, 25 Kebeles, 14 in Habro district and 11 in Melka Bello district, were assigned to the control area, and another 23 Kebeles, 14 in Habro district and 9 in Melka Bello district, were assigned to the intervention area (Figure 3.3).

Figure 3.3. Study design for the proposed study



3.2.5 Subject selection

This study attempted to prospectively study child growth and feeding practices among mothers of children 6 to 24 months of age. Children aged 6 to 12 months of age and their caregivers living in a study site in the Habro and Melka Bello districts were enrolled. The demographic information for the two districts was listed, including the

estimated numbers of children under one year of age and the number of underweight children by Kebele (Appendix 3.1 and 3.2).

Sample size: Sample sizes were calculated to detect a range of differences in the means of length-for-age z scores (LAZ) between the two intervention groups. The detectable difference estimates were calculated using the Dupont and Plummer sample size formula for calculating a difference in population means (10). There was no available information on Intra-cluster Correlation Coefficient (ICC), prevalence of stunting or LAZ in the study site, so that values were excerpted from relevant literature. A 0.2 z scores difference in LAZ was derived from a meta-analysis about complementary feeding trials (2). Hence, we expected that LAZ in children in the intervention area would be at least 0.2 Z higher than children in the control area. Fenn B et al. analyzed the clustering, estimation of ICC, using DHS data in 46 developing countries. The median ICC for national samples for childhood undernutrition were 0.054 for stunting and 0.032 for wasting (11); hence, this study utilized the value of 0.054 per ICC for sample size estimates. For a cluster-randomized trial, suppose now that n individuals are sampled in each cluster, σ_0 and σ_1 are within cluster standard deviations, k is the coefficient of variation of true proportions between clusters within each group, then c, the number of clusters required, is given by

$$c = 1 + \frac{(z_{\alpha/2} + z_{\beta})^2 [(\sigma_0^2 + \sigma_1^2)/n + k^2(\mu_0^2 + \mu_1^2)]}{(\mu_0 - \mu_1)^2}$$

$$n = \frac{(\sigma_0^2 + \sigma_1^2)}{[\{(c-1) * (\mu_0 - \mu_1)^2 / (z_{\alpha/2} + z_{\beta})^2\} - k^2(\mu_0^2 + \mu_1^2)]}$$

A sample size of 1,032 per group was required to find a 0.2 Z difference in between-group means; α was set at .05, power at 0.80, cluster size at 172, lost to follow-up at 10%, SD of 0.9 Z score and ICC at 0.054 (Table 3.1). The estimated number of children eligible for this study by group and by cluster is listed in Table 3.2. The total

number of children assigned to the control group and intervention group was equal but the number of children assigned to each cluster, consisting of the control group and the intervention group, was determined proportionate to the population size of the clusters.

Table 3.1 Projected sample sizes per cluster and in total for a range of minimal detectable difference in LAZ and standard deviation differences

Assumed Standard deviation	Minimum detectable difference in LAZ scores	LAZ in control area at 12 month follow up (10% lost to follow-up)					
		-2.0Z	-1.9Z	-1.8Z	-1.7Z	-1.6Z	-1.5Z
		Total	Total	Total	Total	Total	Total
$\sigma = 0.8$	0.2Z	3888	2616	1992	1632	1392	1236
	0.25Z	900	804	744	684	648	600
	0.3Z	468	444	420	408	396	384
	0.35Z	300	300	288	276	276	264
$\sigma = 0.9$	0.2Z	4920	3300	2520	2064	1764	1548
	0.25Z	1128	1020	936	864	804	768
	0.3Z	588	564	540	516	480	468
	0.35Z	384	360	348	336	336	324
$\sigma = 1.0$	0.2Z	6072	4068	3108	2544	2184	1908
	0.25Z	1392	1260	1056	1056	996	936
	0.3Z	720	684	636	636	600	576
	0.35Z	468	444	420	420	420	408
$\sigma = 1.1$	0.2Z	7344	4944	93768	3072	2628	2316
	0.25Z	1680	1524	1392	1284	1200	1140
	0.3Z	876	588	792	756	720	696
	0.35Z	564	540	528	516	504	480
$\sigma = 1.2$	0.2Z	8736	5868	4476	3660	3120	2748
	0.25Z	2004	1800	1644	1524	1428	1356
	0.3Z	1044	984	936	900	864	828
	0.35Z	672	648	624	600	588	576

Table 3.2 Estimated number of children enrolled to intervention groups based on proportionate to the population size of the clusters.

Cluster No.	Group	No. of Kebeles	No. of assigned children by intervention group and by cluster (N=2,064)
Cluster	Control area	25	1,032
1_1	Habro	3	115
2_2	Habro	5	234
3_2	Habro	6	180
4_2	Melka Bello	4	162
5_1	Melka Bello	3	144
6_2	Melka Bello	4	197
Cluster	Intervention area	23	1,032
1_2	Habro	3	85
2_1	Habro	6	283
3_1	Habro	5	207
4_1	Melka Bello	2	147
5_2	Melka Bello	3	154
6_1	Melka Bello	4	156

An established birth registration system—which was required for the random selection of children—was absent in the study area; thus, we requested district health offices to create a roster of children in the study area aged 0 to 12 months of age, which allowed us to carry out the random selection of children according to the sample size assigned to each cluster. To facilitate this process, EINP project staff constructed a calendar indicating Ethiopian years and dates as well as a Gregorian calendar for the last two years, to estimate the children’s ages as accurately as possible. The year 2004 in the Ethiopian calendar began on September 12, 2011 A.D. of the Gregorian calendar. A child roster form was employed that included the following information: Kebele name, village name, community volunteer’s name, the child’s name, birth date and sex, the mother’s name, father’s name, household location including key landmark near the house.

Health extension workers (HEWs) and community volunteers collected the data in the study site. After a brief training, each one visited ~50 households assigned

to each of them in a village, identified all children under one year of age, recorded the relevant information to the child roster form using the calendar, and reported it to their supervising HEWs. All children roster information was compiled by HEWs of the Kebele and was again reported to health centers in the District. Collected data were entered into a Microsoft Excel program by the data management team; thus, each child was assigned a unique identification number. Using a unique identification number that we assigned to each child, 2,064 children 4 to 11 months of age were randomly selected proportional to the population size of each cluster.

Data collectors visited 2,064 households; out of the 2,064 randomly selected children from the roster, 914 children from control and 876 children from intervention areas were enrolled in the study.

3.3 DEVELOPMENT OF THE INTERVENTIONS

This study involved three interventions: CPNP, ENA, and CMAM programs. The design and implementation process of the EINP was conducted by World Vision experts and the study investigators. Out of the three interventions implemented in the study, the CMAM program and the ENA program were embedded entirely in the established government health system and performed by HEWs or community volunteers, whereas the CPNP program had a separate operating system with hired employees within the World Vision local offices. Each of the interventions in the EINP is summarized in Table 3.3, and distribution of the EINP target population of the two districts is presented in Table 3.4.

Table 3.3 Summary of key interventions of the CPNP, ENA, and CMAM programs¹

	CPNP	ENA	CMAM
Target group	Underweight children 6 to 24 months of age	All children under two years of age and pregnant and lactating women.	Acutely malnourished children 6 to 59 months of age
No. of target groups	~3,000 children and their caregivers in intervention area	~10,000 children under 2 years old in Habro rural area and ~9,300 in Melka Bello rural area	~900 moderately acute malnourished (MAM) under two years old ~230 severely acute malnourished (SAM) under two years old
Screening of eligible children	Weight-for-age z score <-2	Ages less than 2 years	SAM children: MUAC <11 cm MAM children: MUAC 11-11.9 cm
Persons in charge of intervention	23 CPNP operators 6 CPNP supervisors	~1,250 community volunteers in both districts	HEWs, 34 OTPs in Habro and 27 OTPs in Melka Bello
Key intervention	A total of 460 group sessions, 20 CPNP sessions per Kebele for 13 months.	Counseling on ENA messages	Plumpy'Nut to SAM children Corn-soy blend (CSB) and vegetable oil to MAM children
Nutrition messages	Child feeding, caring, hygiene and health seeking behaviors	Mainly breastfeeding & complementary feeding practices, child care during illness	-
Reporting structures	CPNP operators report to their supervisors in their Kebele	-	Records were kept in health centers/health posts

¹CPNP: Community-based participatory nutrition promotion; CMAM: community-based management of acute malnutrition; ENA: Essential Nutrition Action; MUAC: mid-upper arm circumference; HEW: Health Extension Workers; OTP: Out-patient therapeutic program.

Table 3.4 EINP site and target population (12)

	Habro	Melka Bello	Total
Total population	191,546	176,813	368,359
Total under five children	31,418	28,997	60,411
Targeted No. of children for ENA	5,403	4,988	10,391
Targeted No. of wasted children	500	500	1,000
Targeted No. of children with MAM	1,700	1,570	3,270
Targeted No. of malnourished women	300	250	550

*2011 projection of the 2007 population (national census report).

3.3.1 Community-based Participatory Nutrition Education (CPNP)

CPNP is a nutrition program based on a behavior change communication (BCC) strategy, adapting some implementation components from an existing PD Hearth approach (3). CPNP program shared some PD Hearth program elements such as 12-day group nutrition Hearth sessions, targeting underweight children, weighing at admission, 2 weeks, and 1 month after the nutrition session, follow-up visits for two weeks, utilization of locally available community resources, and community sensitization and participation. However, CPNP program had no community-specific positive deviant behaviors. Instead, generally identified PD practices with regard to feeding, caring, hygiene, and health-seeking were recommended. CPNP menu was designed by World Vision nutrition experts using local foods, and nutrition sessions were led by CPNP operators, not by voluntary mothers who practiced PD behaviors. Factors that modified original PD Hearth model into CPNP program included large project area that covered ~180,000 population with various topography, limited project time period (~20 months), and community and project staff capacity

Six CPNP supervisors for each of the six clusters and 23 CPNP operators for the 23 Kebeles were hired. CPNP supervisors took responsibility for CPNP scheduling, supervising, follow-up visits, and meeting with community members.

CPNP operators screened underweight children, prepared places for group sessions, discussed how foods and materials would be prepared with participating mothers, and led the two-week group sessions. Ahead of the first CPNP session in each Kebele, CPNP operators convened a meeting with influential leaders in each Kebele to explain the intention of CPNP program and to call for the community's contribution and cooperation. Upon discussion, participants brought either one ingredient, firewood, or utensils every day, which enhanced their program participation and easy adoption of lessons in the future. Thus, the prepared menu varied day-by-day according to the mothers' food contributions. Complementary foods were prepared by two or more caregivers in rotation during sessions.

The CPNP menu, such as energy-dense and micronutrient rich foods, was designed by nutrition experts of World Vision Ethiopia. They went to local market to find available and affordable food ingredients in the community, and based on those ingredients, prepared an example recipe recommended (Table 3.5); however, the menu varied depending on how participants contributed and on seasonal change.

Table 3.5 An example of the CPNP menu and its nutrient composition (13)

Example of CPNP Menu	Nutrient composition
Beans = 160 g	Energy = 661.7 Kcal
Dark green leave = 80 g	Protein = 17.98 g (7.02)
Carrot = 160 g	Vitamin A = 350.55 Ugm RAE
Palm oil = 40 ml	Vitamin C =23.3 mg
Maize = 1 kg	Iron = 5.05 (4.95) mg
Banana = 400 g	Zinc = 3.29 mg

Each CPNP session was attended on average by seven to ten moderately or severely underweight (weight-for-age Z, WAZ < -2) children 6 to 24 months of age and their caregivers. The key messages below were delivered by CPNP

supervisors/CPNP operators.

Good feeding: Breastfeed child up to 12 times in a day / Feed child 4-5 times in a day with foods containing protein, carbohydrates, and vitamins.

Good health: When a child is sick, go to health center / Prevent illness such as deworming / Get children immunized / Have micronutrient supplementation (vitamin A every 6 months).

Good hygiene: Wash hands after using toilet / Wash their clothes and clean their bodies / Clean house and kitchen / Clean latrine everyday / Put pigs, mules, dogs or other animals outside / Child is to be bathed everyday / Nails are to be clipped / Child is to wear shoes.

Good caring: Get child vaccinated / Feed child often during times of illness / Mother or others play with child and grandmother cares for child / Mother tells stories and sings songs to child / Someone helps child eat.

Good environment: Use latrine / Discard waste materials to landfills / Burn waste materials.

Participating mothers were instructed to share CPNP lessons and methods of preparation of nutrient-dense meals that they learned with their neighbors in the same Kebele. Community volunteers weighed the participating children at entry and at the completion of each two-week CPNP session. The discharge criteria in the CPNP sessions was defined as gaining 200 to 400 grams during a two-week stay in CPNP sessions and more than 400 grams by the end of two additional weeks of home follow-up. Those children who gained less than 200 grams were referred to the next CPNP session held in nearby villages. Those children were weighed again at 1, 3, and

6 months after his/her graduation from the CPNP sessions. For 13 months, a total of 460 CPNP sessions in 23 Kebeles were planned, 20 sessions per Kebele. 280 sessions in 14 Kebeles of Habro district and 180 sessions in 9 Kebele in Melka Bello district. The number of targeted underweight children 6 to 24 months of age was estimated to be less than 3,000 children (14) for 13 months.

3.3.2 Essential Nutrition Action (ENA) intervention

The ENA program was mainly defined as individual counseling on key nutrition messages through household visits by community volunteers. Before the EINP started, community volunteers were available in the study site, but not appropriately trained for nutrition knowledge and did not have counselling skills. Nutrition experts of World Vision Ethiopia provided a week nutrition counselling training to 120 HEWs; next, by these HEWs, ~1,250 community volunteers in both districts were trained for ENA messages and counseling skills through a 4-day training. Trained community volunteers were supposed to visit and counsel pregnant women and mothers of children under two years of age. The seven key nutrition messages were as follows: (1) optimal breastfeeding (e.g. exclusively breastfeeding for the first six months and continued breastfeeding up to 24 months), (2) adequate complementary feeding beginning at six months, (3) optimal feeding of the child during and after illness, (4) control of vitamin A deficiency, (5) control of anemia, (6) promotion of iodized salt consumption by all families, and (7) promotion of improved women's nutrition. Community volunteers' activities were entirely voluntary-based and not mandatory. There was no reporting structure of the ENA program in the district health offices. All children under five years of age received vitamin A supplementation twice a year, and children above 24 months of age had de-worming pills twice a year.

3.3.3 CMAM program

The CMAM program was designed to treat children 6 to 59 months of age who had severe or moderately acute malnutrition. The CMAM program has three treatment components: an out-patient therapeutic program (OTP), a supplementary feeding program (SFP), and a stabilization center (SC) (15).

OTPs were located at health posts/health centers in all Kebeles that provided out-patient treatment care. HEWs screened acutely malnourished children with MUAC tapes and referred the identified malnourished children to OTPs. Children whose age was 6 months and above and whose MUAC was less than 11.0 cm with good appetite test or no medical complications were admitted to the OTP program; however, if the children had poor appetite or medical complications, the child was referred to inpatient care. Plumpy’Nut was provided to the children according to the Ethiopia national protocol (16) and were followed up weekly in the OTP. If the MUAC of an admitted child increased greater than 11.0 cm, he/she was discharged.

On occasion, families with moderately wasted children with MUAC of 11-11.9 cm and pregnant and lactating women in a moderately malnourished state received a monthly ration of corn-soy blend (CSB) and vegetable oil for three months ration at distribution sites. SCs were available at district health hospitals or large health centers. Children 6 to 59 months of age with poor appetite or with medical complication or edema were hospitalized and treated at an SC.

3.3.4 Summary of intervention implementation

HEWs and community volunteers were under the government health system structure, represented as the Health Extension Program (HEP), which was an innovative community-based program in Ethiopia that improved the primary health care

coverage from 76.9% in 2005 to 90% in 2010 (7). Since its start by the Federal Ministry of Health (FMoH) in 2003, the HEP has trained 30,578 HEWs on knowledge and skills, including disease prevention, family health, environmental hygiene and sanitation, and health education and communication, after which HEWs transferred health knowledge and skills to directly households in rural areas or by training community volunteers (17). Under the overall supervision of district health offices (DHOs) regarding all health activities carried out in health centers and health posts, HEWs and community volunteers provided primary health services in a health post in the Kebeles. Every Kebele had a health post where two female HEWs were recruited from the area. One HEW supervised on average 30 community volunteers, each of whom was in charge of approximately 50 households in the Kebele.

At first year of the EINP project, 111 HEWs in Habro district and 35 HEWs in the Melka Bello district were trained for ENA counselling. In general, two female HEWs served one Kebele, delivering primary health care services directed by the Ethiopian government. Following the training sessions, 580 (429 females and 151 males) and 395 community volunteers were trained for ENA counseling in the Habro and Melka Bello districts, respectively. At the second year of the project, 56 HEWs and 892 community volunteers from Habro district only attended the ENA refresh training. There were 35 and 28 OTP sites in Habro and Melka Bello districts, respectively. Over the project period (July 2012 to Aug 2013), 1,914 and 1,938 children 6 to 59 months of age were treated with Plumpy'Nut in Habro and Melka Bello districts, respectively. By district, guidelines to provide CSB and oil were somewhat different. In the Habro district, screened households received 8.3 kg of CSB at a time per month. But in Melka Bello district, screened households received 24.9 kg of CSB, a 3-month portion at once. The fact of receiving Plumpy'Nut means

that the child was admitted to the outpatient therapeutic program (OTP), which is one component of the CMAM program, operated at either health centers or health posts. It was reported that 82.8% and 80.5% out of admitted children were discharged after recovery in Habro and Melka Bello districts, respectively.

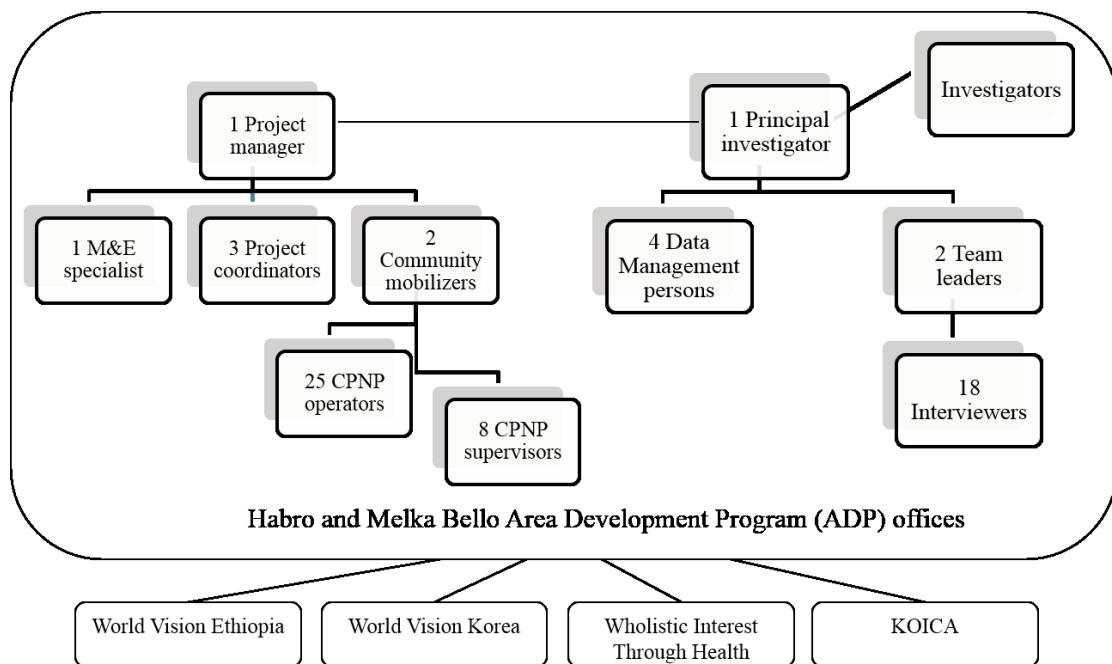
3.4 DATA COLLECTION

All forms and questionnaires were designed by reviewing and modifying relevant questions excerpted from the Caregiver Survey-Modules of World Vision International (18) (see the questionnaires in Appendix C, D and E). Developed questionnaires were first prepared in English and later on translated into *Afan Oromo* by government-registered translators (Appendix G). All forms and questionnaires were pre-tested prior to data collection. At each visit, questionnaires were photocopied in Addis Ababa and delivered to each district before a new data collection round started.

Eighteen data collectors and 2 team leaders, 9 data collectors and 1 team leader at each district, were locally recruited and trained for 5 days on obtaining informed consent, measuring child length and weight with measuring board and weighing scale, and interviewing with questionnaires. The data management team consisted of four female workers who learned information-technology at a local vocational school. The roles and responsibilities of the project team and research team were clearly distinguished and mutually supported, but data collectors were not involved in the project implementation. Data collectors and data management team were hired as community workers for the Habro and Melka Bello World Vision ADP offices. The EINP and present study were conducted with support from the head

office of World Vision Ethiopia, World Vision Korea, WITH, and KOICA. Figure 3.4 presents the operation structure of the EINP project and research teams.

Figure 3.4 Structure of EINP project team and research team



For effectiveness evaluation, the data collection was carried out at five major time points: visit1 (enrollment), visit2, visit3, visit4, and visit5, each three months apart. Anthropometric measurements and household surveys to interview caregivers regarding behaviors involving feeding and hygiene practices were carried out every three months. Upon oral or written informed consent (Appendix C), mothers were interviewed and, for illiterate mothers, oral informed consent was obtained with permission of household members. Each interview did not last more than 1.5 hours. The interviewers worked independently and were not involved in project implementation duties. Prior to the first data collection of the study, a certain portion of subjects experienced more than one nutrition service out of the three interventions

due to the preceding intervention schedule than the data collection at visit1. Out of 2,064 child and mother pairs that were randomly selected from a child roster, 1,790 pairs—914 in the control area and 876 in the intervention area—were enrolled in this study.

For the PIP analysis, data were collected from routine monitoring records and a survey in connection with the effectiveness data collection. Main components evaluated in the PIP analysis included the following: (1) quality of the implementation process, (2) participants' program acceptance, (3) participants' message recall, (4) child feeding and hygiene at initial stage, (5) influence on exposure to ENA and CMAM programs.

Visit1 was conducted from November 20, 2012 to February 19, 2013; visit5 was conducted from November 20, 2013 to February 19, 2014. Visit1 was conducted four months after the CPNP sessions and the CSB distribution of the CMAM program had started; thus, we were unable to collect true baseline information prior to program implementation. Enrollment information collected at visit1 was used to assess comparability between the two groups, although it was recognized that some program elements may already have altered behaviors and knowledge. Data collection methods, outcomes, and sample size for study outcomes are summarized in Table 3.6. The main variables and data collection methods are described below.

Anthropometric measurement: Children's weight and length were measured by trained data collectors every three months from enrollment (visit1) to visit5. Both weight and length were measured in duplicate. Weight was measured to the nearest 0.01 kg by a digital scale (model 354, SECA/GERMANY) using a standardized protocol (19). Locally designed measuring boards were used to measure supine length

to the nearest 0.1 cm. Standardization of anthropometric measurements were achieved by taking multiple measurements on non-study subjects during the training sessions. Refresher training was done when necessary. Regular supervision visits were made by the student investigator and research supervisors during the data collection period.

Child feeding practices: Mothers were visited every three months—a total of five times from visit1 to visit5—by trained data collectors using structured 24-hour diet recall questionnaires and asked about infant and young child feeding (IYCF) practices of the breastfed child adhering to the WHO guiding principles (4, 5). Mothers were asked whether they currently continued to breastfeed their child (current breastfeeding), how many times they fed the child in the past 24 hours (meal frequency), and what type of foods they fed the child in the past 24 hours using a list of food items (dietary diversity). At each visit, mothers were asked whether they fed the food item/food groups to her child using the following 15 food items/food groups: breast milk; formula; animal milk (e.g., cow milk); any food made from grains (e.g., millet, sorghum, maize, rice, wheat, teff, or ingera); any food made from pumpkins, carrots, red sweet potatoes, mango, or papaya; any green leafy vegetables; any other fruits (bananas, tomatoes, apples, or avocados); any liver, kidney, heart or other organ meats; any meat (e.g., beef, lamb, goat, chicken, or duck); any food made from legumes or nuts (e.g., peas, beans, lentils, or peanuts); any food made with oil, fat, or butter; eggs; fish; cheese or yoghurt; any sugary foods (e.g., chocolates, sweets, candies, pastries, cakes or biscuits, or sugary juice).

Hand washing practices: Every six months (at visit1, 3 and 5) mothers were asked whether they washed their hands with water and soap at four critical time points, i.e. after defecation, after cleaning the child's bottom, before preparing foods, and before feeding the child.

Socioeconomic and demographic characteristics: The following characteristics were asked at visit1 as enrollment information: Household head information (e.g., sex, age, marital status, literacy, and occupation), household economy (e.g., main income source, access to land for farming, and household asset), household dwelling characteristics (e.g., ownership, construction materials, electricity use, access to market and health facility), maternal characteristics (e.g., age, parity, antenatal and post natal services, and education), and infant characteristics (e.g., age, sex, immunization, vitamin A supplementation).

Household food insecurity: An established Household Food Insecurity Access Scale (HFIAS) was used to measure food insecurity in the study site in the past four weeks (20). The main domains of the HFIAS are (1) worry and anxiety, (2) insufficient food quality, and (3) insufficient food intake. The nine questions of HFIAS were followed by frequency questions from which the four levels of food insecurity are computed.

Social capital: The Short Social Capital Assessment Tool (SASCAT)—a shortened version of the Adapted Social Capital Tool (A-SCAT) (21)—was used to quantitatively measure structural and cognitive social capital.

Exposure to programs: Mothers were asked the following at each visit, every three months: (1) whether they ever participated in the ENA activity through the HEWs/community volunteers/1 to 5 network in the past three months, (2) whether the child ever received Plumpy'Nut/CSB in the past three months, and (3) whether they ever participated in CPNP sessions.

Project records review and data extraction: We reviewed an attendance book for 3,299 participants who ever attended the CPNP session over the 13 months of project period and 3-day observation checklists for 114 sessions. 23 CPNP operators routinely recorded attendance books (Appendix E.1), which included information of Kebele and village names, session starting dates and completion dates, child name, mother and father names, child sex and age, weight at admission and 2 weeks, 1 month and 3 month after CPNP session, and attending days. The observation checklists were intended to help the operators effectively supervise each session. 8 supervisors prepared the observation checklists (e.g. cleanliness of session place, key nutrition/health message discussed, hand washing practice by caregivers before feeding) for 114 sessions (Appendix E.2). Each item in the checklists was scored as follows: 0 (not performed), 2 (moderately/modestly performed), or 4 (actively performed), with a range of 0-12 for three days. All food ingredients prepared by mothers at the session were listed. From the observation checklists, the total score of three days for each item was extracted from this project records.

Participants' acceptance to CPNP program: Of the 197 mothers who participated in a CPNP session at the time of visit², 76 mothers in Habro district and 179 mothers in Melka Bello district were asked about the following, using Likert scales: (1) how

actively they participated in the session activities (e.g., singing, child feeding, food preparation, hand washing, and discussion), (2) how they perceived the session (e.g., satisfaction with the session, confidence in adhering to the CPNP practices, usefulness of CPNP practices), and (3) what materials they contributed to the session (e.g., foods, utensils). The mothers were asked to recall discussed messages and food ingredients at the session and were asked about type of foods currently used.

Participants' CPNP message recall: In connection with the effectiveness trial, using a structured questionnaire, mothers who had ever attended sessions by visit2 were asked whether they learned a series of CPNP messages (e.g., preparing nutritious complementary foods, responsive (actively) feeding, hand washing) at the CPNP sessions, and which food ingredients they used at the CPNP sessions.

Mother and child cleanliness: Through spot-check hygiene observation, data collectors assessed how clean (e.g. clean, dusty, or dirty) the mother and child were for their hands, hair, clothes, and face by observation at every six-month survey visit.

Table 3.6 Summary of data collection methods and main outcomes by evaluation component of the community-based participatory nutrition promotion (CPNP) program, Habro and Melk Bello area, Ethiopia (2012 to 2014)¹

Evaluation components	Methods	Main outcomes	Study group
Enrollment characteristics	Survey		C: 914 mothers, I: 876 mothers; at enrollment
Aim1. Child growth	Anthropometric measurement	Length, weight, length-for-age z score (LAZ), weight-for-age z score (WAZ), and weight-for-length z score (WLZ) stunting, wasting, and underweight	C: 914 mothers, I: 876 mothers; five times every three months
Aim2. Child feeding and hygiene	Survey	Scores of currently breastfeeding, dietary diversity, meal frequency, hand washing and composite feeding	C: 914 mothers, I: 876 mothers; five times every three months (every six month for hand washing)
C1. Quality of the implementation process	Records review and data extraction	% dose delivered & dose received % fidelity to intervention protocol Fidelity scores to intervention protocol	I: 3,299 participants in 6 clusters in the intervention area for 13 months I: 114 sessions in the intervention area for 6 months
C2. Participants' acceptance	Survey (recall)	Scores of active participation in session activities, material contribution, and perception to the session	I: 197 CPNP participants at visit ²
C3. Participants' message recall	Survey (recall)	Scores of CPNP messages and food ingredients recalls	I: 197 CPNP participants at visit ²
C4: Child feeding and hygiene at initial stage	Survey Spot check observation	% of infant and young child feeding (IYCF) indicators % of hygiene practices (hand washing and cleanliness)	C: 869 mothers I: 836 mothers (including 141 CPNP participants) at visit ¹
C5. Influence on other program exposure	Survey	% receiving ENA counseling in the past three months % receiving Plumpy'Nut ³ in the past three months	C: 914 mothers, I: 876 mothers; five times every three months

¹ CPNP: Community-based participatory nutrition promotion; ENA: Essential Nutrition Action; CMAM: community-based management of acute malnutrition program; I: intervention area; C: control area; C1 to C5: component 1 to component 5.

² Survey visits started from 4 four months after the CPNP session started, continued every three months, a total of five times (visit 1 to visit5).

³ Plumpy'Nut was provided to severely acute malnourished children through the community-based management of acute malnutrition program.

3.5 DATA MANAGEMENT AND QUALITY CONTROL

All forms were tested in the field prior to being finalized and translated. All collected data were reviewed by supervisors of the data collection team and were entered by data entry personnel using data-entry formats prepared by study investigators in a Microsoft Excel program. Participating child/mother pairs were assigned a unique identifier. All data were cross-checked with questionnaires or abstraction forms for possible errors to ascertain inconsistent data and values outside specific ranges.

Backup copies of the database were generated on a daily basis. Data entered into the database were converted to a Stata format for further data analysis. Households were revisited within one week if data were missing or beyond the acceptable range. Data analysis was performed using Stata version 12.0 (Stata Corporation, College Station, TX, USA).

For conducting the research, this study was led by the investigator group and the data collection team. The investigators took overall responsibility for this study, including periodical reporting of research progress. Under supervision of the investigator team, the data collection team, consisting of two supervisors, one for each study site, and twenty data collectors and four data entry personnel, took responsibility for data collection and entry. The data collection team was intensively trained and not involved in the intervention performance or study design procedures. The investigators regularly visited the study field to train the data collection team and data entry personnel, to monitor the progress of the study and data collection, to work on proposal writings for additional funding sources, and to present the ongoing research to a variety of stakeholders. The data collection team had bi-weekly team meetings to resolve challenges in the field. Errors in anthropometric measurements were found at visit1.

To ensure data reliability, all instruments and forms were tested in the pilot study. Quality checks were performed periodically by the supervisors. Instruments providing values outside the acceptable range were replaced. Specially formatted forms were provided for the data collection log. These forms kept records of anthropometric data and other collected data. Participants' names and location of their households were carefully identified. All forms and questionnaires were kept in the World Vision Ethiopia offices in Habro and Melka Bello districts on a regular basis and compiled in the Habro district office.

3.6 STATISTICAL ANALYSIS

Exploratory analysis

The objectives of the exploratory data analysis was to describe the study population and to examine the distribution of each variable. Box plots and histograms were performed for continuous variables, and frequency distributions were examined for categorical variables. Normality was assessed by looking at skewedness and kurtosis, Q-Q plot, and outliers were checked. Maternal and child characteristics, socio-economic status, household food insecurity, child feeding and caring, hygiene practices, CMAM performance, and community volunteers' counseling performance were described in terms of their means or median values, comparing distributions between intervention groups using Student *t*-tests. Categorical variables were summarized with percentile and frequency distributions, and distribution was tested using chi-square test. Significance for all analyses was defined as a *p* value less than or equal to 0.05.

Construction of variables/indicators

Age- and sex- specific z scores: The length and weight measurements for each child were converted to LAZ, WAZ and WLZ scores using the international growth reference from the WHO Multicenter Growth Reference Study (22). Stunting, underweight, and wasting were defined as height (or length)-for-age, weight-for-age, and weight-for-height (length) more than two standard deviations below the median of the WHO growth reference.

Household wealth index: Household wealth status was assessed by constructing an index generated from principal components analysis. The following household socioeconomic and demographic variables were included in the principal component analysis: dwelling in one's own house, occupation of head of household, land holding, source of drinking water, type of fuel for cooking, number of livestock, electricity, possessed furniture, and sanitary latrine (23). The regression scores from the first component were used to create an index that was divided into quintiles, and then grouped as highest 20%, middle 40%, or lowest 40% (23).

Household food insecurity (HFI) scores: The Household Food Insecurity Access Scale consisted of nine occurrence questions (20). For each question, mothers were asked if they experienced the condition in the household in the past four weeks. If the answer was 'yes' to the question, a frequency question was followed up to identify whether the condition occurred rarely (once or twice), sometimes (three to ten times) or often (more than ten times). The responses were coded as 0 = never, 1 = rarely, 2 = sometimes, or 3 = often, giving a range of HFI scores from 0 to 27 for the nine

questions. According to the HFI scores, we categorized households into four groups such as food-secure and mild, moderately, and severely food-insecure.

IYCF indicators: Minimum dietary diversity and minimum meal frequency were computed according WHO guidelines (24); minimum dietary diversity is the proportion of children 6–24 months of age who receive foods from 4 or more food groups. Minimum meal frequency is for breastfed and non-breastfed children 6 to 24 months of age who receive solid, semi-solid, or soft foods the minimum number of times or more.

Child feeding and hygiene scores: Based on child feeding practices and hygiene practices, we constructed the age-specific feeding and hygiene scoring system (see the details in Table 5.1), separately for three age groups: 6–8, 9–11 and 12–24 months. Current breastfeeding, meal frequency, dietary diversity, and two types of child feeding scores were examined at each five visits, except for the hygiene score, which was examined across three visits.

Mother (or child) cleanliness: If a mother (or child) was assessed as clean for all their face, clothes, hands, and hair, the mother or child was grouped as clean, otherwise, as not clean. Mother (or child) cleanliness was defined as the proportion of mothers (or child) who were clean at all their face, clothes, hands, and hair.

Process indicators: The process indicators linked to the conceptual program impact pathway (PIP) model include the following. percentage *dose delivered* is defined as percentage of intervention activities completed by project staff out of the total expected, as specified in the accreditation criteria; percentage *dose received* is defined

as the percentage of intervention receipt by the intervention target population out of the total expected; *Fidelity* is defined as the percentage or scores of intervention activities completed by project staff that adhered to intervention protocols; *Exposure* is defined as the percentage of exposure to intervention activities by caregivers; *Message recall* is defined as the percent recall of CPNP messages by caregivers; *Proximal outcomes* are the percentage of infant feeding behaviors consistent with key project messages, as well as caregivers' mean scores for a key child feeding and hygiene.

3.6.1 Aim 1: Effectiveness evaluation of CPNP on child growth

The main outcomes of this study aim were differences in LAZ, weight-for-length z score (WLZ), and WAZ, and risk of stunting, wasting, and underweight in children 6 to 24 months of age between the intervention and control areas.

The growth pattern of children was described by plotting the mean length, weight, LAZ, WAZ, and WLZ against age in months at each time point of follow-up. This study had no true baseline due to logistical limitations, and study enrollment was made after four months of CPNP program implementation, so enrollment characteristics were used to check comparability. Enrollment characteristics included child and parents' characteristics (e.g., age, education), socio-economic status (e.g. household assets, main living source), household food insecurity, water and sanitation facilities, and social capital. .

Enrollment characteristics were compared using linear, logistic and ordinal logistic regression to account for cluster effects between areas. All variables that differed at enrollment were adjusted during further analyses.

Comparison of covariates was conducted to determine whether there were

imbalances on potentially important confounding variables that occurred by chance despite the randomization process. Variables that were identified as unbalanced between intervention groups were adjusted in the analysis.

All analysis of intervention effects was done on an intention-to-treat basis. The effect of the CPNP program as compared to control area was estimated using a three-level mixed effect model using a longitudinal dataset and to account for correlations of outcomes within children and within cluster, adjusting for confounding variables such as household food insecurity, fathers' education, household wealth index, type of nearest health facility, district, and child age, and accounting for geographical clustering effect. A sensitivity analysis to improve data quality was carried out on anthropometric measurements (Chapter 4).

Since this analysis includes data clustered at different levels (individual and cluster), a multilevel analysis that accounts for differences among child growth (random intercept and random slope for age) of children by cluster (random intercept) may be appropriate. The distribution of anthropometric outcomes at 6 to 24 months of age was graphically presented by Lowess curves derived from nonparametric, locally weighted regression analyses (25). Cox proportional hazards regression with shared frailty for recurrent events model (26) was used to analyze the effect of the CPNP program on the repetitive risk of stunting, wasting, and underweight of subject children during the 12-month follow-up. In this model, the different time periods for each event for the same subject were analyzed separately and adjusted for the fact that time periods within each subject are dependent.

3.6.2 Aim 2: Effectiveness evaluation of CPNP on child feeding and hygiene practices

Applying the same methods, enrollment characteristics of the control and intervention areas were compared using logistic, ordinal, or multinomial logistic regression accounting for geographic clustering, and variables that differed by intervention group were included in further analysis. A total of 1,199 mothers who were questioned at all five visits were included in the data analysis. Bar graphs were prepared to present scores of feeding and hygiene at each visit in the control and intervention groups. Based on infant and young child feeding indicators (IYCFs), scores of currently breastfeeding, meal frequency, dietary diversity (DDS), hand washing, and composite feeding were developed. The scores were defined separately for each of the three age groups: 6–8, 9–11, and 12–24 months and examined at each visit, except for the hygiene score, which was examined across three visits. Detailed scoring methods are described in Chapter 5. The composite feeding score was constructed adapting child feeding indices proposed by Ruel and Menon (27). Multilevel linear models were constructed to estimate the differences in scores of current breastfeeding, meal frequency, dietary diversity, hand washing, and composite feeding between the control and intervention groups, adjusting for variables that differed at enrollment.

3.6.3 Aim 3: Program impact pathway (PIP) analysis of CPNP

Descriptive analyses were conducted for five critical implementation components, which were identified from the program impact pathway (PIP) (Figure 6.1). For evaluation of the quality of the implementation process of CPNP (component 1), process indicators, such as percentage dose delivered, percentage dose received, and percentage or scores of fidelity to intervention protocol were constructed based on extracted data from the attendance book and observation checklists, and were compared in six intervention clusters by chi-squared test. The following variables

were evaluated regarding the participants' program acceptance (component 2): material contribution to the CPNP session, perception of the session (e.g., satisfaction, usefulness of CPNP message, confidence in putting the CPNP messages into practice), and active participation in main CPNP activities (e.g., singing, hand washing, and feeding). These variables were presented as percentages of those accepting/participating/perceiving of specific elements out of surveyed participants. Participants' message recall (component 3) was presented as a percentage of those who remembered specific CPNP messages (e.g. preparing nutritious complementary foods) out of surveyed participants. For proximal outcomes of child feeding and hygiene behaviors (component 4), multilevel mixed effect models were constructed and tested between the control and intervention areas (detailed information in Chapter 5 and 6). *P*-values were calculated by multilevel linear regression analysis, accounting for cluster effect to compare (1) control group vs. intervention area, or (2) non-CPNP participants vs. CPNP participants in the intervention area. Indicators of exposure to ENA and CMAM programs (component 5) were calculated by summing up all events from visit1 to visit5 divided by the total number of subjects to estimate mean percentages compared by two-sample tests of proportions.

3.7 ETHICAL CONSIDERATIONS

The study proposal, consent forms, and modules received ethical approval from the Ethical Review Committee of Oromia Regional Health Bureaus (ORHB) in Ethiopia (BEFO/AH/UTR/1-84/29021, Aug. 23, 2012) (Appendix F). Yunhee Kang was listed as an investigator in the study. Informed consent was obtained from mothers of subject children. For illiterate mothers, we used oral informed consents under permission of one of the household members, with a local language translated consent

form. Contents of the informed consents were read by data collectors. Study object, method, expected results, each measurement time and process and potential benefit/harm was informed in the local language, *Afan Oromo*. Women who consented to join the study agreed to let their child be measured for 12 months as scheduled by the project for their length and weight at visit1 to visit5. Caregivers were informed that they were allowed to leave this study at any time if they felt uncomfortable or were not available to participate in this study due to any reasons. All information collected in this research was not particularly sensitive, but was collected and managed only by trained interviewers; confidentiality was maintained by keeping secure records and de-identifying the records during analysis and dissemination. While the potential benefits of participation were minimal, the risks associated with participation were also negligible. The time commitment for participation was less than one hour per interview. Providers may have experienced mild psychological discomfort when taking the survey, but this was highly unlikely because sensitive topics were not included in the survey. Because most of the mothers were illiterate, all mothers of study subject children were provided detailed information about the study verbally at visit1 before data collection, and only mothers who signed written or verbal informed consent were enrolled to this study. This trial was registered with Current Controlled Trials, ISRCTN 89206590.

