Effectiveness of enhancing face-to-face peer-led nutrition education methods with an intervention of nutrition-related cell phone messaging on Kenyan women's knowledge, attitudes, and practices

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Abstract

In developing countries, where food insecurity and micronutrient malnutrition are severe, food-based agricultural interventions have been shown to be effective in enhancing food availability, access, and, ultimately, reducing micronutrient malnutrition. Current research indicates that the most successful of these interventions have a nutrition education component, most of which are delivered via traditional face-to-face methods. There is little known, however, about whether the use of cell phone technology as a nutrition education strategy is effective in improving knowledge, attitudes and practices among women in developing countries. The primary purpose of this study was to compare the dietary knowledge, attitudes, and practices of women who received a series of nutrition-related text messages in their local dialect, Kimeru, to augment face-to-face peer-led nutrition training (intervention group, n=24) to that of women who received face-to-face peer-led nutrition training only (comparison group, n=29). The study was conducted in Naari, in rural Kenya among women belonging to two self-help groups, where there was a high penetration of cell phone ownership and use. The study employed a mixed methods research design to explore the effectiveness of a cell phone messaging intervention on knowledge, attitudes and practices. All women in the study received a face-to-face peer-led nutrition education session. Women in the cell phone intervention group were then sent a series of text reminders about five of the key nutrition messages from the face-to-face intervention twice weekly over five weeks. The five messages were:1) using equal portions of maize and beans to increase protein intake; 2) soaking maize and beans to conserve iron in the food; 3) using two or more vegetables in meals to increase vitamin A intake; 4) taking fruits with meals to enhance iron absorption; and, 5) deworming children on a regular basis. Quantitative data, including women's knowledge of nutrition messages, their attitudes regarding the importance of the messages, and whether they were practising the recommended behaviours, were collected during home visits via questionnaire. Qualitative data regarding the intervention group's perceptions towards the intervention were collected through individual interviews and focus group discussions. Results indicated that the mean knowledge scores regarding conserving iron ($p=0.05$), consuming foods rich in vitamin A ($p=0.02$), and deworming ($p=0.03$) were higher in the intervention group than the comparison group. Moreover, nutrition messages relating to 1) iron ($p=0.0008$); and 2) deworming ($p=0.05$) were considered more important in the intervention group than the comparison group post-intervention. Similarly, a higher proportion of the intervention group reported implementing practices relating to increased consumption of protein ($p=0.009$) and vitamin A ($p=0.02$) than the comparison group. The themes identified in the interviews and focus group discussion were consistent with these quantitative results. Results suggest that adding a cell phone 'booster' to nutrition education sessions using the local dialect can contribute to positive changes in nutrition-related knowledge, attitudes, and practices.

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Abbreviations and Acronyms

AT – Activity Theory

US CDC – United States Centre for Disease Control and Prevention

DDM – Dietary diversification and modification

FAO – Food and Agriculture organization

FDG – Facilitated group discussions / Focus group discussions

FHF – Farmers Helping Farmers

FSIN – Food Security Information Network

IFAD – International Fund for Agricultural Development

IFPRI – International Food Policy Research Institute

ILSI – International Life Sciences Institute

IYCF – Infant and young child feeding

IYCN – Infant and young child nutrition

KAP – Knowledge, attitudes, and practices

KARI – Kenya Agricultural Research Institute

KNBS – Kenya National Bureau of Statistics

MCH – Maternal and child health

MNM – Micronutrient malnutrition

NACOSTI – National Commission for Science, Technology, and Innovation

PSCU – Presidential Strategic Communications Unit

REB – Research and Ethics Board

SAS – Statistical Analysis System

SMS – Short message service

UNESCO – United Nations Education, Scientific and Cultural Organization

UNICEF – United Nations International Children's Emergency Fund

UPEI – University of Prince Edward Island

USAID – United States Agency for International Development

WFP – World Food Programme

WHO – World Health Organization

WIC – Women, infants, and children

Operational Definition of Terms

1. Champs – Women leaders who are selected by their self-help group members because of various factors including the fact that they are both good cooks and farmers.
2. Food Security – A state in which "all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2006)
3. Micronutrient deficiency – It is the lack of essential vitamins and minerals required by the body in small amounts for growth and development.
4. Non-champs – Regular members of the self-help groups who do not hold any leadership position.
5. Self-help group – A group of women that provide mutual support to each other in a variety of ways.
6. Undernutrition – A condition that results from undernourishment and/or poor nutrient utilization due to recurrent infections and diseases (FAO, 2015)

Chapter 1: Introduction

In this research study, I evaluated the effectiveness of enhancing face-to-face peer-led nutrition education methods with an intervention of nutrition-related cell phone messaging aimed at increasing nutrition related knowledge, attitudes, and practices. The ultimate aim of this intervention is to alleviate food insecurity and micronutrient deficiencies. The primary purpose of this study was to compare and contrast the dietary knowledge, attitudes, and practices of women trained using face-to-face teaching with a peer-led model only to that of women who received nutrition-related text messages to augment the conventional education methods. It focused on women belonging to two self-help groups from a rural area in Kenya.

I anticipate that this research study will contribute to the literature on the effectiveness of cell phone learning as a means of enhancing nutrition education in developing countries. The findings could also be useful for educators, health professionals and other nutrition stakeholders in that they would be able to identify effective approaches to nutrition education. It was hoped that the study would contribute to improvement in the women's nutrition-related knowledge, attitudes, and practices. This would ultimately lead to household food security, healthier nutrition and health status of the women and their household members, and finally, help prevent and control micronutrient deficiencies.

Statement of the Research Issue

The number of people experiencing food insecurity is increasing globally. An estimated 815 million global citizens were hungry in 2016 as compared to 777 million in 2015 (Development Initiatives, 2017; FAO, IFAD, UNICEF, WFP, & WHO, 2017), while 108 million of them are experiencing crisis level food insecurity, which exists when people can barely meet their minimum food needs (FSIN, 2017). The existence of varying degrees of poverty, conflicts, and climate-related factors are primarily responsible for the current state

of food insecurity (FAO, 2009; Roser & Ritchie, 2017), which has resulted in 815 million undernourished individuals globally who are unable to acquire sufficient food to meet the daily minimum dietary energy requirement over a one-year period (FAO et al., 2017). The FAO et al. (2017) report further claims that the highest numbers of undernourished people are from developing countries. The same report highlights that the state of food insecurity has worsened in parts of South-eastern and Western Asia as well as sub-Saharan Africa. In sub-Saharan Africa, the Eastern Africa of the region is most food insecure resulting in one-third of the population being undernourished (FAO et al., 2017). In Kenya, the number of food insecure individuals increased from 1.3 million in 2016 to 2.2 million in February 2017 mainly due to drought (FSIN, 2017). This state prompted the Kenyan government to declare drought a national disaster (PSCU, 2017). Both poverty and hunger are particularly high in rural areas (FAO, 2015), with 1.3 million food insecure individuals residing in Kenyan rural areas (KARI, 2012).

Food insecurity at the household level is the underlying cause of inadequate dietary intake and, consequently, undernourishment or undernutrition (UNICEF, 2013), which is responsible for approximately half the number of deaths of children under five years of age globally but mainly in Asia and Africa (UNICEF, 2016). Undernutrition is classified as macronutrient undernutrition, which is the lack of nutrients like carbohydrates, proteins, and fats that are required by the body in large amounts, while micronutrient malnutrition (MNM) is deficiency of nutrients such as vitamins and minerals that are needed in small amounts. Similar to macronutrient undernutrition, MNM has a cause-effect relationship with poor health outcomes, lower academic achievement, decreased work capacity, lower income, and ultimately, poverty (Bailey, West, & Black, 2015). Unfortunately, out of the seven billion people in the world, two billion of them suffer from various types of micronutrient deficiencies (Bailey et al., 2015; IFPRI, 2016; Laitsch, 2009; Muller & Krawinkel, 2005).

It is crucial to investigate strategies to alleviate MNM, which is closely associated to the vicious cycle of undernutrition, underdevelopment, poverty, and food insecurity that poses a significant threat to the socio-economic development of third world nations (FAO & ILSI, 1997). Since the 1980s when these countries began focusing on MNM as opposed to macronutrient undernutrition only (WHO, 2014), their primary focus has been on mass supplementation, food fortification, and public health interventions. There has been relatively minimal focus on dietary diversification and modification (DDM), which involves promoting the consumption of a variety of food groups over a given period. For instance, the Government of Kenya has a National Nutrition Action Plan (2012 – 2017) that aims to implement high impact nutrition interventions such as iron, folate, vitamin A, and zinc supplementation, food fortification, hand washing, and deworming among many others (Republic of Kenya, 2012). Although these interventions may have an impact on the target populations, they fail to sufficiently address poverty and food insecurity that are root causes of MNM (Dairo & Ige, 2009; Thompson, 2014; WHO, 2014). However, food-based agricultural interventions effectively deal with these two root causes. These interventions aim at enhancing food production, availability, access, and consumption (Morón, 2006) by: promoting small-scale horticulture and providing horticulture training; providing access to water; and, advocating for fortification of local foods (Darnton-Hill, 2015). Although food-based agricultural interventions such as promotion of local food production and consumption take longer to implement, research has demonstrated that these interventions are sustainable, economically feasible, culturally acceptable, and are the recommended strategies for preventing and reducing MNM (Dairo & Ige, 2009; Gibson & Hotz, 2001; WHO, 2014). Since agriculture is the backbone of the Kenyan economy, with 80% of Kenyans engaged in farming, these interventions have a high potential of reducing both hunger and poverty particularly in rural areas (KARI, 2012).

There are two distinct features of successful food-based agricultural interventions aimed at eradicating MNM: women's involvement, and inclusion of a nutrition education component (Darnton-Hill, 2015). Firstly, involvement of women is key, since a large proportion of women make a living through agriculture. In fact, 43% of women engage in agricultural activities in developing countries, with 50% in Sub-Saharan Africa, and even higher rates (75 – 89%) in Kenya (Ahearn & Tempelman, 2010; FAO, 2011). Moreover, women play a central role not only in food preparation and distribution, but also in every food-related decision-making process at the household level (Gunewardena, 2014; Lewis, 2014). Although a lack of assets is a primary challenge, research reveals that empowering women would increase farm yields by 20 – 30% and, consequently, reduce the number of hungry people by 12 – 17%, which is equivalent to 150 million people globally (FAO, 2011; FAO, 2015).

Secondly, including nutrition education in food-based agricultural interventions has been shown to be of prime importance in the promotion of household consumption of micronutrient-rich foods (Allen, 2003; Gibson & Hotz, 2001; Thompson, 2014). Nutrition education is "any combination of educational strategies, accompanied by environmental supports, designed to facilitate voluntary adoption of food choices and other food and nutrition-related behaviours conducive to health and well-being" (Contento, 2008). Burchi, Fanzo, and Frison (2011) noted that the holistic approach of combining agricultural production and nutrition education improves both food security and dietary diversity. Nutrition education is crucial since it not only promotes change in behaviours and attitudes (Food & Nutrition Service, 2010), but it also enhances knowledge and skill acquisition in the areas of food processing, preparation, and cooking among many others (Gibson, 2014). A report produced by the FAO indicates that several agricultural projects in developing countries that had a nutrition education component resulted in improvement of women's

dietary diversity, increased vitamin A intake, decreased hunger, and ultimately improved household food security status (FAO, 2016). However, this report emphasizes the need for more research aimed at investigating the channel, duration, and intensity of nutrition education that produces best results.

In regard to channels of nutrition education, various forms of traditional training methods, most of which are face-to-face techniques have been used over the years in both developing and developed countries. However, the technological advancements that have characterized the 21st century provide an opportunity to seek new approaches to enhance nutrition education. Due to the affordability of cell phones (Bastawrous, Henning, & Livingstone, 2012), coupled with high mobile-cellular subscriptions (World Bank, 2015), developing countries are catching up with the developed nations regarding cell-phone ownership and use (Aker & Mbiti, 2010; Voice of Africa, 2015). Using cell phones for education has a great potential for improving the food and nutrition status of people in these low and middle-income countries (Neuenschwander, Abbott, & Mobley, 2012). However, a review of studies on phone use reveal that cell phones are primarily used for conveying information on maternal and child health (MCH) or infant and young child nutrition (IYCN) (Viljoen & Sowah, 2015). There is currently no research on the use of cell phones to empower people with knowledge on food-based strategies to prevent and control micronutrient deficiency. This is in spite of the fact that according to the Republic of Kenya (2012), there is inadequate knowledge about the importance of micronutrients among both health service providers and the general public. Since mobile phones are steadily becoming effective change agents (Rojas-Ruiz & Diofasi, 2014), it is important to investigate their effectiveness in enhancing traditional education methods aimed at improving dietary diversity and thus alleviating food insecurity and MNM.

This investigation was personally meaningful to me for two reasons. First, having practiced nutrition in a clinical setting, I cared for patients with severe micronutrient deficiencies such as iron deficiency anaemia. Some patients would be discharged from the hospital and then suffer a relapse of the same condition due to lack of follow-up at the community level. Although all patients were given comprehensive nutrition counselling and education before leaving the hospital, some failed to adhere to advice due to lack of support and resources, which made it impossible to obtain nutritious foods. Owing to the high amounts of workload by dietitians in Kenyan hospitals as well as lack of resources allocated for follow up, it was impossible to reach each patient at the community level. However, I believe that MNM can be prevented only if people in the community received food-based agricultural interventions combined with nutrition education. Secondly, as a nutrition educator, I have always strived to use creative and engaging methods to convey dietary knowledge in a manner that will achieve the desired attitude and behaviour changes. The mobility and increased penetration rates of cell phones made me want to utilize the mobile technology in the future. However, as a dietitian and educator, one critical question still lingers: What is the impact of using cell phones to complement a combined agricultural and nutrition education intervention on knowledge, attitudes and practices?

Research Context

The study location for this research was Naari Sub location, which is in Buuri Constituency, Meru County, Kenya (See Appendix I). This location had been selected as a target community for a livelihood-enhancement project (Queen Elizabeth Scholarship [QES] project) having horticulture and nutrition intervention and facilitated by Farmers Helping Farmers, an NGO aimed at improving livelihoods of rural populations in Kenya. Naari is situated in the Eastern parts of Kenya on the North-eastern side of Mt Kenya. Being on the windward side of this geographical landmark that determines the climatic conditions of the

region, the average amount of rainfall is 500 – 2600mm annually and the temperatures ranges from 16 – 23 degrees Celsius depending on the seasons (Kenya Information Guide, 2015). Due to these favourable weather conditions, the area relies mainly on agriculture primarily for household food but also for economic sustainability. A majority of people practice subsistence farming whereby they grow crops such as maize, beans, sorghum, millet, potatoes, cabbages, and fruits among many others. They also rear livestock like cattle, goats, sheep, chicken, and rabbits on a small-scale.

Meru is one of the most densely populated counties in Kenya with an estimated total population of 1.5 million people (KNBS, 2010). According to this census report, 12% of this population reside in the urban areas of the county, while the rest live in the countryside. Naari is a rural Sub location that has an area of approximately 118.60 square kilometres and is home to about 27,299 residents (The Kenyan, n.d.). The Kenya National Census conducted in 2009 revealed that more than half of the total residents of Meru County owned a phone. In Imenti North, a former district in which Naari Sub location is situated, 162,397 people confirmed that they own a phone out of the total 239,019 people interviewed (KNBS, 2010). With the increased mobile penetration rates in the rural areas, the mobile ownership rate is much higher since the last census in Kenya.

Background to the QES Project

This research study was part of a larger project aimed at improving the food security and livelihoods of smallholder farmers in Naari area. The project is a partnership between Farmers Helping Farmers (FHF), UPEI, Kenyatta University, University of Nairobi, and Naari Dairy Cooperative Society (Appendix XIII). FHF is a Canadian based non-profit organization that have been working with Kenyan farmer groups for over 35 years. In 2014, the organization initiated a collaboration with Naari Dairy Cooperative Society and two

women's groups in the area. It provided the women with agricultural resources like water tanks, drip irrigation, and vegetable seeds as well as providing them with horticultural training designed to improve sustainability and yields from kitchen (vegetable) gardens and increase household income. FHF staff also collaborate with UPEI undergraduate and graduate students in facilitating agricultural and nutrition-based training to the farmers. In addition to dealing with farmers, the organization has also partnered with schools in the Naari region to develop vegetable gardens so that students could have healthy lunches.

FHF works closely with Naari Dairy Cooperative Society (NDCS), which is a cooperative that improves the livelihood of the small-scale farmers in the area though selling milk provided by about 500 families. Other than collection and sale of milk, the cooperative society also offers credit and financing opportunities to the farmers. The high willingness of these farmers to learn about family nutrition and the health and management of cattle lead to the overall success of this project. Two women's groups comprising of approximately 30 members each have been actively involved in the project. While women groups are common in Kenya since members can not only support each socially and emotionally but also grow themselves economically by saving money and taking loans. The members of the group have been involved in the FHF's kitchen gardening project since 2014. They also participated in project training and research activities with FHF staff, Canadian undergraduate student interns, and Kenyan graduate student researchers.

Finally, the project also involves two institutions of higher learning in Kenya: Kenyatta University and University of Nairobi. The institutions acted as the grounds for recruiting the Kenyan graduate students involved in the project. Moreover, the faculty members in various disciplines in the institutions were collaborators and academic supervisors for the students.

Research Question

The central question that this research study intended to answer was: to what extent does the use of cell phone enhancements to a combined agriculture and nutrition education intervention improve the nutrition-related knowledge, attitudes, and practices of women belonging to self-help groups in Naari, Meru County, Kenya?

Purpose of the Study

The purpose of this study was to investigate whether enhancing face-to-face peer-led training with cell phone messaging has an impact on the nutrition related knowledge, attitudes, and practices of women belonging to self-help groups in Naari, Meru County, Kenya. Non-technological nutrition education generally aims to increase dietary knowledge and lead to positive changes in attitudes and practices through one on one or group didactic education sessions (Smith & Smitasiri, 1998). Farmers Helping Farmers, an NGO based in Kenya, in collaboration with UPEI conducted peer-led education interventions in 2010-2013 and in 2016, but the two organizations have not explored the use of mobile technology to enhance the nutrition education offered. Therefore, this research provided in-depth information on the extent to which combining cell phone use with a face-to-face peer-led nutrition education and agriculture intervention influenced knowledge gain and dietary practices aimed at preventing MNM. I compared the knowledge regarding nutrition messages taught, and dietary practices such as food preparation and cooking methods, between women trained using the peer-led education sessions only and those who received cell phone notifications and reminders as a supplement to the training received. In addition, this study also explored the perceived benefits and challenges of cell phone use among women leaders from the self-help group that receive this enhancement.

Significance of the Study

The research generated information about the effectiveness of enhancing face-to-face peer-led nutrition education methods with cell phone messaging on women's knowledge, attitudes, and practices. It is hoped that the results and findings will add to the current nutrition education knowledge base. They will also add to the literature on the use of mobile learning for delivering nutrition education since it is a low cost method that could be widely adopted if successful. The findings will be particularly beneficial to nutritionists/dietitians, nutrition educators, health-care workers, programme planners, and policy-makers in governmental, non-governmental or privately owned organizations involved in nutrition education and promotion within the developing countries context where there is little research on nutrition education. The research study will be instrumental in enabling them to decide whether to adopt cell phones as an educational tool for conveying additional nutrition information apart from the current MCH and IYCF related information. Since the research also aimed to identify the benefits and challenges of using cell phones, nutrition stakeholders could use these findings in capitalizing on the positive elements of cell phones while responding to any challenges associated with using this technology. Subsequently, these professionals could maximize the potential of use of mobile phones for nutrition education, given that ownership rates are high in both urban and rural areas.

The research study could contribute significantly to improvement of the nutrition-related knowledge, attitudes, and practice through both non-technological and technologically enhanced nutrition education sessions and agriculture interventions provided to the women. This improvement could subsequently help in preventing and controlling micronutrient deficiencies. Since women have the responsibility of caring for themselves and their households, it was hoped that the nutrition-and agriculture intervention combined with cell-phone booster obtained would be utilized effectively for the benefit of all the household

members. Consequently, these households will produce healthier and well-nourished individuals who have the full potential of attaining high levels of academic and work capacity. Having such individuals will not only result in household food security and eradication of poverty but will also contribute significantly to the nation's economic growth.

Finally, this research was significant to me as a nutritional practitioner and researcher. As a dietitian, this research study provided an excellent opportunity for me to contribute in alleviating MNM at the community level where it was needed most as opposed to managing severe conditions in acute care settings that could easily be prevented. Seeing women utilizing the knowledge provided in the training sessions and giving follow-up support through the cell phones aimed at improving their nutrition and health status was very satisfying to me. As a researcher, I also hope that this research will be the foundation for subsequent research studies aimed at enhancing nutrition education by utilizing cell phones at a broader scale.

Summary of Chapter 1

In chapter one, I have discussed some nutrition-related problems experienced by people in developing countries like food security and micronutrient deficiencies. Nutrition education has the potential of helping to alleviate these issues especially with a technological addition of cell phones, which are increasingly penetrating these nations. The research location was a rural area in Kenya called Naari. The main purpose of the study was to investigate the impact of using a technological booster to augment face-to-face peer-led nutrition training on the nutrition knowledge, attitudes, and practices of women organized in self-help groups. In the next chapter, I provide a detailed description of literature that focusses on the nutrition-related problems as well as non-technological and technological nutrition education methods that can potentially mitigate these problems.

Chapter 2: Literature Review

This chapter focusses on nutrition education as an intervention aimed at alleviating food insecurity that result in various forms of undernutrition such as micronutrient malnutrition (Weigel, Armijos, Racines, & Cevallos, 2016). Initially, I provide an overview on food insecurity and undernutrition then give an insight into the micronutrient malnutrition situation globally, in developing nations, and in Kenya. I then expound on the food-based intervention strategies such as supplementation, food fortification, as well as dietary diversification and modification (DDM) already present in developing countries. Since nutrition education in DDM is my primary goal, I provide details on nutrition messages, target audience, as well as education and communication methods used. As for the educational methods, I focus on both traditional education methods and technology-enhanced methods with particular emphasis on the use of cell phones to convey health and nutrition messages. For a better understanding of the selection of cell phones over other technologies, I provide an overview of the phones' ownership and usage from a global, African and Kenyan context. Finally, I address the effectiveness of using cell phone enhancements to traditional nutrition education methods.

Food Insecurity and Under Nutrition

Household food insecurity results from income poverty, food unavailability or inappropriate household food distribution (Fawole, Ilbasmis, & Ozkan, 2015). While food security is defined as a state in which "all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2006), food insecurity occurs when there is either inadequate or no food at all. Food insecurity, alongside other factors such as poor childcare practices, unclean environments, and insufficient health services lead to inadequate

dietary intake and disease, which are the basic causes of undernutrition (Bailey et al., 2015; Gibson, 2014; Laitsch, 2009; UNICEF, 2013). The 2013 UNICEF conceptual framework of malnutrition (Appendix II) illustrates these multifactorial causes of undernutrition. This condition, which is highly prevalent in Southeast Asia and Sub-Saharan Africa (Muller & Krawinkel, 2005), is classified into macronutrient and micronutrient deficiencies. Macronutrient deficiencies are associated with protein-energy undernutrition that takes three forms: stunting or shortness for age, wasting or thinness for height, and underweight for age (UNICEF, 2006). On the other hand, micronutrient deficiencies, which are of interest in this research study, refer to insufficiency in essential vitamins and minerals required to sustain life and for optimal physiological functioning (Bailey, West, & Black, 2015).