3.8 TIMELINE

The total duration of the study—including proposal writing, data analysis, and thesis write-up—was 39 months. IRB approval and finalization of study procedures were approved by the Ethical Review Committee of the Oromia Regional Health Bureau. Apart from data collection, interventions were individually implemented by the World

Vision project team jointly with district health offices. Subject enrollment began November 2012; follow-up continued up to January 2013. Data collection, entry, and management began upon enrollment of the participants. Data collection was completed in February 2014, and data entry and crosschecking was finished by the end of April 2014. Data analysis and write up took approximately one year to complete from the mid-point of data collection. The entire process was completed by December 2014 (Table 3.7).

Table 3.7 Intervention implementation schedule and data collection activities by month

Phase	2012				2013				2014				2015
	1	2	3	4	1	2	3	4	1	2	3	4	1
Project implementation	X	X	X	X	X	X	X						
Writing research proposal and developing forms	X												
Local IRB Approval			X										
Establishing child registration system & randomization			X										
Setting up of data management system			X										
Training of interviewers				X									
Obtaining informed consent				X									
Data collection (Effectiveness survey)				X	X	X	X	X	X	X			
Data collection (Recall survey)					X	X							
Data cleaning										X			
Final data analysis									X	X	X	X	
Thesis write-up									X	X	X	X	X

Appendix 3.1 Demographic information of rural area in Habro district according to the population projection in 2012 (14)

Geographical area	Population in 2007			Population projection in 2012	Number of children <2 (5.71%)	Estimated number of underweight children <2 (34%)
	Both sexes	Male	Female			
Habro-Rural	165,222	85,055	80,167	187,426	10,702	3,639
Hunde Dhaba	7,082	3,605	3,477	8,034	459	156
Lelisa	8,611	4,440	4,171	9,768	558	190
Derera	6,422	3,289	3,133	7,285	416	141
Arede Bora	6,133	3,229	2,904	6,957	397	135
Oda Anani	5,461	2,835	2,626	6,195	354	120
Lugo	7,240	3,642	3,598	8,213	469	159
Chefa	4,837	2,501	2,336	5,487	313	107
Chefa 12	5,576	2,844	2,732	6,325	361	123
Melike Belo	6,277	3,173	3,104	7,121	407	138
Gerbi Goba	6,538	3,323	3,215	7,417	423	144
Lega Bera	7,807	4,028	3,779	8,856	506	172
Weyini Kelo	5,512	2,779	2,733	6,253	357	121
Kelecha	5,783	3,028	2,755	6,560	375	127
Badhadha	1,855	945	910	2,104	120	41
Bereda	4,964	2,551	2,413	5,631	322	109
Haro Chercher	7,816	4,038	3,778	8,866	506	172
Gerb Teka	3,823	1,915	1,908	4,337	248	84
Busetu	3,117	1,617	1,500	3,536	202	69
Oda Muda	6,890	3,539	3,351	7,816	446	152
Weyini Guda	7,541	3,867	3,674	8,554	488	166
Mada Jalala	7,953	4,082	3,871	9,022	515	175
Efa Gamachu	9,146	4,880	4,266	10,375	592	201
Dikicha	6,132	3,175	2,957	6,956	397	135
Firjiru	4,348	2,261	2,087	4,932	282	96
Danse	5,910	3,093	2,817	6,704	383	130
Efa Jiru	3,587	1,849	1,738	4,069	232	79
Gadisa	3,726	1,904	1,822	4,227	241	82
Kufa Kas	5,135	2,623	2,512	5,825	333	113
Average	5,901	3,038	2,863	6,694	382	130

Appendix 3.2 Demographic information of rural area in Melka Bello district according to the population projection in 2012 (14)

Geographical area	Population			Population projection in 2012	Number of children <2 (5.71%)	Estimated number of underweight children under two (34.0%)
	Both sexes	Male	Female			
Melka Belo-Rural	168,074	85,475	82,599	190,661	10,887	3701
Melka Belo-Rural (Excluding two remote Kebeles)	143,943	73,090	70,853	163,287	9324	3170
Kufekasa	4,537	2,299	2,238	5,147	294	100
Bifitu Oromiya	5,269	2,696	2,573	5,977	341	116
Chefe Jeneta	6,525	3,315	3,210	7,402	423	144
Burika Negeya	6,640	3,421	3,219	7,532	430	146
Fale Negeya	7,323	3,740	3,583	8,307	474	161
Welda Misima	4,471	2,276	2,195	5,072	290	98
Melisa Haka	11,197	5,741	5,456	12,702	725	247
Daba Kenisa	10,323	5,238	5,085	11,710	669	227
Tokuman Kane	8,496	4,347	4,149	9,638	550	187
Dire Kufa Kuter 4	5,254	2,590	2,664	5,960	340	116
Welikituma Bilusuma	9,908	5,145	4,763	11,239	642	218
Firi Kebiso	8,279	4,191	4,088	9,392	536	182
Tokuma Jalela	7,902	4,010	3,892	8,964	512	174
Degaya Bello	11,827	5,990	5,837	13,416	766	260
Mekanisa	4,084	2,044	2,040	4,633	265	90
Efa Basi	7,280	3,793	3,487	8,258	472	160
Chefe Weliteha	10,893	5,447	5,446	12,357	706	240
Boko Jalela	4,870	2,447	2,423	5,524	315	107
Bifitu Negeya	5,786	2,870	2,916	6,564	375	127
Debile	3,079	1,490	1,589	3,493	199	68
Average	7,197	3,655	3,543	8,164	466	159

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CHAPTER 4. EFFECTIVENESS OF A COMMUNITY-BASED PARTICIPATORY NUTRITION PROMOTION PROGRAM TO IMPROVE CHILD GROWTH IN EASTERN RURAL ETHIOPIA

4.1 ABSTRACT

Background: Appropriate complementary feeding and hygiene may reduce child undernutrition. **Objective & Design:** We designed a community-based participatory nutrition promotion (CPNP) program in Ethiopia, adopting in part the theory of positive deviance. Through group nutrition sessions, this program engaged mothers in “learning by doing” around child feeding and hygiene and the use of affordable resources. This program was implemented in addition to the existing government nutrition programs of Essential Nutrition Action (ENA) and Community-based Management of Acute Malnutrition (CMAM) and tested in a cluster randomized trial to examine its effectiveness in improving child growth in 12 rural areas in Ethiopia.

Results: 1,790 children 6 to 12 months of age were enrolled in the trial and measured for their length and weight every three months for 12 months. A total of 38.9% of the children enrolled in the intervention area attended the CPNP program. In multi-level mixed effect regression models based on longitudinal data ($n = 1,475$) controlling for clustering effects and enrollment characteristics, children in the intervention area had a significantly greater increase in length-for-age z score (LAZ)/month of 0.021 (95% CI: 0.008, 0.034) and weight-for-age z score (WAZ)/month of 0.015 (95% CI: 0.003, 0.026), length/month (diff: 0.059 cm; 95% CI: 0.027, 0.092), and weight/month (diff: 0.031 kg; 95% CI: 0.019, 0.042) compared to children in the control area. There was no difference in the recurrent risk of stunting, underweight, or wasting between intervention and control groups. **Conclusions:** A novel community participatory

nutrition promotion program appeared to be effective in improving child growth in the rural Ethiopian context.

4.2 INTRODUCTION

Undernutrition is associated with deaths by preventable diseases in early childhood, as well as long-term consequences in human capital development, including delayed cognitive and motor development, poor learning performance at school, increased risk of non-communicable disease followed by excessive weight gain later in life, and low income and productivity in the adult stage (1). As a global commitment to tackle this public health issue, WHO targets to reduce the number of under-five stunted children by 40% from 171 million in 2010 to 100 million in 2025 and to reduce wasting to less than 5% (2). The period of 1000 days from conception to 24 months of age was recognized as the most effective intervention period to mitigate the adverse effects of undernutrition, thus evidence-based nutrition-specific interventions have been delivered with a focus on this period (3).

Ethiopia is a developing country with a high burden of child undernutrition and micronutrient deficiencies; 44.4% of children under five years of age are stunted, 9.7% are wasted, and 40% have anemia (<11.0 g/dl) (4). Factors associated with undernutrition in Ethiopia are multifaceted as with the UNICEF malnutrition framework as follows: insufficient nutrient intake (5), inappropriate breastfeeding and complementary feeding practices (6-9), prenatal influences (8), poor access to and low utilization of health care (10-12), household socioeconomic status (9, 13), food insecurity (14), and level of parental education (9). In Ethiopia, only 4% of breastfed children age 6-23 months are given foods from at least four food groups, while 48% are fed the minimum number of times or more per day (4). Inequality in appropriate

feeding practices were found to be according to residence and wealth quintile.

Complementary feeding interventions were effective in improving child nutritional status in developing settings (3, 15, 16). These intervention strategies featured multi-dimensional behavioral change communication activities, such as locally acceptable and affordable recipes development, intensive group education or individual counselling, use of mass media, involvement of community groups and health care workers, and were embedded within existing health programs (17-23). Given the current poor condition of child feeding practices, contextualized, effective, and sustainable child feeding strategies are needed in Ethiopia that are in line with Ethiopia National Nutrition Strategies (NNS)/Programs (NNP) (24).

There were two types of community-based nutrition programs in poor rural districts: the Essential Nutrition Action (ENA) program and Community-based Management of Acute Malnutrition (CMAM) program. The ENA activity was first introduced by USAID/Ethiopia as an approach of ENA framework to improve the nutrition of women and children focusing on improving breastfeeding, complementary feeding, and micronutrient deficiencies, and had successful outcomes (25). In 2008, an end-line evaluation of pre-post design showed that consumption of three or more types of foods increased compared to baseline (53% vs. 33%); the proportion of meeting the minimum acceptable diet was greater among children in the project area compared to children in non-project areas (24% vs. 12%) (26). Despite the achievement of ENA implementation at the regional level, poor working structure in the ENA framework was found to be an obstacle in addressing undernutrition. The CMAM program was also integrated into the government health system to treat acutely malnourished children at the community level (27).

ENA activities were supposed to be delivered by community volunteers, but

they themselves had poor knowledge of child feeding practices and poor counseling skills in convincing mothers to keep recommended feeding practices. There was no available supervision or incentive system to monitor the entire volunteer delivery structure (28). The CMAM program, on the other hand, though promising in treating severe wasting with ready-to-use therapeutic foods (RUTF) (29), had no prevention program components and depended entirely on external emergency funding to purchase related therapeutic or supplementary foods (30, 31).

With this backdrop, World Vision Korea and World Vision Ethiopia designed a new program model—which we called “community-based participatory nutrition promotion (CPNP)”—in collaboration with Wholistic Interest Through Health (WITH, a Korea-based NGO) and Ethiopia local health governments (Appendix A and B). The new model aimed to address the gaps in the ENA and CMAM programs and to strengthen community participation and program ownership, in part adopting a positive deviance theory but designed for scale implementation (32). This new model attempted to promote appropriate complementary feeding and hygiene among caregivers by using locally affordable and available resources.

The idea was that this new model would eventually lead to improvements in the child nutritional status at the community level. The CPNP was added to the existing ENA activities and to the CMAM program, and was implemented from August 2012 to August 2013 in two rural districts of eastern Ethiopia. The CPNP was evaluated to assess its effectiveness on the growth of children 6 to 24 months of age in a cluster randomized trial (CRT) compared to areas with the existing ENA and CMAM programs only.

4.3 METHODS

The CRT compared the effectiveness of the CPNP program added to existing ENA and CMAM programs with the existing programs only (control program) in improving length-for-age (LAZ), weight-for-age (WAZ), and weight-for length (WLZ) z scores, and for reducing stunting, underweight and wasting among children 6 to 24 months of age in two rural districts in Ethiopia. Additionally, we tested whether CPNP participants had faster weight gain and a greater WAZ scores than non-participants in the intervention area. Stunting, underweight, and wasting were defined as height (or length)-for-age, weight-for-age, and weight-for-height (length) more than two standard deviations below the median of the WHO growth reference (33). Child growth was followed up for 12 months up to 18 to 24 month of age. The effects of the CPNP program on child feeding and hygiene of mothers were among secondary outcomes that were reported in Chapter 5.

4.3.1 Participants and population site

The effectiveness study was conducted in the Habro and Melka Bello districts of eastern Ethiopia. The total population of Habro and Melka Bello districts was estimated at 191,546 and 176,813, respectively, in 2011 (34). The study site included all 29 rural Kebeles (the smallest administrative unit of Ethiopia) of Habro district and 20 of 22 rural Kebeles of the Melka Bello district. The study Kebeles had an estimated average population of 6,300 and 416 children 0 to 24 months of age. Both districts were typical of eastern rural Ethiopian communities, with limited development and dependence on mixed crop agriculture, mainly sorghum, maize, and other vegetables, livestock rearing, and the production of Khat, a stimulant plant with amphetamine-like effects, as a predominant cash crop (35, 36). These districts were

selected not only because that they displayed typical characteristics of eastern rural Ethiopia but also because of their poorly working ENA activity structures of community volunteers and availability of therapeutic foods such as Plumpy'Nut that were given to treat severely acute malnourished children at health centers/health posts through the CMAM program. World Vision Ethiopia has implemented the Area Development Program (ADP) for more than five years, building close ties with community members in the two districts.

Study subjects could be any children aged 6 to 12 months at enrollment residing in the study area, except for twins, regardless of preceding intervention exposure. Due to the nature of public group nutrition sessions of CPNP, it was expected that the program would influence not only participants themselves but also their neighboring mothers, who could either observe the session in their communities or learn CPNP lessons from CPNP participants.

4.3.2 Outcomes

The primary outcomes of the study were differences in LAZ, WAZ, and WLZ, and differences in risk of stunting, underweight, and wasting of children 6 to 24 months of age between the control and intervention areas. The length and weight measurements for each child were converted to LAZ, WAZ and WLZ scores using the international growth reference from the WHO Multicenter Growth Reference Study (33).

4.3.3 Sample size

We estimated that a sample of 2,064 children ($n = 1032/\text{group}$) would be required to increase a 0.2 z score in LAZ in 18-24 months of age based on an expectation of a -1.7 z score in the control area (37), accepting a type I (α) error of 5%, power at 0.80,

cluster size at 172, lost to follow up at 10%, standard deviation of 0.9 z score (38). There was no available intra-cluster correlation coefficient (ICC) information for anthropometric indicators in the study area, so we assumed an ICC of 0.054, which was calculated based on DHS in 46 developing counties in another study (39).

4.3.4 Randomization

A cluster was used as a unit of randomization. The procedure of forming clusters was as follows. First, all 49 Kebeles in the Habro and Melka Bello districts were ranked according to the level of socio-economic condition assessed by the qualitative information of Agricultural Officers of the World Vision ADPs. Statistical information to assess socio-economic status at the Kebele level was absent. Second, two to six nearby Kebeles presumed to share similar socio-economic living environments were grouped into a cluster, eventually resulting in 12 clusters with 6 clusters per district. One cluster included 4 Kebeles on average. Each cluster was matched to the other cluster in the same district based on the similarity of agricultural and wealth information from World Vision local staff and local government officers. By tossing a coin in the presence of the local authorities, if one cluster was randomly decided as an intervention area, the paired cluster automatically became a control area. Intervention allocation was not blinded among study subjects and community members due to the public nature of the intervention. Borders between the control area and the intervention area were not separated.

4.3.5 Interventions: The Ethiopia Integrated Nutrition Project (EINP)

The CPNP was implemented as part of the Ethiopia Integrated Nutrition Project (EINP), which was comprised of CPNP, ENA and CMAM programs. The CPNP was

called “*Sagantaa Shuuro*” in Afan Oromo, which meant “*porridge program*.” Some program elements, such as a two-week group session and utilization of community available and affordable resources, were partially adapted from the Positive Deviance Hearth program (40, 41). The CPNP session operation unit was a village (“Ganda”), a sub-community structure in a Kebele. One female CPNP operator was recruited from her Kebele, who prepared and led a 12 day long CPNP session. Seven to twelve child and mother pairs participated in each CPNP session, where they contributed various food ingredients and session materials such as firewood, prepared complementary foods per recipes developed by NGO nutrition experts, and fed their children on the spot. Mothers discussed feeding, caring, hygiene and health-seeking messages with CPNP operators. During the session, all mothers took turns in pairs preparing porridge. All enrolled children were weighed on the 1st day and 12th day of the session, one month, and three months after the session. The CPNP participants had 1 to 2 follow-up visits by CPNP operators or supervisors during the following two weeks. Once a CPNP session was carried out in a village in a Kebele, the next session was prepared in a neighboring village within the Kebele.

The ENA activity aimed to deliver nutrition messages to all mothers with children under two years of age by HEWs or community volunteers. Adequate breastfeeding and appropriate complementary feeding practices, proper care for sick children, maternal nutrition, and micronutrient deficiency were the main nutrition messages in the ENA counseling (42).

Severely wasted children with mid-upper arm circumferences (MUAC) of less than 11 cm but without complications were referred to the nearest health post/health center and received Plumpy’Nut until their recovery (43). Through a few rounds of distribution, children with MUAC greater than 11 cm but less than 12 cm received 8.3

kg of corn-soy blend (CSB) and oil per month from their assigned health center for three months. The list of beneficiary households were prepared by the district health office every three months.

The EINP was launched in January 2012 and was phased out in August 2013. The ENA training of HEWs and community volunteers and the CMAM training of HEWs were conducted in both districts from March to May 2012. For the CMAM program, Plumpy’Nut was available year round, but CSB was provided occasionally due to logistical limitations. The first CSB distribution was put in place in August 2012 at the time when the first CPNP session began in the intervention area. World Vision Korea and World Vision Ethiopia had full responsibility for designing CPNP, training the ENA and CMAM program health staff, HEWs, and community volunteers. Implementation of the ENA activity and the CMAM program was the responsibility of the district health offices.

4.3.6 Procedures

An established birth registration system which could be used for the random selection of subject children was absent in the study area, so we requested the Habro and Melka Bello district health offices to prepare a roster of children in the study area aged 0 to 12 months of age. To facilitate this process, we prepared a calendar indicating Ethiopian years and dates as well as a Gregorian calendar for the last two years to estimate the children’s ages as accurately as we could. The Ethiopian calendar year of 2004 began on September 12, 2011 A.D of the Gregorian calendar. After a brief training session, HEWs and community volunteers visited households in their Kebele, recorded the relevant information to the child roster form. The form included Kebele and village name, HEWs and community volunteers’ name, mother’s name, and

child's name, birthdate, age and sex. After the surveillance, the forms were submitted to health centers first, then compiled and delivered to the district health offices. The information was entered into a Microsoft Excel program. Using a unique identification number that we assigned to each child, 2,064 children 4 to 11 months of age were randomly selected proportional to the population size of each cluster. Because the roster was prepared a month before the data collection started at visit1 and a round of data collection took three months' collection, we had to consider the aging of subject children. Eventually, four months after the CPNP sessions began (August 2012), the first visit for the data collection was made (November 2012) and continued for 15 months until February 2014. The data collection was carried out at five major time points for a cohort of children aged 6 to 12 months: enrollment (visit1), 3 month (visit2), 6 month (visit3), 9 month (visit4) and 12 month follow-up (visit5). Thus, the children who were enrolled at the age of 6 to 12 months at visit1 turned 18 to 24 months old at visit5. The CPNP program was phased out when visit4 started.

The data collection team was comprised of one team leader and nine enumerators in each district, and the data management team consisted of four female members, all of whom were recruited from their district and trained by World Vision nutrition experts and study investigators for anthropometric measurement and household interviews. A structured questionnaires was initially prepared in English and translated into the local language ("Afan Oromo") by a government-registered translator. The data collection tool was pre-tested in a neighboring Kebele outside the study area.

After providing informed consent (Appendix C.1), the weight and length of the children were measured using standardized procedures (44) every three months

from the moment of enrollment (visit1) to the 12-month follow-up (visit5). Weight was measured to the nearest 0.01kg by a digital scale (model 354, SECA/GERMANY). A locally designed measuring board was used to measure supine length for children to the nearest 0.1 cm.

At enrollment, using a structured questionnaire, mothers of subject children were asked about household demographic and socioeconomic information, dwelling condition, maternal and infant characteristics, household assets, food insecure conditions, social capital, water sources, and sanitation facilities. The Household Food Insecurity Access Scale (HFIAS) was used to measure food insecurity (45). Short Social Capital Assessment Tool (SASCAT) was used to quantitatively measure structural and cognitive social capital (46). Infant and young child feeding practices and hygiene practices were asked every three months and every six months, respectively (Chapter 5). The mothers were asked whether or not they participated or received each of the three interventions, i.e. attendance to CPNP session, receipt of ENA activity/counselling, or receipt of Plumpy’Nut or CSB through the CMAM program in the past three months. Enumerators and the data entry team had no interaction with the intervention implementation staff or government health staff. Twelve-month follow-up of child anthropometric status was completed by February 20, 2014.

4.3.7 Data quality control

Standardization of anthropometric measurements was achieved by taking multiple measurements on non-study subjects during the training prior to commencement of data collection, and refresher training was done when necessary. Regular supervision visits by team leaders were made during data collection visits. The data collection

team had bi-weekly team meetings to resolve challenges in the field. Errors in anthropometric measurement were found at visit1. To prevent further error occurrence, we strengthened refresher training at the beginning of visit2, and provided reminders on how to accurately measure length and weight. Collected questionnaires and forms were submitted to team leaders regularly during team meetings and delivered to the data management team in the Habro district. All entered data were cross-checked with another data entry person.

After all data were entered, a sensitivity analysis to improve data quality was carried out on anthropometric measurements as follows: data with z-scores in unacceptable ranges (i.e., < -6 for LAZ and WAZ, etc.) were deleted. Specifically, if LAZ scores were greater than 6 or below -6, the LAZ scores and corresponding length values were deleted together. If WAZ scores were greater than 6 or below -6, or if WLZ scores were greater than 5 or below -5, the WAZ and WLZ scores and corresponding weight values were deleted. Subsequently, we deleted data of enumerators who had systematic measurement errors in their measures. To find such errors, we calculated monthly length and weight changes by age and sex of all enumerators and compared these values with those of WHO Child Growth Standards children (47). We removed length measures at visit1 if there were unacceptably high increases in length between visit2 and visit1, since many errors were reported during the visit. We deleted length data with subsequent measures that were lower than those of prior visits. Last, we included into data analysis the anthropometric data of children who had two or more measures in length and weight out of five visits.

4.3.8 Statistical analysis

Descriptive statistics for continuous variables were presented as mean \pm SD, while categorical variables were presented as number (*n*) and proportion (%). Analyses were by intention to treat. Statistical significance was set at $P < 0.05$ with all tests being two-tailed.

Enrollment characteristics were compared using linear, logistic and ordinal logistic regression to account for cluster effects between areas. All variables that differed at enrollment were adjusted during further analyses. Univariate linear or logistic models were used to explore the difference in length, weight, and z scores between children in the control and intervention areas or the odds ratio of prevalence of stunting, underweight, and wasting for each visit. Longitudinal data analysis using anthropometric measures was conducted using three-level mixed effects linear regression models to estimate linear and ponderal growth rate to compare the control area vs. intervention area, or CPNP participants vs. non-CPNP participants.

Data of subjects with at least two measurements at different time points were included in the longitudinal data analysis. The models added quadratic terms of age, accounted for cluster level effect and baseline differences in fathers' education, household food insecurity, type of nearest health facility, district, and anthropometry persons, as these variables differed at study enrollment. Fixed-effects covariates included intervention (control area vs. intervention area), child age, sex and variables that differed at visit1. Random intercepts were present at both the individual and cluster levels, and the random slope was at child age.

The distribution of anthropometric outcomes at 6 to 24 months of age was graphically presented by Lowess curves derived from nonparametric, locally weighed regression (48). Cox proportional hazards regression with shared frailty for recurrent events model (49) was used to analyze the effect of the CPNP program on the

repetitive risk of stunting, wasting, and underweight of subject children during the 12-month follow-up. In this model, the different time periods for each event for the same subject were analyzed separately and adjusted for the fact that time periods within each subject are dependent. Logistic regression analysis using the robust cluster variance estimator were used to estimate prevalence of stunting, underweight, and wasting at 12-months of follow-up.

Data management and statistical analysis were performed using Stata version 12.0 (Stata Corporation, College Station, TX, USA).

4.3.9 Ethical review

The study proposal, questionnaires, and subject consent forms were submitted and approved by the Oromia Regional Health Bureau (IRB No: BERO/AHKTF/1-89/29021, Aug 23, 2012) (Appendix F.1 and F.2). All mothers of study subject children were provided detailed information about the study verbally at enrollment (visit1) prior to data collection, and only mothers who provided consent were enrolled in this study. This trial was registered with Current Controlled Trials, ISRCTN 89206590.

4.4 RESULTS

Out of the 2,064 randomly selected children from the roster, 914 children from control and 876 children from intervention areas were enrolled in the study.

Exclusions were related to not finding children/refusal to participate (n = 89 in intervention and n = 14 in control area) or age criteria not being met (n = 67 in intervention and n = 104 in control area). Thus, a total of 1,790 child and mother pairs were enrolled at visit1 and followed up with every three months. Groups had no

difference in the percentage of being followed by visit, except for a 3.5% difference at visit2 (88.5% in control area vs. 85.0% in intervention area); 1,552 (86.7%) were followed at visit2, 1,546 (86.4%) were followed at visit3, 1,501 (83.9%) were followed at visit4, and 1,394 (77.9%) were followed at visit5 (Figure 4.1).

Enrollment information from the 1,790 child and mother pairs was used to assure comparability between control and intervention areas (Table 4.1). Groups did not differ in child age and sex, parents' age, mothers' education, parity, main living sources, religion, water source and sanitation use, and social capital. The mean (SD) age of enrolled children was 8.7 (1.9) months, the mean (SD) age of fathers and mothers was 32.3 (6.8) and 26.1 (5.4) years, respectively, and 82.3% of mothers were illiterate. More than 90% of the households depended on mixed farming for their livelihoods. Z scores and prevalence of child undernutrition were not significantly different by group, reflected by LAZ (-0.90 vs. -0.87), WAZ (-1.00 vs. -1.00), and WLZ (-0.62 vs. -0.72), and stunting (19.2% vs. 20.0%), underweight (19.2% vs. 19.2%) and wasting (16.9% vs. 16.7%), in the control and intervention area. However, the intervention area had a significantly greater percentage of fathers with primary education (48.6% vs. 37.8%; $p = 0.044$), fewer households with severe food insecurity (12.4% vs. 34.7%; $p = 0.001$), greater access to the local hospital (1.0% vs. 14.4%; $p < 0.001$), and marginally better household wealth status. These variables were not comparable between groups, so that all those were accounted for during further analysis.

According to the CPNP program records, 372 CPNP sessions were held, and 3,299 mother and child pairs attended the CPNP sessions in the intervention area during the 13 months before the phase out of the EINP. Out of the 3,299 participant children, 67.8% gained more than 200g after attending the CPNP session of 2 weeks

(Chapter 6). Of 876 study subjects in the intervention area, the proportion of CPNP session attendants was 16.5% (n = 97) at visit1 but increased up to 38.9% (n = 340) by visit5 (Table 4.2). In the control area, 3.3% of children reported to have experienced CPNP participation. Regarding the exposure to CMAM and ENA programs, there was no difference in the proportion receiving CSB between control and intervention areas. By contrast, fewer children received Plumpy'Nut (6.8% vs. 2.9%, $P < 0.001$) and more mothers were exposed to the ENA activity (15.1% vs. 23.4%, $P < 0.001$) in the intervention than in the control area.

Out of the 1,790 subject children, 750 (82.1%, N = 914 in control area) and 725 (82.8%, N = 876 in intervention area) children in the control and intervention areas, respectively, were included in the longitudinal analysis of child growth as they had at least two measures at different time points after the data cleaning procedure. As a result, 315 (17.6%) children were completely excluded from the longitudinal data analysis, and their enrollment characteristics were comparable to the children included in the data analysis. Z scores, length and weight among study children were listed by visit in Appendix 4.1.

All longitudinal models accounted for cluster level effect and differences in enrollment characteristics. Using a longitudinal analysis by age, children in the intervention area were estimated to have significantly better growth in terms of LAZ (diff: 0.021 z score/month; 95% CI: 0.008, 0.034), WAZ (diff: 0.032 z score/month; 95% CI: 0.016, 0.039), WLZ (diff: 0.042 z score/month; 95% CI: 0.024, 0.059), length (diff: 0.059 cm/month; 95% CI: 0.027, 0.092) and weight (diff: 0.031 kg/month; 95% CI: 0.019, 0.042) compared to children in the control area (Table 4.3 and Figure 4.2). Differences in these anthropometric indicators between two areas were apparent by 18 months of age and continued up to 24 months of age (Figure

4.2). Furthermore, children who had ever attended the CPNP session exhibited even faster monthly weight gain (diff: 0.035/month, 95% CI: 0.017, 0.053) and WAZ (diff: 0.029 score/month, 95% CI: 0.012, 0.047) than non-CPNP participants in the intervention area (Table 4.4).

Estimated from a longitudinal analysis by visit, differences in child growth after 12 months follow-up were as follows: 0.33 LAZ (95% CI: 0.07, 0.59), 0.339 WAZ (95% CI: 0.07, 0.61), 0.474 WLZ (95% CI: 0.14, 0.81), 0.925 cm in length (95% CI: 0.27, 1.58) and 0.398 kg in weight (95% CI: 0.144, 0.652) (Figure 4.3). The differences between the two areas were apparent by visit4 (9 months follow-up) or later and continued up to a year.

In the Cox proportional hazard models with shared frailty, adjusting for child sex and age only, the hazard ratio had significant differences on wasting (HR 0.749, 95% CI: 0.589, 0.951) and underweight (HR 0.785, 95% CI: 0.628, 0.980) between the groups. However, adjusted with all variables that differed at enrollment, the CPNP program appeared not to significantly reduce the risk of child undernutrition [Hazard Ratio (HR) 1.01, 95% CI: 0.811, 1.266 for stunting, $p = 0.907$; HR 0.826, 95% CI: 0.643, 1.061 for underweight, $p = 0.135$; and HR 1.048, 95% CI: 0.812, 1.354 for wasting, $p = 0.718$, respectively] (Table 4.4). Prevalence of stunting was lower in the intervention area by 7.5% ($p = 0.037$) at 9 month follow-up and by 7.3% at 12 month of follow-up (latter was not significant) (Figure 4.4, Appendix 4.1).

4.5 DISCUSSION

Using a cluster randomized controlled trial, this study demonstrated that a community-based participatory nutrition promotion (CPNP) program—added to the existing government programs of ENA and CMAM—could effectively improve child

growth in the rural context of eastern Ethiopia, by enhancing appropriate child feeding and hygiene in eastern rural context in Ethiopia. Specifically, the CPNP program improved child growth in terms of z scores, length, and weight in the intervention area. The CPNP participants, who were in a group directly exposed to the intervention, had faster weight gain and a greater increase in WAZ score than non-CPNP participants in the same intervention area. Risk of stunting, wasting, and underweight was not reduced by this program.

To suggest the intervention mechanism which led to these results, we need to collectively review the implementation process of the CPNP program and its interaction with existing programs and the potential mediating outcomes, such as improved child feeding practices among mothers, since child growth would be the last terminal of the causal framework. The occurrence of better child growth in the intervention areas can be supported first by the successfully implemented intervention process—done with high program dose and fidelity to the intervention guidelines and active participation and contribution—with 67.8% of the children having more than 200g of weight gain after two weeks of CPNP sessions (Chapter 6). The CPNP participants had positive attitudes towards the CPNP sessions and their messages and practices, and continued practices related to the CPNP lessons onward. Second, overall year-round ENA activity in the intervention area was greater than in the control area (23.4% vs. 15.1 %; $P < 0.001$), which was mainly attributed to active participation by CPNP mothers in the intervention area (Table 4.2 and Chapter 6). Third, mothers in the intervention area showed better child feeding practices (Chapter 5). Additionally, the high proportion of weight gain (67.8%) in the two-week sessions (Chapter 6) could in part support the possibility that children who had ever participated in the sessions kept faster weight gain and WAZ than non-CPNP

participants. The continued catch-up growth in terms of weight gain among participating children were reported elsewhere (50). The risk of stunting, wasting, and underweight showed no differences between control and intervention areas. Despite improvement of child growth in terms of z scores, the CPNP program did not lead to a significant decrease in stunting, underweight, or wasting at the community level.

The results of the study were by and large consistent with previous studies on the effect of interventions to promote complementary feeding through various behavioral change communication channels (15, 16). In five efficacy complementary feeding trials and four programs conducted between 1970 and 1997, improvement of child growth rates was between 0.1 and 0.5 SD (51). A meta-analysis with 17 studies showed that provision of appropriate complementary foods with or without nutritional counseling led to an extra gain of 0.25 kg (± 0.18) in weight and 0.54 cm (± 0.38) in height in children aged 6 to 12 months, whereas education about complementary feeding resulted in an extra gain of 0.30 kg (± 0.26) in weight and 0.49 cm (± 0.50) in height (16). Education on complementary feeding alone (fortified or unfortified, but not micronutrients alone) resulted in significant increases in HAZ (standard mean difference (SMD): 0.23, 95% CI: 0.09, 0.36) and WAZ (SMD 0.16, 95% CI: 0.05, 0.27) (15, 16). In food insecure settings, education on complementary feeding alone resulted in improvements in HAZ (SMD 0.25, 95% CI: 0.09, 0.42, 1 study) (22) and WAZ scores (SMD 0.26, 95% CI: 0.12, 0.41, 2 studies) (22, 52) and reduced the rates of stunting (RR 0.68, 95% CI: 0.60, 0.76, 1 study) (22). In view of the above results, our outcomes of 0.33 LAZ/month and 0.33 WAZ/month, 0.059 cm/month in length, and 0.031 kg/month in weight seemed to be somewhat larger than anticipated but still lie within the reasonable range of values.

Some studies adapting the Positive Deviance (PD) theory, as this study did, reported inconclusive results. A trial in Vietnam on the impact of the PD Hearth program, using randomized controlled trial design, prospectively followed up to 240 children for 12 months and showed no significant difference in growth patterns between intervention groups (53). Among them, children whose age was less than 15 months and who were more malnourished at baseline had on average far less drop of WAZ scores in the intervention group, while counterpart children in the control group lost 0.25 HAZ scores (0.05 vs. 0.25) (54). A study in Haiti reported no significant differences in nutritional status between study groups (55).

The strengths of this study included the use of a cluster randomized study design, prospective and longitudinal data collection on a large scale, and the use of a statistical approach to account for correlation within individual children and geographical clusters.

There were a few limitations in this study. First, our anthropometric measurements had considerable measurement errors despite constant error checking and refresher training, but we improved the data by excluding suspected data with systematic ways through sensitivity analysis. Second, allocation of intervention to the matched clusters was made randomly, but, by chance, imbalances were found in the enrollment characteristics at visit1 between control and intervention areas, such as fathers' education, household food insecurity, and type of nearest health facilities in favor of the intervention area. These variables were included in our statistical models and adjusted.

Third, this study had no true baseline because the first data collection was conducted four months after the CPNP sessions started within the communities. It was expected that the CPNP program already impacted child nutritional status in the

community. However, there was no significant difference in anthropometric measurement and indicators, and comparison for such indicators was mainly done by monthly rate comparisons. Fourth, the intervention allocation and data collection procedures were not blinded to subject mothers and interviewers by the nature of intervention of the CPNP. Some mothers knew of the existence of the CPNP program in their community but had no idea of the impact comparison purpose of this study. Interviewers were constantly reminded to conduct accurate data collection with neutral attitudes regardless of intervention allocation. Additionally, CPNP participants were found in the control area with 3.3% of mothers in the control area. Since the border between clusters were not regulated, mothers living on the borders of clusters would have opportunities to attend the CPNP session. This could be a contaminating factor which is likely to affect the effect of CPNP on the outcomes. Nevertheless, we did not exclude the CPNP participants in the control area, abided by the intention to treat analyses principle. We suggested that 3.3% contamination would not be great enough to decrease the program effect size, and that this type of intervention contamination is expected in actual programmed settings. The effect sizes might be presented as slightly conservative.

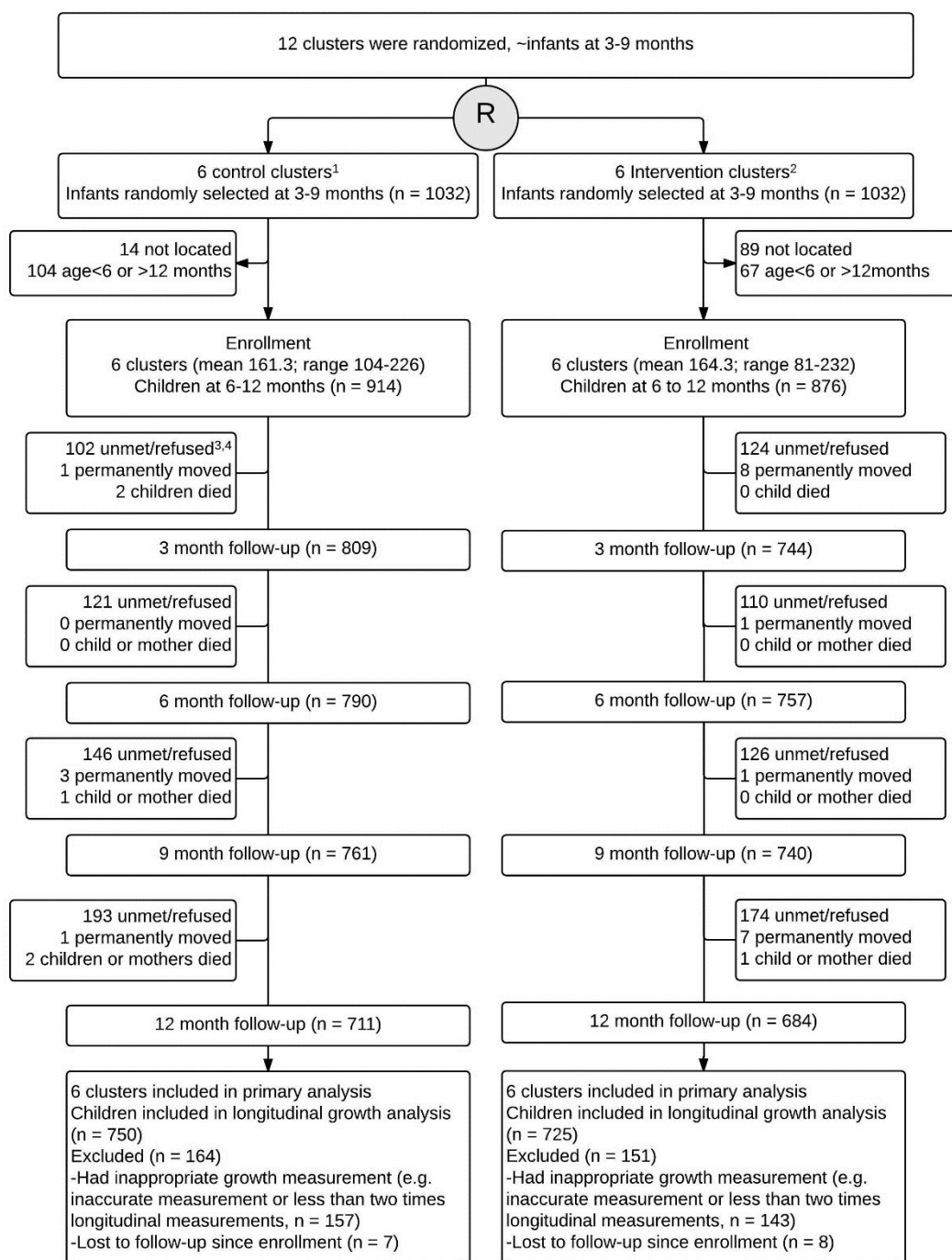
Further research is needed to determine the sustainability of the CPNP program effects on child growth beyond 24 months of age in the Habro and Melka Bello districts, and the generalizability of the intervention needs to be assessed at a wider scale in similar communities in Ethiopia and other African countries.

Conclusion

This study showed that a community-based participatory nutrition promotion program improved child growth when added to the existing government nutrition programs in

Ethiopia. Despite a few limitations, this study has implications of being an operational research study that evaluated the effectiveness of a nutrition program using a rigorous study design in a setting where child undernutrition is high and where effective interventions are urgently needed. These research findings will help spur community participation and strengthen the community health systems. We suggest that rather than implementing the CPNP independently, the program should be adapted in conjunction with existing government nutrition programs to increase its effectiveness and build the community's capacity to address child undernutrition. This will also complement the work of the Ethiopia National Nutrition Strategies (NNS)/Programs (NNP) and will help develop the nutrition program strategies of non-government organizations.