The Micronutrient Malnutrition Situation

Micronutrient malnutrition (MNM) is a silent epidemic of great concern since it affects people of all ages and genders (Tulchinsky, 2010). 'Hidden hunger' is a term used alternatively for MNM because it does not trigger physical sensations like hunger in affected individuals in contrast to protein-energy undernutrition (Bevis & Barrett, 2015). Moreover, micronutrient deficiencies are not explicitly visible in affected individuals but instead take the form of diseases and conditions (Bailey, West, & Black, 2015). MNM is responsible for poor growth and development, intellectual impairments, reproductive health complications, increased morbidity and mortality, and reduced work capacity among many others as illustrated in Appendix III (Bailey et al., 2015). These adverse health consequences have a greater impact on women and children who are among the high-risk population subgroups (Laitsch, 2009). Moreover, these effects are irreversible particularly for young children who have no control over their diets (Bevis & Barrett, 2015).

MNM is also of concern because of its relatively high prevalence rates. The most prevalent micronutrient deficiencies worldwide are those of iron, vitamin A, iodine, folate, and zinc (Bailey et al., 2015; Bhutta, Salam, & Das, 2013; Muller & Krawinkel, 2005). Over two billion people globally suffer from one or more of these deficiencies (Bailey et al., 2015; IFPRI, 2016; Laitsch, 2009; Muller & Krawinkel, 2005). Moreover, half the children aged between six months to five years worldwide have at least one deficiency (CDC, 2015). In developing countries, iron and vitamin A deficiencies, which are the two most widespread deficiencies, are responsible for 40% of anaemic pre-schoolers and 20% of maternal deaths (WHO, 2016a; WHO, 2016b). In addition to that, the same reports note that Vitamin A deficiency causes blindness in approximately 250 million children; half of these children die annually. In Kenya, an estimated 80% of children under five are deficient in vitamin A while 43% of childbearing women aged between 15 and 49 years are anaemic (Save the Children, 2015).

Nutrition Interventions to Prevent MNDs

The three-pronged food-based interventions of alleviating micronutrient deficiencies in developing countries are supplementation, fortification, and dietary diversification and modification (Allen, 2003; Nair, Augustine, & Konapur, 2015; Thompson, 2014). While supplementation and fortification are policy level interventions, dietary diversity and modification are household level interventions. The other non-food based interventions include promotion of public health measures like breastfeeding, immunization, proper sanitation, and parasite control as well as socio-economic developmental measures such as female literacy, family spacing, and income generation (Waswa, Jordan, Herrmann, Krawinkel, & Keding, 2015). This literature review focuses on policy level and household level interventions, but does not dwell on the non-food based interventions.

Policy Level Interventions

First, supplementation involves the provision of pharmacologically prepared nutrition supplements to affected individuals or those at risk (Bailey et al., 2015; Thompson, 2014). These authors contend that supplements are for prevention or therapeutic purposes against severe forms of MNM. For instance, research reveals that half the countries in the world provide vitamin A supplementation to children less than five years of age and postpartum mothers for the first six weeks (Allen, 2003). Although supplementation improves the micronutrient status of targeted groups within a short period, there is poor compliance especially if individuals need to take micronutrients for long periods (Allen, 2003). Moreover, supplementation does not address the root causes of MNM (Bailey et al., 2015) nor the larger untargeted population (Allen, 2003).

Secondly, food fortification involves the addition of micronutrients to food vehicles like flour, oil, salt, and sugar or even homemade food for home fortification (Save the Children, 2015; Bhutta et al., 2013). Through engagement of food industries, fortification is an intervention that reaches a broad population (Bailey et al., 2015). For example, the most typical fortification is an addition of iodine to salt whereby approximately 120 countries globally have adopted the strategy (Leung, Braverman, & Pearce, 2012). Despite the fact that fortification reaches larger masses of people, those with a low socio-economic status are less likely to buy the slightly more expensive fortified foods (Allen, 2003). Furthermore, changes in foods' sensory qualities, the limited bioavailability of the added fortificants, and nutrient-nutrient interactions are other barriers to fortification.

Household Level Intervention

Dietary diversification and modification (DDM) is a food-based agricultural approach that involves changes in food production, selection, preparation, and processing of local foods aimed at enhancing food availability, access, and utilization of nutrients year round (Gibson, 2014). It promotes production and consumption of traditional staple foods such as indigenous vegetables, fruits, roots, and tubers like sweet potatoes, carrots, green leafy vegetables, pumpkins and many more (Hongo, 2003). DDM is one of the most efficient strategies for addressing the root causes of MNM, which are poverty, food insecurity and undernutrition (Thompson, 2014). As opposed to short-term strategies like supplementation and food fortification, DDM is a long-term sustainable strategy that enables communities and households to feed themselves without external support (Bailey et al., 2015; Nair et al., 2015; Thompson, 2014; Waswa et al., 2015). In fact, improving dietary diversity not only enhances individual micronutrient statuses but it also increases the overall food intake of the entire household (Gibson, 2014). In addition to improving the household food security due to improved food productivity and accessibility, DDM also improves the household income (Levinson, 2011; Nair et al., 2015).

Research studies reveal that the most successful DDM interventions have a nutrition education component (Nair et al., 2015; Thompson, 2014; Waswa et al., 2015). For instance, Gibson (2014) reviewed ten home gardening interventions and concluded that eight of them that incorporated nutrition education resulted in increased consumption of vitamin A as compared to the remaining two. On a different perspective, lack of knowledge of the nutritional value of some indigenous foods in Kenya has led to underutilization of the same (Hongo, 2003). Therefore, nutrition education is very crucial since it helps to improve food consumption and dietary practices by providing essential knowledge and skills (Food &

Nutrition Service, 2010; Reinbott et al., 2016). In other words, it can change the nutrition-related knowledge, attitudes, and skills of individuals leading to changes in dietary behaviours. Moreover, it aids in changing misguided attitudes about agricultural production of indigenous plants as well as food-related behaviours and practices (Gibson, 2014). Nutrition education is unique not only because of its applicability in individual and household levels but also at institutional, community, and policy levels that support DDM interventions (Food & Nutrition Service, 2010; Hawkes, 2013). Furthermore, Hawkes (2013) argued that it applies to different contexts such as food producers, sellers, and consumers.

Nutrition Education

It is evident that nutrition education is effective in not only influencing dietary knowledge and attitudes but also practices of individuals (Contento, 2008). Nutrition education is "any combination of educational strategies, accompanied by environmental supports, designed to facilitate voluntary adoption of food choices and other food and nutrition-related behaviours conducive to health and well-being" (Contento, 2008, p. 176). Three phases of nutrition education can be deduced from this definition. First, the motivation phase aims at improving dietary awareness and motivation to change among the intended audience (Contento, 2008). The second phase, which is the action step, provides the skills necessary to act on information provided and eventually, the environmental phase provides an enabling food environment to support the actions taken in the second phase (Contento, 2008; Hawkes, 2013). When properly designed and implemented, nutrition education motivates participants to adopt healthy dietary behaviour and provides them with relevant knowledge and skills on healthy food choices in the contexts of their lifestyles and socio-economic statuses (Food & Nutrition Service, 2010). However, according to the transtheoretical model of health behaviour change, these changes in health and nutrition-

related behaviours vary depending on the stage of change in which individuals are (Prochaska & Velicer, 1997). Therefore, successful nutrition education interventions need to take into consideration the nutrition message, target population subgroup as well as education and communication methods used.

Nutrition Messages

Framing nutrition messages appropriately is of prime importance since it influences the persuasiveness and effectiveness of nutrition education (Fox, Hanson, Briefel, Olander, & Aldridge, 2009). In fact, these authors stipulate that factors, which influence the messages' persuasive power, are their ability to portray the likelihood of achieving a particular outcome and most importantly expressing the value of the result. For instance, some benefits of eradicating micronutrient deficiencies include improvement of the immune system, cellular functioning, work capacity, reproductive health, and cognitive functioning among others (Bhutta et al., 2013). Therefore, households need education and support in increasing their dietary diversity by producing and consuming a broad variety of foods from their kitchen gardens and small livestock (Muller & Krawinkel, 2005). Moreover, they need education on food preparation methods and food combination strategies to increase dietary enhancers and eliminate inhibitors of absorption to ensure maximum utilization of micronutrients (Thompson, 2014). The specific details of each of these key nutrition messages are included in Table 2.1.

Table 2.1: Summary of Key and Specific Nutrition Messages, adapted from Thompson (2014)

KEY MESSAGE	SPECIFIC MESSAGES
Increasing production and consumption of micronutrient rich foods.	• Increase production of micronutrient-rich fruits and vegetables like green leafy vegetables, carrots, pumpkins, sweet potatoes etc.
	• Improve micronutrient density of homemade meals by consuming the micronutrient-rich vegetables produced.
Reducing intake of absorption inhibitors.	• Soaking cereals and legumes to eliminate phytates that form insoluble complexes with iron, zinc, and calcium.
	• Avoiding tea and coffee within 2 hours of eating meals since caffeine, tannins, and polyphenols in the beverages interfere with iron absorption.
Increasing intake of absorption enhancers.	• Consumption of foods rich in ascorbic acid/vitamin C to enhance absorption of iron.
	• Consumption of whole grain cereals to make B vitamins available for absorption.

Target Population Subgroup

The population subgroup chosen to receive the nutrition messages determines the effectiveness and sustainability of nutrition education programs. Although nutrition education applies to all population subgroups (Smith & Smitasiri, 1998), it is more impactful

when women are involved (Berti, Faber, & Smuts, 2014; WHO, 2000). Women are not only a high-risk group for micronutrient deficiencies (USAID, 2014) but are also involved in food production, decision making, processing, preparation, allocation and distribution, timing, frequency and quantities determination, as well as caring for themselves and their entire household (Gunewardena, 2014; Johnson-Welsh, 1999; Lewis, 2014). In fact, Thompson (2014) and Lewis (2014) agreed that successful interventions are those that fully involve the community and women following a comprehensive understanding of the local context. For instance, a Malawian micronutrient and health program organized by the World Vision, which incorporated a nutrition education component, resulted in reduction of anaemic rates in pregnant women from 59% to 42% within four years (Thompson, 2014). Similarly, the same study found that the proportion of anaemic under five children decreased from 84% to 66%.

Research shows that among the different population subgroups, educating groups is more effective than individuals. In fact, Contento (2011) states that "working with groups is at the heart of nutrition education" (p. 365). For example, a study investigating the impact of group education on health-related cognitions and nutrition behaviour of socio-economically disadvantaged populations in Netherlands confirmed the hypothesis that education at a group level resulted in a more positive attitude and greater consumption of fish, fruits, and vegetables (Siero, Broer, Bemelmans, & Meyboom-de Jong, 2000). The primary advantage of group approaches is the availability of peers such that the learners can learn and support each other (California WIC Program, 2002; Siero et al., 2000; Stang & Story, 2005). More importantly, using pre-existing groups is beneficial because the participant recruitment process is easy, there is a regular attendance of education sessions, and it is cost-effective (Dollahite & Scott-Pierce, 2003). Despite the numerous benefits, group level nutrition education has its challenges such as working with group members with different temperaments such as quiet, dominant, distractors, and complainers, among others.