Figure 4.1 Consort diagram for trial participants from trial enrollment through 12 months follow-up, Habro and Melka Bello districts, Ethiopia (2012-2014)



¹ Control clusters: Community-based Management Acute Malnutrition (CMAM) program and Essential Nutrition Action (ENA) counselling only were implemented in control clusters.

² Intervention clusters: In addition to the CMAM program and ENA counselling, the Community-based Participatory Nutrition Education (CPNP) was implemented in intervention clusters.

³ Unmet: the subject moved out of the area or was not at home at the time of the survey.

⁴ Refused: the subjects decided not to participate at the time of the survey, which did not mean necessarily their complete leaving the study participation.

Table 4.1 Comparison of characteristics at visit1 for the Ethiopia Integrated Nutrition Project (EINP) trial, Habro and Melka Bello districts, Ethiopia (2012-2014)

	Control area (N = 914)			Intervention area (N = 876)		
	N	n	%	N	n	%
A. Child characteristics						
Male sex	914	471	51.5	876	468	53.4
Stunting	620	119	19.2	614	123	20.0
Wasting	614	104	16.9	611	102	16.7
Underweight	735	141	19.2	713	137	19.2
	N	mean	SD	N	mean	SD
Age (month)	914	8.7	1.9	914	8.8	1.9
Length-for-age z score	620	-0.90	1.37	614	-0.87	1.41
Weight-for-age z score	735	-1.00	1.16	713	-1.00	1.21
Weight-for-length z score	614	-0.62	1.41	612	-0.72	1.38
B. Parents characteristics						
	N	n	%	N	n	%
Mother education						
Never educated	914	791	86.7	876	706	80.6
>Primary		122	13.3		170	19.4
Father education						
Never educated	914	569	62.2	876	450	51.4*
>Primary		345	37.8		426	48.6
	N	mean	SD	N	mean	SD
Parity	914	3.7	2.1	876	3.7	2.1
Mother age (years)	914	26.1	5.6	874	26.0	5.2
Father age (years)	913	32.0	6.9	868	32.7	6.6

*P < 0.05, p-values were calculated by linear, logistic, or ordinal logistic regression accounting for clustering effect.

Table 4.1 Comparison of baseline characteristics at visit1 for the Ethiopia Integrated Nutrition Project (EINP) trial, Habro and Melka Bello districts, Ethiopia (2012-2014) (continued)

	Control area (N = 914)			Intervention area (N = 876)		
	N	n	%	N	n	%
D. Socioeconomic status						
Muslim religion	911	867	95.2	875	829	94.7
Father as a household head	913	857	93.8	876	857	97.8
Main living-source						
Self-supporting farming	914	817	89.8	872	825	94.6
Laborer/self employed		93	10.2		47	5.4
Household wealth index						
Poor	914	393	43.0	876	306	34.9*
Middle		386	42.2		339	38.7
Rich		135	14.8		231	26.4
Electricity use	900	56	6.2	863	88	10.2
Household food insecurity						
Food secure	912	180	19.7	876	272	31.1*
Mild food insecure		130	14.3		340	36.5
Moderately food insecure		286	31.4		154	20.0
Severely food insecure		316	34.7		110	12.4
E. WASH						
Use of protected water sources ¹	914	468	51.3	791	584	66.7
No latrine use	910	246	26.9	871	182	20.8
Inadequate waste disposal	909	316	34.8	874	242	27.7
F. Access to community infrastructure						
Distance to market within 1hr	913	239	26.2	871	310	35.6
Nearest health facility						
Health post	908	420	46.3	868	292	33.6*
Health center		479	52.8		451	52.0
Clinic/Hospital		9	1.0		20	14.4
G. Social Capital						
Membership of +2 groups	912	175	19.2	874	313	35.8
Support from +2 individuals	912	87	9.5	874	90	10.3
Active citizenship activities	912	469	51.4	874	452	51.7
High cognitive social capital	912	362	39.7	874	250	28.6

¹ Protected water sources include public tap/standpipe, tube well/borehole, and protected well.

*P < 0.05, p-values were calculated by linear, logistic, or ordinal logistic regression accounting for clustering effect.

Table 4.2 Program participation and use of services in Essential Nutrition Action (ENA) activity and Community-based Management of Acute Malnutrition (CMAM) programs and among mothers in control and intervention areas, in Habro and Melka Bello (MB) districts, Ethiopia (2012-2014)

	Control area		Intervention area		p-value
	N	n (%)	N	n (%)	
CMAM program					
Ever received corn-soy blend in the past three months (%)	3225	524 (16.2)	3069	466 (15.2)	0.2465
Ever received Plumpy'Nut in the past three months (%)	3506	238 (6.8)	2921	86 (2.9)	0.0000
ENA activity					
Ever received ENA counselling at least once a month in the past three months (%)	3222	485 (15.1)	3064	717 (23.4)	0.0000
Ever CPNP participation	914	30 (3.3)	876	340 (38.9)	0.0000

*p-values were calculated by two-sample test of proportions.

Table 4.3 Longitudinal regression models for average marginal monthly effect of intervention on child-growth outcomes compared with control group (Cleaned observed No=6,401) in Habro and Melka Bello (MB) districts, Ethiopia (2012-2014)

Outcomes ¹	N ²	Control area	N ²	Intervention area	Difference (95% CI) in monthly change between control and intervention area	p-value
		Monthly change Mean (SE)		Monthly change Mean (SE)		
Change in LAZ/month	3285	-0.095 (0.004)	3040	-0.074 (0.005)	0.021 (0.008, 0.034)	0.0011
Change in WAZ/month	3408	-0.060 (0.004)	3120	-0.032 (0.004)	0.028 (0.016, 0.039)	0.0000
Change in WLZ/month	3275	-0.030 (0.006)	3030	0.011 (0.006)	0.042 (0.024, 0.059)	0.0000
Change in length /month (cm)	3285	0.803 (0.012)	3040	0.862 (0.012)	0.059 (0.027, 0.092)	0.0004
Change in weight/month (kg)	3408	0.136 (0.004)	3120	0.167 (0.004)	0.031 (0.019, 0.042)	0.0000

¹ LAZ, length-for-age z score; WAZ, Weight-for-Age z score; WLZ, Weight-for-length z score.

² N, number of observations⁶ All values are β (95% CI). Adjusted for the child age, mother's education, literacy, antenatal care, father's education, households' living sources, distance from market and health facility, household food insecurity, wealth status, and type of nearest health facilities at baseline.

Figure 4.2 Predicted length-for-age, weight-for-age, and weight-for-length z scores, and length and weight of children in control and intervention areas during 6 to 24 months of age. The graphs were produced by locally weighted regression on the predicted values from a quadratic growth model with a random intercept and random slope (56), in Habro and Melka Bello districts, Ethiopia (2012-2014)

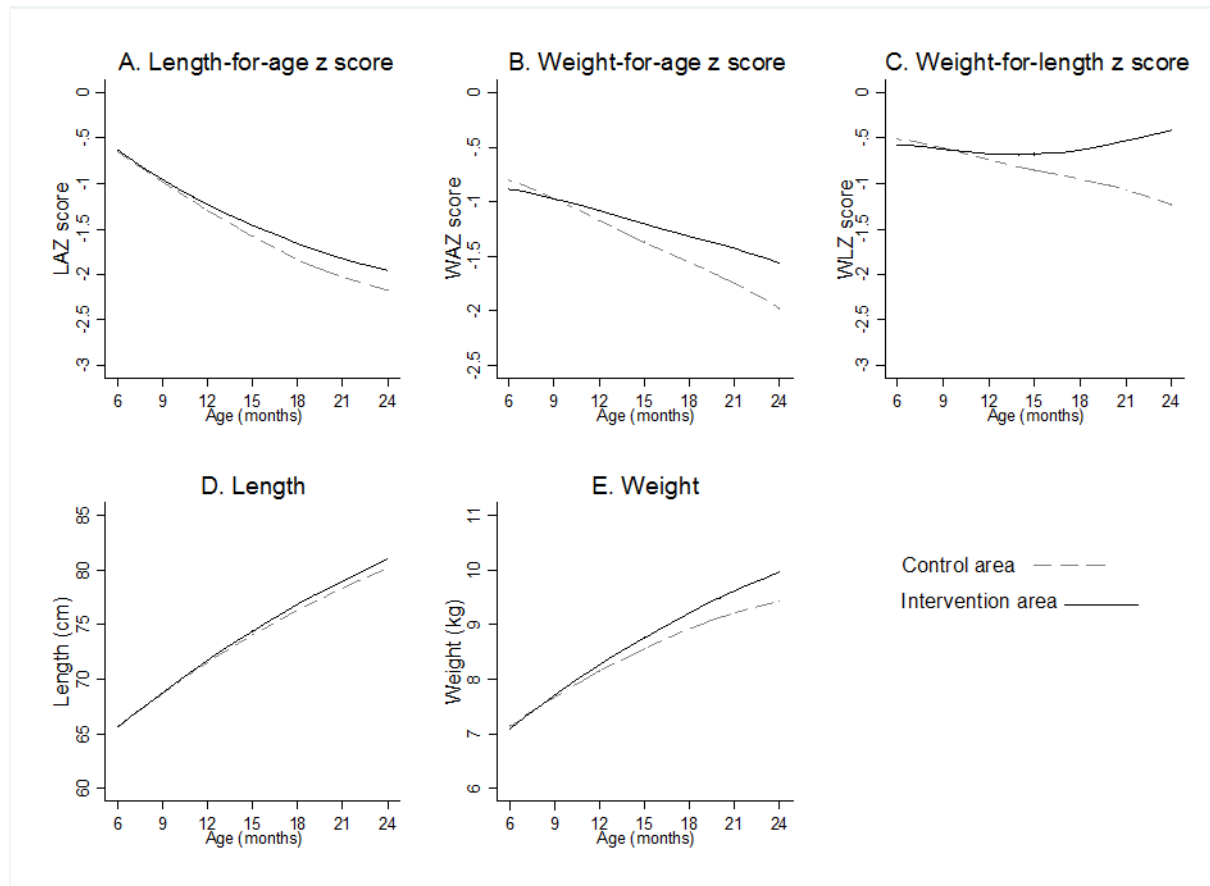


Figure 4.3 Predicted length-for-age, weight-for-age, and weight-for-length z scores, and length and weight of children in control and intervention areas during 12-month follow-up. The graphs were produced by locally weighted regression on the predicted values from a quadratic growth model with a random intercept and random slope at area level (56), in Habro and Melka Bello districts, Ethiopia (2012-2014)

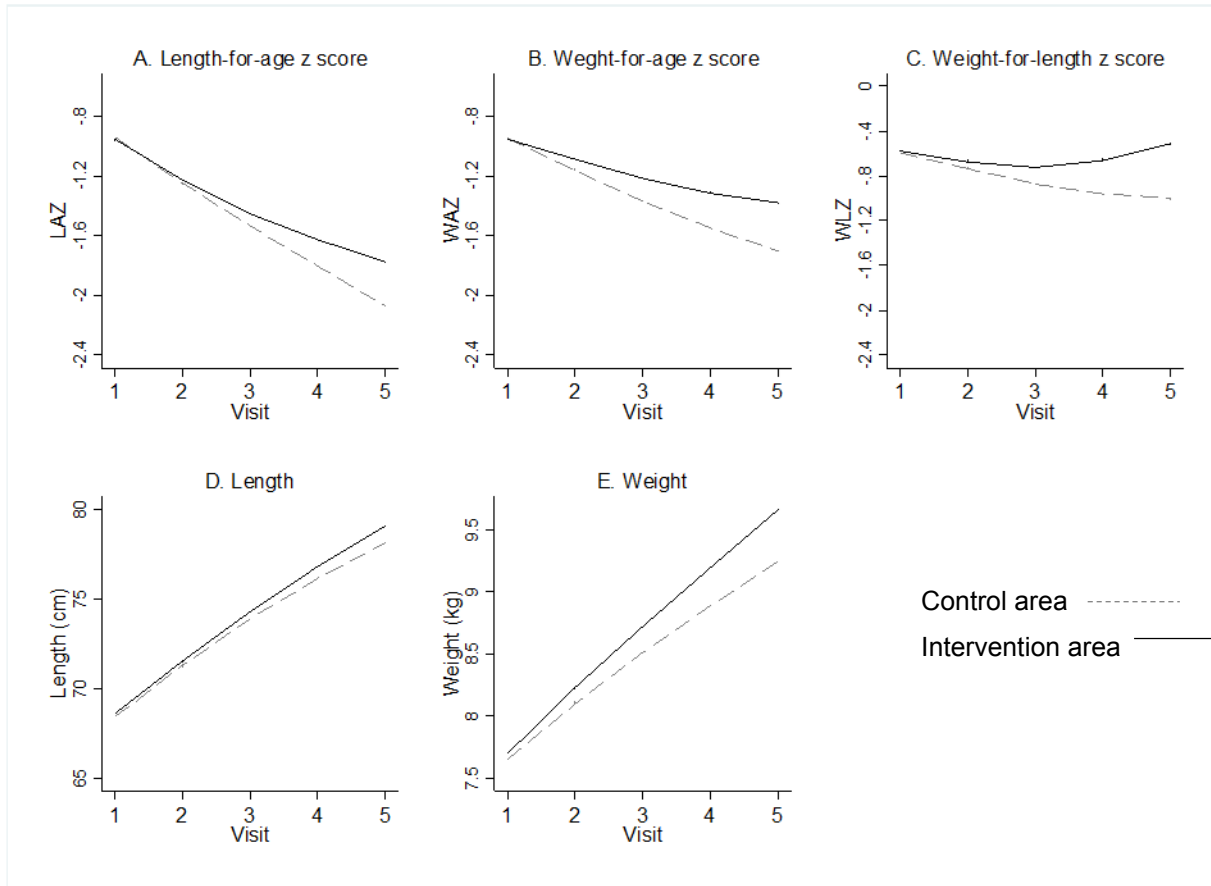


Table 4.4 Longitudinal regression models for average marginal monthly effect of intervention on child-growth outcomes compared with control group/CPNP group (Cleaned observed No=6,401) at individual level

Outcomes ¹	Non-CPNP participants		CPNP participants		Difference (95% CI) in monthly change between non-CPNP participants and CPNP participants
	N ²	Monthly change Mean (SE)	N ²	Monthly change Mean (SE)	
Change in WAZ/mo	1893	-0.044 (0.005)	1227	-0.014 (0.007)	0.029 (0.012, 0.047)*
Change in WLZ/mo	1850	-0.007 (0.008)	1180	0.045 (0.010)	0.053 (0.025, 0.081)*
Change in weight (kg)/mo	1893	0.152 (0.005)	1227	0.188 (0.007)	0.035 (0.017, 0.053)*

¹ LAZ, length-for-age z score; WAZ, Weight-for-Age z score; WLZ, Weight-for-length z score.

² N, number of observations⁶ All values are β (95% CI). Adjusted for the child age, mother's education, literacy, antenatal care, father's education, households' living sources, distance from market and health facility, household food insecurity, wealth status, and type of nearest health facilities at baseline.

Table 4.5 Effect of a community-based participatory nutrition promotion (CPNP) on the risk of stunting, underweight, and wasting during the 12 month follow-up, in Habro and Melka Bello districts, Ethiopia (2012-2014)¹

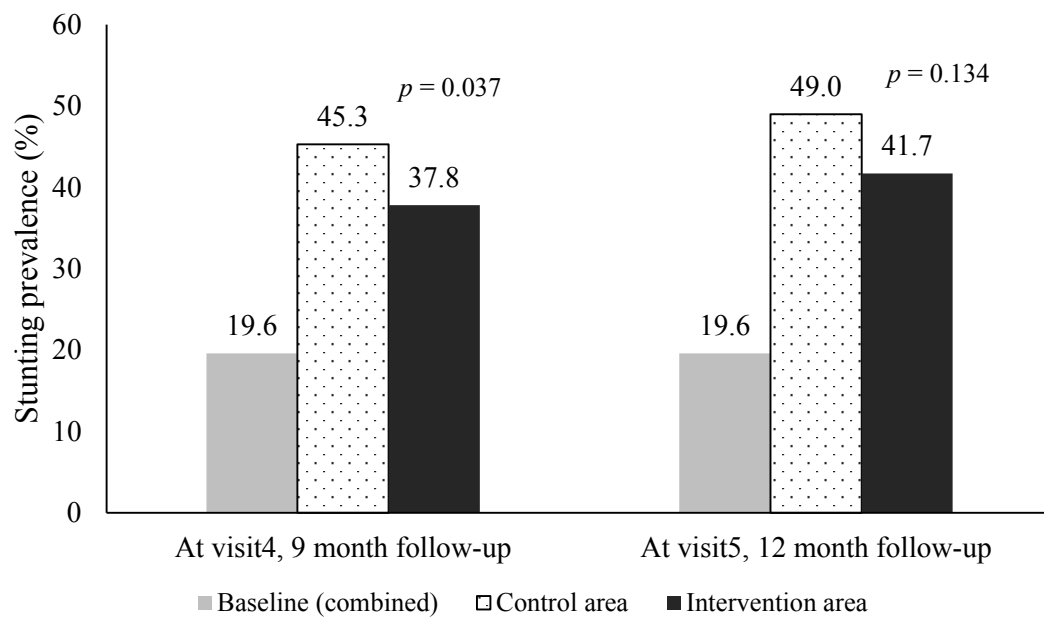
Outcome	Control area		Intervention area		Hazard ratio (95% CI) ³	p-value
	<i>Infant- months</i> ²	Events	<i>Infant- months</i> ²	Events		
Stunting	19,527	956	17616	788	1.013 (0.811, 1.266)	0.907
Underweight	19,641	843	17448	616	0.826 (0.643, 1.061)	0.135
Wasting	19,485	598	16578	470	1.048 (0.812, 1.354)	0.718

1 Stunting, wasting, and underweight were defined from length-for-age, weight-for-length, and weight-for-age z scores, respectively, as less than -2 of the WHO reference groups in 2006 (47).

2 For each outcome, infants were censored when they were lost to follow-up, dead, or at the end of the follow-up period.

3 CI, confidence interval; HR, hazard ratio. Estimated from Cox proportional hazards regression for recurrent events models with time-to-event as the outcome and intervention (intervention area compared to control area) as predictors. Adjusted with child sex, child age, fathers' education, household food insecurity, with/without phone, household wealth index, type of nearest health facilities, enumerators and district.

Figure 4.4 Prevalence of stunting at visit 4 (9 month follow-up) and visit 5 (12 month follow-up)¹.



¹ Stunting was defined from length-for-age z score as less than -2 of the WHO reference groups.

² Groups were not different at baseline. * $P < 0.05$; Estimated from logistic regression for the outcome and intervention (intervention area compared to control area). Adjusted with child sex, child age, fathers' education, household food insecurity, household wealth index, type of nearest health facilities, enumerators and district at enrollment.

Appendix 4.1 Anthropometric measurements in control and intervention area over 12 month follow-up by visit^{1,2}

Visit No.	Control area			Intervention area			Difference (95%CI) between control and intervention area	p-value*
	N	mean	SD	N	Mean	SD		
LAZ								
Visit 1	612	-0.90	1.37	614	-0.87	1.41	-0.03 (-0.19, 0.12)	0.7028
Visit 2	703	-1.07	1.16	636	-1.16	1.33	0.09 (-0.05, 0.22)	0.1995
Visit 3	692	-1.57	1.08	647	-1.50	1.05	-0.07 (-0.19, 0.04)	0.2211
Visit 4	658	-1.94	1.09	630	-1.72	0.98	-0.22 (-0.34, -0.11)	0.0001
Visit 5	612	-1.98	1.05	513	-1.88	0.90	-0.10 (-0.22, 0.02)	0.0933
WAZ²								
Visit 1	735	-1.00	1.16	713	-1.00	1.21	0.00 (-0.12, 0.12)	0.9715
Visit 2	703	-1.10	1.07	630	-0.96	1.11	-0.14 (-0.26, -0.02)	0.0217
Visit 3	690	-1.41	1.09	646	-1.30	1.08	-0.11 (-0.23, 0.01)	0.0630
Visit 4	656	-1.63	1.12	630	-1.34	1.20	-0.30 (-0.42, -0.17)	0.000
Visit 5	624	-1.69	1.18	501	-1.42	1.17	-0.27 (-0.41,-0.13)	0.001
WLZ³								
Visit 1	614	-0.62	1.41	612	-0.72	1.38	0.10 (-0.06, 0.26)	0.2130
Visit 2	703	-0.75	1.26	630	-0.50	1.27	-0.25 (-0.38, -0.11)	0.0040
Visit 3	690	-0.91	1.33	645	-0.82	1.29	-0.09 (-0.23, 0.05)	0.2110
Visit 4	656	-0.97	1.40	630	-0.73	1.53	-0.24 (-0.40, -0.08)	0.0034
Visit 5	612	-1.03	1.62	513	-0.35	1.96	-0.68 (-0.89, -0.47)	0.0000
Length (cm)								
Visit 1	620	68.32	3.66	614	68.51	3.60	-0.19 (-0.59, 0.22)	0.3605
Visit 2	703	71.78	3.07	636	71.75	3.24	0.03 (-0.31, 0.37)	0.8751
Visit 3	692	73.82	3.15	647	74.15	2.66	-0.32 (-0.64,-0.01)	0.0427
Visit 4	658	75.73	3.30	630	76.51	2.61	-0.77 (-1.10, -0.45)	0.0000
Visit 5	612	78.25	3.25	513	78.63	2.46	-0.38 (-0.73, -0.04)	0.0289
Weight (kg)								
Visit 1	735	7.58	1.12	713	7.62	1.20	-0.04 (-0.16, 0.08)	0.4853
Visit 2	703	8.18	1.03	630	8.36	1.14	-0.18 (-0.30, -0.07)	0.0021
Visit 3	690	8.47	1.08	646	8.61	1.10	-0.14 (-0.26, -0.02)	0.0191
Visit 4	656	8.78	1.15	630	9.14	1.29	-0.36 (-0.49, -0.22)	0.000
Visit 5	624	9.25	1.25	501	9.58	1.29	-0.33 (-0.48, -0.18)	0.000

¹ Every visit was 3 month apart.

² LAZ, Length-for-Age Z score; WAZ, Weight-for-Age Z score; WLZ, Weight-for-Length Z score.

*p-values were calculated by linear regression analysis (unadjusted).

Appendix 4.1 Anthropometric measurements in control and intervention area over 12 month follow-up by visit (continued)¹

	Control		Intervention		Difference (95% CI)	P-value*
	N	%	N	%		
Stunting						
Visit 1	620	19.2	614	20.0	0.8 (-3.6, 5.2)	0.711
Visit 2	703	19.6	636	23.3	3.6 (-0.8, 8.0)	0.105
Visit 3	692	31.8	647	29.1	-2.7 (-7.7, 2.2)	0.277
Visit 4	658	45.3	630	37.8	-7.5 (-12.9, -2.1)	0.006
Visit 5	612	49.0	513	41.7	-7.3 (-13.1, -1.5)	0.014
Underweight						
Visit 1	735	19.2	713	19.2	0.0 (-4.0, 4.1)	0.988
Visit 2	703	20.6	630	15.6	-5.1 (-9.2, -0.9)	0.017
Visit 3	690	28.7	646	24.6	-4.1 (-8.8, 0.7)	0.092
Visit 4	656	37.2	630	30.3	-6.9 (-12.0, -1.7)	0.009
Visit 5	624	41.0	501	33.5	-7.5 (-13.2, -1.8)	0.010
Wasting						
Visit 1	614	16.9	611	16.7	-0.2 (-4.4, 4.0)	0.909
Visit 2	703	15.5	630	11.9	-3.6 (-7.3, 0.1)	0.057
Visit 3	690	20.6	645	18.5	-2.1 (-0.6, 2.1)	0.327
Visit 4	656	23.3	630	23.5	0.2 (-4.5, 4.8)	0.943
Visit 5	611	31.8	429	29.8	-1.9 (-7.6, 3.8)	0.511

⁴ p-values were calculated by linear regression analysis (unadjusted).

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CHAPTER 5. EFFECTIVENESS OF A COMMUNITY-BASED PARTICIPATORY NUTRITION PROMOTION PROGRAM IN IMPROVING CHILD FEEDING AND HYGIENE AMONG CAREGIVERS IN RURAL EASTERN ETHIOPIA

5.1 ABSTRACT

Background: Appropriate complementary feeding and hygiene practices reduce child stunting. **Objectives:** A community-based participatory nutrition promotion (CPNP) program was designed and its effectiveness evaluated in the context of the ongoing Essential Nutrition Action (ENA) and Community-based Management of Acute Malnutrition (CMAM) programs on caregivers' feeding and hygiene practices in two rural districts in Ethiopia. **Design & Methods:** A cluster randomized trial was conducted with 12 clusters; the CPNP was implemented in 6 intervention clusters, while the existing programs of ENA and CMAM were carried out in all 12 clusters. A total of 1,790 mothers with children 6 to 12 months of age who were randomly selected from the study area were enrolled in this study. Using a 24-hour diet recall questionnaire, mothers were asked about their infant and young child feeding (IYCF) practices, such as currently breastfeeding, meal frequency, and dietary diversity, every three months, and hand washing practices with soap and water every six months, for a year follow-up. We scored the condition of child feeding and hygiene at each visit, adjusting the scores based on three age groups: 6–8, 9–11, and 12–24 months, and summed up the scores for all five visits (three visits for hand washing). The composite feeding score¹ was computed summing the scores of current breastfeeding, meal frequency, and dietary diversity; the composite feeding score² was computed summing the scores of meal frequency and dietary diversity only. **Results:** A total of

1,199 mothers (67.0%) who completed the surveys all five times—629 in the control area and 570 in the intervention area—were included in the data analyses. The first survey was done four months after implementation of the CPNP in the intervention area. We assessed the condition of the feeding and hygiene over the 12-month follow-up. Mothers in the intervention area showed higher scores of meal frequency (diff: 1.02, 95% CI: 0.33, 1.70), composite feeding 1 (diff: 1.30, 95% CI: 0.41, 2.19), and composite feeding 2 (diff: 1.39, 95% CI: 0.48, 2.23) than mothers in the control area, but there were no differences in the scores of current breastfeeding (diff: -0.08, 95% CI: -0.22, 0.06), dietary diversity (diff: 0.38, 95% CI: -0.21, 0.98), and hand washing (diff: 0.41, 95% CI: -0.21, 1.02) between mothers in the two areas. **Conclusion:** The new nutrition program model was effective in improving meal frequency and composite feeding practices but did not impact current breastfeeding or dietary diversity in a rural Ethiopian context.

5.2 INTRODUCTION

Stunting affects 165 million children worldwide. Stunting in early childhood can have life-long implications such as adverse effects on physical and cognitive development in later childhood, poorer performance in school, and adverse reproductive health outcomes in adulthood (1, 2). Optimal complementary feeding can ensure adequate child growth by providing sufficient energy and balanced nutrients, and appropriate hygiene practices may reduce the risk of stunting by decreasing the risk of diarrheal morbidity and environmental enteropathy, a condition considered to be an important cause of child stunting (3, 4). Either education alone regarding complementary feeding or providing complementary foods with or without education has shown to improve height-for-age z scores (HAZ) and weight-for-age z (WAZ) scores, and to

reduce undernutrition in both food secure and food insecure populations (5, 6). In this sense, interventions based on behavior change communication (BCC) are promising strategies to improve feeding and hygiene practices if they are appropriately contextualized, affordable, and sustainable (7-10).

In Ethiopia, community-based nutrition programs—including the Essential Nutrition Action (ENA) (11, 12) and the Community-Based Management of Acute Malnutrition (CMAM) programs—have been available (13, 14). Nutrition counselling volunteers in the ENA program may not have adequate knowledge about child nutrition and appropriate counselling skills, and poor community health systems may not be able to do structured managing of their activities (15). The CMAM program focuses primarily on treating wasting (with mid-upper arm circumference less than 11 cm) and lacks caregivers counseling, which results in relapse in wasting (16). It has been reported that as high as 60% to 70% of rehabilitated children from moderately or severely wasted conditions in supplementary feeding programs relapse to wasted status within a year (17).

Given this background, a new community-based participatory nutrition promotion (CPNP) program was developed to address the identified weaknesses of the ENA and CMAM programs. The CPNP, involving a two-week group nutrition session, adapting program components of the Positive Deviant Hearth Program (18, 19), aimed to improve child nutritional status by promoting appropriate feeding and hygiene of mothers, attempted to utilize locally affordable resources, and boost community participation, and was expected to strengthen the existing community health system.

This new approach of the CPNP was integrated with the existing ENA and CMAM programs to design, implement and test a new package—the Ethiopia

Integrated Nutrition Project (EINP)—by World Vision Korea in collaboration with World Vision Ethiopia and WITH (a Korea-based NGO) from January 2012 to August 2013 in two districts of Ethiopia (Appendix A and B). The CPNP program attempted to impact caregiver behaviors related to feeding and hygiene practices through intensive group-based educational sessions and to ultimately improve child nutritional status in the study area. An effectiveness evaluation study was undertaken aimed at examining the impact of CPNP on child feeding and hygiene practices among mothers with children 6 to 24 months of age, in addition to growth and stunting as primary outcomes, compared to the practices of mothers living in the control area where only the ENA and CMAM programs were being implemented. Indicators of infant and young child feeding (IYCF) included current breastfeeding, 24-h meal frequency, and dietary diversity and a hygiene indicator of hand washing at critical time points. We hypothesized that the child feeding and hygiene scores would be higher among mothers in the intervention area compared to mothers in the control area. We also examined whether the CPNP participants maintained better feeding and hygiene practices over the 12-month follow-up compared to others in the community who had not been exposed to the group educational sessions in the intervention area.

5.3 SUBJECTS AND METHODS

5.3.1 Study design

This study was conducted in the Habro and Melka Bello districts in rural eastern Ethiopia. Both districts have predominantly Muslim communities belonging to the Oromo tribe. The districts are largely agricultural, poor, with limited development, and are frequently subject to long periods of drought.

We conducted a cluster randomized effectiveness trial to evaluate the CPNP program. We created 12 geographical clusters—3 intervention and 3 control clusters in each district—based on 49 Kebeles (the smallest administrative unit of Ethiopia). The agricultural officers of the local government and World Vision agricultural officers were asked to create pairs of clusters that they considered (qualitatively) to be similar on agricultural and economic conditions within each district. Allocation of the interventions was made by tossing a coin in front of community leaders and local authorities. If a cluster was assigned to an intervention area, its paired cluster became the control area. As a result, we had six control clusters and six intervention clusters. Intervention allocation and implementation to the study area was not blinded to community members by the nature of public nutrition education of the CPNP program.

5.3.2 Subject selection

The study population consisted of mothers of children 6 to 12 months of age who lived in the study area, regardless of their preceding participation in the implemented programs of CPNP, CMAM and ENA. For the study, 2,064 child and mother pairs (1,032 per group) were randomly selected from a roster of children 6-12 months of age in the two districts. There was no available birth-registration system in the two districts, so we kindly requested the district health offices to prepare a roster of children 0-12 months of age who resided in the area. The roster was prepared with support of Health Extension Workers (HEWs) and community volunteers, and each child was given an identification number. Using the random number-generating table of the Emergency Nutrition Assessment for SMART (2011 version), 2,064 children were randomly selected, proportional to the population size of each cluster.

The sample size of 2,064 was determined, accepting a type I (α) error of 5%, power at 0.80, cluster size at 172, lost to follow-up at 10%, standard deviation of 0.9 z score, and intra-cluster correlation coefficient (ICC) at 0.054, to see a difference of 0.2 z score in the primary outcome of length-for-age z score (LAZ) (see details in Chapter 4).

5.3.3 Interventions

In the control area, the ENA and CMAM programs were implemented, while all three programs including CPNP were conducted. Detailed operation of the CPNP program is described in Chapter 3. In brief, the CPNP program involved two-week group nutrition sessions consisting of cooking demonstrations, feeding child, messages discussions, singing, and practicing hand washing. The sessions were organized by 23 CPNP operators recruited from their Kebele and supervised by 9 supervisors, but all materials and food ingredients were contributed voluntarily by participants. A total of 372 CPNP sessions were held, and 3,299 mothers attended CPNP sessions in the intervention area (data not shown).

As part of the CMAM program, severely acute malnourished children with mid-upper arm circumferences (MUAC) of less than 11.0 cm also received Plumpy'Nut from nearby health centers/health posts; moderately acute malnourished children with MUAC of 11-11.9 cm occasionally received corn-soy blend and vegetable oil.

Although the ENA program was designed to conduct community volunteer-led monthly nutrition counselling on breastfeeding and complementary feeding practices for mothers with children under two years of age, there was a modification in the service delivery platform early on during the program implementation period.

Due to the Ethiopian government's adoption of new cadre of health workers called the Health Development Army (HDA)^f through a local community structure called one to five networks engagement, where one women functioned as leader of the network and five women operated as network members, into primary health care delivery and support, the structure of the ENA counselling was modified to include group information sharing. Because of the nature of the group nutrition education conducted in various places in the communities, intervention allocations were not blinded to study mothers, other community members in the control and intervention areas, or data collecting enumerators.

Data collectors had no interaction with the project implementation team or government health staff, but they knew which clusters had CPNP sessions through contact with selected mothers at survey.

5.3.4 Data collection

The effectiveness study proposal and protocol were reviewed and approved by the Oromia Regional Health Bureau in Ethiopia (Appendix F.1 and F.2).

Study mothers enrollment and the first data collection were done four months after the CPNP sessions due to logistical limitations; thus, we were unable to collect true baseline information prior to program implementation. Enrollment information collected at visit1 was used to assess comparability between the two groups. Visit1 (the 1st data collection) was conducted from November 20, 2012, to February 19, 2013, and every three months, following data collection visits (visit2 to visit5) was done; the last data collection (visit5) was conducted from November 20, 2013, to February 19, 2014. The current study was prepared by a Memorandum of

^f “a community level group of 30 households (women) organized in a “1 to 5” network of members, where one women functions as leader of the network and five women operate as network members.”

Understanding (MOU) among World Vision Korea, Wholistic Interest Through Health (WITH), and World Vision Ethiopia (Appendix A). The present trial was funded by World Vision Korea (USD 100,000, project number E197814). This trial was registered with Current Controlled Trials, ISRCTN 89206590.

Data collection was conducted by 18 data collectors who had completed at least college education, were fluent in the local Afan Oromo language, and were recruited from the study area. The data collectors were hired by World Vision Ethiopia Habro and Melka Bello Area Development Program (ADPs) offices. Most of them were male workers 20-25 years of age. The data collectors were trained with structured questionnaires translated in the local language (Appendix C). The questionnaires included generic questions about IYCF practices of the breastfed children in accordance with WHO guidelines (20). Questions about household demographic and socioeconomic information, dwelling conditions and household assets, water source and sanitation facilities were used from the Caregiver Survey-Modules (21). The Household Food Insecurity Access Scale (HFIAS) was used to measure household food insecurity in the past 4 weeks (22); the main domains of the HFIAS are (1) worry and anxiety, (2) insufficient food quality, and (3) insufficient food intake. The nine questions of HFIAS were followed by frequency questions from which the four levels of food insecurity were computed. Maternal social capital questions were taken from the Short Social Capital Assessment Tool (SASCAT) to capture structural and cognitive social capital of the selected mothers (23). The questionnaires were modified for the local setting and context by study investigators, and were pre-tested in a neighboring Kebele outside the study area. Upon obtaining informed consent from mothers of children who were enrolled in the study, an enrollment and first interview (visit1) was conducted by 18 data collectors, 9 per

district. Selected children and households were visited every three months, a total of five times (visit1 to visit5) during the year.

Using a structured questionnaire for a 24-hour diet recall, mothers were asked whether they were currently breastfeeding their child, how many times they had fed the child in the past 24 hours (meal frequency), and what type of foods they had fed the child in the past 24 hours using a list of food items (dietary diversity). Mothers were asked whether they had washed their hands with water and soap in the past 24 hours at four critical time points: after the mother's defecation, after cleaning the child's bottom, before preparing foods, and before feeding the child (hand washing). The hand washing practice was evaluated at visit1, 3, and 5 only.

5.3.5 Development of scores of currently breastfeeding, meal frequency, dietary diversity score (DDS), hand washing, and composite feeding.

The age-specific feeding and hygiene scoring system is described in Table 5.1. The scores were defined separately for three age groups: 6–8, 9–11 and 12–24 months and examined at each five visits, except for the hygiene score, which was examined across three visits.

Current breastfeeding score: Current breastfeeding was defined as a mother breastfeeding the child at the time of the visit. The score ranged between 0 and 2 before the age of 11 months and between 0 and 1 after the age of 12 months for each child at each visit. The total score summed across five visits gave a possible range of 0-7.

Meal frequency score: Meal frequency was defined as the number of times the infant/child was given meals other than breast milk in the past 24 hours. The meal frequency for the child during the previous day was categorized into three scores by specific age range (Table 5.1). The meal frequency score had a possible range of 0-2 for each child at each visit before 12 months of age and a range of 0-3 from 12 months of age. These scores were summed across five visits, giving a possible range of 0-15.

Dietary diversity score (DDS): Dietary diversity was calculated on the basis of the number of different food groups the infant consumed in the past 24 hours (24). At each visit, mothers were asked whether they had fed a food item/food group to her child using the following 15 food items groups: breast milk; formula; animal milk (e.g., cow milk); any food made from grains (e.g., millet, sorghum, maize, rice, wheat, teff, or ingera); any food made from pumpkins, carrots, red sweet potatoes, mango, or papaya; any green leafy vegetables; any other fruits (bananas, tomatoes, apples, or avocados); any liver, kidney, heart or other organ meats; any meat (e.g., beef, lamb, goat, chicken or duck); any food made from legumes or nuts (e.g., peas, beans, lentils, or peanuts); any food made with oil, fat or butter; eggs; fish; cheese or yoghurt; any sugary foods (e.g., chocolates, sweets, candies, pastries, cakes or biscuits, or sugary juice). During data analysis, these items were grouped into seven food groups as follows: (1) grains, (2) legumes and nuts, (3) dairy foods such as animal milk, formula, cheese and yogurt, (4) vitamin A rich fruits and vegetables, (5) green leafy vegetables and other fruits, (6) flesh foods such as meat, poultry, and fish, and (7) eggs. The sum of food groups consumed by the infant during the previous day was categorized into three scores by specific age range (Table 5.1), giving a possible range

of 0-2 for DDS for each child at each visit. These scores were summed across five visits, giving a possible range of 0-10.

Hand washing score: The hand washing score was calculated by summing up the score of hand washing practice at visit1, 3, and 5. Hand washing practice was assessed by asking whether the mother washed her hands with soap and water in the past 24 hours at four critical points: after defecation, after cleaning the child's bottom, before preparing food, and before feeding the child. Washing their hands with soap and water at 3-4 different points was scored 2; washing at 1-2 different points was scored 1. If they never washed their hands with soap and water, mothers were scored 0. These scores were summed across visit1, 3, and 5, giving a possible range of 0-6.

Composite feeding score1 and 2: To represent multidimensional feeding practices of interest, we constructed two types of composite feeding scores, adapting child feeding indices proposed by Ruel and Menon (25). The composite feeding score1 included indicators of current breastfeeding, meal frequency, and dietary diversity; the composite feeding score2 involved indicators of meal frequency and dietary diversity only. Those composite feeding scores were constructed by summing the scores of meal frequency and dietary diversity, with or without currently breastfeeding collected at each visit. These scores gave a possible range of 0-30 for the composite feeding score1 and of 0-25 for the composite feeding score2 over the five visits.

5.3.6 Statistical Analysis

The enrollment characteristics of mothers and children in the control and intervention areas were compared using linear (binary variables), logistic (binary variables), or

multinomial logistic (ordinal variables) regression analyses accounting for geographic clustering.

Scores of current breastfeeding, meal frequency, dietary diversity, hand washing and composite feeding 1 and 2 were computed by visit and summed to present scores for the 12 months follow-up.

Bar graphs were used to plot unadjusted means (95% confidence interval, CI) of scores of the above mentioned feeding and hygiene by visit. Unadjusted means (95% CI) of above mentioned feeding and hygiene scores were compared using Student *t*-test (1) between mothers in the control area and mothers in the intervention area or (2) between non-CPNP participants and CPNP participants in the intervention area.

Multilevel linear regression models were run to estimate the differences in scores of breastfeeding, meal frequency, dietary diversity, hand washing, and composite feeding scores 1 and 2, over the 12-month follow-up, accounting for the clustering effect and adjusting for differences in enrollment characteristics, such as household food insecurity, fathers' education, household wealth index, type of nearest health facility, and district location. The difference in outcome scores was compared as follows: (1) between children in the control area and children in the intervention areas and (2) between CPNP participants and non-CPNP participants in the intervention area. Significance of the intervention effect was tested at $p < 0.05$. Data analysis was performed using Stata version 12.0 (Stata Corporation, College Station, TX, USA).