Therefore, the educator needs to understand group dynamics and be ready to confront any challenges (Contento, 2011).

Education and Communication Methods

There are two broad categories of these methods: traditional and technology-enhanced methods.

Traditional education methods.

Face-to-face educational methods are the traditional approaches used for either training the target population subgroups directly or educating trainers of these groups, an approach called 'train-the-trainer' or 'peer-led training' (Smith & Smitasiri, 1998). Peer-led training is a very effective and inexpensive approach to reach community members (Yarber et al., 2015) because the trainers are local and familiar people who not only have direct contact with the target groups but also share and participate in the local cultural beliefs and practices (Escamilla, Fiedler, Lopez, Millan, & Perez, 2008; Hosmer, Dwyer, & Villaroel, 1998). The face-to-face methods used to train these groups include lectures, debates, and brainstorming as well as group discussions, demonstrations, and workshops.

Some of the most efficient ways of educating the communities are through group discussions, experiential learning, and workshops. Since facilitated group discussions (FGDs) allow the participant to verbalize their opinions in the learning process (Contento, 2011), they gain confidence and knowledge necessary to make informed decisions about their dietary practices (Abusabha, Peacock, & Achterberg, 1999). In fact, these authors argue that FGDs are more effective than lectures and face-to-face sessions since participants can address their root problems rather than having information imposed on them. On a different note, experiential learning, which involves learning through doing, such as food preparation and

tasting are motivational ways of teaching skills while allowing participants to explore their ideas and attitudes thus enabling them to make necessary dietary changes (Abbott, Davison, Moore, & Rubinstein, 2012). Similarly, Contento (2011) stipulates that learners remember 90% of what they are actively involved in, making experiential learning very efficient. Finally, workshops, which are a combination of presentations, group discussions, and hands-on-learning, are not common in developing countries.

Technologically enhanced education methods.

In the 21st century, nutrition education is increasingly being disseminated using new technologies as the primary channel of communication or accompanying traditional methods (Contento, 2011). Some of these technologies include mass media, computers and the internet, video and audio, as well as mobile technologies. Mass media strategies like television and radio began to be used some years ago following massive advertisement of foods high in sugar, fat, and salt (Ullrich, 1978). Although these strategies are widely used, with about 75% of households in developing countries owning a radio for example, (UNESCO, 2012), they are expensive, non-tailored to the participants' needs due to the large audience, and non-interactive making follow-up difficult (Hosmer et al., 1998; Smith & Smitasiri, 1998). On the other hand, with 50% of low- income populations having access to a computer (Neuenschwander, Abbott, & Mobley, 2012), the internet is useful for sourcing, creating, and distributing nutrition related information (Brug, Oenema, Kroeze, & Raat, 2005). However, these authors argue that the main challenge of the internet is the credibility of some sources. Audio, video, and audio-visual media are inexpensive and entertaining means of training, but their disadvantage is that they are non-interactive and require extra equipment to play (Hosmer et al., 1998). These media also need electricity, which rules out the majority of the rural poor. Finally, researchers have identified mobile technologies and especially cell phones as a very promising mode of

delivering nutrition education mainly due to its extensive coverage in both developed and developing nations (Neuenschwander et al., 2012).

Cell Phones

Rates of Ownership

From 1994 to 2015, mobile cellular subscriptions rates have risen steadily worldwide (Statista, 2016; World Bank, 2015). According to Nair (2015), the number of cell-phone subscribers was seven billion at the end of 2015 as per a report produced by the International Telecommunication Union. Among the total numbers of subscribers globally, 70% of them live in low and middle-income countries (Bastawrous, Henning, & Livingstone, 2012). In fact, Europe and Asia-Pacific have the highest subscription rates followed by sub-Saharan Africa (Winsor, 2015b). With the number of cell phone users in Africa increasing from 348 million in 2014 to 388 million in 2015, and with 88% of the African continent having a mobile cellular signal (Winsor, 2015b), the continent has bypassed the prevalence of landline telecommunication technologies in developed countries (Aker & Mbiti, 2010; Winsor, 2015a).

The rising trend in mobile ownership found across Africa is also evident in Kenya. The mobile penetration rate in Kenya is higher than that of Africa. For instance, while the cell phone penetration rate in Africa was 65% in 2012, it was 75.4% the same year in Kenya (Crandall et al., 2012). A report by the Communications Authority of Kenya (2014) reveals that the penetration rates rose to 80% in 2014. In the following year, the rates soared up to 88% with the number of mobile subscribers increasing to 37.8 million (Communications Authority of Kenya, 2015; Kariuki, 2016). Despite the high ownership rates, cell phone ownership in Kenya is dependent on gender, literacy levels, and area of residence among others. For instance, more men than women own cell phones; similarly, less educated

individuals are less likely to own a phone as compared to the more educated group (Pew Research Centre, 2015). In regards to the area of residence, the average cell phone ownership in urban areas is 58% while it is 39% in rural areas (Wesolowski, Eagle, Noor, Snow, & Buckee, 2012). Mobile sharing is common: research conducted in rural Kenya indicated that while 85% of rural residents used a phone, only 44% of these had a personally owned phone (Maree, Piontak, Omwansa, Shinyekwa, & Njenga, 2013; Wesolowski et al., 2012). Finally, poor rural women are the most underrepresented group in cell phone ownership (Crandall et al., 2012; Wesolowski et al., 2012).

Cell Phone Usage

The exponential growth of mobile ownership solicits a question: how are they being used? Knowing how people use their phone is crucial in designing educational interventions that uses the phone as a tool for conveying information. Other than talking, 80% of cell phone subscribers in Africa use their phone for texting, 53% for either taking videos or pictures, and 30% use them for sending and receiving money (Pew Research Centre, 2015). Likewise, 100% of Kenyan cell phone owners use them for making and receiving calls while 83% use them for texting (Crandall et al., 2012). Money transactions using phones have a uniquely high prevalence in Kenya compared to other African countries (Crandall et al., 2012; Winsor, 2015a). The cell phone uses in Kenyan rural areas is depicted in Appendix IV. According to Eriksson (2008), short message service (SMS) is one of the cost effective functions of phones in these areas. In fact, Dobush (2015) notes that cell phones are effective channels which can influence the lives of rural residents positively by changing how they handle money, work, participate in government issues, and ultimately, how they learn. Other less frequent uses include listening to FM radios, browsing social media sites, political news channels, job application sites, and health awareness sites among others.

In addition to these general uses of cell phones, developing countries are using them for conveying health messages (Bastawrous et al., 2012; Kaplan, 2006). Moreover, some of these countries are specifically utilizing cell phones for delivering nutrition education messages (King & Osei, 2015; Temple & Steyn, 2016). The majority of programs using phones focus on maternal and child health (MCH). For example, UNICEF has a mobile midwife program in Nigeria and another program in Mexico that follows up on children's health and nutrition for their first one thousand days of life (UNICEF Innovation, 2015). The WHO also has an SMS awareness program in Bangladesh (WHO, 2013), which targets women's nutrition through pregnancy and child nutrition for the first days of life. Furthermore, Tanzania and Kenya has an "mNutrition" program, which is a cell phone intervention that entails sending reminders and informative text messages to support pregnant and new mothers on issues regarding supplementation, balanced diet, and exclusive breastfeeding. (Viljoen & Sowah, 2015). On the same note, the Ministry of Health and that of telecommunications in unison with mobile operating companies send reminders on maternal and child health issues to over 10 million cell phone subscribers in Cameroon (Achanyi-Fontem, 2013), while cell phones are in use in Egypt's rural areas for the same purpose (Chetley, 2006). Viljoen and Sowah (2015) noted that the mNutrition programs present in Kenya and other African countries address maternal topics such as the use of locally available foods, promotion of micronutrient and fortified food intake among others. Although this information is very crucial in preventing micronutrient deficiencies, it only targets pregnant and new mothers without focussing on the rest of the population. Finally, phones have also targeted infant and young child feeding (IYCF project) knowledge, attitudes and practices in these nations (Graziose, O'Brien, Downs, & Fanzo, 2016).

Effectiveness of Using Cell Phones to Convey Health and Nutrition Messages

According to Viljoen and Sowah (2015), the effectiveness of cell phones for health and nutrition education is measured in consideration of user efficacy, impact on the health system, user adoption, and cost rather than the knowledge, attitudes, and practices of the target group. In regards to efficacy, most research studies reveal that cell phone use had a positive influence on the participants. For instance, a study using phones in IYCF-related educational campaigns found out that there was an improvement in exclusive breastfeeding rates (Graziose et al., 2016). Similarly, a cell-phone enhanced MCH program in Mozambique resulted in a significant proportion of malnourished children attaining a healthy nutrition status (Viljoen & Sowah, 2015). Cell phone use results in information retention rates of 68% and is particularly efficacious when the text or app uses the participant's name (Head, Noar, Iannarino, & Harrington, 2013).

It is evident that the use of cell phones in developing countries has a positive impact of improving the health outcomes of targeted groups (Achanyi-Fontem, 2013; Kaplan, 2006). In fact, Kaplan (2006) notes that cell phones improve this outcome by promoting new learning as well as increasing access to health and nutrition information. The timely information empowers not only the participants but also the community and health workers through facilitating communication and interaction (Achanyi-Fontem, 2013; Chetley, 2006; WHO, 2013). On a different perspective, the high mobile network coverage, particularly in the rural areas, enables the underserved areas to receive relevant information since they need it most (UNICEF Innovation, 2015). Researchers also agree that cell phone use is efficient because it is both time- and cost-effective as well as widely accepted globally (Achanyi-Fontem, 2013; Head et al., 2013). The ubiquitous nature of cell phones also makes them very useful in conveying health and nutrition information (Kaplan, 2006). However, technical

challenges such as small screen size and unreliable battery life are some of the greatest challenges of cell phone use in rural areas (Achanyi-Fontem, 2013).

By and large, a recent review assessing cell phone use concluded that most research studies conducted in developing countries suggest that using cell phones can be an effective method to improve health literacy and outcomes (Gurman, Rubin, & Roess, 2012). Achanyi-Fontem (2013) also noted that most programs utilizing cell phones are implemented in Africa because of the ubiquity of these phones even in the rural and remote areas. Therefore, effective utilization of mobile technologies in financing, governance, agriculture, education, and health have a great potential of lifting people from poverty (UNICEF Innovation, 2015), which is the primary cause of food insecurity that leads to micronutrient malnutrition (Bailey et al., 2015; Gibson, 2014; UNICEF, 2013). However, most nutrition-based programs utilizing cell phones in African rural areas focus primarily on maternal and child health (Viljoen & Sowah, 2015). None of these programs address family diet diversity and food security and they also leave out other population subgroups like the women used in this research study. There is also limited research on the use of cell phones to enhance nutrition education programs aimed at improving dietary diversity through food-based agricultural interventions thus curbing food insecurity and associated micronutrient malnutrition. Farmers Helping Farmers (FHF), a non-governmental organization with operations in the study area, has conducted peer-led training sessions from 2010-2013 and in 2016 whereby food security and dietary diversity has been assessed. However, they have never used technological training methods like cell phones or investigated the target group's knowledge, attitudes, and practices. Therefore, to gain an in-depth understanding of the effectiveness of the cell phones in these interventions, this study aims to answer the following question: to what extent does the use of cell phone enhancements to a combined agriculture and nutrition education intervention improve the dietary knowledge, attitudes, and practices of women

belonging to self-help groups in Naari, Meru County, Kenya? To do this, the study addressed the following two sub-questions:

1. How do knowledge gain, attitudes, and nutrition practices of women in the self-help group receiving cell phone enhanced nutrition education compare with those of women from the self-help group who receive face-to-face peer-led trainings only?
2. What are the benefits and challenges of using cell phones as a supplement to face-to-face peer-led model of education?