5.4 RESULTS

Out of the 2,064 mothers/children randomly selected in the study area, 914 in the control and 876 (n = 1,790, 86.7%) in the intervention areas were enrolled and followed up every three months for a year (Figure 5.1). Exclusions were related to not finding children/refusal to participate (n = 89 in intervention and n = 14 in control area) or age criteria not being met (n = 67 in the intervention area and n = 104 in the control area). Out of 1,790 children, study groups had no difference in the percentage of being followed by visit; 86.8% (n = 1,553) were visited at visit2, 86.4% (n = 1,547) at visit3, 83.9% (n = 1,501) at visit4, and 77.9% (n = 1,395) at visit5 (Figure 5.1).

Out of 1,790 enrolled mothers, 1,199 (67.0%) mothers—629 (68.8% of 914) in the control area and 570 (65.1% of 876) in the intervention areas—were completely followed up from visit1 to visit5, and comprised a complete longitudinal dataset of child feeding and hygiene analyses (Figure 5.1). Compared to the mothers (n = 1,199) included in the analysis, those lost to follow-up (n = 591) had significantly greater radio possession (36.2% vs. 26.1%, $p = 0.01$), more living without latrines (18.4% vs. 26.1%, $p = 0.002$), and included severely food insecure groups (36.0% vs. 18.5%, $p < 0.001$) (data not shown).

The enrollment characteristics did not differ by intervention group regarding child age, sex, household assets, water and sanitation facilities, and social capital adjusted for clustering effect (see Table 4.1 in Chapter 4); however, in the intervention area, more fathers had primary school education (48.6% vs. 37.8%, $p = 0.04$), and fewer households showed severe household food insecurity (12.4% vs. 34.7%, $p = 0.001$), used clinic/hospital (14.4 % vs. 1.0%, $p < 0.001$), compared to the control area. Household wealth status was marginally better in the intervention area. The mean (SD) age of mothers was 26.1 (5.4) years and 82.3% of mothers were

illiterate in the control and intervention areas. The mean (SD) age of children was 8.7 (1.9) in the intervention area and 8.8 (1.9) in the control area. The mean age of the child increased by 3 months at each visit such that the mean (SD) age at visit5 was 20.7 (1.9) and 20.8 (1.9) in the two areas, respectively.

Data are presented by visit (Figure 5.2). At visit1, the mean (SD) current breast-feeding scores for all was 1.89 (0.32), which was the highest score, showing that almost all children were breastfed. Since then, the current breastfeeding scores decreased over time (Figure 5.2.A), mainly because of the reduced score range of 0-1 after 12 months of age compared to the score range of 0-2 before 12 months of age. The mean (SD) current breastfeeding score slightly but continuously decreased by visit5 at 0.93 ± 0.26 (Appendix 5.1.A). For our study mothers/children, the mean (SD) meal frequency score was highest at 1.80 (0.67) at visit1, decreased by visit 2, and persisted by visit5; 1.39 (0.84) at visit3, 1.32 (0.75) at visit4, and 1.40 (0.80) at visit5 (Appendix 5.1.A). Specifically, the unadjusted difference in meal frequency score was largest -0.44 (95% CI: -0.54, -0.34, $p < 0.001$ tested by Student's *t*-test) among mothers in the intervention area at visit2, but its difference reduced by -0.10 (95% CI: -0.19, -0.00) at visit5. The dietary diversity score increased over time (Figure 5.2.C). The mean (SD) dietary diversity score for all increased up to 1.43 (0.73) at visit5, from 0.70 (0.85) at visit1 (Appendix 5.1.A). With unknown reasons, the unadjusted mean dietary diversity score was higher at visit2 (diff: 0.11, 95% CI: 0.02, 0.20, $p = 0.015$) and visit 3 (diff: 0.16, 95% CI: 0.07, 0.25, $p = 0.0009$) among mothers in the control area compared to mothers in the intervention area. The mean (SD) of hand washing score lingered over a year: 0.99 (0.89) at visit1 and 0.93 (0.81) at visit 5.

The mean (SD) composite feeding score1 was highest at 4.40 (1.09) at visit1, became lowest at 3.20 (1.11) at visit3, and increased again over the next visits, while

composite feeding score₂, which removed the scores of current breastfeeding from composite feeding₁, increased over time and presented the highest scores [Mean (SD): 3.77 ± 1.15] at visit₅. At each visit, the differences in mean composite feeding score₁ between control and intervention group was almost equal to the differences in mean composite feeding score₂ between these groups (Appendix 5.1.B). Thus, the difference in the two composite feeding scores was mainly attributed to scores of meal frequency and dietary diversity. The hand washing score differed by group in visit₁, but the difference in mean scores decreased from -0.29 (95% CI: $-0.38, -0.29$, $p < 0.001$ tested by Student's *t*-test) at visit 1 to 0.01 (95% CI: $-0.07, 0.10$, $p = 0.7577$) at visit₅ (Appendix 5.1.C).

Mothers in the intervention area were found to feed their children significantly more often and practice better child feeding behaviors than their counterparts in the control area over the 12-month follow-up with regard to meal frequency (diff: 1.02 , 95% CI: $0.33, 1.70$), composite feeding score₁ (diff: 1.30 , 95% CI: $0.41, 2.19$) and composite feeding score₂ (diff: 1.39 , 95% CI: $0.48, 2.23$) (Table 5.2). There were no differences in scores of current breastfeeding (diff: -0.08 , 95% CI: $-0.22, 0.06$), dietary diversity (diff: 0.38 , 95% CI: $-0.21, 0.98$), and hand washing (diff: 0.41 , 95% CI: $-0.21, 1.02$) between mothers in these two areas.

The involvement of CPNP participants in the analyses became greater over time as follows: 92 (16.1%) out of 570 mothers in the intervention area were at visit₁, 164 (28.8%) were at visit₂, 194 (34.0%) were at visit₃, and 232 (40.7%) were at visit₄ and 5. The CPNP program was phased out at the beginning of visit₄, so there were no additional participants at visit₅. At none of the five visits, the mean scores of current breastfeeding had no difference between non-CPNP participants and CPNP participants (Appendix 5.2.A and Figure 5.3). The largest difference in dietary

diversity score between non-participants and CPNP participants presented at visit3 (diff: 0.27, 95% CI: 0.12, 0.41), but reduced onward. Composite feeding score1 and composite feeding score2 were higher among CPNP participants at each visit except for visit 1 ($p < 0.05$ tested by Student *t*-test) (Appendix 5.2.B). The difference in these two composite feeding scores increased by visit4; 0.44 (95% CI: 0.24, 0.64) for composite feeding score1 and 0.43 (95% CI: 0.23, 0.63) for composite feeding score2, but decreased by visit5 (Figure 5.3.D and 5.3.E). The mean of hand washing score of CPNP participants was not different from CPNP participants (Appendix 5.2.C).

Using mixed effect linear regression models and adjusting for clustering and differences in enrollment characteristics, none of the child feeding and hygiene scores were significantly different between non-participants and CPNP participants specifically regarding the scores of breastfeeding (diff: 0.09, 95% CI: -0.01, 0.18), meal frequency (diff: 0.24, 95% CI: -0.11, 0.60); dietary diversity (diff: 0.04, 95% CI: -0.28, 0.35), composite feeding score1 (diff: 0.40, 95% CI: -0.09, 0.88), composite feeding score2 (diff: 0.30, 95% CI: -0.17, 0.77), or hand washing (diff: 0.12, 95% CI: -0.13, 0.37) (Table 5.3).

5.5 DISCUSSION

The CPNP—a new model of a community-based nutrition program—was added to the ongoing ENA and CMAM programs, and improved some child feeding practices in rural eastern Ethiopia. Using summary scores, we evaluated child feeding and hygiene practices for one year among mothers of children 6 to 24 months of age in intervention vs. control areas and CPNP participants vs. non-participants in the intervention area. Two types of composite child feeding scores and the individual meal frequency score were significantly higher among mothers in the intervention

area than in the control area, but we found no significant difference in breastfeeding, dietary diversity, or hand washing scores between the two groups. CPNP participants did not show better feeding scores than non-participants, when adjusting clusters and enrollment characteristics, suggesting that practices were widely adopted across the community.

It was likely that the CPNP program resulted in a positive influence on increasing meal frequency and improving overall child feeding practices, but not on breastfeeding. The program impact was even indicated among CPNP participants at visit1 for dietary diversity and visit2 for meal frequency and composite feeding (unadjusted). Given that implementation of the CPNP program preceded the first data collection by four months, the impact of the CPNP program on feeding behaviors was already apparent, influencing some feeding behaviors of neighboring mothers in the same intervention area.

In our study area, 92% of mothers were found to keep breastfeeding their children at 18-24 months of age. This proportion turned out to be higher compared to the 96% of mothers who continued breastfeeding at one year and the 82% who continued breastfeeding at two years from the Ethiopia Demographic Health Survey (26). The mean (SD) of meal frequency score of 1.40 (0.80) at visit5 corresponds to 3-4 times of complementary feeding per day. WHO defines minimum meal frequency as receiving solid or semi-solid food at least twice a day for infants 6-8 months of age and at least three times a day for children 9-23 months of age (27). No information about energy density (kcal/g) was available in this study area; thus, although children in the study area on average met the WHO guidelines of meal frequency, further study is warranted—considering energy density of local foods—regarding the appropriateness of this meal frequency (28). The decrease in meal frequency score

over visits would be related to the caregivers' reduced concern when the child gets older. This is also supported in part by a case in Vietnam, where mothers used the intended franchise service less often as the children grew (29). The dietary diversity score increased over time as children could consume more diverse family foods. In our study setting, consumption of diverse foods was likely to be better than that of the country average. The mean (SD) score of dietary diversity was 1.43 (0.73) at visit 5, which corresponds to the 3-4 food group consumption for children 18-24 months of age. In Ethiopia, consumption of 4 or more food groups was only 7.6% among children 18 to 23 months of age (26). The hand washing score at 0.93 (0.81) could be interpreted as using soap and water at 1-2 out of the critical four time points.

At each visit, CPNP participants showed higher meal frequency, dietary diversity, composite feeding score¹ and 2 than non-CPNP participants before adjustment for the enrollment difference and clustering effect. However, when summed as a year scores and adjusted with enrollment characteristics such as household food insecurity, fathers' education, nearest health facilities, and clustering effect, none of these differences were significantly different. This adjustment procedure counterbalanced the absolute difference between non-CPNP and CPNP groups.

At visit³, differences in scores of dietary diversity, meal frequency, and composite feeding decreased between the control and intervention areas. This may be associated with seasonality as this marked the start of the rainy season when food shortages increased. Against our expectations, the one-year dietary diversity score did not show a significant difference between the control and intervention areas. Higher dietary diversity scores in the control area at visit² and visit³ were related to this non-

significant difference in the one-year dietary diversity scores between control and intervention areas.

Over time the percentage of CPNP participants in the intervention area increased from 16.1% at visit1 to 40.7% at visit4; however, the increase in the proportion of CPNP participants did not translate into bigger differences in scores between the control and intervention groups over time, but the differences in these feeding scores generally continued by visit4.

Interestingly, the differences in the scores between control and intervention areas turned out to be reduced at the last visit. We suggest two latent factors as possible reasons for this decrease in score differences at the last visit: (1) a weakened program impact after the phase-out (at visit4) of CPNP in the intervention area and (2) increased communication about feeding messages of CPNP sessions between the control and intervention areas. Since the borders of the control and intervention areas were not apart, mothers in the control area might have had opportunities to get information of CPNP lessons either from the participants or community members in the intervention area. Anecdotally, mothers in the control area reported seeing the CPNP participants.

The finding of no difference in the currently breastfeeding mothers between the two areas was reasonable, considering that the programmatic nature of the CPNP placed more emphasis on complementary feeding after exclusively breastfeeding and because information of breastfeeding practice was given from other sources such as the ENA, which was present in both areas. Our survey did not involve the quality of breastfeeding such as daily breastfeeding frequency or amount of breast milk.

Contrary to our expectations, the difference in hand washing scores between the two trial groups was mostly attributed to non-participants in the intervention area,

but the levels of hand washing scores were similar at visit5. It would be implausible that non-participants had better knowledge regarding appropriate hand washing practices. In a Kebele, mothers were exposed to hygiene information through the Health Extension Program in Ethiopia, and knowledge of hand washing with soap were prevalent and equal for all mothers in a Kebele unit. Rather, CPNP mothers might have had more caution in practicing hand washing and may have been more sensible when they truly washed their hands. Still, what contributed to the better hand washing practices among non-CPNP mothers in the intervention area remains inconclusive.

Overall, a few randomized trials of interventions involving group nutrition education or counselling showed promising impact on complementary feeding practices (8, 10, 30-34). Since such interventions were designed based on specific contexts and the child feeding messages and communication channels were contextualized, it would be inappropriate to consider these complex interventions to be the same. In food secure contexts, nutrition education or counselling was delivered by health care providers who belonged to health centers (8, 10). Enhancing specific types of food consumption such as animal foods was possible in these settings. In Peru, children in an intervention area had more energy intake from complementary foods, consumed more animal foods, iron and zinc (8). Prevalence of stunting decreased, but feeding practices based on 24-hour diet recall did not show significant differences between the two groups. In a study in China, the intervention improved the percentage of consumption of meat, beans, and yellow and orange colored foods (10).

In contrast, in food insecure settings in South Asia, paraprofessional community workers or peer mothers were often recruited, trained, and played a role of

delivering nutrition education to community caregivers (30, 31). In South Asia, complementary feeding education trials increased energy intakes from complementary foods or daily feeding frequency among intervened children (31, 32, 34). In a randomized controlled trial (RCT) in Bangladesh, the intervention group that received weekly nutrition education for 6 months at community nutrition centers improved complementary feeding frequency and increased use of nutritious food (khichuri) (33). In a longitudinal prospective RCT in Vietnam, the Hearth program based on the theory of positive deviance increased breastfeeding frequency and the amount of food consumption per day more for the intervention group than for the comparison children at month 12 (30). Our study is an extension of these feeding trials and showed consistent results with these studies such as improved meal frequency and composite child feeding practices.

Child feeding indices (CFIs) designed to examine comprehensive feeding practices and their associations with child growth and energy and micronutrient intake were examined in a few African and Asian countries including Ethiopia (25, 35-38). In general, five types of indicators—breastfeeding, dietary diversity based on 7-8 food groups in the past 24 hours, meal frequency, bottle feeding, and food group frequency in the past week—have been used to construct these indices (25). Our study used only three of these indicators: breastfeeding, meal frequency, and dietary diversity based on 24-hour recall. Bottle feeding was not appropriate to be measured in the study settings, even though the prevalence of bottle use (11%) was considerable in Ethiopia (26). Notably few studies of longitudinal child feeding indices were available, and all studies were adapted from Moursi et al.'s method to construct a longitudinal index, as indications of a long period of diet quality, and showed associations with LAZ scores (39, 40). So far only one study has applied child feeding index scores to evaluate the

intervention effect (41). Their child feeding index scores were significantly higher at each follow-up point in an intervention group.

The strength of our study was the use of a cluster randomized trial study design to compare long-term feeding and hygiene practices by tracking a cohort of mothers longitudinally for a year. There were a few limitations in this study. First, the CPNP program was not blinded as the CPNP activities could be observed by any community members; however, the data collection procedure was standardized, and enumerators were trained to keep unbiased attitudes towards all mothers to help limit any bias. Potential confounders adjusted in the analysis, which resulted in some change in the findings, suggesting the potential role of these factors (such as household food insecurity among others) in influencing the behavioral outcomes.

Child undernutrition is a major cause of child morbidity and mortality in Ethiopia. The CPNP program improved child feeding practices of mothers in this population. Further research is needed to determine the sustainability of the CPNP program in Habro and Melka Bello districts and to examine the impact of the CPNP on other behavioral aspects related to child nutrition. Further studies are also needed to ensure the generalizability of the nutrition strategy to similar settings in Ethiopia and East African countries.

Table 5.1 Scoring system used to construct scores for breastfeeding, meal frequency, dietary diversity (DDS), and hand washing and a composite feeding score in Habro and Melka Bello district, Ethiopia¹

	Child age			Range across five visits
	6 to 8 months	9 to 11 months	12 to 24 months	
Currently breastfeeding score	Yes = 2 No = 0	Yes = 2 No = 0	Yes = 1 No = 0	0-7
Meal frequency score	1 time = 0 2 times = 1 3 or more times = 2	0-2 times = 0 3 times = 1 4 or more times = 2	0-2 times = 0 3 times = 1 4 times = 2 5 or more times = 3	0-15
Dietary diversity score	0-1 food group = 0 2 food groups = 1 3 or more food groups = 2	0-2 food groups = 0 3 food groups = 1 4 or more food groups = 2	0-2 food groups = 0 3 food groups = 1 4 or more food groups = 2	0-10
² Hand washing score	0 point = 0 1-2 points = 1 3-4 points = 2	0 point = 0 1-2 points = 1 3-4 points = 2	0 point = 0 1-2 points = 1 3-4 points = 2	0-6
³ Composite feeding score1	0-6	0-6	0-6	0-30
⁴ Composite feeding score2	0-4	0-4	0-5	0-25

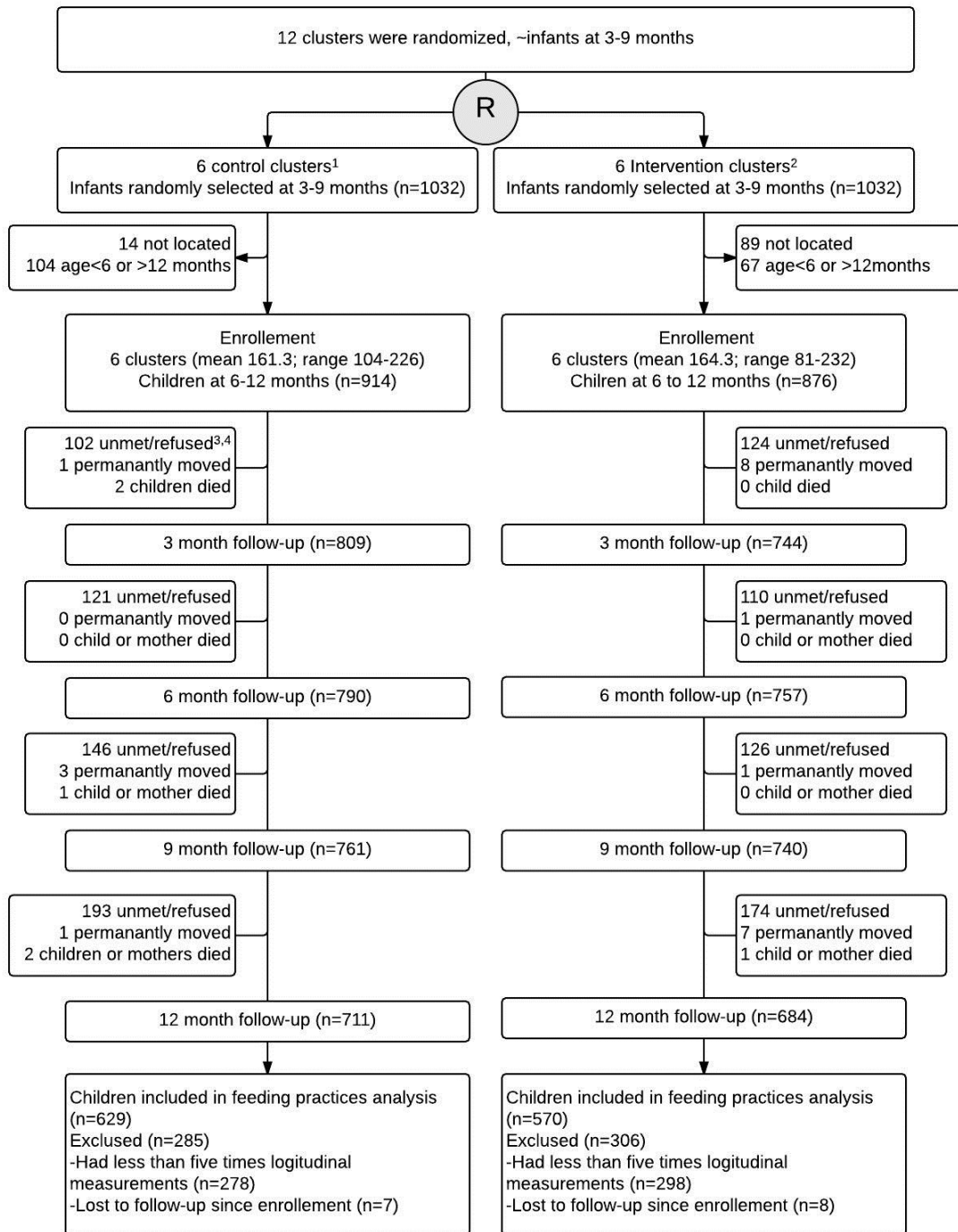
¹ Scoring of indicators was adapted to the child feeding indices proposed by Ruel et al. and Moursi et al. (25, 38)

² Hand washing with water and soap was assessed at four critical points: (1) after the mother's defecation, (2) after cleaning the child's bottom, (4) before preparing foods, and (4) before feeding the child in the past 24 hours.

³ Composite feeding score1 is a sum of scores of currently breastfeeding, meal frequency and dietary diversity.

⁴ Composite feeding score2 is a sum of scores of meal frequency and dietary diversity.

Figure 5.1 Consort diagram for trial participants from enrollment through the 12-month follow-up, Habro and Melka Bello districts, Ethiopia (2012-2014)



¹ Control clusters: Community-based Management Acute Malnutrition (CMAM) program and Essential Nutrition Action (ENA) counselling only were implemented in the control clusters.

² Intervention clusters: In addition to CMAM and ENA programs, Community-based Participatory Nutrition Education (CPNP) was implemented in the intervention clusters.

³ Unmet: the subject moved out of the area or was not at home at the time of the survey.

⁴ Refused: the subject decided not to participate at the time of the survey.

Figure 5.2 Unadjusted mean (95% Confidence Interval) child feeding and hygiene scores at five visits, each three months apart, among study subjects in control area and intervention area, Habro and Melka Bello districts, Ethiopia (2012-2014) (N = 1,199 for A,B,C,D and E; N = 1,350 for F). Composite feeding score1 was constructed based on scores of breastfeeding, dietary diversity, and feeding frequency, and composite feeding score 2 was based on scores of dietary diversity and feeding frequency.

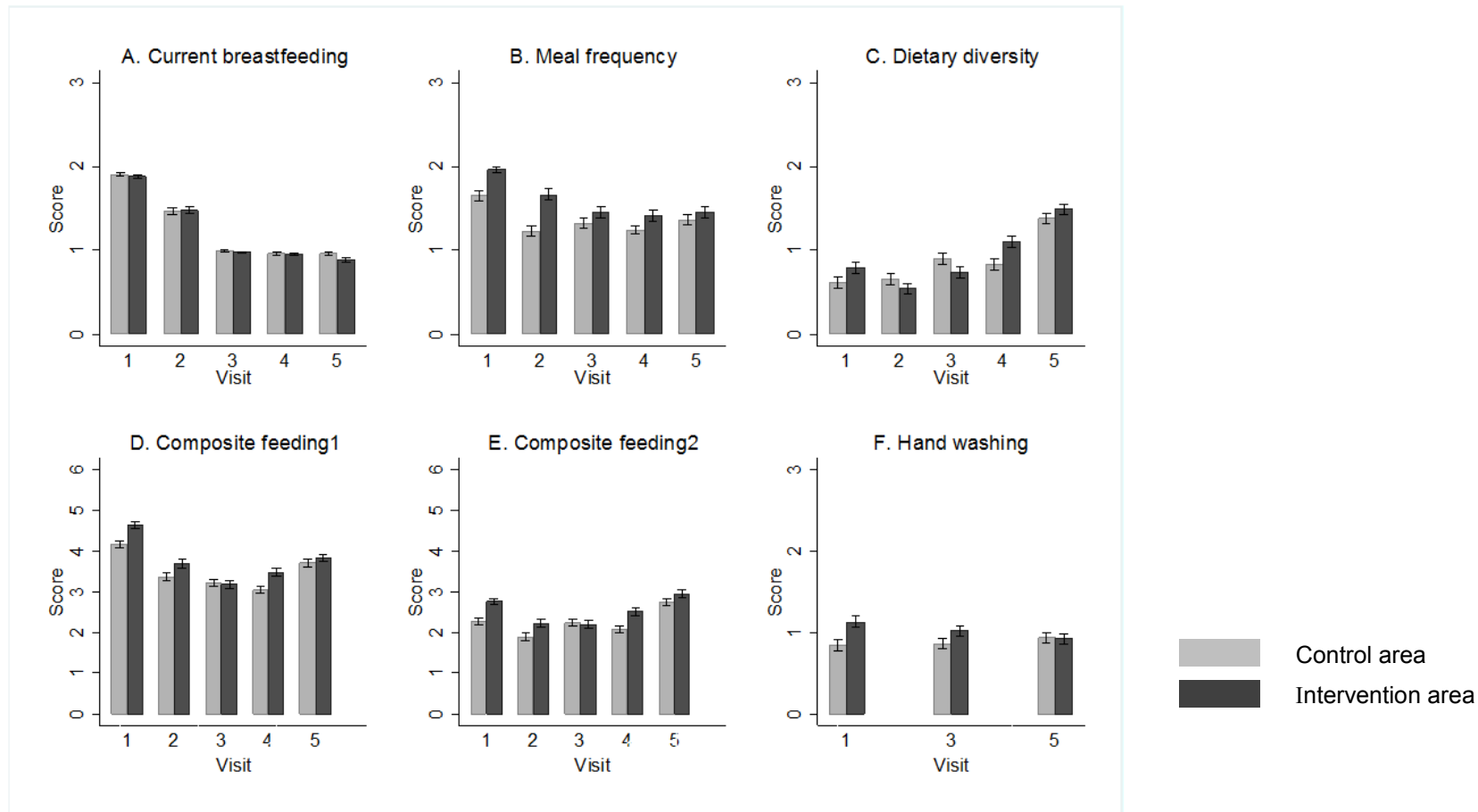


Table 5.2 Scores of breastfeeding, meal frequency, dietary diversity (DDS), composite feeding and hand washing for all five visits among study mothers in control and intervention areas, Habro and Melka Bello districts, Ethiopia (2012-2014)^{1,2}

	Score range	Control		Intervention		Difference in score between control and intervention area (95% CI) ⁵	p-value ⁶
		N	Mean ± SD	N	Mean ± SD		
Currently breastfeeding score	0-7	629	6.29 ± 0.83	570	6.18 ± 0.93	-0.08 (-0.22, 0.06)	0.234
Meal frequency score	0-15	629	6.82 ± 1.92	570	7.95 ± 2.28	1.02 (0.33, 1.70)	0.004
Dietary diversity score	0-10	629	4.40 ± 2.39	570	4.68 ± 2.31	0.38 (-0.21, 0.98)	0.208
Composite feeding score1 ³	0-30	629	17.50 ± 2.91	570	18.82 ± 3.39	1.30 (0.41, 2.19)	0.005
Composite feeding score2 ⁴	0-25	629	11.2 ± 2.81	570	12.6 ± 3.36	1.39 (0.48, 2.23)	0.003
Hand washing score	0-6	676	2.64 ± 1.85	674	3.07 ± 1.88	0.41 (-0.21, 1.02)	0.195

¹ N = 1,199 for currently breastfeeding, meal frequency, dietary diversity, composite feeding1 and composite feeding 2; N = 1,350 for hand washing.

² Control: mothers/children enrolled from the control area; Intervention: mothers/children enrolled from the intervention area.

³ Composite feeding score1 was constructed based on scores of breastfeeding, dietary diversity, and feeding frequency.

⁴ Composite feeding score2 was constructed based on scores of dietary diversity, and feeding frequency.

⁵ 95% CI: 95% confidence interval.

⁶ P-values were calculated by multi-level linear regression analysis accounting for clustering effect, child age and sex, father education level, type of nearest health facility, household food insecurity, use of mobile phones, and district.

Figure 5.3 Unadjusted mean (95% Confidence Interval) child feeding and hygiene scores at five visits, each three months apart, among non-CPNP participants and CPNP participants in intervention area, Habro and Melka Bello districts, Ethiopia (2012-2014) (N = 570 for A,B,C D, and E; N = 674 for E). Composite feeding score1 was constructed based on scores of breastfeeding, dietary diversity, and feeding frequency, and composite feeding score2 was based on scores of dietary diversity and feeding frequency.

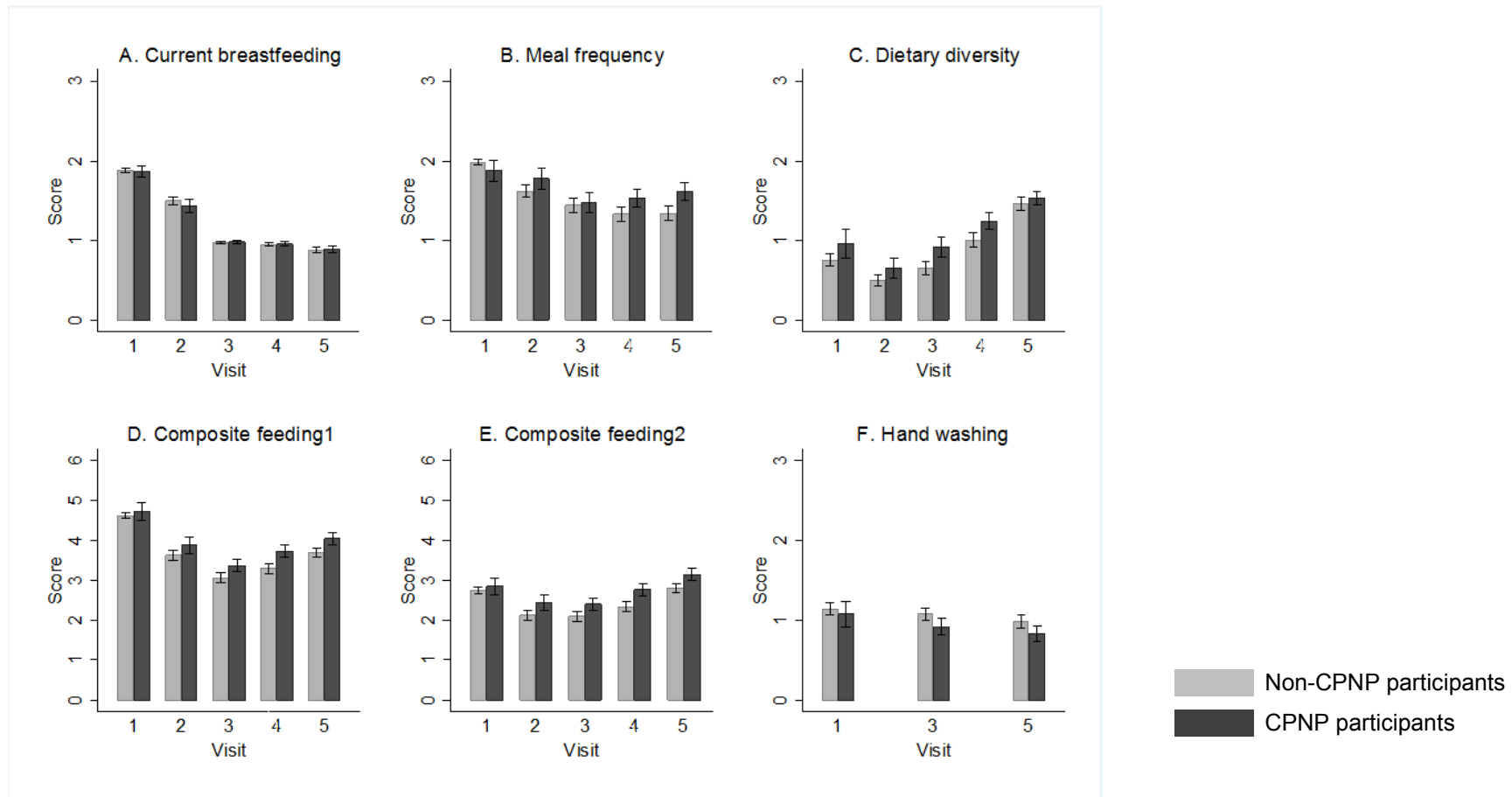


Table 5.3 Scores of breastfeeding, meal frequency, dietary diversity (DDS), composite feeding and hand washing for all five visits among non-CPNP participants and CPNP participants in intervention area, Habro and Melka Bello districts, Ethiopia (2012-2014)^{1,2}.

	Score range	Non-CPNP participants ³		CPNP participants		(95% CI) ⁴	p-value ⁵
		N	Mean ± SD	N	Mean ± SD		
Currently breastfeeding score	0-7	338	6.20 ± 0.97	232	6.16 ± 0.88	0.09 (-0.01, 0.18)	0.079
Meal frequency score	0-15	338	7.67 ± 2.26	232	8.36 ± 2.24	0.24 (-0.11, 0.60)	0.175
Dietary diversity score	0-10	338	4.20 ± 1.94	232	5.38 ± 2.61	0.04 (-0.28, 0.35)	0.826
Composite feeding score1 ³	0-30	338	18.08 ± 2.98	232	19.89 ± 3.65	0.40 (-0.09, 0.88)	0.110
Composite feeding score2 ⁴	0-25	338	11.88 ± 3.03	232	13.73 ± 3.51	0.30 (-0.17, 0.77)	0.217
Hand washing score	0-6	413	3.55 ± 1.88	261	2.64 ± 1.87	0.12 (-0.13, 0.37)	0.333

¹ N = 570 for scores of currently breastfeeding, meal frequency, dietary diversity, and composite feeding1 and composite feeding 2; N = 674 for hand washing.

² Non-CPNP participants; mothers who never attended CPNP session in the intervention area; CPNP participants: mothers who ever attended CPNP session in the intervention area.

³ Composite feeding score1 was constructed based on scores of breastfeeding, dietary diversity, and feeding frequency.

⁴ Composite feeding score2 was constructed based on scores of dietary diversity, and feeding frequency.

⁵ 95% CI: 95% confidence interval.

⁶ P-values were calculated by multi-level linear regression analysis accounting for clustering effect, child age and sex, father education level, type of nearest health facility, household food insecurity, use of mobile phones, and district.

Appendix 5.1 Scores of breastfeeding, feeding frequency, dietary diversity, composite feeding and hand washing among study mothers in control area and intervention area, Habro and Melka Bello districts, Ethiopia (2012-2014) (N = 1,199)^{1,2}

A. Current breastfeeding score, meal frequency score and dietary diversity score

		N	Current breastfeeding score			Meal frequency score			Dietary diversity score		
			Mean ± SD	diff (95% CI) ⁵	p-value ⁶	Mean ± SD	diff (95% CI)	p-value	Mean ± SD	diff (95% CI)	p-value
Visit1	Control	629	1.90 ± 0.31	0.02		1.65 ± 0.79	-0.31		0.62 ± 0.83	-0.18	
	Intervention	570	1.88 ± 0.33	(-0.01, 0.06)	0.2250	1.96 ± 0.47	(-0.39, -0.24)	0.0000	0.79 ± 0.87	(-0.27, -0.08)	0.0003
Visit2	Control	629	1.47 ± 0.52	-0.01		1.23 ± 0.80	-0.44		0.66 ± 0.82	0.11	
	Intervention	570	1.48 ± 0.52	(-0.07, 0.05)	0.7808	1.67 ± 0.86	(-0.53, -0.34)	0.0000	0.55 ± 0.76	(0.02, 0.20)	0.0159
Visit3	Control	629	0.99 ± 0.09	0.01		1.33 ± 0.82	-0.13		0.90 ± 0.80	0.16	
	Intervention	570	0.98 ± 0.15	(0.00, 0.03)	0.0346	1.46 ± 0.85	(-0.22, -0.03)	0.0086	0.74 ± 0.85	(0.07, 0.25)	0.0009
Visit4	Control	629	0.96 ± 0.19	0.01		1.24 ± 0.67	-0.17		0.84 ± 0.84	-0.27	
	Intervention	570	0.96 ± 0.20	(-0.01, 0.03)	0.5204	1.41 ± 0.83	(-0.25, -0.08)	0.0001	1.11 ± 0.81	(-0.36, -0.18)	0.000
Visit5	Control	629	0.96 ± 0.19	0.07		1.36 ± 0.75	-0.10		1.38 ± 0.74	-0.11	
	Intervention	570	0.89 ± 0.31	(0.04, 0.10)	0.0000	1.45 ± 0.85	(-0.19, -0.00)	0.0401	1.49 ± 0.72	(-0.19, -0.03)	0.0108

Appendix 5.1 Scores of breastfeeding, feeding frequency, dietary diversity, composite feeding and hand washing among study mothers in control area and intervention area, Habro and Melka Bello districts, Ethiopia (2012-2014) (N = 1,199) (continued)^{1,2}

B. Composite feeding score1 and composite feeding score2 (N=1,119)

		N	Composite feeding score1 ³			Composite feeding score2 ⁴		
			Mean ± SD	diff (95% CI) ⁵	p-value	Mean ± SD	diff (95% CI) ⁵	p-value
Visit1	Control	629	4.17 ± 1.11			2.27 ± 1.05		
	Intervention	570	4.64 ± 1.01	-0.47 (-0.59, -0.35)	0.000	2.76 ± 0.97	-0.49 (-0.60, -0.37)	0.0000
Visit2	Control	629	3.36 ± 1.29			1.89 ± 1.19		
	Intervention	570	3.69 ± 1.32	-0.34 (-0.48, -0.19)	0.0000	2.22 ± 1.28	-0.33 (-0.47, -0.19)	0.000
Visit3	Control	629	3.22 ± 1.05			2.23 ± 1.06		
	Intervention	570	3.17 ± 1.18	0.05 (-0.08, 0.17)	0.4630	2.20 ± 1.18	0.03 (-0.09, 0.16)	0.6162
Visit4	Control	629	3.04 ± 1.07			2.08 ± 1.06		
	Intervention	570	3.47 ± 1.21	-0.43 (-0.56, -0.30)	0.0000	2.52 ± 1.22	-0.43 (-0.56, -0.31)	0.000
Visit5	Control	629	3.70 ± 1.15			2.74 ± 1.12		
	Intervention	570	3.84 ± 1.15	-0.13 (-0.26, -0.00)	0.0498	2.95 ± 1.14	-0.20 (-0.33, -0.07)	0.0020

C. Hand washing score (N = 1,350)

		N	Hand washing score		
			Mean ± SD	diff (95% CI) ³	p-value
Visit1	Control ²	676	0.84 ± 0.86		
	Intervention	674	1.13 ± 0.89	-0.29 (-0.38, -0.19)	0.0000
Visit3	Control	676	0.86 ± 0.82		
	Intervention	674	1.02 ± 0.83	-0.16 (-0.25, -0.07)	0.0004
Visit5	Control	676			
	Intervention	674	0.94 ± 0.79	0.01 (-0.07, 0.10)	0.7577

¹ N = 1,199 for currently breastfeeding, meal frequency, dietary diversity, composite feeding1 and composite feeding 2; N = 1,350 for hand washing.

² Control: mothers/children enrolled from the control area; Intervention: mothers/children enrolled from the intervention area.

³ Composite feeding score1 was constructed based on scores of breastfeeding, dietary diversity, and feeding frequency.

⁴ Composite feeding score2 was constructed based on scores of dietary diversity, and feeding frequency.

⁵ 95% CI: 95% confidence interval.

⁶ p-values were calculated by Student's *t*-test.

Appendix 5.2 Scores of breastfeeding, feeding frequency, dietary diversity, composite feeding and hand washing among non-CPNP participants and CPNP participants in the intervention area, Habro and Melka Bello districts, Ethiopia (2012-2014) (N = 570)¹

A. Current breastfeeding score, meal frequency score and dietary diversity score

	N	Breastfeeding score			Meal frequency score			Dietary diversity score		
		Mean ± SD	diff (95% CI) ⁵	p-value	Mean ± SD	diff (95% CI)	p-value	Mean ± SD	diff (95% CI)	p-value
Visit1										
Non-CPNP	478	1.88 ± 0.33	-0.01		1.98 ± 0.43	-0.10		0.76 ± 0.86	0.21	
CPNP	92	1.88 ± 0.32	(-0.09, 0.06)	0.724	1.88 ± 0.63	(-0.21, 0.00)	0.059	0.97 ± 0.90	(0.01, 0.40)	0.037
Visit2										
Non-CPNP	406	1.50 ± 0.52	-0.06		1.62 ± 0.85	0.16		0.50 ± 0.74	0.15	
CPNP	164	1.44 ± 0.51	(-0.16, 0.03)	0.180	1.78 ± 0.88	(0.00, 0.32)	0.044	0.66 ± 0.79	(0.02, 0.29)	0.029
Visit3										
Non-CPNP	376	0.98 ± 0.15	0.00		1.45 ± 0.85	0.03		0.65 ± 0.82	0.27	
CPNP	194	0.98 ± 0.13	(-0.02, 0.03)	0.802	1.47 ± 0.86	(-0.12, 0.18)	0.717	0.92 ± 0.89	(0.12, 0.41)	0.000
Visit4										
Non-CPNP		0.95 ± 0.21	0.01		1.33 ± 0.82	0.20		1.01 ± 0.80	0.23	
CPNP	232	0.96 ± 0.19	(-0.03, 0.04)	0.625	1.53 ± 0.84	(0.06, 0.34)	0.004	1.24 ± 0.81	(0.10, 0.36)	0.001
Visit5										
Non-CPNP	570	0.89 ± 0.31	0.00		1.34 ± 0.79	0.27	0.000	1.46 ± 0.75	0.07	
CPNP	232	0.89 ± 0.31	(-0.05, 0.06)	0.862	1.62 ± 0.90	(0.13, 0.41)		1.53 ± 0.68	(-0.05, 0.19)	0.236

Appendix 5.2 Scores of breastfeeding, feeding frequency, dietary diversity, composite feeding and hand washing among non-CPNP participants and CPNP participants in the intervention area, Habro and Melka Bello districts, Ethiopia (2012-2014) (N = 570) (continued)¹

B. Composite feeding score1 and composite feeding score2 (N=570)

		N	Composite feeding score1 ³			Composite feeding score2 ⁴		
			Mean ± SD	diff (95% CI)	p-value	Mean ± SD	diff (95% CI)	p-value
Visit1	Non-CPNP	478	4.63 ± 0.99			2.74 ± 0.95		
	CPNP	92	4.72 ± 1.08	0.09 (-0.13, 0.32)	0.424	2.85 ± 1.04	0.11 (-0.11, 0.32)	0.339
Visit2	Non-CPNP	406	3.62 ± 1.29			2.13 ± 1.27		
	CPNP	164	3.87 ± 1.40	0.25 (0.01, 0.49)	0.042	2.44 ± 1.29	0.31 (0.08, 0.55)	0.008
Visit3	Non-CPNP	376	3.07 ± 1.17			2.10 ± 1.18		
	CPNP	194	3.37 ± 1.16	0.30 (0.10, 0.50)	0.004	2.39 ± 1.16	0.30 (0.09, 0.50)	0.004
Visit4	Non-CPNP	338	3.29 ± 1.19			2.34 ± 1.22		
	CPNP	232	3.73 ± 1.19	0.44 (0.24, 0.64)	0.000	2.77 ± 1.17	0.43 (0.23, 0.63)	0.000
Visit5	Non-CPNP	338	3.69 ± 1.10			2.80 ± 1.10		
	CPNP	232	4.04 ± 1.19	0.35 (0.16, 0.54)	0.000	3.15 ± 1.17	0.35 (0.16, 0.54)	0.000

C. Hand washing score (N = 674)

		N	Hand washing score		
			Mean ± SD	diff (95% CI) ³	p-value
Visit1	Non-CPNP	563	1.14 ± 0.89		
	CPNP	111	1.07 ± 0.87	-0.07 (-0.25, 0.11)	0.461
Visit3	Non-CPNP	456	1.07 ± 0.85		
	CPNP	218	0.92 ± 0.78	-0.11 (-0.25, 0.03)	0.117
Visit5	Non-CPNP	413	0.98 ± 0.85		
	CPNP	261	0.83 ± 0.78	-0.07 (-0.20, 0.06)	0.311

¹ N = 1,199 for currently breastfeeding, meal frequency, dietary diversity, composite feeding1 and composite feeding 2; N = 1,350 for hand washing.

² Control: mothers/children enrolled from the control area; Intervention: mothers/children enrolled from the intervention area.

³ Composite feeding score1 was constructed based on scores of breastfeeding, dietary diversity, and feeding frequency.

⁴ Composite feeding score2 was constructed based on scores of dietary diversity, and feeding frequency.95% CI: 95% confidence interval.

⁵ p-values were calculated by linear regression analysis (unadjusted).

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CHAPTER 6. PROGRAM IMPACT PATHWAY ANALYSIS OF A COMMUNITY-BASED PARTICIPATORY NUTRITION PROMOTION APPROACH TO IMPROVE CHILD FEEDING AND HYGIENE PRACTICES IN RURAL ETHIOPIA

6.1 ABSTRACT

Background: The implementation process of complex nutrition interventions need to be examined to better understand how they achieve expected outcomes. **Objectives:** We conducted a program impact pathway (PIP) analysis to evaluate how a community-based participatory nutrition promotion (CPNP) program—involving a two-week group nutrition session—improved the nutritional status of children in rural Ethiopia. The PIP analysis evaluated five program components: (1) quality of the CPNP implementation process, (2) participants’ acceptance of the CPNP program, (3) participants’ message recall, (4) child feeding and practices and child growth at the community level, and (5) the influence of exposure to other ongoing nutrition programs. **Methods:** We reviewed the attendance records of 3,299 participants and the observation checklists of 114 CPNP sessions and extracted process evaluation indicators such as the percentage of dose delivered, percentage of dose received, and score of fidelity to the intervention protocols. We conducted a household survey every three months (a total of five times) as part of a cluster randomized trial among 914 and 876 mothers randomly selected from control and intervention areas, respectively, to assess feeding and hygiene practices based on infant and young child feeding (IYCF) indicators, and to ask whether the mothers were involved in the ENA and CMAM programs. We also examined the recall of mothers’ (n = 197) experiences related to the CPNP group sessions. **Results:** CPNP sessions were delivered at 81% of

the expectation level; fidelity to intervention protocols varied between 68% and 92% of the expectation. Out of 197 participants, 95% ever contributed materials to a session, 90% showed positive perception to the session practices. For each of the session activities (e.g. food preparation), ~70% rated their participation level as active. The participants recalled 5.0 ± 2.0 (SD) out of the 8 messages (e.g. preparing nutritious complementary foods) asked. At the initial program stage (4 months of the CPNP implementation), a greater percentage of CPNP participants met the minimum dietary diversity, compared to non-participants in the intervention area (34.0% vs. 19.9%, $p < 0.05$). Over the 12-month follow-up, mothers in the intervention area had better practice of meal frequency and composite feeding than mothers in the control area ($p < 0.05$; details in Chapter 5). We found a higher involvement of CPNP participants in the existing program (e.g., Essential Nutrition Action) over the project period compared to non-participants within the same intervention area (32.3% vs. 19.8%, $p < 0.001$). **Conclusions:** Using a PIP analysis, our results suggest that the CPNP program was adequately implemented and well-accepted among participants. As a result, the improved feeding practices spread out at community, giving the additional benefit of positively influencing the ongoing ENA program, and eventually resulting in improved child nutritional status.

6.2 INTRODUCTION

Undernutrition threatens child wellbeing, and eventually weakens human capital at national levels. As a recent international commitment to address childhood undernutrition, the WHO global nutrition target aims to reduce by 40%—from 171 million (2010 baseline) to 100 million in 2025—the number of children under the age of five who are stunted (1). In Ethiopia, 44.4% of children are stunted and 9.7% are

wasted (2). The Ethiopian government committed to address childhood undernutrition through the National Nutrition Programme (3), of which mainly two types of community-based nutrition programs were implemented by the local governments: the Essential Nutrition Action (ENA) and the Community-based Management of Acute Malnutrition (CMAM). In brief, the ENA activity provides brief nutrition counseling by community volunteers (4), and the CMAM program treats moderately or severely wasted children with therapeutic or supplementary foods (5, 6). Both programs are currently operated by district health offices as part of the primary health services, with promising program impacts being reported in a few reports (7-9). However, in some rural areas, the limitations of these programs were often reported among program implementing actors, such as poor capacity of community volunteers in delivering nutrition information (10). Moreover, treated children through the CMAM program often relapse in a short time despite extensive treatment with therapeutic foods (11). As a result, mothers remain without appropriate capacity to address child undernutrition on their own, depending on external food assistance (12, 13).

To address these program gaps, World Vision Korea and World Vision Ethiopia developed a community-based participatory nutrition promotion (CPNP) program, which was a two-week intensive group nutrition session, mainly focused on behavior change in child feeding and hygiene of caregivers, emphasizing utilization of locally available resources and community participation. The program was added to the existing government programs of ENA and CMAM, and its effectiveness in improving child feeding among caregivers and child nutritional status was demonstrated in a cluster randomized trial in two rural districts (Chapter 4 and 5).

Indeed, despite a few significant findings of behavior change communication

(BCC) strategies in improving child growth and healthy practices of caregivers (14, 15), what and how such interventions were implemented, modified, and accepted remains unexamined or only briefly described in most community-based trials. Furthermore, lack of understanding of the implementation process of community nutrition programs based on BCC strategies may hinder effective program development, implementation, and scaling up to other similar settings. In response to these questions, theory-driven process evaluation has been proposed and utilized to open the “black box” of the implemented programs (16-19).

Program impact pathway (PIP) analysis is one of the methodological approaches to carry out process evaluation (19). In a 2008 WHO/UNICEF meeting, the term *program impact pathway* (PIP) was defined as “the pathway from an intervention input through programmatic delivery, household and individual utilization to its desired impact” (20).

A PIP analysis focuses on the causal mechanisms of programs and the intention to move beyond static input-out program models, so that a PIP analysis reveals the various operational components of a program, identifies successes and failures in the mechanisms by which programs are expected to impact outcomes. Until now, only a few implementation studies considering the program impact pathway have examined the implementation processes of complementary feeding trials (21-23). However, the need to examine pathways or the mechanisms of nutrition intervention programs grows among program practitioners as well as policy makers.

The Alive & Thrive project, which attempted to improve infant and young child feeding practices (IYCF) in Bangladesh, Ethiopia, and Vietnam, recently conducted a theory-driven process evaluation, which also provided useful information on process evaluation in large-scale nutrition programs (24-26).

Using a similar approach, the present study describes findings from a PIP analysis of the CPNP program to improve child feeding and hygiene practices in rural Ethiopia. We examined five specific program components to evaluate the levels of implementation process of the CPNP to assess its proximal outcomes, and to understand how the program achieved intended outcomes of change in infant and young child feeding and hygiene behaviors.

6.2.1 Program description

The PIP analysis was carried out in the context of three nutrition programs: CPNP, and the existing Government of Ethiopia programs—CMAM, and ENA. These programs were implemented in Habro and Melka Bello districts under the Ethiopia Integrated Nutrition Project (EINP), which was a 20-month-long activity (January 2012 to August 2013) conducted by World Vision Korea, in collaboration with World Vision Ethiopia, Wholistic Interest Through Health (WITH, a Korea-based NGO), and local Ethiopian governments, and was funded by an air-ticket solidarity levy[§] entitled "Global Poverty Eradication Contribution" of Korea international cooperation agency (KOICA).

CPNP: The CPNP was a community-based 2-week group nutrition education session, in part adapting elements of the Positive Deviance Hearth model such as enhancing community participation and resource utilization and rehabilitating underweight children (27, 28). Underweight children in the community were screened ahead of

[§] Introduced on September 30, 2007, the levy imposes a contribution of 1000 Korean won (approx. 1 USD) for each passenger departing from Korea. It is expected to raise annual revenue of around 20 million USD for Korea's ODA. KOICA will use this fund for various disease eradication and control initiatives, including contributions to the UNITAID (an international drug purchase facility), mainly in the African region.

each session, and mothers of the underweight children were encouraged to attend group nutrition sessions. We planned 460 nutrition sessions for 4600 children in the study area over the 13-month project period. Approximately seven to twelve child and mother pairs attended each session. All 23 female operators were recruited from their Kebeles and led group nutrition sessions at different villages within the Kebele; 8 supervisors supported and supervised the operators' activities. The participants were encouraged to contribute food ingredients and materials such as firewood, cooking utensils, and feeding plates to the sessions. At the start of each session, the mothers sang a song together about the importance of child nutrition. Next, two mothers prepared complementary foods according to recommended recipes with locally available and affordable food ingredients, such as grains (sorghum, maize, wheat, and barley), bean flour, potato, sweet potato, egg, green leafy vegetables, animal milk, oil, and tomato. All ingredients but green leafy vegetables were boiled first together into an energy-dense porridge, and the green leafy vegetables were added into the porridge later. As the porridge was being prepared and distributed, mothers washed their hands and the children's hands with soap and water and fed their children on the spot. Nutrition message discussions with the mothers were then led by the operators. All enrolled children were weighed on the first and twelfth day of the session and then after one month. Their weight was recorded and the weight change was tracked. The children who followed the program regularly had a good appetite, but no weight gain was examined for diarrheal disease and parasitic infestations. Diarrhea cases were treated and deworming tablets were provided as needed. The participants were supposed to have every other day follow-up visits for two weeks by the operators or supervisors in the following two weeks. Once a CPNP session was carried out in a

small village unit within a Kebele, the next session was prepared in a neighboring village within the same Kebele.

ENA: The ENA activity was mainly intended for community volunteers to deliver monthly nutrition-related counselling to all mothers with children under two years of age in the study area. To support this intervention, the ENA counseling training was preferentially provided to the HEWs, who delivered the same training to the community volunteers in their Kebeles. Upon launching the EINP, a Health Development Army (HDA) was adopted in the project site by the district health offices, defined as “a community level group of 30 households (women) organized in a 1 to 5 network of members, where one women functioned as leader of the network and five women operated as network members” (3). In effect, community volunteers became leaders of the networks, and the intended ENA operating structure gradually transitioned into group discussions. The main ENA messages are on adequate breastfeeding and appropriate complementary feeding practices, caring for sick children, maternal nutrition, and the importance of micronutrients. The ENA training to HEWs/ community volunteers was conducted in both districts from March to May 2012; all 54 HEWs in the Habro district and 35 HEWs in the Melka Bello district attended the training sessions. Following the HEWs’ training, 580 (429 females and 151 males) and 395 (no sex information) community volunteers, more than 95% of all volunteers, were trained for the ENA counseling in the Habro and Melka Bello districts, respectively.

CMAM: The CMAM program was scaled up countrywide in 2008 and conducted as a part of the Health Extension Program (HEP) in Ethiopia (9). In the CMAM

program, severely wasted children—with mid-upper arm circumference (MUAC) less than 11 cm but without other complications—were referred to the nearest health post/health center to receive Plumpy’Nut, a type of therapeutic food, until their recovery (5, 29). HEWs manage their admissions and follow up for maximum eight weeks till they reach discharge criteria according to the national guidelines, recovery and discharge, and report these records monthly to the district health office. On occasion, families with moderately wasted children—with MUAC of 11-11.9 cm—and pregnant and lactating women in moderately malnourished state also receive a monthly ration of corn-soy blend (CSB) and vegetable oil for three months at distribution sites. The first CSB distribution was put in place in August 2012 at the same time as the start of CPNP session in the intervention area.

6.2.2 PIP of the CPNP

We created a conceptual diagram for a program impact pathway (PIP) through which the CPNP program would be expected to impact child feeding and hygiene (Figure 6.1). The mapping of the PIP was based on the original program logic model (Refer to Figure 3.1), review of mid- and final program evaluation report, and dialogues among the project team and research investigators. Five key program components were examined, as cited below. Successful outcomes at the program stages involving these components would improve our understanding of how the CPNP achieved intended outcomes of improving child feeding and hygiene among mothers. Following the conceptual program pathway, this study attempted to analyze the implementation process and proximal outcomes of program components by addressing research questions below.

- 1) ***Quality of the CPNP implementation process:*** To what extent was the CPNP program implemented? Process indicators such as dose delivered, dose receipt, and fidelity to intervention protocol were created.
- 2) ***Participants' acceptance of the CPNP program:*** To what extent did CPNP participants participate, contribute materials, and perceive the CPNP sessions?
- 3) ***Participants' message recall:*** To what extent did the participants recall discussion messages and food ingredients of the CPNP menu?
- 4) ***Child feeding and hygiene at the community level:*** Were there differences in practices of child feeding and hygiene among the participants compared to the non-participants and the control group at an early stage of CPNP implementation? Were there differences in child feeding and hygiene and child growth between intervention and control areas over the project period?
- 5) ***Influence of exposure to the ENA and CMAM programs:*** Did the CPNP program influence the degree of exposure to the ENA and the CMAM programs?

6.3. METHODS

6.3.1 Study area and settings

This study was conducted in Habro district in the West Hararghe zone and in the Melka Belo district in the East Hararghe zone of Oromia National Regional State. The two districts have limited development, depend on mixed crop agriculture, and are frequently subjected to drought and persistent poverty. World Vision Ethiopia has implemented the area development program for more than five years, building close ties with community members in the two districts. The two districts are ~120 km

apart.

6.3.2 Study design and sampling

This study was conducted in connection with a cluster randomized effectiveness trial. To conduct the trial and to further construct matched clusters within each district, 48 Kebeles from Habro and Melka Bello districts were divided into 12 clusters, with 6 clusters per district. The procedure of 12 cluster construction and random allocation of the intervention is described in Chapter 3. The CPNP program, together with the ENA and CMAM programs, was implemented in 6 intervention clusters, while the ENA and CMAM programs only were carried out in 6 control clusters. Out of the 6 intervention clusters, 3 clusters belonged to Habro district and another 3 belonged to Melka Bello district. The study participants consisted of 1,790 randomly selected children 6 to 12 months of age paired with their mothers, 914 in the control area and 876 pairs in the intervention area. This sample size was determined to have 0.2 length-for-age z score at the end of the 12-month follow-up between children in the control area and children in the intervention area (see the Chapter 4 for more details on this RCT). These selected children and mothers were visited every three months, a total of five times for 12 months (visit1 to visit5). Eighteen locally recruited and trained data collectors interviewed the mothers after obtaining informed consent (Appendix C.1 and C.2).

6.3.3 Data collection

Data collection methods, outcomes, sample size, and frequency for the five program components are listed in Table 6.1. Visit1, the first round data collection, was conducted from November 20, 2012 to February 19, 2013; visit5, the last round data

collection, was conducted from November 20, 2013 to February 19, 2014. Every visit was three months apart. Visit1 was conducted four months after the CPNP sessions and after the corn-soy blend distribution of the CMAM program had started. The data collectors worked independently and were not involved in project implementation duties.

For the quality of CPNP program implementation (component 1), we reviewed the attendance book for 3,299 CPNP participants over the 13-month CPNP implementation period and 3-day observation checklists for 114 group nutrition sessions over the six months, which were prepared by CPNP supervisors and operators. (The attendance book and observation checklist forms are listed in Appendix E.1 and E.2). We extracted the following information from the attendance book: child age, sex, attending days, weight at first and twelfth days, session starting dates and completion dates. The observation checklists were designed to help the operators effectively manage the sessions. Each item in the checklists was scored 0 (not performed), 2 (moderately/modestly performed), or 4 (actively performed), giving a range of 0-12 scores for the three days. All food ingredients contributed by mothers at the sessions were listed.

At survey visit2, data collectors locally recruited and trained by study investigators conducted a recall survey—using a structured questionnaire in the *Afan Oromo* language—regarding the participants’ program acceptance and recall of message and food ingredients (component 2 & 3) of the participants who had ever attended a CPNP session by that time. Mothers were asked about how actively they had participated in session activities such as feeding, food preparation, and hand washing, and rated their participation at (1) I actively participated, (2) I participated, but not actively, somewhat, or (3) I didn’t participate. Perceptions regarding the

session (satisfaction with the session, putting the CPNP lessons into practice confidently, and feeling of usefulness for the session) was assessed using Likert scales, but were later categorized into binary indicators during data analysis. The mothers were asked whether they had contributed materials to the session and what items they had contributed, and were asked to recall the discussed nutrition messages and food ingredients at the session, and were also asked about currently used type of foods.

The proximal outcomes of child feeding and hygiene at the community level (component 4) are presented in detail in Chapter 5. At each visit (a total of five visits), all 1,790 mothers who participated in the effectiveness evaluation study were asked about child feeding practices based on infant and young child feeding (IYCF) indicators that were structured based on 24-hour diet recall questionnaires. Minimum dietary diversity and minimum meal frequency were computed according WHO guidelines (30). In brief, minimum dietary diversity is the proportion of children 6–24 months of age who receive foods from 4 or more food groups. Minimum meal frequency is for breastfed and non-breastfed children 6 to 24 months of age who receive solid, semi-solid, or soft foods the minimum number of times or more. Hand washing practice was assessed at every six months by asking whether or not the mothers washed their hands with soap and water at four critical time points: (1) after defecation, (2) after cleaning the child’s bottom, (3) before preparing food, and (4) before feeding the child. Through spot-check hygiene observation, data collectors assessed how clean the mother and child were for their hands, hair, clothes, and face by observation at every six-month survey visit. Mother (or child) cleanliness is the proportion of mothers (children) who were assessed as clean all for their hands, hair, clothes, and face.

To assess the influence of exposure to the ENA and CMAM programs (component 5), all 1,790 selected mothers were asked at each visit whether they had ever received/ participated in an ENA activity from HEWs/community volunteers in the past three months, and whether the child ever received Plumpy'Nut or corn-soy blend in the past three months.

6.3.4 Construction of process indicators

As defined for this study, the process indicators, linked to the conceptual model, include the following (16). The process indicators linked to the conceptual program impact pathway (PIP) model (Fig 6.1) include the following: percentage of *dose delivered* is defined as the percentage of intervention activities completed by project staff out of the total expected; percentage *dose received* is defined as the percentage of intervention received by the intervention target population out of the total expected; *Fidelity* is defined as the percentage or scores of intervention activities completed by project staff that adhered to intervention protocols; *Exposure* is defined as the percentage of exposure to intervention activities by caregivers; *Message recall* is defined as the percentage of recall of the intervention messages by the target population; *Proximal outcomes* are the percentage of infant feeding behaviors consistent with key project messages, as well as caregivers' mean scores for key child feeding and hygiene behaviors.

6.3.5 Data Analysis

Data were entered into the Microsoft Office Excel 2007 program and cleaned; data analysis was performed using Stata version 12.0 (Stata Corporation, College Station, TX, USA). Descriptive analyses were conducted for five critical implementation

components, which were identified from the program impact pathway (PIP). Percentage of monthly CPNP program enrollment and percentage of cumulative CPNP enrollment was calculated to the total number of CPNP participants. For evaluation of the quality of the implementation process of CPNP (component 1), process indicators, such as percentage dose delivered, percentage dose received, and percentage or scores of fidelity to intervention protocol were constructed based on extracted data from the attendance book and observation checklists, and were compared in six intervention clusters by chi-squared test. The following variables were evaluated regarding the participants' program acceptance (component 2): material contribution to the CPNP session, perceptions of the session (e.g., satisfaction, usefulness of CPNP message, confidence in putting the CPNP messages into practice), and active participation in the main CPNP activities (e.g., singing, hand washing, and feeding). These variables were presented as percentages of those accepting/participating/perceiving specific elements out of surveyed participants. Participants' message recall (component 3) was presented as a percentage of those who remembered specific CPNP messages (e.g., preparing nutritious complementary foods) out of surveyed participants.

For proximal outcomes of child feeding and hygiene behaviors and primary outcomes of child growth (component 4), multilevel mixed-effect models were constructed and tested among three groups: (1) mothers in the intervention area, (2) non-CPNP participant mothers in the intervention area, and (3) CPNP participants in the intervention area (cf. detailed information in Chapter 5 and 6). *P*-values were calculated by multilevel linear regression analysis, accounting for cluster effect to compare control area vs. intervention area, or non-CPNP participants vs. CPNP participants in the intervention area. Statistical significance was set at $p < 0.05$ with

all tests. Indicators of exposure to the ENA and CMAM programs (component 5) were calculated by summing up all events from visit1 to visit5 divided by the total number of subjects to estimate mean percentages compared by two-sample tests of proportions. All collected data were delivered to and managed by the data management team in the Habro district.

6.3.6 Ethical issues

The EINP was approved by the Ministry of Finance and Economic Development and the Ministry of Health, Ethiopia (Appendix B). This study, including its effectiveness and process evaluation, was approved by the ethical committee board, Oromia Regional Health Bureau, Ethiopia (Appendix F.1 and F.2). This trial was registered with Current Controlled Trials, ISRCTN 89206590.

6.4 RESULTS

6.4.1 Subject characteristics

The characteristics of the selected child and mothers for the survey are described in Chapter 4. In brief, the age of mothers was 26.1 ± 5.4 years, and 82.3% of the mothers were illiterate. More than 90% of households depended on mixed farming for their livelihoods. When the clustering effect was adjusted, the intervention area had fewer households in severe food insecurity condition (12.4% vs. 34.7%; $p = 0.001$), greater access to the local hospital, and marginally better household wealth status. There were no differences in social capital, age and education among mothers, religion, or water sources and sanitation utilities between the control and intervention areas.

On average, 16.2 CPNP sessions were held every 3.5 weeks in each Kebele for 13 months; new CPNP sessions were operated at different locations within the

Kebele. Out of the 3,299 participants of the CPNP program during its 13 months of operation, ~60% had attended at least one session by the 6th month of the program, and ~80% had attended at least one session by the 9th month (Table 6.2). On average, 8.9 mother and child pairs attended each session.

6.4.2 Quality of CPNP implementation process

We reviewed the attendance book of 3,299 participants attending 372 sessions for 13 months (August 2012 to August 2013) and the observation checklist records for 141 sessions. Percentage of dose delivered of CPNP session was 80.9% of expected session numbers (Table 6.3); 372 sessions were held out of 460 expected sessions. Percentage of dose received by CPNP participants was 71.7% of 4,600 expected number of participants, varying from 62.3% to 82.7% across the six intervention clusters. The percentage of fidelity to the intervention protocol was overall satisfactory; 91.7% of the sessions consisted of 7 to 12 participants, which would be considered an appropriate number for a group activity; 95.5% of the children were 6 to 24 months of age, and 90.3% of participants attended for 10 to 12 days. As a proximal outcome as well as fidelity indicator, the percentage of children who gained weight of more than 200g was good at 67.8%. Admission of underweight children was exceptionally low, with a range of 19.2% to 37.9% across the six intervention clusters.

While dose delivered had no difference across six clusters, the percentage of dose received of total expected and some of percentage of fidelity indicators varied by cluster. The variation was most likely to be attributable to differences in the district ($p < 0.05$; chi-squared test). Intervention clusters in Harbo district indicated lower percentage of dose received (62.3% to 70.0%) than in the Melka Bello district (76.0%

to 82.7%). The average number of attendants per nutrition session was higher in Melka Bello (8.5 vs. 9.3). Children with more than a 200g weight gain after two weeks session was higher in the Habro district (range: 72.6 to 79.7%) than in the Melka Bello district (48.0 to 64.8%).

Each item of observation checklist was scored 0 to 12 for three days evaluation. As the score range of 8-12 was considered as being operated with good quality considering the scoring process of each item in the checklists being scored 0 (not performed), 2 (moderately/modestly performed), or 4 (actively performed) per day. According to these criteria, the fidelity scores of most of the checklist items presented a mid-to-high level (Table 6.4).

The session operation involved community support; 66.7% of the sessions were supported by HEWs; 57.9% were supported by community volunteers. It was likely that a reasonable amount of meals were provided to children (score: 9.8 ± 4.0 , range 0 to 12). In principle, the sessions depended entirely on the food ingredients that CPNP participants volunteered. Mainly the following ingredients were constantly prepared: wheat, barley, sorghum, and maize flour, *shiro* flour (chick-peas based food ingredient), green leafy vegetables, vegetable oil, and milk were constantly prepared. Additional ingredients such as sweet potatoes, tomatoes, milk, etc., were included on occasion. For 86% of all sessions, 7 to 8 food ingredients were in place. As recommended in the original protocol, a 5 days follow-up visit for two 2 weeks, was also practiced at a low level of expectation; only 5.8% of CPNP participating mothers (n = 197) received 5 or more visits by the CPNP operators. 53.9% received 1 to 2 times follow-up visits and 27.7% never had follow-up visits (data not shown).

6.4.3 Participants' program acceptance

Acceptance of the program was evaluated based mainly on responses from the CPNP participants. At visit₂, out of 744 mothers surveyed in the intervention area, 197 mothers were identified to attend the CPNP sessions ahead of survey visit₂. The participants rated their participation level as active for the various activities (e.g. hand washing, food preparation) with a range of 62.1% to 79.2% (Table 6.5). 94.9% of the participants replied that they had ever contributed to the sessions, with most of them bringing at least two items to the sessions (mean \pm SD: 2.1 ± 1.6 , range 1 to 7). More than 90% of the participants replied that they were satisfied with the sessions, and that the session messages were useful, and 80.2% replied that they could confidently put the CPNP messages into practice.

6.4.4 Recall of messages and food ingredients among CPNP participants

Out of 197 CPNP participants, most of mothers (88.3%) recalled the message of preparing nutritious complementary foods was and the mothers recalled other messages at 61.4% to 69.0%, with the exception of messages regarding health seeking practices (e.g., going to the Health Center when their child was sick) (31.0%) (Table 6.6). Largely they remembered about five of eight messages asked (5.0 ± 2.0 , range 1 to 8); 72.6% of the participants replied that they were preparing complementary foods as they had learned at the sessions. The participants remembered by and large about 3 food ingredients used in the sessions (3.2 ± 1.8 , range 1 to 9). Food ingredients such as grains (81.2%), oil (58.3%), sweet potato/potato/yam (42.1%), milk (41.8%), and green-leafy vegetables (33.5%) were well recalled.

6.4.5 Feeding and hygiene practices at the community level

The evaluation of child feeding and hygiene practices was based on the premise that participants vs. non-participants were exposed to the CPNP sessions at least at the early stage of the program and before the program spread out to the whole community as intended. The CPNP session operation preceded four months before survey visit1, so we used the data at visit1 to compare the CPNP participants to the non-participants or the control group. At visit1, 141 participants, out of 876 mothers in the intervention area were found to have attended the sessions. The ages of the enrolled children ranged from 6 to 12 months; thus, all mothers were breastfeeding across the three groups. The percentage of those who met minimum dietary diversity was greater in the CPNP participants compared to the non-participants in the intervention area (34.0% vs. 19.9%, $p < 0.05$) as well as the control group (34.0% vs. 16.8%, $p < 0.05$), adjusting for child age, sex, and variables differing at enrollment, and clustering effect (Table 6.7). A larger portion of CPNP participants reported that they washed their hands with water and soap at four critical time points (35.7% vs. 26.0%, $p < 0.05$) than the control group, but not greater than the non-CPNP participants. At the spot-check observation, a greater proportion of CPNP mothers looked cleaner than the non-participant mothers (40.0% vs. 14.6%, $p < 0.05$) in the intervention area as well as the mothers in the control area. Over the 12 months follow-up, mothers in the intervention area showed higher scores of meal frequency (diff: 1.02, 95% CI: 0.33, 1.70), composite feeding involving breastfeeding, dietary diversity, and meal frequency (diff: 1.30, 95% CI: 0.41, 2.19) than mothers in the control area, but there were no differences in scores of current breastfeeding, dietary diversity, and hand washing between mothers in the two areas (Refer to Chapter 5). Furthermore, children

in the intervention area showed improvement in length-for-age z score and weight-for-age z score (Refer to Chapter 4).

6.4.6 Influence of CPNP on exposure to ENA program

Out of the 914 and 876 survey subjects in the control and intervention areas, 46.7% and 52.4%, respectively, replied that they had ever participated in the ENA program. CPNP participants showed a significantly greater tendency of being involved in the ENA activity than the non-CPNP participants in the same intervention area (32.3% vs. 19.8 %; z-test, $p < 0.05$) or mothers in the control area (32.3% vs. 15.1%, $p < 0.05$) (Table 6.8). Out of 1,790 subjects, 24.1% and 9.1% had ever received Plumpy’Nut in the control and intervention areas, respectively, at a similar level in the CPNP participants and non-CPNP participants in the intervention area.

6.5 DISCUSSION

The PIP analysis showed the degree to which the CPNP program was delivered and received, and the degree to which caregivers accepted and utilized the intervention components, and how the program influenced other nutrition programs ongoing in the rural districts of Ethiopia. In summary, the CPNP were successfully performed with an appropriate level of dose delivered and exposure, and high fidelity to the intervention protocol for various aspects of the nutrition sessions. Participants’ active participation and contributions, and positive perceptions supported that the program was adequately accepted in this rural Ethiopian setting. Some of the feeding and hygiene behaviors improved among the CPNP participants at the initial project stage, and over the 12-month project period, the intervention mothers presented better child feeding practices (e.g. meal frequency and composite feeding) than mothers in the

control group. Furthermore, the participants were more engaged in the ENA activities, likely due to an increased demand of the existing community health service. These linked activities and proximal outcomes would lead to better nutritional status in children in the intervention area. This study is an example of one of few PIP studies which have employed a process evaluation for behavior change communication (BCC) interventions to improve infant and child feeding practices and will be used as a useful resource for further scale up of nutrition programs to be operated by civil societies and the Ethiopian government.

Overall, the CPNP session performance was appropriate; 80.9% of dose delivery of the expected 460 sessions and 71.7% of dose received by the 4,600 participants were achieved. Since the numbers of 460 sessions and 4,600 participants were considered to be maximum achievement, the CPNP had been operated at a completely ideal level. Thus, we gauged that these process outcomes were greater than 70% of total expected and would be judged as an operation with high quality. It is notable that the variation across the six clusters, mostly in two districts, in the percentage of dose received of total expected participants and some of the percentage of fidelity indicators was attributable to differences in the districts. Process outcomes such as dose delivered and dose received may represent CPNP supervisor and operators' capacity, and reciprocal action among community members, and need further study to explore what factors in the study districts contributed to the difference in the process indicators. The adequacy of dose received of CPNP participation was supported by a few additional estimations; at least 30% out of the total population 6 to 24 months of age in the intervention area (data not shown) attended nutrition sessions (31), and 38% of selected children in the intervention area for the effectiveness study replied that they had ever attended the sessions.

Out of 3,299 children, 67.8% children showed weight gain of more than 200g after two weeks. Importantly, their weight gain was likely to continue after the program; children who had ever attended the CPNP session exhibited even faster monthly weight gain (diff: 0.035/month, 95% CI: 0.017, 0.053) and 0.029 WAZ score/month (95% CI: 0.012, 0.047) greater than non-CPNP children in the intervention area (Chapter 4). Percentage of fidelity was more than 90% with regard to sessions having 7 to 12 participants, admission age of 6 to 24 months of age, and attending days of 10-12 days indicated that the basic elements for CPNP were well set-up. The reason for low fidelity (29.5%) to admitting underweight children was also indicated in the final evaluation report that over time, the operators reported difficulty in finding underweight children, a targeted group, in their Kebele and would admit children without applying this criteria at a later program stage (data not shown) (32). As the CPNP was not aimed to treat the underweight condition but to rehabilitate such children, these adjustments in admission criteria might not reduce the program effect; rather, it could have an advantage of engaging many mothers with interest in CPNP participation. This change in program operation needs to be understood as a context-specific program-adapting process.

It was likely that the CPNP program was well accepted by participants. Such positive perceptions of the CPNP program might help participants have a strong desire to put these CPNP messages into practices with confidence and have a sustainable program impact. Current results of the participants' positive perceptions has significance that this program operation entirely depended on their own resources except for employment of CPNP operators and supervisors by World Vision. From a programmatic aspect, these results have a greater implication because there was

resistance from the community at the start of the CPNP session regarding their own material contribution to the NGO-leading program.

The participants remembered the messages discussed in the sessions and kept utilizing the food ingredients presented in the sessions to prepare their children's foods. The nutrition messages discussed in the PD Hearth programs are types of universal child feeding, caring, personal and environment hygiene, and health seeking practices (27, 33). In our program settings, CPNP operators were supposed to discuss one of these messages per day with participants and to repeat the messages in the following week (detailed messages are described in Chapter 3). Given that this was an intervention protocol, it could be a good indication of an effectively implemented message discussion that mothers could recall 5 out of 8 messages.

It is notable that many participants replied that they were preparing child foods as they learned at the sessions, which could be a tentative indication for the program sustainability. Yellow-vegetables (21.8%), eggs (18.3%), and legumes (13.7%) were recalled at a lower level than other food ingredients such as grain or milk, even though the sessions encouraged all these foods. To strengthen the program effect on diverse food consumption, we need to further investigate why these foods were less available at group sessions, whether it was attributable to individual affordability or resulted from lower fidelity to the food ingredient preparation.

Despite this lack of some types of food availability recommended at the session, it was found that CPNP participants kept higher scores of dietary diversity than non-CPNP participants in the intervention area over the project period (not adjusted) (Chapter 5). At the initial stage of the program, mothers of CPNP participating children were found to feed their children more diverse foods and be cleaner at their face and clothes than non-participants in the intervention area. These

significant differences in behaviors between CPNP participants and non-CPNP participants disappeared over time. Instead, the impact of the program was spread out at the community level; consequently, mothers in the intervention area maintained better child feeding and composite feeding than the control group (Chapter 5). No difference in hand washing practice between the control and intervention areas might be attributable to the hygiene messages of environmental and personal hygiene provided by the existing Health Extension Program (HEP) service (34, 35).

It is noteworthy that the higher ENA activity level in the intervention area was mostly attributed to the higher engagement of CPNP participants to the ENA activity. The CPNP participants might be more sensitized to attaining nutrition information, and have stronger motivation and willingness to participate in the ENA activity than their neighbors. This change could increase demand for government health services, spurring HEWs and community volunteers to improve their health service activity. Given that the ENA activity level in the current context was far below the expected monthly visit, the CPNP session operation can be a facilitating factor to supplement the weakness of ENA activity. A probable interpretation may be that the interaction between the CPNP and the ENA activity could bring some synergy effect in improving mothers' better practices across various facets of feeding and hygiene, which might eventually lead to better child growth outcomes.

Receiving Plumpy'Nut indicated that the child was in a condition of severely acute malnutrition. There was no difference in receiving Plumpy'Nut between non-participants and the participants, although we had expected a lower proportion of receiving Plumpy'Nut among the CPNP participants. There was no information available regarding when the severely acute malnourished status was manifest, that is,

whether it was before or after the CPNP session participation. Further detail study is needed to examine the effect of CPNP on preventing severely malnourished cases.

Consequently, all the above results could give useful knowledge and influential understanding as to the mechanism of how the CPNP program led to positive feeding behaviors and improved nutritional outcomes at the community level.

To date, only a few process evaluation studies are available for complementary feeding trials based on BCC strategies, demonstrating the adequacy and feasibility of these interventions (21-23, 25, 36). In these study, mixed methods involving quantitative and qualitative methods were used, and data collection was simultaneously carried out in control and intervention groups.

A PIP analysis for the Alive & Thrive (A&T) BCC intervention in Bangladesh, which attempted to improve infant and young child feeding (IYCF) practices, described the capacity of the implementation staff and the extent of fidelity to the intervention; facilitating factors such as family support and barriers including lack of resource were described (25). The A&T social franchise model attempted to improve infant and young child feeding (IYCF) practices in Vietnam and indicated its effective management of the franchise system and challenges in service utilization (36). In a cluster randomized trial for complementary feeding in Peru—where health personnel delivered a multicomponent intervention as part of usual care in government health centers—various process indicators were assessed such as the extent of delivery dose and fidelity to intervention protocol, barriers to implementation and context; the indicators quantified the extent of program implementation and the quality, and demonstrated additional benefits to existing government programs by the intended interventions (37). In the same context, the study team conducted a pathway analysis and found significant determinants to the

improvement outcomes such as health center implementation, caregiver exposure, and caregiver message recall (21). Using a PIP analysis based on program theory framework, the Homestead Food Production Program in Cambodia showed that program components delivered as planned and utilized, and identified program gaps in the pathway to reduce program impact and, based on the process results, suggested increasing some intervention components to improve the impact (38).

Given the government-driven health system structure for primary health care in Ethiopia, this research findings could be evidence on how the CPNP program could strengthen or facilitate existing government health programs. Additionally, it will be worthwhile to consider how to graft components of the CPNP program onto the existing health programs, including the ENA activity and CMAM program. As such examples, we suggest referring children who recovered from severe malnourished status to the CPNP program or granting CPNP participants a facilitating responsibility in ENA activities with incentives or support from HEWs.

A distinctive feature of this process evaluation study was the utilization of various data sources, such as program attendance records and the checklists generated from the project team, a household survey and its nested recall survey conducted by the research team. Inter-comparison with these data resources enabled in-depth understanding of multifaceted aspects of intervention implementation while saving on the additional cost of collecting and processing these data.

In the process of conducting this study, it was a challenge to catch changes in intervention modalities on a timely basis such as ENA activity, and its assessment methods had to be adjusted promptly. The programs had to be modified in line with government policy, implementing NGO's capacity, and community own events or desires for interventions. Constant communication and meetings between the project

team and the study investigators were necessary for mid-course corrections in the questionnaires to be used and data collection management. Additionally, it would be beneficial for this quantitative process evaluation to be complemented with qualitative description, which could better explain the program context such as facilitating and impeding factors.

This study has a few limitations. First, we had no information for the level of knowledge, capacity, and activity of HEWs/community volunteers in the study area due to logistical limitations, but it might confound the effect of the CPNP program on feeding and hygiene of the study subjects. Second, indicators in the session checklists might be biased to better performance outcomes since the project team prepared these forms. However, since most indicators were straightforward, the conclusion that sessions were adequately prepared and smoothly operated could still be supported. Third, a question could arise as to whether this low percentage would represent program acceptance of all participants and message recall. The total of 197 mothers to be included in the recall survey was 6.0% of the 3,299 mothers who attended the nutrition sessions.