Summary of Chapter 2

Chapter two primarily focused on literature related to nutrition education as a means of alleviating some rampant nutritional problems present in both developed and developing countries, but felt more severely in the later nations. It gives a detailed overview of the magnitude of these problems and the strategies that have been employed to solve them. It specifically expounds on traditional and technologically enhanced nutrition education methods and particularly the use of cell phones. The chapter also explicitly shows the research gap that this research study was trying to fill. Therefore, the next chapter dwells on the specific research methods and procedures used in this study to answer the questions that have not been answered by previous studies.

Chapter 3: Methodology

In this section, I describe how this research study was conducted to find answers to the two research sub-questions. Therefore, I focus on researcher positionality, theoretical framework, and particular research methods and procedures.

Researcher Positionality

Since it is impossible for researchers to separate themselves from their research (Creswell, 2014), I would like to describe my role as a dietitian and nutrition educator. I had an opportunity to contribute to the nutritional management of various diseases and conditions in a hospital setting, which made me appreciate the value of preventive nutrition interventions like nutrition education at the community level. Therefore, as mentioned earlier, I have an interest in empowering communities with nutrition knowledge aimed at prevention because it is more effective than trying to manage or cure diseases or conditions. In light of this, I was involved in nutrition education using face-to-face peer-led training as a volunteer with Farmers Helping Farmers (FHF), a volunteer-based non-profit organization that has been working on projects in Kenya since 1980 (http://www.farmershelpingfarmers.ca/).

At this point, it is worth noting that this research study was one part of a larger research project titled 'Integrating Innovative Research and Training Methods for Improved Sustainable Livelihoods of Kenyan Smallholder Dairy Farms.' The project, which began in 2015, was a five-pronged partnership between University of Prince Edward Island (UPEI), which was the lead partner; FHF, a Canadian non-governmental organization based in Prince Edward Island; Kenyatta University; University of Nairobi; and, Naari Dairy Cooperative Society. Its primary objective was to improve nutrition, food security, and livelihoods of smallholder farmers in Naari. To achieve this goal, some project activities were already in progress with the involvement of FHF employees based in Kenya, Naari Dairy Cooperative

Society members, and the interdisciplinary team of students from the three Universities noted above. Therefore, I, as part of the nutrition team comprising of two undergraduate students from UPEI, two graduate students from UPEI, and employees of FHF, facilitated the women's nutrition training sessions. These sessions included discussions about selected nutrition messages, home fortification in which women leaders learnt how to add nutritious crops to their food, as well as food preparation and tasting sessions.

Theoretical Framework

This research study uses an activity theory (AT) model that has its origins in the early twentieth century as developed by Russian psychologist Vygotsky and his student, Leontiev (Impedovo, 2011). In 1987, Engestrom, a Finnish educationist, expanded the theory to what it is today making the theory spread beyond Russia to other parts of the world (Hasan & Kazlauskas, 2014; Impedovo, 2011). The theory states that human activity such as learning takes place purposefully with the mediation of factors like tools and community among others (Figure 3.1). It has been widely used in designing, implementing, and evaluating the effectiveness of mobile learning in both formal and informal settings (Barhoumi, 2015; Dissanayeke, Hewagamage, Ramberg, & Wikramanayake, 2015). According to AT, a subject uses a tool or tools to perform an activity to achieve a particular objective and ultimately, accomplish an outcome. During this process, the execution of the activity is mediated by a series of variables such as rules, community, or division of labour, as shown in Figure 3.1 below.

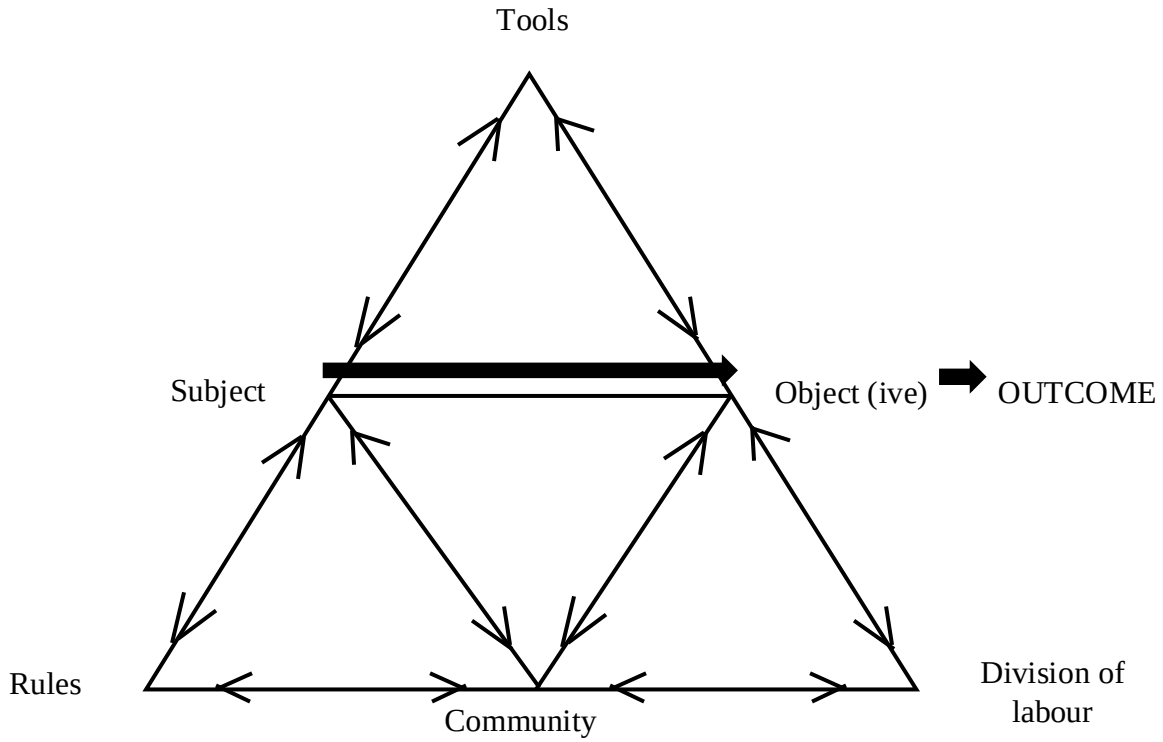

Figure 3.1: Illustration of Activity Theory designed by Engestrom (Barhoumi, 2015)

In this research, the subjects were individual women of a self-help group engaged in an activity of learning. The objective of this activity was acquiring nutrition knowledge on strategies for improving the nutritional value of their household food while the ultimate outcome was increased intake of micronutrient-rich foods among other good nutrition-related practices. As noted earlier, an activity is not that independent and straightforward, but instead, tools and community mediate it (Hasan & Kazlauskas, 2014). While tools can be both physical and psychological materials that humans use to carry out an activity, a community is a group of people who share the same objective (Impedovo, 2011). The community supports the subjects to achieve their goal by performing roles such as facilitators, peers, and education institutions (Dissanayeke et al., 2015). In the case of this research, tools were the cell phones. The community was self-help group members, nutrition education sessions facilitators, and any other individuals who worked with the women to achieve the objective.

In addition to tools and community, other mediators in the overall activity system are rules and division of labour. As shown in Figure 2.1, rules mediate the interaction between the subject and the community. Rules are conventions and guidelines that regulate activities in the activity system (Barhoumi, 2015). For instance, the women who received the cell phone enhancement got the nutrition-related text messages on a weekly basis. On a different perspective, division of labour mediates the relationship between the community and overall objective. In this research study, division of labour was not relevant since the self-help groups had already divided roles and responsibilities among them. By and large, taking the AT perspective informed the research study's quantitative measure of the impact of incorporating cell phone (tools) enhancements to conventional education methods among women (subjects) in self-help groups (community) on their learning outcomes (objective). Moreover, it guided the qualitative aspect of the research study that sought to understand the perceptions of the women (both subject and community) towards the use of cell phones (tools).

Research Design

In this research, I used a mixed methods design. According to Johnson, Omwuegbuzie, and Turner (2007), this approach involves combining "quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study or set of related studies" (p. 120). Mixed methodology, which originated in the late 1980s based on research from varied fields of study (Creswell, 2014), was the chosen approach since it provided a holistic understanding of this study's research questions. This methodology gave a better understanding of the experimental results of comparing and contrasting the knowledge, attitudes, and practices (KAP) of women in self-help groups trained using traditional face-to-face training methods with those who received cell phone

messages as an addition to this training. In fact, more researchers in the health field are using the mixed methods approach since the qualitative element of the research provides a better understanding of the quantitative data (Tariq & Woodman, 2013). It also incorporated the perspectives of the latter group in regards to the technological enhancement they received.

I used an embedded mixed method approach, which nests one form of methodology (quantitative or qualitative) within the context of a broader design (Creswell, 2014). In this case, qualitative data was embedded within quantitative data to enrich and add more meaning to it. Simply, quantitative data about the women's dietary knowledge, attitudes, and practices were collected from the intervention group (women who received the cell phone messages to boost traditional nutrition education) and the comparison group (women who received conventional nutrition education only). For a closer examination of the cell phone technology enhancement, qualitative data regarding the benefits and challenges of using cell phones were collected from the intervention group only. The embedded mixed method design was beneficial in this study since it not only helped in evaluating the impact of augmenting the face-to-face peer-led trainings with a cell phone intervention, but it also allowed for a closer examination of the experiences and perspectives of those who used the cell phones. Figure 3.2 provides an illustration of the research design involved in this study.