Conclusion

In conclusion, the PIP analysis applying process evaluation at key program stages indicated that the CPNP was successfully implemented, adequately accepted in this context, and positively influenced service delivery of the existing ENA program. Future application of these research findings and evaluation procedures will help the Ethiopian government and development NGOs design appropriate and contextualized strategies for scaling up nutrition programs.

Figure 6.1 Conceptual program impact pathway (PIP) of program activities, proximal outcomes, and impact outcomes of community-based participatory nutrition promotion (CPNP), Habro and Melka Bello districts, Ethiopia

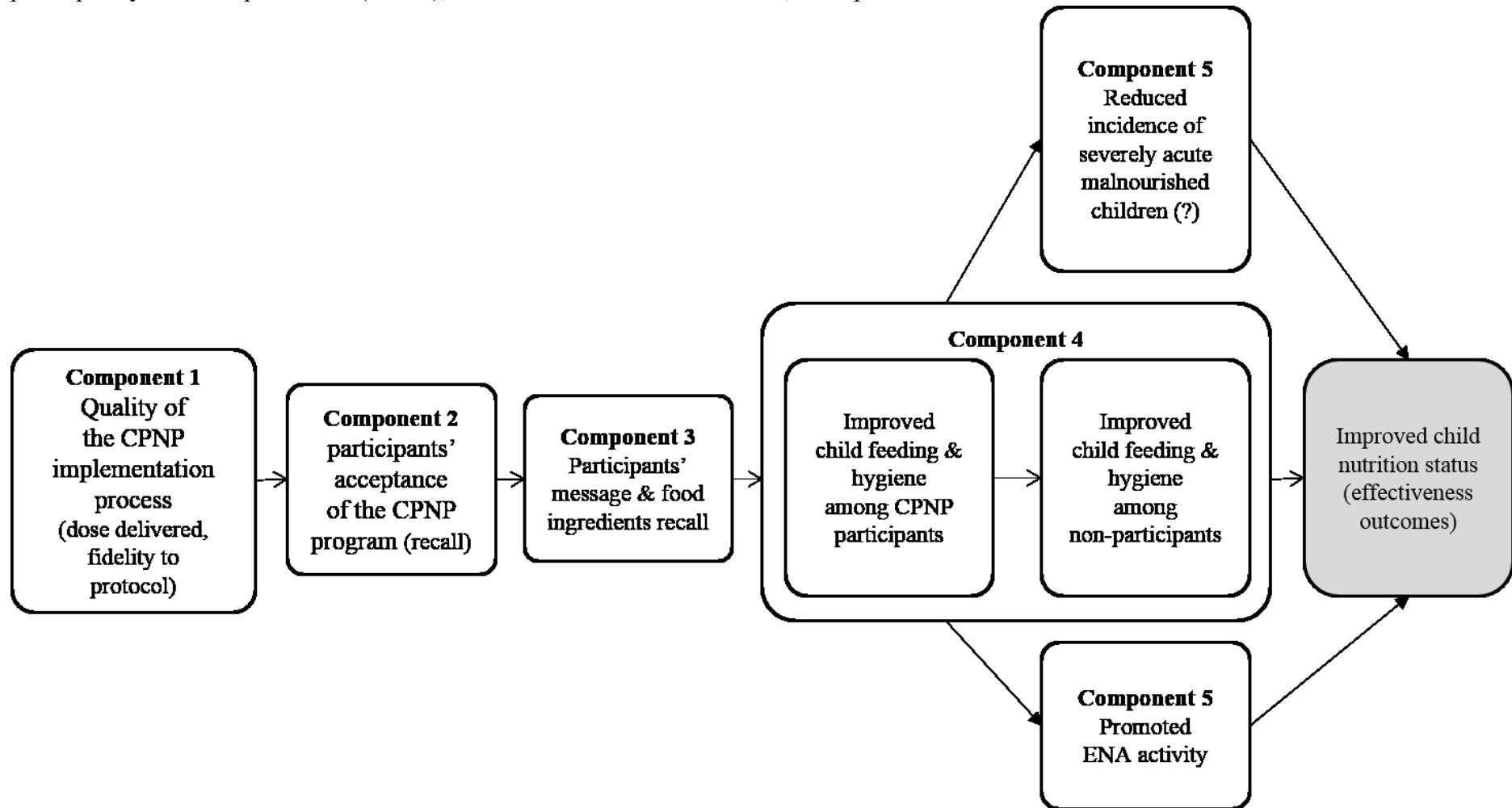


Table 6.1 Summary of data collection methods and main outcomes by evaluation component of community-based participatory nutrition promotion (CPNP), Habro and Melk Bello area, Ethiopia (2012 to 2014)¹

Evaluation components	Methods	Main outcomes	Study group	Frequency
C1. Quality of CPNP implementation process	Records review of attendance book;	<u>% dose delivered & dose received</u> % number of session and participants of expected <u>% fidelity to intervention protocol</u> e.g., % children 6 to 24 months of age on admission e.g., % weight gain of >200g at 12th days of session	I: 3,299 participants in 6 clusters in the intervention area	For 13 months
	Records review of observation checklists	<u>Fidelity scores to intervention protocol</u> Scores for the degree of preparedness of session, support from community, and session activities such as hand washing, food preparation, child feeding, and discussion)	I: 114 sessions in the intervention area	For 6 months
C2. Participants' program acceptance	Survey (recall)	Scores of active participation in session activities, material contribution, and perception to the session	I: 197 CPNP participants ²	At visit2
C3. Participants' message recall	Survey (recall)	Scores of CPNP messages and food ingredients recalls	I: 197 CPNP participants	At visit2
C4: Child feeding and hygiene and child growth	Survey	% of infant and young child feeding (IYCF) indicators	C: 914 mothers	Visit1 to visit5
	Spot check observation	% of hygiene practices (hand washing and cleanliness)	I: 876 mothers	Every three months apart
C5. Influence on exposure to other programs	Survey	% receiving ENA counseling in the past three months	C: 914 mothers	Visit1 to visit5
		% receiving Plumpy'Nut ³ in the past three months	I: 876 mothers	Every three months apart

¹ CPNP: Community-based participatory nutrition promotion; ENA: Essential Nutrition Action; CMAM: community-based management of acute malnutrition program; I: intervention area; C: control area; C1 to C6: component 1 to component 6.

² Survey visits started from 4 four months after CPNP session started, continued every three month, a total five times (visit1 to visit5).

³ Plumpy’Nut was provided to severely acute malnourished children through community-based management of the acute malnutrition program (CMAM).

Table 6.2 Enrollment in Community-based Participatory Nutrition Education (CPNP) program by month at intervention area, Habro and Melka Bello districts, Ethiopia (N=3,299)

Program duration (month)	Monthly CPNP enrollment n (%)	Cumulative CPNP enrollment n (%)
1 st	208 (6.3)	208 (6.3)
2 nd	382 (11.6)	590 (17.9)
3 rd	348 (10.5)	938 (28.4)
4 th	255 (7.7)	1193 (36.2)
5 th	371 (11.2)	1564 (47.4)
6 th	385 (11.7)	1949 (59.1)
7 th	235 (7.1)	2184 (66.2)
8 th	241 (7.3)	2425 (73.5)
9 th	185 (5.6)	2610 (79.1)
10 th	258 (7.8)	2868 (86.9)
11 th	184 (5.6)	3052 (92.5)
12 th	151 (4.7)	3203 (97.1)
13 th	96 (2.9)	3299 (100)

All information were excerpted from EINP program monitoring report (World Vision).

¹Population projection in 2012 estimated from 2007 Ethiopia Population Census. Proportion of children <2 was estimated as 5.71%.

²CPNP program started August 2012 and ended August 2013.

Table 6.3 Community-based participatory nutrition promotion (CPNP) implementation process I: evaluated by percentage of dose delivered, dose received, and fidelity to protocols¹ in Habro and Melka Bello districts, Ethiopia (2012 to 2014)¹

	Intervention cluster No. ²						Total
	1	2	3	4	5	6	
Dose delivered							
Expected number of sessions	60	120	100	40	60	80	460
Number (%) of completed sessions	49 (81.7)	90 (75.0)	80 (80.0)	34 (85.0)	52 (86.7)	67 (83.8)	372 (80.9)
Dose received³							
Expected number of participants	600	1200	1000	400	600	800	4600
Number (%) who attended CPNP sessions*	374 (62.3)	840 (70.0)	656 (65.6)	325 (81.3)	496 (82.7)	608 (76.0)	3299 (71.7)
Fidelity							
Sessions having 7 to 12 participants (%)*	79.1	94.1	81.6	93.9	100.0	99.0	91.7
Underweight children at admission (%)*	28.7	37.9	33.6	22.4	19.2	26.3	29.5
Children 6 to 24 months of age (%)*	96.2	92.6	94.1	99.7	97.2	99.3	95.9
Children with more than 200g weight gain after 2 weeks session (%)*	79.7	77.7	72.6	54.5	48.0	64.8	67.8
Participants attended 10-12 days (%)*	94.1	93.7	84.7	93.2	92.5	85.7	90.3

¹All information were excerpted from EINP program monitoring report (World Vision); CPNP: Community-based participatory nutrition promotion.

²Out of 6 intervention clusters, clusters 1 to 3 are located at Habro district and clusters 4 to 6 are located at Melka Bello district.

³CPNP participants: those who ever attended sessions during the 13-month CPNP implementation period (August 2012 to August 2013).

*p<0.05; compared in six intervention clusters by chi-squared test.

Table 6.4 Community-based participatory nutrition promotion (CPNP) implementation process II: evaluated by indicators of fidelity to protocols using observation evaluation in Habro and Melka Bello districts, Ethiopia¹

Evaluation item (fidelity indicators) ²	Total (N = 114)
	mean ± SD
Drinking water is treated (boiled/chlorine/covered)	8.4 ± 5.1
Latrine available	9.6 ± 4.0
Cleanliness of session place	9.4 ± 2.6
Cleanliness of food utensils	9.9 ± 2.6
Hand washing is practiced by caregivers before feeding	11.5 ± 1.3
Hand washing is practiced by caregivers before food preparation	11.2 ± 1.8
Hand washing is practiced by children before feeding	10.5 ± 2.6
Food is prepared according to menu	11.5 ± 1.9
Size of portion served is age appropriate	9.8 ± 4.0
Key nutrition/health message discussed	10.6 ± 2.8
	n (%)
At least one day supported by Health Extension Workers	76 (66.7)
At least one day supported by community volunteers	66 (57.9)
Use of 7-8 food ingredients at 1 st visit	101 (88.6)
Use of 7-8 food ingredients at 2 nd visit	98 (86.0)
Use of 7-8 food ingredients at 3 rd visit	96 (84.2)

¹ All information was excerpted from observation evaluation records prepared regularly by 6 supervisors (World Vision) and analyzed for this study purpose; CPNP: Community-based participatory nutrition promotion; SD: standard deviation.

² each checklist item had a score range of 0 to 12 for three days evaluation.

Table 6.5 Participants' acceptance to the program: degree of participation and contribution, and perception among participants of community-based participatory nutrition education (CPNP) program, in Habro and Melka Bello districts, Ethiopia (2012 to 2014)¹

	Total (N = 197)
	n (%) or mean ± SD
I actively participated at session activity below (%)	
Food preparation	144 (73.1)
Singing	121 (62.1)
Hand washing	156 (79.2)
Discussion	132 (67.0)
Child feeding	132 (67.0)
No. of actively participating activity (mean ± SD)	3.5 ± 1.9
I contributed the below materials to the session (%)	
	(N = 187)
Cooking pots/utensils	85 (42.8)
Bowls/water pitchers/basins	53 (28.3)
Spoons/cups	43 (23.0)
Soap	26 (13.9)
Mats	13 (7.0)
Fuel/firewood	78 (41.7)
Foods	119 (61.0)
No. of contribution material (mean ± SD)	2.1 ± 1.6
Perception to the session (%)	
I was satisfied with the session	181 (91.9)
I put the CPNP lessons into practice confidently	158 (80.2)
² I felt CPNP practices was useful	183 (95.8)

¹ This analysis only included CPNP participants who attended session by visit 2; CPNP: Community-based participatory nutrition promotion; SD: standard deviation.

² N = 191

Table 6.6 Participants' recall for session messages and food ingredients to the community-based participatory nutrition promotion (CPNP) session in Habro and Melka Bello districts, Ethiopia (2012 to 2014)¹

	Total (N = 197)
	n (%) or mean ± SD
Recalled CPNP messages (%)	
Preparing nutritious complementary foods	174 (88.3)
Responsive (actively) feeding.	126 (64.0)
Age appropriate feeding	136 (69.0)
Drinking water from safe source	127 (64.5)
Cleanliness of House	128 (65.0)
Cleanliness of food utensils	121 (61.4)
Hand washing	134 (68.0)
Health seeking practice	61 (31.0)
No. of recalled messages (mean ± SD)	5.0 ± 2.0
Recalled CPNP food ingredients (%)	
Grains	169 (81.2)
Yellow-color vegetables	43 (21.8)
Green-leafy vegetables	66 (33.5)
Sweet potato/potato/yams	83 (42.1)
Fruits	28 (14.2)
Egg	37 (18.3)
Oil	115 (58.3)
Legumes	27 (13.7)
Milk	86 (41.8)
No. of recalled food ingredients (mean ± SD)	3.2 ± 1.8
Food ingredients in currently use (%)	
Grains	163 (83.6)
Yellow-color vegetables	28 (14.4)
Green-leafy vegetables	61 (31.3)
Sweet potato/potato/yams	73 (37.4)
Fruits	17 (8.7)
Eggs	37 (19.0)
Oil	124 (63.6)
Legumes	29 (14.9)
Milk	110 (56.4)
No. of food ingredients in currently use (mean ± SD)	3.3 ± 1.6

¹ Only participants who attended session by visit2 were included; CPNP: Community-based participatory nutrition promotion; SD: standard deviation

Table 6.7 Infant and young child feeding (IYCF) and hygiene practices among the study subjects in control area and intervention area, and subjects who participated CPNP session in the intervention area at first round of survey, Habro and Melka Bello districts, Ethiopia (2012 to 2014) (N = 1706)

	Control area ¹		Intervention area			
	N	n (%)	Non-CPNP		CPNP	
			N	n (%)	N	n
<u>Feeding</u>						
Continued breastfeeding (%)	869	867 (99.8)	695	693 (99.7)	141	141 (100)
² Minimum dietary diversity (%)	870	146 (16.8)	695	138 (19.9)	141	48 (34.0)*#
³ Minimum meal frequency (%)	869	743 (85.5)	694	683 (98.4)*	141	136 (96.5)*
<u>Hygiene</u>						
⁴ Mothers cleanliness (%)	865	126 (14.6)	692	166 (24.0)	140	56 (40.0)*#
⁴ Child cleanliness (%)	866	123 (14.2)	693	133 (19.2)	141	48 (34.0)*
⁵ Hand washing (%)	864	225 (26.0)	694	303 (43.7)*	140	50 (35.7)*

¹ Control: mothers enrolled from the control area; Non-CPNP: mothers enrolled from the intervention area but never attended CPNP session during survey visits; CPNP: mothers enrolled from the intervention area and ever attending CPNP session during survey visit.

² Minimum dietary diversity: proportion of children 6–24 months of age who receive foods from 4 or more food groups.

³ Minimum meal frequency: for breastfed and non-breastfed children 6 to 24 months of age who receive solid, semi-solid, or soft foods the minimum number of times or more.

⁴ Hand washing practice is assessed by asking whether or not mother washed their hands with soap and water at four critical time points, 1) after defecation, 2) after cleaning the child's bottom, 3) before preparing food, and 4) before feeding child.

⁵ Through spot-check hygiene observation, data collectors assessed how clean mother and child were for their hands, hair, clothes, and face.

*p<0.05 (when compared to control group), # p<0.05 (when compared to non-CPNP participants); p-values were calculated by logistic or multinomial regression accounting for 50 Kebeles clustering, mother and father education level, household head, household asset, household food insecurity, size of owned land, and district, compared to control area.

Table 6.8 Exposure to the Essential Nutrition Action (ENA) activity and Community-based Management of Acute Malnutrition (CMAM) program among surveyed mothers in control area, and non-CPNP participants and CPNP participants in the intervention area, in Habro and Melka Bello districts, Ethiopia (2012 to 2014)¹

	Control ²		Non-CPNP		CPNP	
	N ³	n (%)	N	n (%)	N	n (%)
CMAM program						
Ever received Plumpy'Nut ⁴ in the past three months (%)	3063	238 (7.8)	1903	41 (2.1)*#	1018	45 (4.4)*
ENA activity						
Ever received ENA counselling at least once a month in the past three months (%)	3222	485 (15.1)	2172	429 (19.8)*	892	288 (32.3)*#

¹ CPNP: Community-based participatory nutrition promotion; ENA: Essential Nutrition Action; CMAM: community-based management of acute malnutrition program

² Control: mothers enrolled from the control area; Non-CPNP: mothers enrolled from the intervention area but never attended CPNP session during survey visits; CPNP: mothers enrolled from the intervention area and ever attending CPNP session during survey visit.

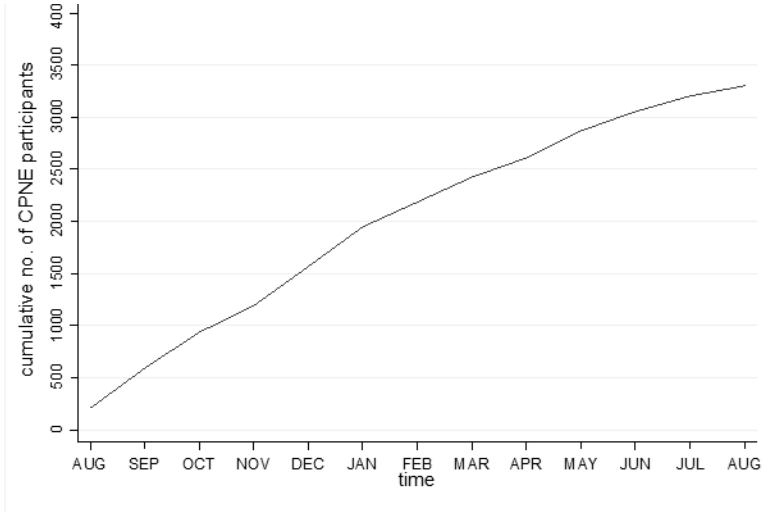
³ N was a total number of mothers surveyed across four visit; n was a total number of mothers exposed to the program of interest across four visits. (visit2 to visit5 for receiving Plumpy'Nut; visit1 to visit4 for the ENA activity exposure); each visit was put in place three months apart.

⁴ Plumpy'Nut was provided to treat severely acute malnourished children in health centers/health posts.

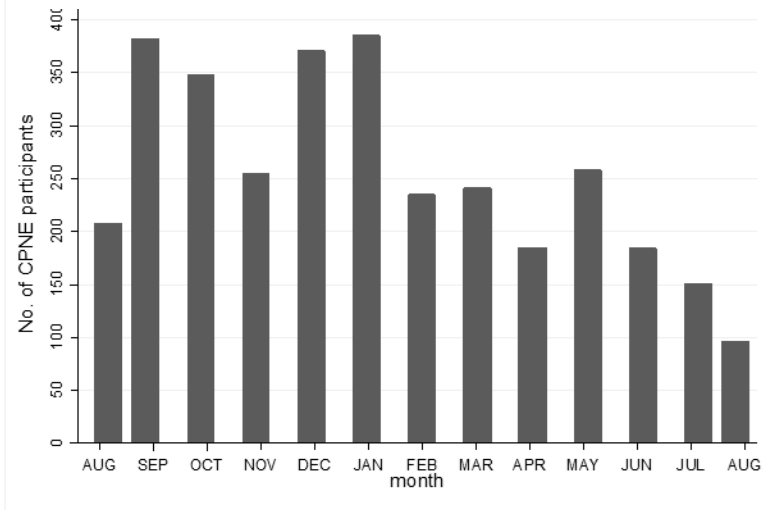
*p-values were calculated by two-sample test of proportions, comparison to control area.

Appendix 6.1 Periodical trend of participation of Community-based Participatory Nutrition Education (CPNP) program, EINP project, Habro and Melka Bello districts, Ethiopia (August 2012 to August 2013)

A. Cumulative number of CPNP participants for 13 months



B. Number of CPNP participants by month



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CHAPTER 7. DISCUSSION

Child undernutrition affects entire life stages and adversely affects next generations (1, 2). Out of the current nutrition strategies to address child undernutrition, enhancing complementary feeding by an educational approach based on behavior change communication (BCC) was recognized as effective intervention (3-5). Basically, in an extension of these BCC studies, we designed a community-based participatory nutrition promotion (CPNP) approach, which was added to the existing programs of Essential Nutrition Action (ENA) and Community-based Management of Acute Malnutrition (CMAM) in rural Ethiopia. The effectiveness of the CPNP to improve child nutritional status and child feeding and hygiene among caregivers was tested in a cluster randomized effectiveness trial. To better understand how implementation of CPNP led to the outcomes—such as child feeding and hygiene practices among caregivers and eventually child growth—we conducted a process evaluation using program impact pathway (PIP) analysis for major program components.

7.1 Summary of research findings

In the first paper (Chapter 4), we compared the length-for-age (LAZ), weight-for-age (WAZ), weight-for-length (WLZ) z scores and the risk of stunting, underweight, and wasting among children 6 to 24 months of age in the intervention area, compared to children in the control area. In a randomized cluster trial, 1,790 child 6 to 12 months of age and their mothers were enrolled, 914 in the control area and 876 in the intervention area. We found that in multi-level mixed-effect regression models based on longitudinal data controlling for clustering effects, children in the intervention area had a significantly

greater LAZ/month of 0.021 (95% CI: 0.008, 0.034), WAZ/month of 0.015 (95% CI: 0.003, 0.026), length/month of 0.059 cm; (95% CI: 0.027, 0.092), and weight/month of 0.031 kg (95% CI: 0.019, 0.042) compared to children in the control area. There was no difference in the recurrent incidence of stunting, underweight, and wasting between groups. Prevalence of stunting was lower in the intervention area by 7.5% ($p = 0.037$) at 9 month follow-up and by 7.3% at 12 month of follow-up (latter was not significant). Findings from this study were consistent with previous complementary feeding trials (4-6). This novel community participatory nutrition promotion program appeared to be effective in improving child growth in the rural Ethiopian context.

In the second paper (Chapter 5), we compared scores of current breastfeeding, meal frequency, dietary diversity, two types of composite feeding, and hand washing over a year follow-up (1) between mothers in the intervention area vs. mothers in the control area or CPNP participants vs. non-participants in the intervention area. The composite feeding score 1 involved current breastfeeding, meal frequency, and dietary diversity, and the composite feeding score 2 involved meal frequency and dietary diversity only. We found that mothers in the intervention area showed higher scores of meal frequency (diff: 1.02, 95% CI: 0.33, 1.70), composite feeding1 (diff: 1.30, 95% CI: 0.41, 2.19) and composite feeding 2 (diff: 1.39, 95% CI: 0.48, 2.23) than mothers in the control area, but there were no differences in scores of current breastfeeding, dietary diversity, and hand washing between mothers in the two areas. None of the child feeding and hygiene scores were significantly different between non-participants and CPNP participants in the intervention area over the 12-months follow-up. We suggested that the program impact of CPNP was spread out in the intervention area. In summary, this new

community-based nutrition program model was effective in improving meal frequency and composite feeding practices in a rural Ethiopian context, as other similar complementary feeding trials successfully improved child feeding practices in underdeveloped settings (7-10).

In the third paper (Chapter6), we conducted a PIP analysis for the five main program components along the flow of the intervention pathway. Our results suggest that the CPNP program was adequately implemented and well-accepted among participants. Consequently, the improved feeding practices spread out beyond the community, giving the additional benefit of positively influencing the ongoing ENA program, and eventually resulting in improved child nutritional status. This new nutrition program approach appeared to be effective in improving child feeding and hygienic practices among caregivers and child growth in the rural Ethiopian context. This study contributed to implementation science, especially behavior change communication interventions to improve child feeding practices in other settings, as well as other similar nutrition trials and programs (11-14).

7.2 Strengths and limitations

Strengths of the study were to use a cluster randomized effectiveness study design and prospective data collection for 12-months follow-up for each child and mother on a large scale. We evaluated the performance outcomes in parallel with effectiveness outcomes. Process evaluation using a program impact pathways analysis helped understanding of impact achievement of the CPNP program on effectiveness outcomes.

There were a few limitations in this study. First, allocation of intervention to the

matched clusters was made randomly, but, by chance, imbalances were found in the enrollment characteristics at visit 1 between control and intervention areas—such as fathers’ education, household food insecurity, and type of nearest health facilities—in favor of the intervention area. These variables were included in our statistical models and adjusted. Second, this study had no true baseline because the first data collection was conducted four months after the CPNP sessions started within the communities. It was expected that the CPNP program had already impacted child nutritional status in the community; however, there were no significant differences in anthropometric measurement and indicators, and comparison for such indicators was mainly done by monthly rate comparisons. Third, the intervention allocation and data collection procedures were not blinded to subject mothers and interviewers by the nature of the intervention of the CPNP. Some mothers knew of the existence of the CPNP program in their community, but had no idea of the impact comparison purpose of this study. However, to help limit any bias, the data collection procedure was standardized, and enumerators were trained to keep unbiased attitudes toward all mothers. Fifth, there could be recall bias regarding behavioral questions. We did not observe the mothers’ behaviors of child feeding and hygiene but recorded their answers to our questions. Especially, hand washing practices were higher among non-CPNP participants in the intervention area, better than CPNP participants. It was likely that CPNP participants were more aware of their true behaviors. Data collectors were trained to keep neutral attitudes in doing their interviews regardless of type of study population and type of control or intervention area. Sixth, indicators in the session checklists might be biased to better performance outcomes since the project team prepared these forms; however, since most

indicators were straightforward, the conclusion that sessions were adequately prepared and smoothly operated could still be supported.

7.3 Future directions for research

Further research is needed to determine the sustainability of the CPNP program effects on child growth beyond 24 months of age in the Habro and Melka Bello districts, and the generalizability of the intervention needs to be assessed on a wider scale in similar communities in Ethiopia and other African countries.

Furthermore, research in the next phases of the CPNP will include the following: (1) developing a better informed and integrated community-based nutrition programming model; (2) scaling up the CPNP approach and applying it to other neighboring districts or other African countries where feasible and appropriate; (3) tracking the long-term effects of the current CPNP approach on a variety of health outcomes of children and caregivers, and (4) strengthening of the community health system and building up the community capacity to sustainably address child undernutrition.

7.4 Public health significance

The findings from this study have community and policy-level implications for several aspects of prevention and treatment of child undernutrition, and design and development of appropriate nutrition intervention in Ethiopia as well as in similar settings of Sub-Saharan African countries.

Future application of these research findings and evaluation procedures will help the Ethiopian government and development NGOs in Ethiopia design appropriate and

contextualized strategies for scaling up nutrition programs. World Vision Ethiopia may want to include the CPNP approach to the nutrition strategy of area development programs. Currently, a local health government in the Habro district, one of the study districts, decided to continue the CPNP program after the phase out of the Ethiopia Integrated Nutrition Project (EINP) by the World Vision team. Instead of hiring CPNP operators, the local health government trained community volunteers to operate CPNP group nutrition sessions in their community. This would be an example of how the CPNP approach was integrated into ongoing government nutrition programs. Furthermore, the study findings provide useful information to improve nutrition strategies to promote child feeding and caring practices for children under two years of age, particularly for the National Nutrition Program (NNP).

Lastly, there is a growing interest in process evaluation using systematic approaches for enhancing ongoing nutrition program results. Preferentially, lessons from this study need to be shared through various opportunities among the health communities of World Vision, especially regarding various methods and tools of effectiveness and process evaluation which were used in this study.

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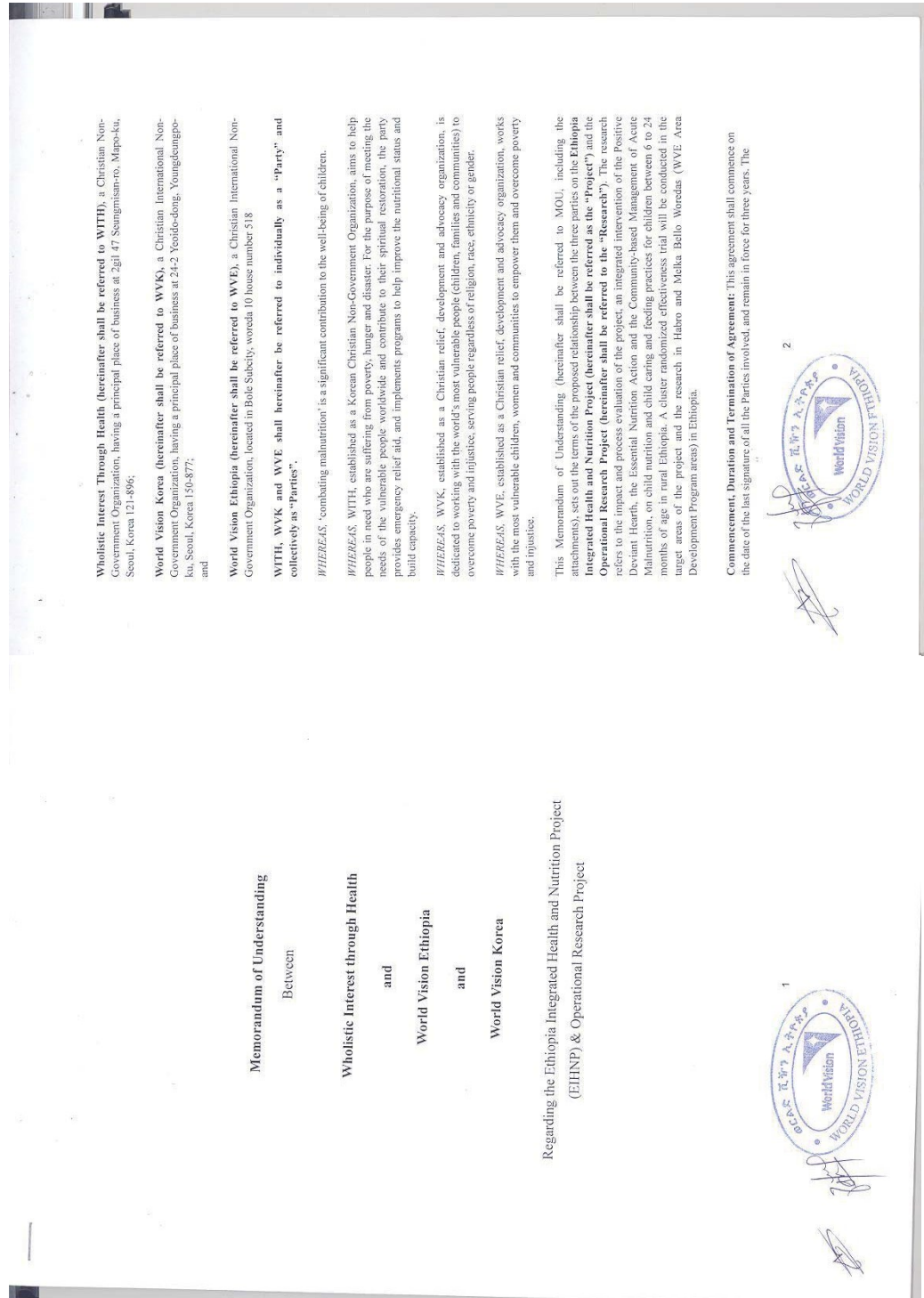
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13. Nguyen PH, Menon P, Keithly SC, Kim SS, Hajeerhoy N, Tran LM, et al. Program impact pathway analysis of a social franchise model shows potential to improve infant and young child feeding practices in Vietnam. *J Nutr*. 2014 Aug 20.

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APPENDIX

Appendix A. Memorandum of Understanding (MOU) for the present effectiveness trial of the Ethiopia Integrated Nutrition Project (EINP) among World Vision Korea, World Vision Ethiopia, and Wholistic Interest Through Health (WITH)



agreement may be amended by the parties only through mutual written consent. The agreement may be terminated by the parties, sixty (60) days after the date of receipt of a written notice of termination.

Attachments to this MOU: Project proposal and Research Project Proposal

INTRODUCTION

WHEREAS, the Parties share broad common interests in the achievement of shared goals, in particular the holistic development of communities by addressing nutritional issues in the developing communities. The Parties agree to upgrade the health and nutritional status of the vulnerable people through the Project.

Article 1 (PURPOSE)

The cooperation between and amongst the Parties provides an excellent opportunity to bolster each and every Party's effort to achieve the nutritional enhancement of the people and communities of our operational areas with a positive impact. In addition, the Parties intend to work towards the mutual efforts in broadening the evidence-based approaches in the field of humanitarian relief aid and development.

Article 2 (SCOPE OF UNDERSTANDING)

THEREFORE, the Parties hereby agree in this MOU as follows:

1. WVE and WVK shall assume responsibility for implementing the project in the field, which includes assessment, monitoring and evaluation, and shall report the accounting report, interim report and final report regularly to the KOCA according to the proposal schedule.
2. WVK will assign the Project Manager that will be based in the project operation area.
3. As a nutrition consulting body, WITH shall assist WVE and WVK to perform nutritional evaluation of the selected site, and provide recommendations on the implementation of the nutritional interventions, research and training of World Vision staff by deploying (a) nutrition specialist(s) in the field.
4. WITH shall collaborate with WVK and WVE in conducting the scientific research to achieve an evidence-based high quality result with regards to the reduction of malnutrition.
5. WVK and WVE will support WITH to build its capacity by having WITH involved in the collaborative work with WVE and its partners, including the Government of Ethiopia and other humanitarian NGOs if applicable.
6. Regarding the release of the project reports and any publications related to the research, the Parties shall inform amongst each other, in advance to obtain consent. The publication materials, upon agreement by the relevant Parties, should specify the contribution of all the respective Parties involved. The publication materials hereby mentioned refer to the project reports.

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research papers and any other forms of writing.

7. WVK and WITH shall jointly collaborate in exploring funding opportunities to finance the research activities.
8. The Parties are permitted to use all project documents for the internal and non-commercial use. Any one Party amongst WITH, WVK and WVE must seek a prior consent from the other two Parties if it wishes to publish any project documents, reports, materials or results, either as a complete or partial version. Such consent will not be unreasonably withheld. WITH, WVK, and WVE shall undertake to attribute the authorship and ownership of all the international intellectual property rights regarding such documents accordingly.
9. All three Parties shall notify each other through the attachment documents about their own dedicated section while executing the project and research.
10. To facilitate the project implementation WVE will:
 - 10.1 Provide the technical and administrative leadership for the project finance and properties;
 - 10.2 Facilitate access to office space at its compound at Habro and Meika Bello ADPs, provide similar office space at the WVE Headquarters during the visit of WITH and WVK staff in Addis Ababa;
 - 10.3 Facilitate the establishment of communication with Ministry of Health and regional health bureau;
 - 10.4 Assist in finding regular access to internet if shared internet access with the ADP is possible at the ADPs
 - 10.5 Support to set up data management system in ADPs for the research and Facilitate the delivery of electronic back-up data files (CDs) from the ADPs to Addis Ababa, for safe storage
 - 10.6 Facilitate the establishment of the contacts with the communities, local and regional administration and also in site selection for project and research
 - 10.7 Facilitate travel from ADP compound to research site & assist with travel arrangements between Addis Ababa and the ADPs
 - 10.8 Facilitate recruitment and hiring of the project staff and staff that will assist the research
 - 10.9 Manage, WVK and WITH staff in-country expenses (meal, accommodation, telephone, taxi rental and printing) during their stay in Ethiopia from the research project fund

Article 3 (PROJECTS OF COMMON INTERESTS)

Based on mutual exchange of resources that include information and personnel, Three Parties will

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decide upon a project of common interest, where collaboration can be established to pursue the achievement of common goal, holistic development of the site.

Article 4 (FUNDING ARRANGEMENT)

1. According to the budget approved by the KOICA, WVK will allocate the budget for implementing and executing the project based on the project proposal.
2. WVK will independently raise the project fund.
3. Although WVK and WITH will collaboratively raise the research fund, WVK will take responsibility for raising the total research budget.
4. WVE will assign staff who assist a manager assist by WVK and manage both the research and project fund at the field level.

Article 5 (CONFIDENTIALITY)

Confidential Information shall mean all written information disclosed hereunder, marked as confidential (including such information orally, electronically or visually disclosed which is promptly reduced to writing) by either Party (Disclosing Party). WVK, WITH, and WVE shall keep the Confidential Information confidential for the duration of five (5) years after receipt of the Confidential Information, and shall be allowed to use it for the sole purposes of this MOU. These obligations are not applicable to Confidential Information, which is:

1. rightfully in the public domain other than by a branch of a duty of the receiving Party;
2. rightfully received from a third party without any obligations of confidentiality;
3. rightfully known to the receiving party without any limitation on use or disclosure prior to its receipt from the Disclosing Party;
4. independently developed without use or reference to the other Party's Confidential Information; or required to be disclosed under the applicable laws or order of any governmental agency;
5. Each Party acknowledges that all Confidential Information (as defined above) disclosed by one Party to the other, whether existing before the commencement of this Agreement, or created during the term of this Agreement, is confidential and, subject to clause x, will be kept confidential and will not be disclosed to any third party without the prior written consent of the disclosing party. Such consent not to be unreasonably withheld.

Article 6 (ETHICAL ISSUES)

Investigators and participating organizations of three Parties are required to adhere to applicable ethical, regulatory and professional standards in all matters related to the project. Research activities will be subject to approval by local IRB Committee in Ethiopia Ministry of Health and ethical review



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committees.

Article 7 (PUBLICATION)

1. WVK have the ownership of raw data (hard copies of survey questionnaires and recording documents) collected through research and project, and WVK&WITH shall have access to those raw data. Three parties shall have the joint ownership and retain a full set of all electronically processed data which are available for analysis. Three parties shall have access to electronically processed data through the process agreed by all three parties.
2. WVK, WITH and WVE will establish the prescribed approval process concerning the utilization of the electronically processed data, in order to prohibit the unreasonable data use and publications against the original research purpose.
3. A person or group in WVK, WITH and WVE, who plan to make any research publications using the data collected from the EIHNP research, shall submit the prescribed abstract forms, indicating the study purpose, methods, expected results, and data to be needed et cetera in order to go through the approval process specified the above article number 6.
4. WVE & WVK acknowledges that WITH will require the results of the project and research, in whole or in part, to be included and published as part of the scientific study that will be conducted by the PHD student which is part of the research project team. The copyright in PHD thesis/project belongs to the student.
5. Each party is entitled to publish the results of the Project and Research provided that:
5.1 the publishing party has provided each non-publishing party with a copy of any proposed publication at least 6 calendar weeks before submission for publication; and
5.2 each other party has provided its written consent to such publication, such consent not to be unreasonably withheld.
5.3 The publishing party acknowledge the contribution of the other two parties and indicate their contribution to the publication

Article 8 (AUTHORSHIP & INVESTIGATORS)

The Parties acknowledge the contribution of those investigators stated on this research proposal to this research, and the authorship of publications which fits to the contribution of those investigators.

Article 9 (OBLIGATION)

The Parties agree and understand that, except for Confidential Article 5, Obligation Article 7, and Governing Law Article 11, this MOU shall not create or give rise to any legally binding obligations upon the Parties hereto in the absence of a separate definitive agreement.



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Article 10 (DISCLOSURE)
Any public disclosure including press release with respect to this MOU shall be subject to the mutual approval of the three Parties, which approval shall not be unreasonably withheld or delayed. The foregoing shall not apply to press releases of the existence and general nature of this MOU.

Article 11 (TERM)
This MOU becomes effective on the date of last signature and continues for the period of the project, which lasts for 3 years. It may be modified by mutual written consent of the Parties. The MOU may be terminated by either party upon a 60-day advance written notice to the other party.

Article 12 (NOTICES)
Any notices pertaining to or required by this MOU shall be in writing and signed by an authorized representative, and shall be delivered by hand or sent by certified mail (with return receipt requested), addressed to the Parties as shown in the signatory page below and shall be deemed to have been given or made as of the date received.

Article 13 (GOVERNING LAW)
This MOU shall be governed by and interpreted in accordance with the laws of the Republic of Korea & Ethiopia without recourse to any conflicts of law provisions that would result in the application of the substantive law of any other jurisdiction.

Article 14 (DISPUTE RESOLUTION)
All disputes arising out of or in connection with this MOU shall be finally settled by the arbitration administered under the Rules of Arbitration of the International Chamber of Commerce. Private international law (conflict of law) principles will be applied. The place of the arbitration shall be at East Africa Regional office of W.V. The arbitration award shall be final and binding upon the Parties hereto without appeal, and shall be enforceable by any court having jurisdiction over the Party against which the award has been rendered or wherever assets of the Party against which the award has been rendered are located. The arbitration shall be conducted in the language recommended by public international law. Nothing in this Article 11 shall prevent any Party from applying to a court that would otherwise have jurisdiction for interim or provisional measures, including but not limited to preliminary injunctive relief.

Each Parties sincerely execute the contents of the understanding memorandum according to faith and sincerity, in order to identify that this MOU is formed, each Parties need to draw up 2 copies of the form and seal registration, keep a copy each.

Article 15. NO LIABILITY

6-7-2012
Haramu Betezo
Legal Service Coordinator
6-17-2012
B. Gaddem Tesfayoh



The parties shall not be liable for any injury, death, damage or loss of property arising from the sub-grantee's performance or its obligations under this Agreement, save and except in the event such injury, death, damage or loss of property arises as a result of the negligence or willful misconduct of its employees, agents, volunteers, members, officers or directors.

Article 16 ATTACHMENTS
Project Proposal
Research Proposal

Acceptance
For World Vision Ethiopia
For Wholistic Interest Through Health

Name: Margaret Schully
Title: National Director

Date: July 9, 2012
Signature: Margaret Schully

Name: _____
Title: _____
Date: _____
Signature: _____

For World Vision Korea

Name: _____
Title: _____
Date: _____
Signature: _____

6-7-2012
Haramu Betezo
Legal Service Coordinator
6-17-2012
B. Gaddem Tesfayoh



Appendix B. Approval document of Ethiopia Integrated Nutrition Project (EINP) of World Vision Ethiopia by Oromia Regional Health Bureau, and the Regional Government of Oromia Bureau of Finance and Economic Development



**WORLD VISION ETHIOPIA
PROJECT DOCUMENT
FOR**

**INTEGRATED NUTRITION PROJECT IN HABRO
WOREDA OF WEST HARARGHE ZONE AND MELKA
BELLO WOREDA OF EAST HARARGHE ZONE OF
OROMIA NATIONAL REGIONAL STATE**



January, 2012

Addis Ababa, Ethiopia



VI
W
E

Project Profile

Project Title: Integrated nutrition Project

General objective of the project: - improved nutritional status of children under five.

Project Duration: 2 years (January 01, 2012- Dec 30, 2014)

Project Time Commencement: January 1, 2012

Area of Operation: Habro Woreda of West Hararghe Zone and Melka Bello woreda of east Hararghe Zone , Oromia National Regional State

Type and Number of beneficiaries:

Total Direct beneficiary: 77,072 under five children

Boys: 38,542

Girls: 38,530

Total Indirect beneficiaries: 30,000 mothers

Implementing Agency: World Vision Ethiopia

Donating Agencies: KOIKA (70% of the project)

World vision Korea (30% of the project)

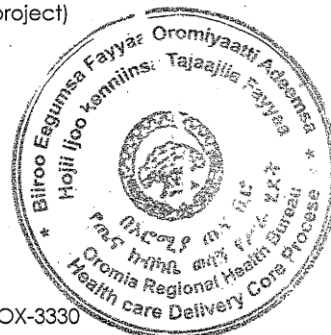
Total Budget in Eth. Birr: 18,394,000

Direct Project Cost: Eth. Birr 12,882,800(70%)

Administration Cost: Eth. Birr 5511200(30%)

Contact Person(s):

Lemma Debele
Tel.251-116-518222
Fax.251-116-293346, P.O.BOX-3330
E-mail: Lemma_Debela@wvi.org.



Appendix C.1 Informed consent (Afan Oromo)

Worliid Viizhin Itoophiyaa

Fi

Worliid Viizhin Kooriyaa fi Hoolistiik Intarast Siruu Heelz (WITH); Sewuul, Kooriyaa Kibbaa

Sanada Mirkaneessa Ramaddii Daa'immanii

Mata duree qorannoo: madaallin sagantaa qindoominaa adeemsa garaagarummaa poozatiivii/hearth, hojimaanni tarkaanfii soorata barbaachisaa fi sagantaa bulchiinsa hanqina sooramaa hawaasa irratti hundaaha haala sooramaa daa'immanii akkasumas bakkeewwan baadiyaa Itoophiyaa keessatti gochaalee soorataa fi kunuunsaa daa'immanii umrii ji'a 6 hanga ji'a 12 jirani; yaalii si'aayinaa kilaastarii guca hin taanee

Qorataan Dura bu'aa: Sisaay Sinaamoo

Lakk IRB: BERO / AHKTF/1-89/29021

Guyyaa: AUG 27, 2012

Seensa

Nagaan isiniif haa ta'u! ani kanan gaaffii gaafadhu Qindoomina Fayyaa Itoophiyaa fi Piroojektii Soorataa (EIHNP) keessatti qorannoo hojimaataa dhaabbilee World Viizhin Itoophiyaa, World Viizhin Kooriyaa fi WITH waliin gaggeeffamu ilaalchisuuni dha.

Kaayyoo qorannichaa

Qorannoo kana keessatti gochaaleen fayyaa fi sooramaa adda addaa guddinaa fi fedhii soorata daa'ima, kunuunsaa, qulqullinaa fi fayyaa irratti dhiibbaa qaban baruu feena. Tola ooltota hawaasummaa kanneen ta'an irraa ji'a ji'aan waa'ee soorata daa'imman umrii ji'a 6 hanga ji'a 12 qabaniif gorsi siif kennamaa jiraachuu ni mala. Hawaasni keessa jirtu waa'ee soorataa fi hojiiwwan dandammachuu irratti barnootaa fi leenjii qabaachuu dandeessa kunis sagantaa PD Hearth kan jedhamu yoo ta'u haadholeen waan naannoo isaanitti argaman irraa daa'imman isaaniif soorata kan irratti qopheessan yoo ta'u akkaatuma haala soorataa daa'ima kee irratti hundaahuun kun sagantaa CMAM ta'uu ni danda'a. eгаа ati kana muuxannoo isaa qabaachuu ykn dhiisuu ni dandeessa.

Kanaafuu amma waa'ee hojiiwwan soorataa kana ilaalchisee muuxannoo qabdu akka nutti himtu feena.

Qorannoon kunis waa'ee fooyyeffama soorata daa'immanii irratti waa'ee sagantaa kanaa ilaalchisee odeeffannoo bareedaa nuuf argamsiisa jennee abdanna.

Akka hirmaattu maaliif barbaadamaa:

Atii fi daa'imni kee waggaa tokkoof hordoffii itti fufinsaa taasisuun atii fi daa'imman kee umrii ji'a 6 hanga ji'a 12 qaban as bakka Worliid Viizhiniitti dhiyoo waan jiraattaniif kanuma irratti akka hirmaattan taasifama.

Adeemsota

Qorannoo kana irratti hirmaachuuf yoo murteessite, waggaa tokkoof ji'a sadi sadiin namni Worliid Viizhin irraa gaaffii si gaafatu hordoffii siif taasisuun daa'ima keef dheerina, ulfina, naannoo harka olii bal'ina qabaatu yeroo yerootti ni safarama.

Yeroo qorannoo jalqabaa irratti, gaaffileen waa'ee mana keessaa ilaallatan haala waliigalaan abbaan warraa/haati warraa eenyu akka tahe, waa'ee kee tiif waa'ee daa'ima kee, waa'ee haala hawaasummaa fi dinagdee keessanii, yeroo ulfaa kunuunsa taasifamu, fi hirmaannaan hawaasa keessatti qabdan kan ilaalamu dha.

Akkasumas beekumsi, yaadni, fi muuxannoon harma hoosisuu irratti qabdu, kunuunsi daa'immanii fi sooratni daa'immanii, qulqullinni fi itti fayyadamni buufata fayyaa, itti fayyadamni bishaanii, fi qulqullinaa, jireenyi nyaataa, dhukkubni daa'immanii tajaajila EIHN argachuu fi argachuu baachuun kee yeroo qorannoo jalqabaa irratti kan gaafataman yoo tahan yeroo hordoffii tokkoon tokkoo isaa walumaagalatti yeroo shaniif taasifama. Yeroo hordoffii tokkoon tokkoo isaanii xumuruuf hanga sa'atii tokkoo kan frudhatu dha. Yeroo daawwannaa xumuraa irratti hirmaannaan hawaasaa keessatti sirraa eegama.

Daawwannaa kana malee, daa'imni kee sagantaa PD Hearth irratti yoo hirmaate, gaaffii gaafataan yaada kee tiif hirmaannaa kana irratti ilaalchi ati qabdu maal akka tahe gaaffilee muraasa ni gaafatama.

Sodaawwan jiraachuu malanii fi mijuu dhabuu

Hojjaa fi ulfina daa'ima kee safaruun miidhaa tokkollee hin qabu. Gaaffileen si gaafannus gaaffilee odeeffannoo dimshaashaa ti. Garuu, yoo siif hin mijanne tahe gaaffilee kanneenif deebii kennuu ykn deebii kennuu dhiisuun murtee mataa keeti. Gaaffilee deebisuu hin feene kamiyyuu irra darbuu ni dandeessa. Ati waan irratti du bbachuu hin barbaadne tokko yeroon si gaafadhu, "lakki ani kana deebisuu hin fedhu" jettee deebisuu dandeessa. Anis gaaffilee kana dhiiseen irran tara.

Faayidaawwan

Qorannoo kana irratti hirmaachuun tajaajiloota EIHPN kennamuun alatti daa'ima keetiif bu'aan fayyaa dabalataa kennu hin jiru. Garuu, yeroo ammaa sagantaa kana kanneen hordofaa jiraniif hawaasaaf muuxannoon ati kennitu faayidaa qabeenssa waan taheef yeroo ammaa fi gara fuula duraafis waan faayidaa qabuuf kunis walumaagalatti fayyaa daa'immanii waan fooyyessuuf barbaachisaa dha. Qorannoo kana irratti hirmaachuun ykn hirmaachuu dhiisuuf murteessuun kee sirrattis ta'e tajaajila fayyaa EIHPN irraa argattu irratti dhiibbaa tokkollee miidhaa tokkollee hin fidu.

Icciitii odeeffannoo eeguu

Qorannoo kana keessatti odeeffannoon sassaabamu hundinuu maqaan kee, maqaan daa'ima kee, hojjetoota waajjiraan icciitiin isaa kan eegamuu fi atis eenyummaan kee waan tokkollee si duraa waan tuqamuu miti. Kanaafis waraqaan eenyummaa siif kennuun hordofiin gaariin akka siif taasifamu godhama. Yeroo sassaabbii odeeffannoo dhimma gaaffii irratti murteen keetii ni eegama. Safariin fi qorannoon hundinuu kan gaggeeffamu bakka atii fi daa'imni keetiif mijataa ta'etti dha. Yoo ati hin feene odeeffannoo ati kennitu namni biraan kamiyyuu akka hin dhageenyee fi bira akka hin dhiyaanne taasisuu ni dandeenya.

Gatii baasii hirmaannaa qorannichaa

Qorannoo kana irratti hirmaachuuf baasiin ati kaffaltu tokkollee hin jiru. Daa'ima kee safaruuf akkasumas gaaffilee qorannichaa deebisuuf yeroo muraasa akka dabarsitu ni gaafatamta kunis tilmaamaan yeroon fudhatu sa'atii tokko hin caalu.

Fedha qabaachuu

Hirmaannaan qorannoo kanaa guutummaan guutuutti fedhii irratti kan hundaaha dha. Yeroo barbaaddetti gaaffii fi deebii kana irratti hirmaachuu addaan kutuu ni dandeessa. Yoo feetes qorannoo qaama biraa keessatti hirmaachuu ni dandeessa. Qorannoo kana irratti hirmaachuuf murteessuun kee sirrattis ta'e tajaajila fayyaa EIHPN irraa argattu irratti dhiibbaa tokkollee miidhaa tokkollee hin fidu.

Namoota si gargaaran

Qorannoo kana ilaalchisee gaaffilee ykn dhimma yoo qabaatte, dhimma ykn gaaffii kee qixaan abbaa taayitaa naannoo jirutti, hojjetoota hearth tiif akkasumas qorattootaaf (ykn qindeessaa dirreetiif) nama qorannoo kana gaggeessuuf Siisaay Sinaamoo tiif karaa sisay_sinamo@wvi.org, 251-911-51-0988, Lammaa Dabalaa karaa lemma_debela@wvi.org, fi Geediyoon Tafarraa W.Mikaa'eel karaa gedion_teferaw.michael@wvi.org dhiyeessuu ni dandeessa. Gara fuula duraattis gaaffii yoo qabaatte, Yunhee Kaang karaa yukang@jhsph.edu ykn lakkoofsa bilbilaa 1-443-255-3664 gaafadhu. Qorannoo kana irratti hirmaachuun waa'ee mirga kee ilaalchisee gaaffii ykn dhimma yoo qabaatte, Koree Naamusaa Biiroo Fayyaa Mootummaa Naannoo Oromiyaa gaafachuu ni dandeessa.

Gaaffii biraa qabdaa? (gaaffilee deebisuuf qophaawi)

Qorannoo kana irratti hirmaachuu ni feetaa? Yoo eeyyen jette, quba keetiin ykn mallatteessuun uunkaa kana kooppii lamaan guuti. Simannaa keetiif galatoomi.
(namni kun barreessuu fi dubbisuu yoo hin dandeenye jecha qorataa fayyadami)
Ani, mallattoon kook an armaan gadii jiru, hirmaataa/hirmaattuu kanaaf afaan dubbattuun adeemsa qorannoo kanaa, soda fi faayidaa qabu waliin haala gaariin ibseeffin jira.

Mallattoo gaafataa

Guyyaa

Qorannoo kana irratti hirmaachuuf yoo eeyyama qabaatte, quba bitaa guddaan bakka duwwaa armaan gadii irratti mallatteessuun fedhii kee agarsiisi.

Mallattoo ykn quba guddaa bitaa hirmaattuu

Guyyaa

Child ID

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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Mallattoo PI ykn bakka buutuu/bu'aa

Guyyaa

Appendix C.2 Informed consent (English)

Consent Form: Child Enrollment Consent Document

*World Vision Ethiopia
and
World Vision Korea and Wholistic Interest Through Health (WITH), Seoul, South Korea*

Child Enrollment Consent Document

Study Title: The evaluation of integrated program of Positive Deviant Hearth approach, Essential Nutrition Action interventions and Community based management of Acute Malnutrition program on child nutritional status and child caring and feeding practices in children 6 to 24 months of age in rural Ethiopia: a cluster randomized effectiveness trial

Principal Investigator: Sisay Sinamo

IRB#: BERO / AHKTF/1-89/29021

Date: AUG 27, 2012

Introduction:

Greetings! I am an interviewer of the operation research project of the Ethiopia Integrated Health and Nutrition Project (EIHNP), jointly implemented by World Vision Ethiopia, World Vision Korea, and WITH.

Purpose of the research:

In this research, we would like to see how various health and nutrition activities of the EIHNP will affect the growth of your child and your child feeding, caring, hygienic and health seeking practices.

You may have monthly nutrition counseling visit from a volunteer community health worker on child feeding practice 6 to 24 months of age. Your community may or may not have special nutrition program with nutrition education and rehabilitation session called PD Hearth where thin mothers will practice cooking with locally available foods children will be fed with the prepared foods or CMAM program according to your child nutritional status.

So we want to learn about your experience with those nutrition activities. We expect that this study will provide important information about the program for the nutrition improvement of children.

Why are you being asked to participate:

You and your child are asked to enroll a one-year study which involves a series of follow-ups, since your child is 6 months to 24 months old and your household is located in World Vision Area development program area.

Procedures:

If you decide to participate in this study, you will be followed up every three months for one year by an interviewer from World Vision, and he/she will measure the height, weight, and mid-upper arm circumference of your child.

At the beginning of the study, questions regarding general characteristics of your household including basic information about the household head, you and your child, household social economic status, your care during pregnancy, and community participation will be asked.

Also your knowledge, opinion, and experience about breastfeeding, child caring and feeding practices, sanitation and hygiene practices, whether to use health facility, water use and sanitation facility, food availability, child illness and whether to get the EIHNP services will also be asked at the beginning of the study and at each follow-up, a total of five times. Each follow-up interview will

take about one hour to finish. Your participation in the community will be asked once during final visit.

Apart from this follow up, if your child participates PD Hearth session, an interviewer will ask about your thought and attitude towards session participation with a few questions.

Possible Risks and discomforts:

Measuring weight and height of your child is safe. The questions we will ask you are about general information. However, if feel uncomfortable, you can decide whether you want to respond to the questions or not. You can skip any questions which you don't want to reply. If I ask you about something which you don't want to talk about, you can say just 'no, I don't' want to reply' . Then I will skip the question for you.

Benefits:

From participating in this study, there will be no health benefits to your child additional to the services that the EIHN program provides. However, your experiences and views will be useful for people in this community who are engaged in programs now and in the future for improving the health of children. Your participation or refusal to this study will not cause any further effects on you or health service you receive from the EIHN program.

Protecting data confidentiality:

All information gathered in this study including your name and your child(ren)'s name(s), will be kept confidentially by the study staff so that your privacy will be completely respected. Instead, an ID will be assigned to you to follow you up appropriately.

Protecting subject privacy during data collection:

All measurements and administration of survey questions will be taken place in a location you and your child feel comfortable. No one will be allowed to listen in or be told about the information you provide if you do not wish.

Cost of participation in the study:

Your participation in this study is free of cost. You will be asked to spend your time for measuring your child and answering the survey questions, which will take approximately one hour.

Voluntariness:

Participation in this study is completely voluntary. You can stop participating in the study at any point if you want to. You can also participate in the part of the study if you wish. Your decision on the participation in this study will not affect the provision of the EIHN services you can receive.

Persons to contact:

If you have questions or problems regarding this study, you can directly address your concerns to the local authority, health workers and to the researchers (or field coordinator) conducting this study at Sisay Sinamo Sisay_Sinamo@wvi.org, 251-911-51-0988 Lemma Debela at Lemma_Debela@wvi.org, and Gedion Tefera W.Michael at Gedion_TeferaW.Michael@wvi.org. If you have questions later, you may contact Yunhee Kang at yukang@jhsph.edu or at 1-443-255-3664. If you have any questions or concerns regarding your rights as a participant in this study, you may contact the Ethical Review Committee at Oromya Regional Health Bureau (ORHB).

Do you have any questions?
(Offer to answer questions)

Do you agree to participate in this study? If so, please sign or print your thumb in the following statement in the two copies of this form. Thank you for your cooperation

(If the subject is unable to read and write, use Investigator's statement)

I, the undersigned, have explained to the volunteer in a language she understands the procedures to be followed in the study and the risks and benefits involved.

Interviewer's signature

Date

If you agree to participate in my study, please indicate that by putting your signature or your left thumb impression at the specified space below

Signature or left thumb impression of subject
(Participation)

Date

Signature of the PI or his/her representative

Date

Appendix D. Questionnaires for effectiveness trial (English version)

EIHNP Operational Research_Impact evaluation module 1

EIHNP Operational Research Child Enrollment form

CE101 Research cluster & Kebelle number

CE102 Village Number

CE103 Child ID - -

CE104 Child name _____
(If the child name is not correct, please write down his/her accurate name here _____)

CE105 Mother name _____
(If the mother name is not correct, please write down her accurate name here _____)

CE106 Interviewer number

CE107 Times of visit (01-05)

CE108. Date of interview (DD-MM-YY) _____ - _____ - _____
(Using international calendar)

Time interview commenced (00:00)_____

Time interview ended.(00:00)_____

Please complete this part of the form

CE109. Form Status: 1=Form completed
2=Form incomplete
6=Refused interview
7=Permanently moved
8=Child OR mother died

→ **STOP interview**

=====
Data entry persons: Name _____ **Date** _____ - _____ - _____

Anthropometric measurement

	Child birth date	Ethiopian date (MM/DD/YY)	International date (MM/DD/YY)
AM101	Child birth date	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
AM102	Child SEX	1=Male 2=Female	CODE:
	Anthropometric measurement	1st measurement	2nd measurement
AM103	Child MUAC (cm)**	<input type="text"/> <input type="text"/> · <input type="text"/>	<input type="text"/> <input type="text"/> · <input type="text"/>
AM104	Child Weight (kg)	<input type="text"/> <input type="text"/> · <input type="text"/>	N/A
AM105	Child Height (cm)	<input type="text"/> <input type="text"/> · <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/>
Mother's anthropometric measurement (Record only at 3 month of follow up visit)			
AM106	Mother's weight (kg)	<input type="text"/> <input type="text"/> · <input type="text"/>	N/A
AM107	Mother's MUAC (cm)	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	N/A
AM108	Mother's Height (cm)	<input type="text"/> <input type="text"/> · <input type="text"/>	N/A
Ask if the child has any younger sibling. If he/she does, measure the younger sibling's age, sex, weight, MUAC, and height.			
Anthropometric measurement for a younger sibling			
AM109	Name:		Code
AM110	Sex	1=Male 2=Female	
AM111	Age	<input type="text"/> <input type="text"/> Month of age	
AM112	Child MUAC (cm)	<input type="text"/> <input type="text"/> · <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/>
AM113	Child Weight (kg)	<input type="text"/> <input type="text"/> · <input type="text"/>	NA
AM114	Child Height (cm)	<input type="text"/> <input type="text"/> · <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/>

**** IF THE CHILD' MUAC IS LESS THAN 11 CM, PLEASE WITHIN TWO DAYS REFER THE CHILD TO HEW/VCHW IN THE KEBELLE IN ORDER FOR THE CHILD TO BE ENROLLED TO CMAM PROGRAM.**

Part I. Household characteristics

HC101. How many members live in your household?

A total of

--	--

Persons

SI #	HC102. Name of person	Hc103. Relationship to the child 1=Self 2=Mother 3=Father 4=Sister or brother 5=Sister or brother-in-law 6=Grandmother or grandfather (paternal) 7=Grandmother or grandfather (maternal) 8=Aunt or uncle (direct, paternal or maternal) 9=Cousins 10=Niece or nephew 11=Other relative 12=Non-biological mother/father (except 03 -10) 13=Not related	HC 104. Sex 1=Male 2=Female	HC105.Age 00-98=Number 99=Don't know Months (1) Years (2) e.g. 24(M) =24 months old 24(Y) =24 years old	HC 106. Marital Status 1=Married 2=Separated 3=Widowed 4=Single 5=Divorced 77=No answer /don't know 88=not applicable (e.g. age is less than 18 years old)	HC107. Literacy (Can read or write a letter in Oromifa or Amharic) 1=No 2=Yes 77= Don't know/ No answer 88= not applicable (e.g. pre-school aged children)	HC 108. Education (completed highest class of school) 1=No education 2=Primary (1 st to 4 th , 5 th to 8 th) 3=Secondary/High school (9 th up to 12 th) 4= Above high school 5=Others, specify: 77=No answer/don't know 88=not applicable (e.g. pre-school aged children)	HC 109. Occupation 1=Salaried employee 2=Mixed Farming 3=Livestock rearing 4=Self-employment/business owner 5=Civil servant 6=Casual laborer/ Factory worker 7=Handcraft 8=Student 9=Housewife 10=Unemployed 11=Others, specify: 77=No answer/don't know 88=not applicable (e.g. pre-school aged children)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

No	Questions	Response	Code
HC110	What is family's religion?	1=Muslim 2=Orthodox 3=Protestant 4=Catholic 5=Others ; specify _____ 77=No answer/ Don't know	
HC111	Are you an only wife to your husband currently?	1= Yes 2=No	
HC112	Who is this household head?	1=Biological father of the child 2=Biological mother of the child 3=Sister or brother 4=Sister or brother-in-law 5=Grandmother or grandfather (paternal) 6=Grandmother or grandfather (maternal) 7=Aunt or uncle (direct, paternal or maternal) 8=Cousins 9=Niece or nephew 10=Other relative 11=Non-biological mother/father (except 03 -10) 12=Not related	

Part 2. Household Economy HE			
No	Questions	Response	Code
HE101	What is the main source of that income/livelihood for your household?	1=Self-supporting farming 2=Laborer 3=Self employed 4=Exchange of own produce (farming, coffee, chat, cereals, etc) 5=Husbandry 6=Wage employment (working for someone else) 7=Other, specify: _____	
HE102	Do you have access to land for farming?	1=Yes 2=No=> Go to HE 104 77=Don't know	

HE103	What type of crops does your household cultivate for farming? Circle more than one	1=Maize 2=Sorghum 3=Barley 4=Wheat 5=Teff 6=Chat 7=Fruits (mango, banana, apple, etc.) 8=Vegetables (onion, cabbages, etc.) 9=Other, specify: _____	
HE104	What are three the main expenses in your household? (Check only three responses in order by highest expenses)	1=Food 2=Education 3=Health cost 4=Clothes 6=Chat 7=Other, specify: _____ 77=Don't know	
Now I would like to ask you a few questions about what things you or any member of the household own. (Name each asset one at a time..)			
HE105	Livestock	<i>Enter number owned, or approximate if the respondent is not sure</i>	Code
	HE1051. Chickens/ducks		
	HE1052. Goats/sheep		
	HE1053. Cows/ox/buffalo		
	HE1054. Horses/donkey/mule		
	HE1055. <i>additional relevant livestock assets e.g. camel)</i>		
HE106	Productive	<i>Enter number owned, or approximate if the respondent is not sure</i>	Code
	HE1061. Hoe/axe/machete		
	HE1062. Plough/fishing net		
	HE1063. Sewing machine/tools/equipment for income generation		
	HE1064. Land for farming (rented)	Temde	
	HE1065. Land for farming (owned)	Temde	
	HE1066. Tractor/boat		
	HE1067. <i>additional relevant productive asset type can be added here)</i>		
HE107	Transport (owned by the household)	<i>Enter number owned, or approximate if the respondent is not sure</i>	Code
	HE1071. Animal drawn cart		
	HE1072. Bicycle		
	HE1073. Motorcycle		
	HE1074. Car		
	HE1075. <i>(additional relevant transport type can be added here)</i>		
HE108	Household electric appliances	<i>Enter number owned, or approximate if the respondent is not sure</i>	Code
	HE1081. Radio		
	HE1082. Mobile Phone		

	HE1083. TV					
	HE1084. Refrigerator					
	HE1085. Satellite antenna/generator					
	HE1086. Kerosene lamp					
	HE1087. <i>(additional relevant asset can be added here)</i>					
HE109	Furniture	<i>Enter number owned, or approximate if the respondent is not sure</i>				
	HE1091. Bed					
	HE1092. Mattress					
	HE1093. Pillow					
	HE1094. Carpet					
	HE1095. Table/chair/wardrobe					
HE110	How long does it take from your household to the nearest market? 1 hour=60 minutes 1.5 hour=90 minutes 2 hour=120 minutes 2.5 hour=150 minutes	<table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="width: 30px; height: 20px;"></td> <td style="width: 30px; height: 20px;"></td> <td style="width: 30px; height: 20px;"></td> </tr> </table> Minutes 77=Don't know				
HE 111	What is the closest health facility to your house? (Choose only one)	1=Health post 2=Health center 3=Clinic 4=Hospital 5=Traditional medicine facility 6=Other, specify: __parmasii_____				
HE 112	How long does it take for you to get to the health facility? 1 hour=60 minutes 1.5 hour=90 minutes 2 hour=120 minutes 2.5 hour=150 minutes	<table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="width: 30px; height: 20px;"></td> <td style="width: 30px; height: 20px;"></td> <td style="width: 30px; height: 20px;"></td> </tr> </table> Minutes 77=Don't know				

Part 3 Status of Dwelling SD			
No	Questions	Response	Code
SD101.	What is the ownership status of the dwelling you are currently living in?	1=Own without title deed 2=Own with title deed 3=Rent from a landlord without a rental contract 4=Rent from a landlord with a rental contract 5=Rent from a government with a contract 6=Living with family members, relatives 7=Living with friends 8=Squatting on land 9=Living on ancestral land / legal claim to land (no title deed, but secure) 10=Other, specify:_____	

SD102.	What is type of roof of your house made of?	1=Grass 2=Corrugated iron 3=Plastic 4=Stone 5=Other, specify: _____	
SD103.	What is type of floor of your house made of?	1=Earth/mud 2=Smearred with cow dung 3=Cemented 4=Other, specify: _____	
SD 104	How many rooms/partition have the residence of household to live in?	# of rooms/partition <input type="text"/>	
SD105	Does the household have electricity?	1=Yes 2=No 77=Don't know	

Part III. Maternal Characteristics MC

This section is about experiences during the most recent pregnancy. "Name" is used to remind the interviewer to use the name of the youngest living child.

No	Questions	Response	Code
MC101	Did you see anyone for antenatal care during your pregnancy with (name)?	1=Yes 2=No=> Go to MC 104 77= Don't know /No Response	
MC102	Whom did you see? <i>Probe: Anyone else? Check all that apply.</i>	1=Doctor 2=Nurse/midwife 3=Traditional birth attendant (TBA) 4=Health extension worker (HEW) 5=Volunteer community health worker (VCHW) 6=Another type of health provider 77=Don't know/I can't remember/no response	
MC103	Did you receive any tetanus injection at any time before your pregnancy with (name), either to protect yourself or another baby?	1=Yes 2=No 77=Don't Know/I can't remember/no response	
MC104	When you were pregnant with (NAME), how did you eat than when you were not pregnant?	1=Less amount than when not pregnant 2=Same amount as not pregnant 3=More amount than when not pregnant 77=Don't Know/I can't remember	
MC105	During your last pregnancy, did you take any iron/folate supplements? <i>Please, show iron/folate tablets to</i>	1=Yes 2=No => Go to MC107 77=Don't know/no response	

	mothers		
MC106	During your last pregnancy, how many iron/folate tablets did you take ?	1=I received but I didn't take it 2=Less than 30 tablets 3=30 to 90 tablets 4=90 to 180 tablets 5=More than 180 tablets 77=Don't know//I can't remember /No response	
MC107	Where did you give birth to (name)?	1=At home 2=At another households (parents/friends) 3=Government hospital 4=Government clinic/health centre 5=Government health post 6=Private hospital 7=Private clinic 8=Private maternity home 9=Other, specify: _____	
MC108	Who assisted with the delivery of (name)?	1=Doctor 2=Nurse/midwife 3=Auxiliary midwife 4=Traditional birth attendant 5=Community health worker 6=Relative/friend 7=No one 8= Other, specify: _____ 77=Don't know/No response	
MC109	After you gave birth to (name), did you go to health facility for postnatal check?	1=Yes 2=No=> Go to MC 113	
MC110	Where did you visit?	1=Hospital 2= Health center 3=Health post 4=Hospital 5=Other, specify: _____ 77=Don't know/No response	
MC111	When did you visit after birth?	1=less than one week after birth 2=Less than one month after birth 3=Less than three month after birth 4=Other, specify: _____ 77=Don't know/No response	
MC112	Who checked on your health at that time? <i>If more than one, record the most qualified person</i>	1=Doctor 2=Nurse/Midwife 3=Auxiliary midwife 4=Traditional birth attendant 5=Community health worker 6=Relative/Friend 7=No one 8=Other, specify: _____ 77=Don't know/No response	

MC113	In the first two months after your last delivery, did you (mother) receive a VITAMIN A dose? Show Vitamin A supplement	1=Yes 2=No 77=Don't know/I don't remember	
MC114	Was the baby weighed at birth?	1=Yes 2=No => Go to Next section (K101) 77=Don't know/I don't remember	
MC115	What was weight of the child at birth?	<div style="display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; width: 40px; height: 25px; margin-right: 5px;"></div> <div style="border: 1px solid black; width: 40px; height: 25px; margin-right: 5px;"></div> <div style="margin-right: 5px;">.</div> <div style="border: 1px solid black; width: 40px; height: 25px;"></div> <div style="margin-left: 10px;">Kg</div> </div> 77=I can't remember	

Part I. Child feeding and hygiene practices

Section 4. Breastfeeding practice (Asking only in 0 time)			
No	Questions	Response	Code
P101	Have you ever breast-fed the child (name)?	1=Yes=> Go to P103 2=No	
P102	What is your reason for never breast feeding the child (name)? <i>Circle all responses</i>	1=Mother sick/weak 2=Child sick/weak 3=Breast disease 4=Not having enough breast milk 5=Breastmilk is not important to child 6=Other, specify: _____ 88=No answer	
P103	How long after birth did you first put the child (name) to the breast?	1=Within one hour 2=Within one day 3=After one day 77=I don't know/I cannot remember	
P104	Did you breast-feed the first milk (colostrums) to your child (name) or squeeze out and throw away?	1=Fed => Go to P108 2=Throw away	
P105	If you threw away the first milk, why did you do so? <i>Circle all responses</i>	1=Not good for the baby 2=Baby is thirsty 3=Baby cannot digest the first milk 4=It is yellow/thick 5=It is the tradition 6=Others, specify: _____ 77=I don't know/I cannot remember	
P106	If you didn't give the colostrums, what did you then feed the child (name)?	1=Plain water 2=Water & sugar 3=Cow's Milk	

	<i>Circle all responses</i>	4=Formula Milk 5=Butter 6=Other, specify: _____ 77=I don't know/I cannot remember	
P107	Why did you give anything other than BREAST MILK to the child (name)? <i>Circle all responses</i>	1=Baby is thirsty 2=More nutritious 3=It is the tradition 4=Encouraged by someone (e.g. husband or mother-in-law) 5=It is easier than breastfeeding 6=Other, specify: _____ 77=I don't know / I cannot remember	
P108	When do you usually breast feed the child (name)? (Read the response) <i>Circle all responses</i>	1=When the child (name) wants 2=When the child (name) cries 3=On schedule 4=When breast engorged 5=When the child (name) sleeps 6=When it is favorable 7=Other, specify: _____	
P109	For how many months did you feed the child (name) with breast milk only, without giving anyother type of food (Write it in months)	<input type="text"/> <input type="text"/> Months 77=I don't know 88=No answer	
P110	Are you still breastfeeding the child (name)?	1=Yes 2=No => Go to P113 88=No answer	
P111	How many times did you breastfeed the child (name), between sunrise yesterday and sunrise today? (If response is not numeric, probe for a numeric response) <i>ANYTIME THAT THE CHILD (name) HAD MILK THAT WAS NOT BREASTMILK (infant formula, tinned, powdered or animal milk) SHOULD NOT BE RECORDED HERE.</i>	<input type="text"/> <input type="text"/> times 77=I don't know 88=No answer	
P112	Up to what age do you intend to breastfeed the child (name)? (Write it in months)	<input type="text"/> <input type="text"/> Months	

	(After the Question 112, Go to Question 115)		
P113	Why did you stop breastfeeding for the child (name)? <i>Circle all responses</i>	1=Mother sick/weak 2=Child sick/weak 3=Breast nipple problem 4=Not enough milk 5=Mother return to work 6=Child refused 7>Weaning age/age to stop 8=Mother got pregnant 9=Mother started using contraceptives 10=Other, specify: _____ 88=No answer	
P114	What was the age of the child (name) when you stopped breast feeding?	<input type="text"/> <input type="text"/> Months 77=I don't know/ I cannot remember 88=No answer	
P115	When you were pregnant or in the period after delivery of the child (name) have you ever been informed /advised about breastfeeding?	1=Yes 2=No 88=No answer	
Section 5. Child feeding and caring practice			
No	Questions	Response	Code
P116	Do you give any other complementary food to the child (name) other than breast milk?	1=Yes 2=No=> Go to P124	
P117	At what age did you first introduce liquids or foods (semi-solid or solid) other than breast milk to the child (name)? (age in months)	<input type="text"/> <input type="text"/> Months 77=I don't know/I cannot remember	
P118	How many times did the child (name) have a meal over the past 24 hours, between sunrise yesterday and sunrise today?	<input type="text"/> <input type="text"/> Times 77=I don't know/I cannot remember	
P119	How many times did the child (name) have a snack over the past 24 hours, between sunrise yesterday and sunrise	<input type="text"/> <input type="text"/> Times	

	today?	77= I don't know/I cannot remember		
P120	I would like to ask you about the types of foods the child (name) has been fed over the past 24 hours, from sunrise yesterday to sunrise today.			
				Code
	FOOD GROUP	1=Yes	2=No	
P12001	Breast milk			
P12002	Water			
P12003	Formula			
P12004	Animal milk (e.g. cow milk)			
P12005	Honey			
P12006	Other liquids (e.g. sugar water, coffee, tea, broth, soft drinks)			
P12007	Any food made from grains (e.g. millet, sorghum, maize, rice, wheat, teff, ingera)			
P12008	Any food made from pumpkins, carrots, red sweet potatoes, mango, papaya			
P12009	Any green leafy vegetables?			
P12010	Any other fruits (bananas, tomatoes, apples, avocados)			
P12011	Any liver, kidney, heart or other organ meats			
P12012	Any meat (e.g. beef, lamb, goat, chicken or duck)			
P12013	Any food made from legumes or nuts (e.g. peas, beans, lentils, peanuts)			
P12014	Any food made with oil, fat or butter			
P12015	Eggs			
P12016	Fish			
P12017	Cheese or yoghurt			
P12018	Any sugary foods such as chocolates, sweets, candies, pastries, cakes or biscuits, sugary juice?			
P12019	Other(Specify): _____			
P121	What did you use to feed the child (name) mashed or fluid foods between sunrise yesterday and sunrise today? <i>Read responses</i>	1=Bottle nipple 2=Cup and Spoon 3=His/her own plate 4=Family plate 5=Other, specify: _____ 77=I don't know		

P122	According to you, at the time of preparing or feeding porridge, what foods can you add to make it more nutritious for the child (name)? (mark all)	1=Add colored fruits and vegetables 2=Add dark leafy vegetables 3=Add egg 4=Add lentils 5=Add fish or meat or liver 6=Add milk to porridge 7=Add a spoonful of oil 8=Give thicker porridge 9= Famix 77=I don't know	
Section 6. Hygiene practice			
No	Questions	Response	Code
P127	The last time the child (name) passed stools, what was done to dispose of the stools?	1=Child used toilet/latrine 2=Put/rinsed into toilet or Latrine 3=Put/rinsed into drain or ditch 4=Thrown into garbage (solid waste) 5=Buried 6=Left in the open field 7=Other, specify: 77= I don't know/I cannot remember	
P128	During the last 24 hours, did you wash your hands after you defecated? If yes, what did you wash your hands with?	1=Yes, washed hands with running water and soap 2=Yes, washed hands with running water and ash 3=Yes, washed hands with running water only 4=No, did not wash hands	
P129	During the last 24 hours, did you wash your hands after cleaning the child (name)'s bottom? If yes, what did you wash your hands with?	1=Yes, washed hands with running water and soap 2=Yes, washed hands with running water and ash 3=Yes, washed hands with running water only 4=No, did not wash hands	
P130	During the last 24 hours, did you wash your hands before preparing food? If yes, what did you wash your hands with?	1=Yes, washed hands with running water and soap 2=Yes, washed hands with running water and ash 3=Yes, washed hands with running water only 4=No, did not wash hands	

P131	During the last 24 hours, did you wash your hands before feeding children? If yes, what did you wash your hands with?	1=Yes, washed hands with running water and soap 2=Yes, washed hands with running water and ash 3=Yes, washed hands with running water only 4=No, did not wash hands	
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Part II. Exposure to intervention

No	Questions	Response	Code
Section 1. ENA counseling			
EC101	In the past three months, has a volunteer community health worker (VCHW) or Health Extension Worker (HEW) ever visited your household?	1=Yes 2=No => Go to section 2. PD Hearth (EC 116)	
EC102	How many times have you been visited by a VCHW or HEW in the last 3 months?	<input type="text"/> Times	
EC103	When you were visited in the last 3 months, has the VCHW or HEW weighed your children?	1=Yes 2=No 77=I don't know/I cannot remember	
EC104	When you were visited in the last 3 months, has the VCHW or HEW measured your child's Mid-Upper Arm Circumference (MUAC)?	1=Yes 2=No 77=I don't know/I cannot remember	
EC105	When you were visited in the last 3 months, has the VCHW or HEW given nutrition counseling on breastfeeding or complementary feeding or any nutrition related messages?	1=Yes 2=No => Go to EC114 77=I don't know/I cannot remember => Go to EC114	
EC106	What nutrition counseling messages can you remember? <i>Circle all responses</i>	Specify: _____ 77=I don't know/I cannot remember	
EC107	How much were you satisfied with nutrition counseling visit by volunteer community health workers (VCHWs) or HEW? <i>Read responses</i>	1=Strongly agree 2=Agree 3=Neither agree nor disagree 4=Disagree 5=Strongly disagree	
EC108	Why or why not were you satisfied/not satisfied with the nutrition counseling by VCHWs?	Specify _____	

EC109	How much was the nutrition counseling useful for you? <i>Read responses</i>	1=Strongly agree 2=Agree 3=Neither agree nor disagree 4=Disagree 5=Strongly disagree	
EC110	Why or why not was the nutrition counseling message useful to you?	Specify_____	
EC111	While you are counseled by a VCHW or HEW, did she use any counseling card/booklet?	1=Yes 2=No	
EC112	In the past three months, have you ever delivered or shared nutrition counseling messages to anyone?	1=Yes 2=No => Go to EC 114 77=I don't know/I cannot remember	
EC113	To whom did you share/deliver nutrition counseling messages that you've counseled?	1=Neighboring mothers in the same Kebele 2=Relatives living in the same Kebele 3=Religious members in the same Kebele 4=Community social group in the same Kebele 5=Friends living in the same village/Kebele 6=Relatives living in the different Kebele 7=Friends living in the different Kebele 8=Others, specify_____	
EC114	In the past three months, have you heard of similar nutrition messages from neighboring mothers other than VCHWs?	1=Yes 2=No => Go to Section 2 (EC 116) 77=I don't know	
EC115	Could you recall the nutrition message heard from the neighboring mothers specifically? <i>Circle all responses</i>	specify: _____ 77=I don't know/I cannot remember	
Section 2. PD Hearth session			
No	Questions	Response	Code
EC116	In the last three months, have you ever participated at PD Hearth?	1=Yes 2=No=> Go to EC 118	