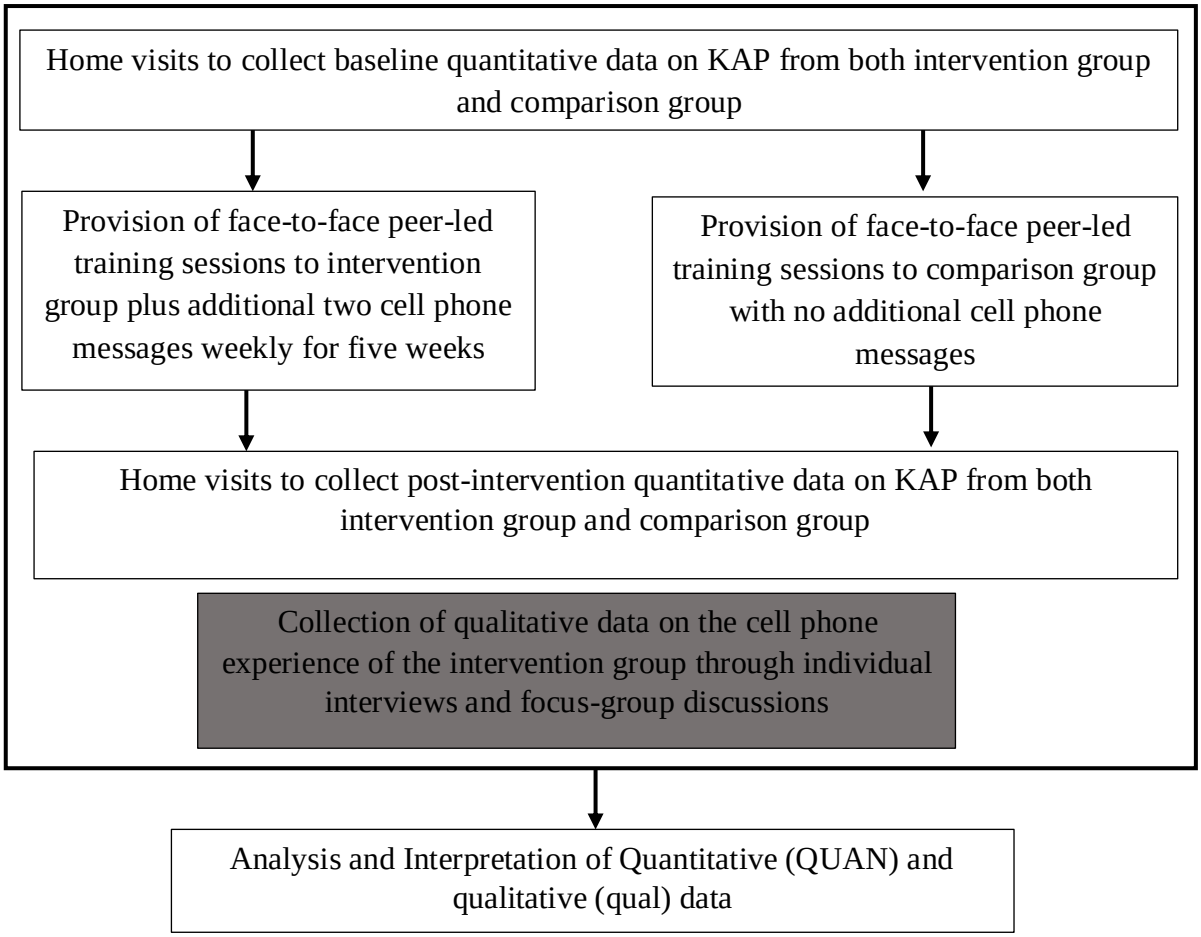

Figure 3.2: Illustration of research processes using embedded mixed methodology

Research Participants

The target population for this research study was two women's self-help groups situated in Naari, Meru County. The two self-help groups were 'Joy', which had twenty-four (24) members and 'Upendo' that had thirty (30) members. Joy women's self-help group acted as the intervention group and Upendo women's self-help group as the comparison group. The two women's groups were not selected randomly but instead FHF, the NGO working in that community, provided them. One woman from each of the two groups was assigned the role of translator. The two women, who held leadership positions in each of the two groups, were selected by their group members to be translators. These two women did not take part in the study. In addition to that, one woman from Joy group did not receive the

intervention, which was the nutrition-related cell phone messages, since she provided a phone number that had one wrong digit. Therefore, the research participants were twenty-two (22) and twenty-nine (29) women from the intervention and comparison group, respectively.

The number of women participating in the quantitative phase of the study was different from that of those participating in the qualitative phase of the study. Firstly, for the quantitative phase, all women from the intervention group (n=22) and comparison group (n=29) participated in the baseline study before the intervention. Each of the two groups had six leaders who were referred to as 'champs', short for champions. Champs were women leaders who had been recognized by their self-help group members as good cooks and good farmers. These champs were required to attend the comprehensive training sessions on nutrition messages that was facilitated by undergraduate and graduate students from UPEI that were part of the nutrition team. The nutrition messages were about nutrition and cooking tips of local meals such as: *githeri*, a mixture of maize and beans; *mukimo*, a mixture of maize and beans mashed with starchy vegetables; *uji* or porridge; *chapatti* or flat bread, and tea (Appendix V). In addition to that, there was also messages relating to deworming. The champs then had the responsibility of training other group members on the same messages that they had been taught as well as helping to organize the food preparation sessions. In addition to this face-to-face training, the intervention group received the booster cell phone messages. After the intervention, the research participants were twenty-one (21) women from the intervention group and twenty-nine (29) women from the comparison group. Although the missing one woman from Joy group received the intervention, she was unable to participate in the study since she was dealing with a serious family matter.

Secondly, the qualitative phase of the study involved women from the intervention group only and was carried out after the cell phone intervention. To get an insight into each

of the women's opinions, individual interviews on the experiences, benefits, and challenges of the cell phone enhancement involved all the twenty-one (21) women. Moreover, two FDGs, one composed of the champs and the other the non-champs, were conducted to get a holistic picture of both leaders and non-leaders. These FDGs involved five champs and six non-champs from the intervention group, each discussing the group's perspective towards the cell phone technology enhancement among other issues. Although the champs consist of six women only five of them where involved in the FDG since one woman had been assigned the role of a translator.

Data Collection Tools

The data collection tools used included: (i) baseline data survey questionnaire; (ii) post-intervention survey questionnaire; and (iii) focus group discussions guides. Although a separate instrument for in-depth interview had been proposed earlier for use on a selected number of women, it was incorporated in the post-intervention survey questionnaire to capture the perspectives of all the women in the intervention group.

Baseline Data Survey Questionnaire (Appendix VI)

This survey questionnaire had four major sections: food use; nutrition knowledge, attitudes, and practices (KAP); cell phone ownership and use; and, household demographics. I adapted the KAP questionnaire developed and used in 2016 by the nutrition team to evaluate the effectiveness of the nutrition education intervention then. Therefore, only relevant information was picked for this research study. Additional information such as cell phone ownership and use as well as household demographics were added to suit this study. The first section, which focussed on food use, was not relevant to this research study. The second section was a KAP survey that is a tool used to measure the understanding, tendencies, and observable actions of an individual in response to a given phenomenon

(FAO, 2014). It was the preferred tool for the study because it effectively obtained baseline and post-intervention data that were helpful in measuring the effectiveness of incorporating cell phone technology into traditional face-to-face nutrition education methods. The survey questions for the questionnaire related to all the targeted nutrition messages taught in the face-to-face peer-led nutrition education sessions although this study focused on only five of these messages. The five messages were: 1) using equal portions of maize and beans to increase protein intake; 2) soaking maize and beans to conserve iron in the food; 3) using two or more vegetables in meals to increase vitamin A intake; 4) taking fruits with meals to enhance iron absorption; and, 5) deworming to protect all the nutrients.

The third section collected data on the rates of cell phone ownership as well as phone usage. This information was vital in comparing and contrasting the cell phone related characteristics of the intervention and comparison group. It also gave an overview of the proportion of women in the intervention group with a phone as well as their basic phone uses. The specific information collected using this tool included: type of phone; access to the phone; phone use; and language used for cell phone-related communication. Finally, the fourth section collected socio-economic/demographic characteristics of the women's households such as age, education level, occupation, and property ownership among others. The entire questionnaire was administered to both the intervention and comparison group.

Post-intervention Survey Questionnaire (Appendix VII)

Similar to the baseline survey questionnaire, this questionnaire had a food use and KAP section. However, the KAP section was shorter since it only contained questions relating to the five nutrition messages that were of primary focus in this research study. In addition to the two sections, it also had a cell phone message intervention section, which only targeted the intervention group. This section included survey questions such as the number of messages received and read, as well as ratings of the women's motivation to implement

nutrition information on the texts, among others. It also had interview questions such as the content of the cell phone messages, the women's ability to understand the messages, and the challenges they encountered. Both the intervention group and comparison group answered the first two sections of this questionnaire. On the other hand, the third part was only administered to women from the intervention group.

Focus Group Discussions (FDG) Guides

FDG was used for this research study because it is a very productive means of generating insights into research topics (Salkind, 2012). Moreover, FDG could enrich the data collected in the surveys and interviews among the intervention group with data regarding the perspectives of the group towards the cell phone technology enhancement. Some of the topics covered included the perceived benefits, challenges, and value of cell phone messaging as an enhancement to traditional education methods among other topics. It also covered topics related to the face-to-face champs training/workshop that the women had before the cell phone intervention. Since the champs received the training and conducted the workshops, their FDG guide was structured slightly differently (Appendix VIII) from the one for non-champs who were involved in the peer-led workshops only (Appendix IX). Nonetheless, the interview guide for the cell phone messaging section was identical for the two (2) groups.

Quantitative Part of the Study

This section describes the research variables, data collection procedures, and data analysis for the quantitative part of this study.

Research Variables

The first research question for this study was: 'How do knowledge gain, attitudes, and nutrition practices of women in the self-help group receiving cell phone enhanced nutrition

education compare with those of women from the self-help group who received traditional face-to-face peer-led training only?' Therefore, the dependent variables were the women's knowledge, attitudes, and practices relating to the nutrition messages while the independent variables were group (intervention and comparison group) and time (pre-intervention and post-intervention). Finally, the study had some demographic factors that had the likelihood of influencing the dependent and independent variables. Some of these demographic characteristics were the women's age, education level, marital status, as well as ownership of a house, agricultural land, and livestock. Moreover, other variables measured were the women's cell phone related characteristics, such as phone ownership, access, and length of use, phone uses, and the language of communication over the phone.

The dependent variable, knowledge, was mainly measured using open-ended questions to avoid bias that would be associated if responses were provided. According to the baseline survey questionnaire (Appendix V), there were twelve open-ended questions. The only closed-ended question was Q39d. The variable assessed the women's familiarity with these five key messages: using equal proportions of maize and beans for *githeri*, soaking maize and beans, adding greens and orange-fleshed vegetables in meals, taking fruits with meals, and deworming children and/or grandchildren. The champs in both the intervention and comparison group had taught their peers about these messages during the face-to-face training sessions. In addition to these trainings, the intervention group received weekly cell phone messages that were created from the information taught to the women during the face-to-face sessions.

On the other hand, a five-point Likert scale was used to measure the attitude variable. This scale ranged from 'extremely important' to 'not important at all'. The attitude variable assessed how the women rated the importance of adding green vegetables, adding orange-

fleshed vegetables, adding two vegetables to githeri, taking fruits with meals, and deworming children. The five attitude questions included Q37c, Q31, Q34, Q35, and Q39a (Table 3.1)

Finally, close-ended questions were used for the practice variables. Majority of these questions required a 'Yes' or 'No' response apart from one question whereby women had to give the exact amount of maize and beans used when preparing *githeri* (Q23b).There were a total of nine close-ended practise questions. The practice variable assessed the women's frequency of deworming their children and/or grandchildren, as well as whether the women soaked their maize and beans, added greens to *githeri*, added orange-fleshed vegetables to meals, or ate fruits with meals.

The KAP survey questions relating to the three dependent variables were categorized according to the nutrient focus of the intervention messages to facilitate understanding of findings and reduce the number of variables as illustrated on Table 3.1. The protein-related questions centred on the message concerning using equal proportions of maize and beans in *githeri*, while the iron-related questions were those dealing with soaking maize and beans, as well as taking a fruit immediately before or after meals. The questions relating to adding green vegetables, orange-fleshed vegetables or both to meals were grouped as vitamin A-related questions. Lastly, any questions regarding deworming were categorized as a protection of all nutrients question since deworming eliminates parasites thus ensuring that an individual's body absorbs all nutrients. The specific survey questions for each of the categories are shown below.

Table 3.1: Dependent variables in the quantitative analysis

Dependent variables	Nutrient categories	Survey items (Appendix VI)
Knowledge	Protein-related questions	Q22, Q23c
	Iron-related questions	Q25b, Q26b, Q27, Q28, Q37b
	Vitamin A-related questions	Q30b, Q30d, Q33b, Q33d, Q33f
	Protection of all nutrients question	Q39d
Attitudes	Protein-related questions	None
	Iron-related questions	Q37c
	Vitamin A-related questions	Q31, Q34, Q35
	Protection of all nutrients question	Q39a
Practices	Protein-related questions	Q23b
	Iron-related questions	Q25a, Q26a, Q37a
	Vitamin A-related questions	Q30a, Q33a, Q33c, Q33e
	Protection of all nutrients question	Q39b

Data Collection Procedures

Home interviews of each of the women in both groups were conducted to collect baseline data on their knowledge, attitudes, and practices, cell phone ownership and use, as well as household demographics (Appendix VI). The data were collected using the baseline data survey questionnaire. In consideration of the different literacy levels and English/Swahili comprehension of the women, a translator asked the survey questions in the local dialect, Kimeru. The process of administering this survey took approximately one hour for each person. Training of the champs then followed this baseline data collection. The champs then facilitated the peer-led nutrition education session in each of the two women's groups.