EC117	<p>What kind of PD practices have you still kept practicing that you learned from the PD Hearth session?</p> <p><i>Circle all responses</i></p> <p>After asking this question, go to EC121</p>	<p>1=Preparing of nutrient dense complementary food 2=Responsive (active) feeding 3=Feeding times appropriate for child age 4=Drinking water from safe source 5=Water is treated (Boiled/chlorine/covered) 6=Cleanness of House 7=Cleanness of food utensils 8=Hand washing 9=Feeding during illness 10=Health seeking practice (e.g. asking health professionals, health facility visiting etc.) 11=Other, specify: _____</p>	
EC118	<p>In the past three months, have you ever met any mother/neighbors who ever participated at PD Hearth?</p>	<p>1=Yes 2=No => Go to EC 128 77=I don't know/I cannot remember</p>	
EC119	<p>What kind of nutrition information did you receive from the mother/neighbors who participated at PD Hearth?</p> <p><i>Circle all responses</i></p>	<p>1=Preparing of nutrient dense complementary food 2=Responsive (active) feeding 3=Feeding times appropriate for child age 4=Drinking water from safe source 5=Water is treated (Boiled/chlorine/covered) 6=Cleanness of House 7=Cleanness of food utensils 8=Hand washing 9=Feeding during illness 10=Health seeking practice (e.g. asking health professionals, health facility visiting) 11=Other, specify: _____</p>	
EC120	<p>What kind of practices have you kept practicing from the information that PD Hearth participating mothers/neighbors shared with you?</p> <p><i>Circle all responses</i></p>	<p>1=Preparing of nutrient dense complementary food 2=Responsive (active) feeding 3=Feeding times appropriate for child age 4=Drinking water from safe source 5=Water is treated (Boiled/chlorine/covered) 6=Cleanness of House 7=Cleanness of food utensils 8=Hand washing 9=Feeding during illness 10=Health seeking practice (e.g. asking health professionals, health facility visiting) 11=Other, specify: _____</p>	
EC121	<p>In the past three months, have you ever delivered or shared PD Hearth practices to anyone?</p>	<p>1=Yes 2=No => Go to EC 128</p>	

EC122	To whom did you share/deliver the information of PD Hearth practices?	1=Neighboring mothers in the same Kebele 2=Relatives living in the same Kebele 3=Religious members in the same Kebele 4=Community social group in the same Kebele 5=Friends living in the same village/Kebele 6=Relatives living in the different Kebele 7=Friends living in the different Kebele 8=Others, specify _____ 77=I don't know/I cannot remember	
EC123	What kind of PD Hearth practices did you deliver or shared with any other mother? (Multiple responses)	1=Preparing of nutrient dense complementary food 2=Responsive (active) feeding 3=Feeding times appropriate for child age 4=Drinking water from safe source 5=Water is treated (Boiled/chlorine/covered) 6=Cleanness of House 7=Cleanness of food utensils 8=Hand washing 9=Feeding during illness 10=Health seeking practice (e.g. asking health professionals, health facility visiting) 11=Other, specify: _____ 77=I don't know/I cannot remember	
EC124	Why did you deliver or share the PD Hearth messages with other mothers/relatives/friends?	Specify _____	
EC125	How much were you satisfied with the information related to PD Hearth practices? Read responses	1=Strongly agree 2=Agree 3=Neither agree nor disagree 4=Disagree 5=Strongly disagree	
EC126	Why or why not were you satisfied with the nutrition counseling?	Specify _____	
EC127	How much was the information related to PD Hearth practices useful to you?	1=Strongly agree 2=Agree 3=Neither agree nor disagree 4=Disagree 5=Strongly disagree	
Section 3. CMAM program			
EC128	In the past three months, has the child (name) been screened for their nutritional status using a MUAC tape by a VCHW or HEW?	1=Yes 2=No 77=I don't know/I cannot remember	

EC129	Did the child (name) have a ration card from the recent screening?	1=Yes 2=No => Go toFH101 77=I cannot remember	
EC130	How many times has your family (or you?) collected food rations from the time of the initial screening to the time of the recent screening?	1=Once 2=Twice 3=More than three times 77=I don't know	

Part IV. Food security and coping strategy

Section 1. Food security and hunger			
No	Questions	Response	Code
FH101	In the past four weeks, did you worry that your household would not have enough food?	1=Yes 2=No=>Go to FH103 77=I don't know=> Go to FH103	
FH102	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) 77=I don't know	
FH103	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?	1=Yes 2=No=>Go to FH105 77=I don't know=> Go to FH105	
FH104	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) 77=I don't know	
FH105	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	1=Yes 2=No=> Go to FH107 77=I don't know=> Go to FH107	
FH106	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) 77=I don't know	
FH107	In the past four weeks, did you 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?	1=Yes 2=No=> Go to FH109 77=I don't know => Go to FH109	
FH108	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) 77=I don't know	
FH109	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	1=Yes 2=No => Go to FH111 77=I don't know => Go to FH111	
FH110	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) 77=I don't know	
FH111	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	1=Yes 2=No=> Go to FH113 77=I don't know => Go to FH113	
FH112	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) 77=I don't know	
FH113	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?	1=Yes 2=No => Go to FH 115 77=I don't know => Go to FH 115	

FH114	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) 77=I don't know	
FH115	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	1=Yes 2=No⇒ Go to FH117 77=I don't know⇒ Go to FH117	
FH116	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) 77=I don't know	
FH117	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	1=Yes 2=No⇒ Go to section WS 101 77=I don't know⇒ Go to section WS 101	
FH118	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) 77=I don't know	

Part V. Water and sanitation (WATSAN)

No	Questions	Response	Code
WS101	What is the main source of drinking water in your house?	1=Public tap/standpipe 2=Tube well/borehole 3=Protected well 4=Unprotected well 5=Protected spring 6=Unprotected spring 7=Surface water (river, stream, dam, lake, pond, canal, irrigation channel) 8=Collected rain water 9=Other, specify: _____	
WS102	How long does it take you to go to collect drinking water, get water and come back? <i>If water source is piped into the house/yard/plot, record 00 minute</i> 1 hour = 60 minutes 1.5 hour = 90 minutes 2 hour = 120 minutes 2.5 hour = 150 minutes	<div style="display: flex; align-items: center; gap: 10px;"> <div style="border: 1px solid black; width: 30px; height: 30px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 30px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 30px; display: inline-block;"></div> Minutes </div> 77=I don't know	
WS103	How do you usually treat the drinking water?	1=Boil 2=Add bleach/chlorine/Wuha Agar 3=Strain it through a cloth 4=Use water filter 5=Let it stand and settle/sedimentation 6=Nothing 7=Other, specify: _____	
WS104	Which water collection instrument does your household use? Read responses	1=Jar Can/Bido 10L 2=Jar Can/Bido 20L (medium size) 3=Jar Can/Bido 25L 4=Traditional pot 9L (medium size) 5=Other, specify: _____	
WS105	In the past three months, with the water collection instrument above mentioned, how many times did you collect water in a day on average?	<div style="display: flex; align-items: center; gap: 10px;"> <div style="border: 1px solid black; width: 30px; height: 30px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 30px; display: inline-block;"></div> Times </div> 77=I don't know	
WS106	In the past three months, with the water collection instrument above mentioned how many water collection instruments did you use in a day on average?	<div style="display: flex; align-items: center; gap: 10px;"> <div style="border: 1px solid black; width: 30px; height: 30px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 30px; display: inline-block;"></div> Jars/Bidos/pots </div> 77=I don't know	

WS107	In the past three months, how many days did your household use less than half amount of water as usual?	<input type="text"/> <input type="text"/> Days	
WS108	What is the reason for using less amount of food than usual? <i>Circle all responses</i>	1=The amount of water reduced 2=The number of people using the water source increased 3=The water was contaminated 4=Other, specify: _____	
WS109	In the past three months, have you ever changed water source that you have used?	1=Yes 2=No ⇒ Go to WS111	
WS110	What is the reason for changing water source?	1=The amount of water reduced 2=The number of people using the water source increased 3=The water was contaminated (e.g. by animal stool) 4=Other, specify: _____	
WS111	What type of latrine do you use? <i>If possible, ask the caregiver to show the latrine the household uses</i>	1=Traditional pit latrine at home 2=Improved pit latrine at home (e.g. Ventilated Improved Pit (VIP)) 3=Non sanitary facility at home 4=Communal traditional pit latrine 5=Communal improved pit latrine (e.g. Ventilated Improved Pit (VIP)) 6=Communal non sanitary facility 7=Open field 8=Other, specify: _____ 77=I don't know	
WS112	How do you dispose of household waste or garbage (that cannot be recycled or re-used)?	1=Burn or bury 2=Into a pit for wastes/garbage 3=Throw away outside home 4=Informal dumping in landfill area identified by community or government (e.g. composting chat) 5=Other, specify: _____	

Part VI. Social capital (SC)–This part will be asked only at 0 and 12 months of follow up

No	Questions	Response	Code
SC101	In the last 12 months have you been an active member of any of the following types of groups in your community?	1=No 2=Work related/trade union 3=Community group 4=Women's group 5=Political group 6=Religious group 7=Funeral/credit group 8=Sports/social group 9=Other, specify: _____	

		77=I don't know	
SC102	In the last 12 months, did you receive from the following group any emotional help, economic help or assistance in helping you know or do things?	1=No 2=Family 3=Neighbors 4=Friends who are not neighbors 5=Community leaders 6=Religious leader 7=Politicians 8=Government officials/civil service 9=Charitable organizations/NGO 10=Other, specify: _____ 77=I don't know	
SC103	In the last 12 months, have you joined together with other community members to address a problem or common issue?	1=Yes 2=No	
SC104	In the last 12 months, have you talked with a local authority or governmental organization about problems in this community?	1=Yes 2=No	
SC105	In general, can the majority of people in this community be trusted?	1=Yes 2=No 77=I don't know	
SC106	Do the majority of people in this community generally get along with each other?	1=Yes 2=No 77=I don't know	
SC107	Do you feel as if you are really a part of this community?	1=Yes 2=No 77=I don't know	
SC108	Do you think that the majority of people in this community would try to take advantage of you if they got the chance?	1=Yes 2=No 77=I don't know	

PLEASE SAY TO MOTHER 'THANK YOU VERY MUCH!'

Section 2.PD Hearth session			
No	Questions	Response	Code
CP_101	Have you ever participated at PD Hearth?	1=Yes 2=No⇒Go to EC 118	
CP_102	When did you participate at PD Hearth? (mm/yy) -Please, record it in international date (Please, record it in international date and record the very recent participation date)	<input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/>	
CP_103	How many days did you attend the PD Hearth session? (00-12 days)	<input type="text"/> <input type="text"/> days	
CP_104	Why did you continue to participate at PD Hearth session?	Specify _____	
CP_105	What did you learn or practice at the PD Hearth session? <i>Circle all response</i>	1=Preparing of nutrient dense complementary food 2=Responsive (active) feeding 3=Feeding times appropriate for child age 4=Drinking water from safe source 5=Water is treated (Boiled/chlorine/covered) 6=Cleanness of House 7=Cleanness of food utensils 8=Hand washing 9=Feeding during illness 10=Health seeking practice (e.g. asking health professionals, health facility visiting) 11=Other, specify: _____	
CP_106	Did you actively participate at food preparation at the PD Hearth session?	1= I actively participate 2= I participate but not actively, somewhat 3= I didn't participate	
CP_107	Did you actively participate at singing PD song at the PD Hearth session??	1= I actively participate 2= I participate but not actively, somewhat 3= I didn't participate	
CP_108	Did you actively participate at the hand washing practice at the PD Hearth session??	1= I actively participate 2= I participate but not actively, somewhat 3= I didn't participate	
CP_109	Did you actively participate at nutrition message discussion at the PD Hearth session??	1= I actively participate 2= I participate but not actively, somewhat 3= I didn't participate	
CP_110	Did you actively participate at feeding your child at the PD Hearth session??	1= I actively participate 2= I participate but not actively, somewhat 3= I didn't participate	
CP_111	Have you ever contributed any foods or any items to PD Hearth session?	1=Yes 2=No => go to CP113	

CP_112	<p>What did you contribute to PD Hearth session?</p> <p><i>Circle all response</i></p>	<p>1=Cooking pots/cooking utensils 2=Bowls/water pitchers/basins 3=Spoons/cups 4=Soap 5=Mats 6=Fuel/firewoods 7=foods 8=others, specify _____</p>	
CP_113	<p>What food items were included in the menu prepared in PD Hearth session?</p> <p><i>Circle all response</i></p>	<p>1=Grains (e.g. sorghum, teff, wheat, rice, maize, millet, barley etc) 2=Yellow-color vegetables (pumpkin, carrot, tomato) 3=Green-leafy vegetables 4=sweet potato/potato/yams 5=Fruits 6=Egg or meat 7=Oil 8=Legumes (bean, chick pea etc) 9=Milk (e.g. cow or goat milk) 10=others, specify _____</p>	
CP_114	<p>How many days did you contribute to PD Hearth session?</p>	<p><input type="text"/> <input type="text"/> Days</p>	
CP_115	<p>How many days did PD supervisors/PD operators visit your households after the end of PD Hearth session?</p>	<p>1=No visit => Go to CP 117 2=1-2 visit 3=3-4 visit 4=5-6 visit 5=more than 7 days</p>	
CP_116	<p>What comments PD supervisor/PD operator give you during follow-up visit?</p>	<p>1=They didn't give any comments 2=Preparing of nutrient dense complementary food 3=Responsive (active) feeding 4=Feeding times appropriate for child age 5=Drinking water from safe source 6=Water is treated (Boiled/chlorine/covered) 7=Cleanness of House 8=Cleanness of food utensils 9=Hand washing 10=Feeding during illness 11=Health seeking practice (e.g. asking health professionals, health facility visiting) 12=Other, specify: _____</p>	
CP_117	<p>Do you prepare child foods as likely that you learned in PD Hearth?</p>	<p>1=Yes => Go to CP_118_1 2=No => Go to CP_118_2 3=I don't know/I can't remember</p>	

CP_118_1	<p>What food items did you include in your child foods, based on the lessons in the PD Hearth session?</p> <p><i>Circle all response</i></p>	<p>1=Grains (e.g. sorghum, teff, wheat, rice, maize, millet, barley etc) 2=Yellow-color vegetables (pumpkin, carrot, tomato) 3=Green-leafy vegetables 4=sweet potato/potato/yams 5=Fruites 6=Egg or meat 7=Oil 8=Legumes (bean, chick pea etc) 9=Milk (e.g. cow or goat milk) 10=others, specify _____</p>	
CP_118_2	<p>What food items did you include in your child foods?</p> <p><i>Circle all response</i></p>	<p>1=Grains (e.g. sorghum, teff, wheat, rice, maize, millet, barley etc) 2=Yellow-color vegetables (pumpkin, carrot, tomato) 3=Green-leafy vegetables 4=sweet potato/potato/yams 5=Fruites 6=Egg or meat 7=Oil 8=Legumes (bean, chick pea etc) 9=Milk (e.g. cow or goat milk) 10=others, specify _____</p>	
EC117	<p>What kind of PD practices have you still kept practicing that you learned from the PD Hearth session?</p> <p><i>Circle all responses</i></p>	<p>1=Preparing of nutrient dense complementary food 2=Responsive (active) feeding 3=Feeding times appropriate for child age 4=Drinking water from safe source 5=Water is treated(Boiled/chlorine/covered) 6=Cleanness of House 7=Cleanness of food utensils 8=Hand washing 9=Feeding during illness 10=Health seeking practice (e.g. asking health professionals, health facility visiting etc.) 11=Other, specify: _____</p>	
CP_119	<p>Can you confidently practice what you learned in PD Hearth?</p> <p><i>Read responses</i></p>	<p>1=Strongly agree that I confidently practice 2=Agree I confidently practice 3=Neither agree nor disagree I confidently practice 4=Disagree I confidently practice 5=Strongly disagree I confidently practice</p>	
CP_120	<p>How much were you satisfied with the information related to PD Hearth practices?</p> <p><i>Read responses</i></p>	<p>1=Strongly agree that I was satisfied 2=Agree that I was satisfied 3=Neither agree nor disagree that I was satisfied 4=Disagree that I was satisfied 5=Strongly disagree that I was satisfied</p>	

CP_121	Why or why not were you satisfied with the information related to PD Hearth practices?	Specify_____	
CP_122	How much was the information related to PD Hearth practices useful to you? <i>Read responses</i>	1=Strongly agree that it was useful 2=Agree that it was useful 3=Neither agree nor disagree that it was useful 4=Disagree that it was useful 5=Strongly disagree that it was useful	
CP_123	Why was the information related to PD Hearth useful to you? AFTER THIS QUESTION, PLEASE GO TO EC 121	Specify_____	
EC118	In the past three months, have you ever met any mother/neighbors who ever participated at PD Hearth?	1=Yes 2=No => Go to EC 131 77=I don't know/I cannot remember	
EC119	What kind of nutrition information did you receive from the mother/neighbors who participated at PD Hearth? <i>Circle all responses</i>	1=Preparing of nutrient dense complementary food 2=Responsive (active) feeding 3=Feeding times appropriate for child age 4=Drinking water from safe source 5=Water is treated (Boiled/chlorine/covered) 6=Cleanness of House 7=Cleanness of food utensils 8=Hand washing 9=Feeding during illness 10=Health seeking practice (e.g. asking health professionals, health facility visiting) 11=Other, specify:_____	
EC120	What kind of practices have you kept practicing from the information that PD Hearth participating mothers/neighbors shared with you? <i>Circle all responses</i>	1=Preparing of nutrient dense complementary food 2=Responsive (active) feeding 3=Feeding times appropriate for child age 4=Drinking water from safe source 5=Water is treated (Boiled/chlorine/covered) 6=Cleanness of House 7=Cleanness of food utensils 8=Hand washing 9=Feeding during illness 10=Health seeking practice (e.g. asking health professionals, health facility visiting) 11=Other, specify:_____	
EC121	In the past three months, have you ever delivered or shared PD Hearth practices to anyone?	1=Yes 2=No =>Go to EC 131	

EC122	To whom did you share/deliver the information of PD Hearth practices?	1=Neighboring mothers in the same Kebelle 2=Relatives living in the same Kebelle 3=Religious members in the same Kebelle 4=Community social group in the same Kebelle 5=Friends living in the same village/Kebelle 6=Relatives living in the different Kebelle 7=Friends living in the different Kebelle 8=Others, specify _____ 77=I don't know/I cannot remember	
EC123	What kind of PD Hearth practices did you deliver or shared with any other mother? (Multiple responses)	1=Preparing of nutrient dense complementary food 2=Responsive (active) feeding 3=Feeding times appropriate for child age 4=Drinking water from safe source 5=Water is treated (Boiled/chlorine/covered) 6=Cleanness of House 7=Cleanness of food utensils 8=Hand washing 9=Feeding during illness 10=Health seeking practice (e.g. asking health professionals, health facility visiting) 11=Other, specify: _____ 77=I don't know/I cannot remember	
Section 3. CMAM program			
EC131	In the last three month, did your child have Plumpy-Nut (Local name)?	1=Yes 2=No=> Go to EC134	
EC132	For how many days did your child receive Plumy-Nut (or stay at OTP program)?	<input type="text"/> <input type="text"/> s Days	
EC133	Was the Plumpy Nut for your malnourished child used for other siblings in your household?	1=Yes 2=No	
EC134	In the last three month, did your child have Famix (Corn soy blend) and oil?	1=Yes 2=No=> Go to SC108	
EC135	How many round did your child/mother (PLW) receive Famix and oil?	<input type="text"/> <input type="text"/> Round	

Appendix E.1 CPNP attendance book (English version)

Part I. Child registration

Part I. Child Registration (This table will be filled up by the PD Operator)

Name of Kebelle _____

Name of PD Supervisor _____

Name of Village _____

Name of PD Operator _____

Number of Hearth session _____

Hearth Session Dates: From _____ To _____

Name of Volunteer _____

	Name of Child	Mother's Name	Father's Name	Child's Sex (M/F)	Date of Birth (mm/dd/yyyy)	Age (months)	Vitamin A (Y/N)	Full Immunization (Y/N)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Part II. Monitoring of weight gain

This table will be filled up by volunteer community health worker, managed into two copies by VCHW and PD supervisor, and PD supervisor will have ultimate responsibility of the forms)

Name of Kebelle _____

Name of PD Supervisor _____

Name of Village _____

Name of PD Operator _____

Number of Hearth session _____

Hearth Session Dates: From _____ To _____

Name of Volunteer _____

	Name of Child	Day 1, Weight (Kg.g)	Day 12, Weight (Kg.g)	Day 12 – Day 1 (g)	1 month, Weight (Kg.g)	1month, Weight – Day 1(g)	3 month, Weight (Kg.g)	3 month – Day 1 (g)	6 month, Weight (Kg.g)	12month, Weight (Kg.g)
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Part III. Child attendance form (*This table will be filled up by PD Operator*)

Name of Kebelle _____

Name of PD Supervisor _____

Name of Village _____

Name of PD Operator _____

Number of Hearth session _____

Hearth Session Dates: From _____ To _____

Name of Volunteer _____

	Days of Hearth												A total days of attendance
	1	2	3	4	5	6	7	8	9	10	11	12	
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													

Appendix E.2 CPNP session observation checklists (English version)

PD Hearth_Supervision of Hearth session: module 8

Name of Kebelle _____

Name of PD Supervisor _____

Name of Village _____

Name of PD Operator _____

Number of Hearth session _____

Date _____

This form will be filled up by PD Supervisors

OBSERVATION LIST		Day #	Day #	Day #	Total
Answer with Yes (Y) or No (N) or Somewhat (S) or a number where appropriate. Add comments to explain answers.					
Location of Session:					
PD801	Water from safe source				
PD802	Drinking water is treated (Boiled/chlorine/covered)				
PD803	Latrine available				
PD804	Cleanliness of PD Hearth place				
PD805	Cleanliness of food utensils				
PD806	Session is conducted by PD operator				
PD807	Session is supported By Health Extension Workers				
PD808	Evidence of being supported by HEW				
PD809	Session is supported By Volunteer Community Health Workers (VCHWs)				
PD810	Evidence of being supported by Session is supported By VCHWs				
PD811	Number of caregivers attending				
PD812	Number of children attending				
PD813	Hand washing is practiced: By caregivers before feeding				
PD814	Hand washing is practiced: By caregivers before food preparation				
PD815	Hand washing is practiced: By children before feeding				
PD816	Number of caregivers who brought food items, oil, and firewood etc.				
PD817	Menu use based on local and affordable food				
PD818	Food is prepared according to menu				
PD819	List of food item	Day # _____ 1) _____ 2) _____ 3) _____ 4) _____ 5) _____ 6) _____ 7) _____ 8) _____	Day # _____ 1) _____ 2) _____ 3) _____ 4) _____ 5) _____ 6) _____ 7) _____ 8) _____	Day # _____ 1) _____ 2) _____ 3) _____ 4) _____ 5) _____ 6) _____ 7) _____ 8) _____	

	Number of caregivers present and actively participate:					
PD820	in food preparation					
PD821	In actively feeding their child					
PD822	in singing a song					
PD823	Size of portion served is age appropriate					
PD824	Number of children who are offered enough food					
PD825	Number of children who eat very well					
PD826	Number of children who do not eat foods (e.g. sick child)					
PD827	Key nutrition/health message discussed (Y/N)					
PD828	Describe the key message of session	Day # _____	Day # _____	Day # _____		
PD829	Caregivers express being motivated by changes in child (Please ask a few mothers, listen their reply, and check it)					
PD830	Caregivers can say what to do when child is sick (Please ask a few mothers, listen their reply, and check it)					

Appendix F.1 Institutional Review Board (IRB) approval document (original version)

BIIROO EEGUMSA FAYYAA
OROMIYAA



OROMIA HEALTH BUREAU
የኦሮሚያ ጤና ጥበቃ ቢሮ

Lakk/Ref. No. BFO/AH/1-29/2002
Guyyaa /Date 21/17/2004

Waajjira Eegumsa Fayyaa Harargee Bahaa tiif

Waaj/Eeg/F/Harargee Lixaa tiif

Harar

Ciroy

Dhimmi: Xalayaa deggersaa ilaala

Akkuma beekamu Biiron keenya ogeeyyii akkasumas namoota qorannoo geggeessuuf propoozaala dhiyeffataniif propoozaala isaanii ilaaludhaan waraqaa deggersaa ni kenna. Haaluma kanaan mata duree "The effectiveness of PD hearth in the context of CMAM & ENA interventions on child nutritional status and care givers' practices in children 6 to 12 months of age in Habro and Melka Bello districts, Oromia region, Eastern Ethiopia: a cluster randomized controlled trial" jedhamu irratti "World Vision Ethiopia" geggeessuuf propoozala dhiyeffataniiru. Kanaafuu, Koreen "Ethical committee" Biiron keenyaa ilaalee akka qorannoon kun hojii irra oolu murteesse jira. Waan kana ta'eef hojii qorannoo kana irratti deggersa barbaachisaa ta'e akka gootaniif jechaa dhaabanni kunis firii qorannoo kanaa kopii tokko Biiron Eegumsa Fayyaa Oromiyaatiif akka galii godhan galagalcha xalayaa kanaatiin isaan beeksifna.

Ani qorannoo kana kanan geggeessu Yunhee Kang firii qoranichaa kopi tokko BFEO tiif galii akka godhuuf mallattoo kootiin ni mirkaneessa.

Mallattoo
Maqaa Yunhee Kang
Guyyaa 21/17/2004
Lakk bilbilaa 0920579690



G/G

Yunhee Kang tiif

Waaj/Eeg/F/A/Habroo

Waaj/Eeg/f/A/Malkaa Balloo

Bakka Jiranitti

Nagaa wajjin

Dr Zalaalam Habtaamuu
IIA/Hogganaa Biiron fi Gaggeessaa
Adeemsa Hojii Ijoo Kenniinsa Tajaajila Fayyaa

Tessoo: Tel: +251-11-371-72-77, Fax: +251-11-371-72-27 P.O.Box.24341 E-mail: ohbhead@telecom.net.et
Address: ADDIS ABABA/FINFINNE-ETHIOPIA

Ethical Review Format

S.No	Criteria/Item	Comments/Rating
1	Title of the research	➤ The Effectivnes of PD Hearth approach in the Context of CMAM & ENA Interventions on Child Nutritional Status and Caregivers' practices in Children 6 to 12 Months of Age in Habro and Melka Belo Woreds, Oromia Region, Eastern Ethiopia: a Cluster Randomized Controlled Trial
2	Is the problem well justified?	Yes
3	Are the objectives of the study clearly stated?	Yes
Methods		
4	Study population	Described
5	Sample size calculation	shown
6	Sampling technique	mentioned Clearly
7	Competence of data collectors	➤ Competent
8	Analysis plan	Indicated, and clear
9	Dissemination plan	Indicated
10	Consent form	Available and Complete
11	Are there provisions to provide standard/best proven care?	Yes
12	Are there the procedures to keep confidentiality well descried?	YES; hard copies will be secured confidentially and the soft will be protected by pass word.
13	Are issues related to special population groups addressed?(PLWHA, Children, Pregnant women, prisoners, etc...)	Yes
14	Budget justification(operational feasibility)	Feasible
15	General Comment	Sucessive comments are included
16	Recommendation	Approved



Appendix F.2 Institutional Review Board (IRB) approval document (English translated version)



YiMi Translation Office
Mobi: 911389636/0913012327
P.O. Box 26670 Addis Ababa - Ethiopia
Code

EMBLEM

HEALTH BUREAU OF OROMIA

Ref. No. BEFO/AH/UTR/1-84/29021

Date: 27/08/2012

**TO EAST HARERGE ZONE HEALTH OFFICE
HARAR**

As it has been pointed out above, it is to be recalled that our bureau examines proposal of organizations that carry out research work and has been providing supportive letter for the same. Accordingly, 'World Vision' has submitted proposal to carry out a project entitled 'The effectiveness of PD hearth in the context of CMAM & ENA interventions on child nutrititonal status and care givers' practices in children 6 to 12 months of age in Habro and Melka Bello districts, Oromiya Region, Eastern Ethiopia; a cluster randomized controlled trial'. Therefore, Ethical Committee of our bureau has examined the proposal and rendered decision permitting the same. Therefore, informing you to furnish the necessary support for this research work, this organization is also informed by this letter to submit one copy of the research findings to Oromia Health Bureau.

I, the researcher, **Yunhee Kang** hereby enter covenant and attest in my signature that I will submit one copy of the research findings.

Signature: Signed
Name: Yunhee Kang
Date: Aug 27, 2012
Tel. No. 0920 579690

With regards,
Signed – Dr. Zelalem Habtamu
D/Bureau Head and Health Care
Delivery Core Process Performer

CC

- To Yunhee Kang
- To Habro District Health Office
- To Melka Bello District Health Office

SEAL

Oromiya Health Bureau
Health Care Delivery Core Process




Mikias Ephrem
G/Manager

CURRICULUM VITAE

YUN HEE KANG, MS, PHD(C)

PERSONAL DATA

Home Address

929 N Wolfe St., 519B
Baltimore, MD 21205
Phone: 1-443-742-0242
E-mail: ykang12@jhu.edu
yhkang0421@gmail.com

Office Address

Human Nutrition Program
International Health Department
The Johns Hopkins University
Bloomberg School of Public Health
615 North Wolfe St., W2501
Baltimore, MD 21205

EDUCATION AND TRAINING

- 2009-present **PhD Candidate in International Health**
Human Nutrition Program, International Health Department, Johns Hopkins
Bloomberg School of Public Health, Baltimore, MD, USA
Dissertation: Effectiveness of a Community-Based Participatory Nutrition
Promotion Program to Improve Child Nutritional Status in Eastern Rural
Ethiopia: a Cluster Randomized Trial (Advisor: Dr. Parul Christian)
- 2001 **MS, Food Science and Nutrition**
Food Science and Nutrition with concentration in Food Microbiology,
Department of Home Ecology, Seoul National University, Seoul, South Korea
Thesis: Development of foreign-gene expression system for *Bifidobacterium*
longum GE1 (Advisor: Dr. Geunok Ji).
- 1994-1998 **BS, Food Science and Nutrition**
Food Science and Nutrition, Seoul National University, Seoul, South Korea

PROFESSIONAL EXPERIENCE

- 2012-2014 **Principal Investigator**
Operation Research Project of Ethiopia Integrated Nutrition Project (EINP),
World Vision Korea/World Vision Ethiopia/Wholistic Interest Through Health
(WITH), Ethiopia (Supervisor: Sungtae Kim, World Vision Korea)
Principal Responsibilities:
▪ Participated in preparing EINP proposal (\$1,100,000, funded by KOICA)
▪ Prepared a research proposal (\$100,000, funded by World Vision Korea)
▪ Trained data collection team and data management team, and managed data
collection
▪ Performed data analysis and wrote papers
- 2007-2009 **Senior Researcher**
Nutrition Research team, WITH, Seoul, Korea
Principal Responsibilities:
▪ Coordinated a seminar (title: Balance) on undernutrition situation and
response strategies in developing countries' (May 2009).

- Edited a journal, ‘Nutrition Action Vol.1’ to introduce nutrition and health programs of Korean NGOs and its research results.
- Produced nutrition education and training manuals for individuals working in developing countries,
- Coordinated a special exhibition ‘The suffering global community Yellow Window’ in a Christian mission conference (Mission Korea 2008), Korea.
- Conducted community assessment surveys for nutrition program development in Myanmar (2008), Cambodia (2008), and Bangladesh (2005), and prepared reports on nutrition programs of NGOs.

2002-2004

Researcher

Nutrition Research team, WITH, Seoul, Korea (Supervisor: Ms. Jisung Woo)

Principal Responsibilities:

- Developed nutritional index to compare health and nutrition situation of developing countries
- Coordinated the nutrition seminar (title: Yellow Window) to introduce undernutrition situation in developing countries
- Conducted community nutrition education projects for the elderly and children in In-jae, Korea and in Yanbian, China

RESEARCH EXPERIENCE

Field Research

2007-2008

Project Manager & Primary Instructor

Strategy Research team, WITH

Principal Responsibilities:

- Coordinated research projects:
 - “Community assessment surveys in Myanmar,”
 - “Community Assessment Survey of Kandal and Prey Bang, Cambodia,”
 - “Development of HIV/AIDS Education Course for Community Health Worker with Cambodia”
 - “Malnourished Children Care and Nutrition Education for Mothers in Truppeang-krasang, Cambodia” in Nutrition Intervention School, Phnom Phen, Cambodia.

2006

Project coordinator & instructor

Strategy Research team, WITH

Principal Responsibilities:

- Trained interviewers and project staff for “Nutrition Assessment for the Pui-tribe community, Yunnan province in China (Oct 2006),” “Review of National Nutrition Program and Nutrition activities of NGOs in Cambodia (Jan 2006),” Strategy Research team, WITH, Korea

2005

Project manager & instructor

Strategy Research team, WITH, Korea

Principal Responsibilities:

- ‘Nutrition survey for mothers of Khulna and Chittagong slum area in Bangladesh (July 2005)’, ‘Strategy development of nutrition-based Christian ministry, Shanghai, China (Feb 2005)’

Public Health Policy

- 2014
June-Dec **Research Assistant**
Nutrition and Health Status of Adolescent Girls: A Six Country Situation Analysis (WFP project), International Health Dep., Johns Hopkins School of Public Health, USA
Principal Responsibilities:
 - Conducted data analysis and prepared a report for the nutrition and reproductive health situation of adolescent girls using Burkina Faso DHS data (PI: Dr. Parul Christian)
- 2014
March **Nutrition consultant**
Principal Responsibilities:
 - Evaluated feasibility for WFP Maternal and Child Nutrition Project (\$3,000,000) through meetings with WFP and MoH staff
 - Produced the evaluation report, WFP Timor Leste, Timor Leste, KOICA, (Supervisor: Jinju Choi)
- 2013
July-Sept **Consultant**
Principal Responsibilities:
 - Consulted preparedness strategy development project for public health crisis of North Korea, Center for Unification Medicine, Seoul National University College of Medicine, South Korea (PI: Haewon Lee, MD)
- 2013-
Present **Manager**
On-line Global Health Seminar, South Korea
Principal Responsibilities:
 - Arranged global health seminar every month/bi-monthly with Korean health professionals working in academia, government, and NGOs
- 2010-2011 **Research Assistant**
International Health Dep., Johns Hopkins School of Public Health, USA
Principal Responsibilities:
 - Conducted systematic review of folic acid and pregnancy outcomes related to Child Health Epidemiology Reference Group (PI: Anne M. Palaia, PhD)

Laboratory Research

- 2005 Dec-
2007 Jan **International Fellow Researcher**
Enteric Microbiology Lab., Laboratory Science division, ICDDR,B Health and Population Research, Dhaka, Bangladesh
Principal Responsibilities:
 - Conducted experiments to evaluate plasmid isolation techniques to gain high yields of plasmid DNA of *Shigella*
 - Detected STEC in food samples, meat and livestock stools in Dhaka, Bangladesh (Supervisor: Kaisar Ali Talukder, PhD).
- 2000 May-
2001 June **Researcher**
BIFIDO CO. Ltd, Seoul, South Korea
Principal Responsibilities:

- Developed foreign-gene expression vectors using plasmids of *Bifidobacterium* spp.
- Measured gene expression efficiency with designed vectors (Supervisor: Dr. Geunok Ji)

1997-1998

Researcher

Samsung Life Science Research Institute, Seoul, South Korea

Principal Responsibilities:

- Conducted experiments for gene expression control of p53 tumor suppressor gene in HeLa cell (Supervisor: Dr. Eun-seung Hwang)

TEACHING EXPERIENCE

2010 Oct-
Dec

Teaching Assistant, International Health Dept., Johns Hopkins School of Public Health, USA

2011 Oct-
Dec

- Supported administrative management and assignments grading for ‘Assessment of Nutritional Status’ course (Supervisor: Kerry Schulze, PhD)

Sep 2008-
Jun 2009

Instructor, Ansan College, Ansan, South Korea

- Gave lectures of ‘Nutrition Counseling and Practices’ to undergraduate student
- Conducted nutrition counseling to elderly group at Silver Care Center (Supervisor: Chang-soon Ahn, PhD).

Sep 1999-
Dec 1999

Teaching Assistant, Food Microbiology experiment, Food science and Nutrition Dep., Seoul National University, South Korea

- Gave a lecture on ‘Principles and experimental skills for food microbiology’ to undergraduate students (Supervisor: Geunok Ji, PhD)

PROFESSIONAL ACTIVITIES

MEMBERSHIP

Academic Association

Korean Society of Global Health 2013-

American Society for Nutrition 2010-

Global Health Council 2015-

HONORS AND AWARDS

2015

Scholarship from the George G. Graham Professorship Endowment (\$800)

2015

Asian Congress of Nutrition 2015 Travel Award, Yokohama, Japan (300,000 JPY)

2014

Elsa Orent Keiles Fellowship award, Johns Hopkins School of Public Health (\$2,500)

2012

Doctors and pastors of Oak Scholarship Award, Korea (\$8,000)

2011

Doctors and pastors of Oak Scholarship Award, Korea (\$9,000)

2010

Scholarship Award, Weiyang Catering company, Korea (\$10,000)

- 2009 DSM Scholarship Award in Human Nutrition, International Health Department, Johns Hopkins University, Baltimore, MD, USA (\$55,000)
- 1999 Scholarship Award, Food Science and Nutrition Department, Seoul National University.

PUBLICATIONS

Books

- Nutrition Action Vol.1. Editor of field research report for developing countries, WITH, Sooyang F&G (2009).
- Yellow Window Statistical Report. Report to introduce nutrition, health and regional status in developing countries. WITH, Sooyang Co. (2004).

PRESENTATIONS

- Yunhee Kang**, Lemma Debele, Youn Kyoung Suh, Hee-Soon Juon, and Parul Christian. Community-Based Participatory Nutrition Promotion Program Improved Child Feeding Practices among Caregivers in Rural Eastern Ethiopia: A Cluster Randomized Trial. 12th Asian Congress of Nutrition 2015, Yokohama, Japan, May 15-18, 2015 (oral presentation).
- Kang Y.H.**, Sinamo S., Kim S. and Parul Christian. Effectiveness of a Community-Based Participatory Nutrition Promotion Program Improving Linear and Ponderal Growth in Children 6 to 24 Months of Age in Rural Eastern Ethiopia: A Cluster Randomized Trial. Experimental Biology 2015, Mar 28-Apr 1, USA (poster presentation).
- Kang Y.H.**, Seo Y.K. The Study for the change in indicators over last 5 years, re-establishment and the index development for Yellow Window, Korean Society of Food and Nutrition, Seoul, Korea (2009).
- Seo Y.K., **Kang Y.H.**, Yu S.J., Kim S.M, The Comparison Kandal province with Prey veng province in Cambodia by community nutrition survey, Korean Society of Food and Nutrition, Seoul, Korea (2009).
- Kang Y.H.**, Health and Poverty in Global society, Session lecture, Mission Korea 2008, Korea (2008).
- Kang. Y.H.**, Malnutrition Care Centers for Children under 5 in West Africa. *Sandglass Seminar*, WITH, Seoul, Korea (2006).
- Seo J. M., **Kang Y.H.**, Cho S.H., Park M.S., Park J. H., Ji G.E. Expression and secretion of *Bacillus* phytase gene in the Genus *Bifidobacterium*. *Proceedings of 9th international symposium on the Genetics of Industrial Microorganism*.
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CERTIFICATES

- 2011 Jan Certificate of completion, Health Emergencies in Large Populations (H.E.L.P), Johns Hopkins School of Public Health, USA

- 2010 June Certificate of completion, Dietary Supplement Research Practicum, Office of Dietary Supplements, National Institute of Health, USA
- 2008 Certificate of completion, Project Cycle Management basic course, KCOC (Korea NGOs Council Overseas Cooperation), Korea (Aug 2008 ~ Feb 2009)
- 2008 Certificate of Attendance, SPHERE training, KCOC, Korea (Apr 21-23, 2008)
- 1999 License of Nutritionist, Ministry of Health, Korea

ADDITIONAL INFORMATION

Research Interests

- Child undernutrition; nutrition-sensitive nutrition program (agriculture, WASH, community empowerment)
- Effectiveness and process evaluation of community-based nutrition program
- Nutrition assessment using anthropometric indicators, biochemical test, and dietary assessment
- General linear/logistic regression, longitudinal/multi-level data analysis, and survival analysis