Cell phone messaging to women in the intervention group followed the face-to-face training workshop. This group received two text messages per week based on five selected key messages illustrated in Table 3.2. The women got the first message at the beginning of each week, which was a reminder of a key nutrition message and its benefits. Women then

received a second text in the middle of each week, which was a reminder of the practise associated with the message. Since there were five nutrition messages, the cell phone messaging period lasted for five weeks. It is worth noting that the messages were in Kimeru. After the intervention, KAP-related post-intervention data were collected from each woman in the intervention and comparison group using the knowledge, attitudes, and practices questions in the post-intervention survey questionnaire. The intervention group were asked additional survey questions regarding their cell phone messaging experience.

Table 3.2: Weekly cell phone messages with the nutrient on focus for the intervention group

WEEKS	TARGETED NUTRIENT	MESSAGES	
		Beginning of week message	**Mid-week message**
Week 1	Protein	Did you know: Both maize and beans in your githeri are equally helpful in giving you strength and building your body? Balance them out!	Remember to measure an equal proportion of maize and beans for the githeri. Always maintain the 1 to 1 ratio!
Week 2	Iron	Did you know: Soaking maize and beans removes substances that hinder absorption of some nutrients in your body? Soak your grains and soak up healthy nutrients!	Remember to soak maize and beans overnight. Before cooking, rinse the soaked grains and water your garden with soaking water. You and your garden will smile!
Week 3	Vitamin A	Did you know: Eating more vegetables makes you healthier and less sick? Add more healthy days to your life and more colour to your pot with more vegetables!	Remember to add two more vegetables to your cooking pot in addition to onions and tomatoes. Add the green leafy vegetables late in the cooking. The more, the healthier!
Week 4	Iron	Did you know: Taking fruits like oranges after meals make iron in food more available for absorption in your body? Say yes to fruits and no to anaemia!	Remember to eat a fruit shortly before or after your food. A fruit a day keeps conditions like anaemia and others away!
Week 5	Protecting all nutrients	Did you know: Worms compete with your body for the nutrients in the food you eat and they make you sick? Eliminate these good for nothing parasites!	Remember to ensure that you and every household member take a dewormer once in every three months. Keep a record of the last time you took the pill lest you forget!

Data Analysis

For the most part, double entry was used to enter all the quantitative survey data. This data entry was done in Kenya using Microsoft Excel and checked for errors. Data were then converted into four Statistical Analysis System (SAS) files: pre and post for each of the intervention and comparison groups. The next step was data cleaning with the major issues being the coding of open-ended questions. The nature of these questions resulted in the women giving different answers such that while some responses given had values, others did not. The lack of responses resulted in participants having missing values for answers they did not provide. Since SAS automatically formats missing values as character variables, all of these had to be converted to numeric variables. There were also some inconsistencies in variable names among the four datasets that was rectified. The data were then analysed using descriptive and inferential statistics.

Firstly, descriptive statistics were generated for the household demographics and the cell phone ownership and use data on the baseline data survey questionnaire that was collected from both the intervention group and comparison group before the intervention. The same statistics were generated for the intervention group's post-intervention data regarding the cell phone messaging intervention, which was collected using the post-intervention survey questionnaire. In regards to the household demographic or socio-economic/demographic data, variables like house ownership, housing land ownership, marital status, women's age, and women's education status categories were recoded to ensure minimum numbers (>5) in each cell. For instance, house ownership and housing land ownership were categorised into two classes: those who own these properties and those who either rent or do not rent but have the properties on consent or squatting basis. Marital status and women's education variables were also categorized into two: those married and those

with other statuses like widowed, single, or separated, as well as those with primary level education or no schooling and those with more than primary education, respectively. Lastly, the women's ages were classified according to those below 50 years, those between 50 and 59 years, and those aged 60 years and above. Chi-squared tests were then used to assess differences between two categorical variables.

Similarly, variables like length of cell phone ownership, the frequency of receiving, sending, and reading texts were collapsed. The length of ownership was categorized depending on those who had their phones for less than one year, two to four years, and more than five years. There were two categories for the frequency of receiving, sending, and reading texts: often (daily or weekly) and either sometimes (monthly) or never. Finally, Chi-square test was used to identify differences in the intervention group's cell phone intervention data for frequency counts as well.

Inferential statistics were used to assess differences between groups before and after the intervention in terms of the women's nutrition-related knowledge, attitudes, and practices. In regards to knowledge, correct answers were assigned for each of the knowledge questions. This process was followed by scoring right answers for each participant and obtaining sums of each of the 15 knowledge questions. These questions were then grouped into the four nutrient categories: protein, iron, vitamin A, and protection of all nutrients. There was only one single question regarding protection of all nutrients through deworming. An average was obtained for the other three nutrient categories that had multiple questions. Eventually, the differences by both group and time were assessed using the Chi-squared test. In addition to the chi-squared test, t-test was conducted to compare the mean knowledge scores of the women by group and time.

The five-point Likert scale used for the attitude variables was collapsed into two levels. The first was 'extremely important' and the second was a combination of the four remaining scales (very important, important, not very important, and not important at all). The reason for collapsing the variable this way was because a majority of the women either selected the 'extremely' or 'very' important categories, with only a few of them choosing the other categories. There was no question related to their attitude towards proteins due to an omission: women were therefore not asked how important it was for them to use equal proportions of maize and beans in githeri. Moreover, there was only one question on the protection of all nutrients (Table 2). Therefore, the variables were classified into two nutrient-related categories: iron and vitamin A, and an average was computed for each. The average nutrient categories were then collapsed into two levels, 'extremely important' and the remaining categories. The differences in attitudes by group and time were then assessed using the Chi-squared test.

Regarding practices, there were single questions for the messages pertaining to protein and protection of all nutrients (deworming). Therefore, the other questions relating to practices or nutrition behaviours were grouped into two nutrient categories as the knowledge questions were. The two nutrient categories were iron and vitamin A. Eventually, averages of each of the two categories was obtained. These average nutrient categories were collapsed into two levels, those who practised all messages and those who practised some messages and not others. Chi-squared tests were then used to assess differences according to group and time.

Qualitative Part of the Study

This section describes the qualitative part of the study in regards to the data collection and data analysis procedures.

Data Collection Procedure

After the intervention, each woman from the intervention group was interviewed about her cell phone messaging experiences such as: why they did not read all the messages; the questions and concerns they had; how understandable the messages were; the challenges encountered; and, their likes and dislikes regarding the intervention. The interview questions were combined with the survey questions on the post-intervention survey questionnaire. Table 3.3 illustrates the specific interview questions asked of the women. In addition to the interviews, two FDGs were conducted on Joy women. The first FDG involved five champs from the intervention group on the group's perspectives of cell phone messaging. Although the FDG was expected to last for 45 minutes, it lasted for three hours since the questions had to be translated to Kimeru and the responses from the women had to be translated back to English. The second FDG involved six randomly selected non-champs. This FDG lasted approximately the same period as the previous FDG due to heavy reliance on translation from the women and research team as well. It is crucial to note that translation for both individual interviews and FDGs was not verbatim to conserve time. The translator would listen to the opinions of a number of women and then report back in English. Therefore, it was not a word-by-word translation.

Table 3.3: Open-ended interview questions for the intervention group

Question number	Specific question
Q38	Why did you not read all the ten (10) messages that were sent to you?
Q47a	What are some of the questions and concerns that you had relating to the number of messages received during the five weeks?
Q47b	How did you handle these questions and concerns?
Q48a	What are some of the questions and concerns that you had relating to the content and understandability of the messages during the five weeks in which you were receiving the messages?
Q48b	How did you handle these questions and concerns?
Q48bi	Why did you ask for help reading the messages?
Q48bii	Why did you ask someone to help you understand what the message said?
Q49	Please tell me any challenge that you encountered during the five (5)weeks of cell phone messaging. If no challenge, what made it easy for you?
Q50a	What did you like about receiving the cell phone messages?
Q50b	What did you not like about receiving the cell phone messages?

Data analysis

For the interviews, I typed all the notes written during the interviews, labelled the document and saved it into the computer. I also transcribed the responses from each of the FDG interviews and saved them appropriately. I manually analyzed the qualitative data collected using highlighters of different colours to distinguish various themes and sub-themes. The qualitative analysis used the three-stage process described by Miles and Huberman (1994). The three stages were data reduction, data display, and conclusion. First, data were reorganized into themes. Then, the themes were mapped and categorized to identify relationships. Last, I came to conclusions on implications and made sense of the data. However, 'sense-making' did not only occur at the end of the data analysis but was ongoing throughout the research. Once I had read the typed notes and transcribed data multiple times, coded it, and identified patterns that formed subthemes, themes, and categories, I interpreted the analysed data and compiled a report of the qualitative findings.

Finally, to establish the credibility of these findings, a graduate student (Anne Shileche) who was part of the larger project but conducting her research in a different field reviewed my interview notes, FDG transcripts, as well as my themes and sub-themes and reported back her findings. The larger part of her findings coincided with my themes and sub-themes, which suggested that the data were credible. Following this review, I refined some of my subthemes by adding extracts that I had earlier overlooked.

Ethical Considerations

Prior to beginning the study, I sought ethical clearance from UPEI's Research and Ethics Board (REB) (Appendix XIIa). The REB was also notified of all the changes that were effected while conducting the data collection (Appendix XIIb). During the study, I disclosed the general purpose of my research project to the participants and obtained voluntary informed consent from each of the participants (See Appendix X). Therefore, despite the fact that all participants were part of a self-help group, no participant was coerced to participate in the study. Moreover, they were free to withdraw from the study at any time. In addition, to avoid disrupting the participants' daily farming activities, I collected data between the mid-morning hours and mid-afternoon hours that are less busy for the participants. On the same note, I rescheduled an interview session to a mutually convenient date and time if the participant was very engaged with farm work upon visitation or was unavailable. During the data analysis process, I dissociated the participants' names from the quantitative data responses. For the qualitative data, I assigned alphanumeric codes to the participants to protect their identities. Finally, the raw data was stored in password-protected computer files and will be erased after five years.

Summary of Chapter 3

This chapter explored the procedures that were used to carry out this research study. The study was guided by activity theory that stipulates that learning takes place through the mediation of a variety of factors including tools like cell phones. In this study, both the intervention (Joy) and comparison (Upendo) groups received face-to-face nutrition education trainings, but in addition to this training, the intervention group received booster cell phone messages for a five-week period. This research employed a mixed methods approach; Quantitative data were collected using surveys, while interviews and focus group discussions yielded the qualitative data.

The quantitative data collected were intended to find answers as to whether the additional cell phone booster messaging had an impact on the intervention group's knowledge, attitudes, and practices as compared to the comparison group, who had no booster. These data were analyzed using both descriptive and inferential statistics. The results of the analysis are presented in the following chapter.

Chapter 4: Quantitative Results

In this chapter, I present the quantitative results of this research study. It specifically answers this sub-question; how does nutrition-related knowledge, attitudes, and practices of women receiving cell phone message-enhanced nutrition education compare with those of women who receive face-to-face peer-led training only?

Descriptive Statistics Results

This part of the thesis presents results on socio-economic/demographic data as well as baseline data on cell phone ownership and use for the intervention and comparison groups. It also provides data on the cell phone messaging intervention collected from the intervention group only.

Socioeconomic/demographic Status

Socioeconomic/demographic data for both the intervention and comparison groups are included in Table 4.1. In regards to their socio-economic status, there were no statistically significant differences in the ownership of a household structure, housing land, agricultural land, and a bank account. While all the women from both groups owned some form of livestock, women in the intervention group were significantly more likely to own exotic cattle than those in the comparison group ($p=0.01$). Households keep this kind of cattle for milk production; they sell the milk and thus can earn some income from their exotic cattle. There were more women from the comparison group owning local cattle, which are kept for domestic chores like transportation, than those from the intervention group, although differences were not statistically significant. There were no differences between groups in terms of demographic characteristics such as age, marital status, and education. The intervention group's mean age was 51 years ($SD=15.67$) while that of the comparison group was 49.3 ($SD=9.24$) years.

Table 4.1: Socio-economic/demographic data of the intervention (n=22) and comparison (n=29) groups in Naari, Kenya in 2017

	Women's group		
Demographic Variable	**Intervention N=22**	**Comparison N=29**	**p-value**
	n (%)	**n (%)**	
Property ownership:			
Household structure	20 (90.9)	26 (89.7)	1.00
Housing land	20 (90.9)	25 (86.2)	0.94
Agricultural land	20 (90.9)	26 (89.7)	1.00
Livestock	22 (100)	29 (100)	n/a
Local cattle	2 (9.1)	8 (27.6)	0.20
Exotic cattle	21 (95.5)	18 (62.1)	0.01*
Bank account	10 (45.5)	14 (48.3)	1.00
Woman's age:			
Less than 50 years	9 (40.9)	14 (48.3)	0.73
50 to 59 years old	9 (40.9)	11 (37.9)	
60 years and above	4 (18.2)	4 (13.8)	
Woman's marital status:			
Married	20 (90.9)	21 (72.4)	0.20
Others (widowed, single, and separated)	2 (9.1)	8 (27.6)	
Woman's highest level of education:			
Less than or equal to primary education	10 (45.5)	16 (55.2)	0.69
Others (vocational school, high school, college, university)	12 (54.6)	13 (44.8)	

Baseline Cell Phone Ownership and Use

The majority of the women owned personal phones and mainly used basic feature phones (Table 4.2). There was no statistical difference in the length of ownership of the cell phones between the two groups. When asked to describe what they use their cell phones for, all the women from both groups stated they used them for making and receiving calls. The top two uses of cell phones were for calls and money transfer. As shown in Table 4.2 (shaded area), no statistics were run on the top uses of cell phones and use of the phones for texting due to the open-ended nature of these questions; women were not specifically asked about different options and therefore, it is possible that we have underestimated the proportion of women in each use category. A numerically higher proportion of women in the intervention group (18 out of 22) used their phones for sending and receiving texts as compared to the comparison group (8 out of 29). In regards to the daily or weekly use of text messaging for receiving, sending, or reading text messages, there was no significant difference between the two women's groups (Table 4.2). Finally, as opposed to English and Kiswahili, Kimeru was the most commonly used language for any kind of communication over the phone by all women (data not shown).

Table 4.2: Cell phone ownership and use data of intervention (n=22) and comparison (n=29) groups in Naari, Kenya in 2017

	Women's group		
Pre-intervention Cell Phone variables	**Intervention N=22**	**Comparison N=29**	
	n (%)	**n (%)**	**p-value**
Cell phone ownership:			
Own personal phone	20 (90.9)	27 (93.1)	1.00
Cell phone use:			
Calling and receiving calls	22 (100)	29 (100)	n/a
Texting	18 (81.8)	8 (26.6)	n/a
Women using cell phones daily or weekly to text:			
Receive texts	13 (59.1)	25 (86.2)	0.06
Send texts	8 (36.4)	9 (31.0)	0.92
Read texts	13 (59.1)	21 (72.4)	0.48

Intervention group's Post-intervention Cell Phone Messaging Data

All women in the intervention group confirmed that they received nutrition-related text messages. Over the five-week period, more than 85% of the women from the group received and read the text messages. Moreover, all the women reported that they read the text each time they received it. About the content of the messages, the women used a five-point scale to rate how informative and understandable the messages were (Appendix VI, question 40). 20 (95.2%) out of the 21 women who provided responses to this question affirmed that the messages were 'extremely informative'; only one (4.8%) said they were 'informative'. On the same note, 9 (42.9%) and 12 (57.1%) out of 21 women indicated that the texts were 'extremely understandable' and 'very understandable', respectively. In addition, the women were highly motivated by the cell phone messages to implement the

nutrition information on the texts as shown in Table 4.3.

Table 4.3: Proportions of women in the intervention group (n=20) who were 'extremely motivated' to implement nutrition messages in Naari, Kenya in 2017

Nutrition message	Nutrient categories	n=20 (%)
Equal proportion of maize and beans	Protein-related question	14 (70)
Soaking dry maize and beans	Iron-related question	16 (80)
Adding two vegetables	Vitamin-A related question	14 (70)
Fruits with meals	Iron-related question	17 (85)
Deworming children frequently	Protection of all nutrients question	16 (80)

Note: n is less than the total number (22) of women since a couple of women did not read some messages.

In regard to the two kinds of messages sent weekly, 15 (71.4%) women reported that the 'did you know' and 'remember to' messages were equally helpful, while 6 (28.6%) of them said that the 'remember to' messages were more useful. Most women in the intervention group (76.2%) that were interviewed experienced no challenge with the cell phone messages or the messaging process itself, with only five (5) women from the group asking for help reading the texts.

Impact of Cell Phone Messaging on Knowledge, Attitudes, and Practices

The section provides results regarding the intervention and comparison group's nutrition-related knowledge, attitudes, and practices before and after the cell phone messaging intervention.

Knowledge Changes

As noted earlier, the knowledge questions, which related to the five key nutrition messages, were categorized according to their nutrients of focus (protein, iron, and vitamin A, plus one pertaining to protection of all nutrients). Before the cell phone intervention, there was no significant difference in the intervention and comparison groups' knowledge about

protein, and protecting all nutrients by deworming (Table 4.4). However, there was a statistical difference in the women's knowledge about how to protect iron during cooking and ensure that the body utilizes iron in food, with more women in the intervention group having knowledge scores above 80% relative to the comparison group. Moreover, there was also a statistically significant difference in their knowledge about Vitamin A, which pertained to adding green as well as orange-fleshed vegetables in meals. A Chi square test indicated that more women from the intervention group had correct responses for the vitamin A-related questions as compared to those from the comparison group.

Table 4.4: Proportions of women from the intervention (n=22) and comparison (n=29) groups with knowledge scores above 80 %, by nutrient category, before the cell phone intervention in Naari, Kenya in 2017

	Women's group		
Nutrient categories	**Intervention N=22**	**Comparison N=29**	
	n (%)	**n (%)**	**p-value**
Protein-related questions	5 (22.7)	3 (10.3)	0.41
Iron-related questions	21 (95.5)	20 (69.0)	0.05*
Vitamin A-related questions	17 (77.3)	8 (27.6)	0.001*
Protecting all nutrients (deworming) question	16 (72.7)	20 (69.0)	1.00

In addition to the chi-square test, a t-test was conducted to compare the mean knowledge scores of the intervention and comparison groups before the intervention (Table 4.5). Similar to the chi-square test, there was a significant difference in the knowledge scores relating to iron and vitamin A, with the intervention group having higher mean scores as compared to the comparison group.

Table 4.5: Mean knowledge scores of the intervention and comparison groups before the cell phone intervention in Naari, Kenya in 2017

	Women's group			
Nutrient categories	**Intervention N=22**	**Comparison N=29**		
	M (SD)	**M (SD)**	**t-value**	**p-value**
Protein-related questions	0.82 (0.57)	0.62 (0.44)	-1.41	0.17
Iron-related questions	1.08 (0.31)	0.82 (0.30)	-3.00	0.004*
Vitamin A-related questions	0.84 (0.20)	0.54 (0.24)	-4.54	<0.001*
Protecting all nutrients (deworming) question	0.72 (0.46)	0.69 (0.47)	-0.29	0.78

After the cell phone messaging intervention, there was a higher proportion of women in the intervention group reporting total knowledge scores of more than 80% for questions relating to iron, and protecting all nutrients (deworming) (Table 4.6). However, there were no statistically significant differences in these scores between the groups. As shown in Table 4.6, the between-group differences in women's knowledge of 'vitamin A', and 'protecting all nutrients through deworming' messages approached statistical significance (p=0.09 and p=0.07, respectively), with the intervention group having higher knowledge levels than the comparison group.

Table 4.6: Proportions of women in the intervention (n=21) and comparison (n=29) groups with knowledge scores above 80 %, by nutrient category, after the cell phone intervention in Naari, Kenya in 2017.

	Women's group		
Nutrient categories	**Intervention N=21**	**Comparison N=29**	
	n (%)	**n (%)**	**p-value**
Protein-related questions	3 (14.3)	7 (24.1)	0.62
Iron-related questions	21 (100)	24 (82.8)	0.13
Vitamin A-related questions	16 (76.2)	14 (48.3)	0.09
Protecting all nutrients (deworming) question	17 (81)	15 (51.7)	0.07

After the cell phone intervention, the mean knowledge scores for women in the intervention group were significantly higher for iron, vitamin A, and protecting all nutrients through deworming categories relative to the comparison group (Table 4.7).

Table 4.7: Mean knowledge scores of the intervention and comparison groups after the cell phone intervention in Naari, Kenya in 2017

	Women's group			
Nutrient categories	**Intervention N=21**	**Comparison N=29**		
	M (SD)	**M (SD)**	**t-value**	**p-value**
Protein-related questions	1.00 (0.27)	0.93 (0.46)	-0.61	0.54
Iron-related questions	1.21 (0.34)	1.01 (0.33)	-2.02	0.05
Vitamin A-related questions	0.82 (0.28)	0.62 (0.30)	-2.37	0.02
Protecting all nutrients (deworming) question	0.81 (0.40)	0.52 (0.51)	-2.18	0.03

There were no significant changes in the proportion of women with scores above 80% for knowledge questions related to protein, iron, vitamin A, and protecting all nutrients in the intervention group when comparing before and after the intervention (Table 4.8).

Table 4.8: Proportions of women in the intervention group with knowledge scores above 80 %, by nutrient category, before and after the cell phone intervention in Naari, Kenya in 2017

	Time period		
Nutrient categories	**Pre-intervention N=22**	**Post-intervention N=21**	
	n (%)	**n (%)**	**p-value**
Protein-related questions	5 (22.7)	3 (14.3)	0.75
Iron-related questions	21 (95.5)	21 (100)	1.00
Vitamin A-related questions	17 (77.3)	16 (76.2)	1.00
Protecting all nutrients (deworming) question	16 (72.7)	17 (81)	0.78

Similarly, there were no statistically significant differences in the mean knowledge scores of the intervention group before and after the intervention in regards to the four nutrient categories.

Table 4.9: Mean knowledge scores of the intervention group before and after the cell phone intervention in Naari, Kenya in 2017

	Women's group			
Nutrient categories	**Intervention N=22**	**Intervention N=21**		
	M (SD)	**M (SD)**	**t-value**	**p-value**
Protein-related questions	0.82 (0.57)	1.00 (0.27)	-1.33	0.19
Iron-related questions	1.08 (0.31)	1.21 (0.34)	-1.28	0.21
Vitamin A-related questions	0.84 (0.20)	0.82 (0.28)	0.24	0.81
Protecting all nutrients (deworming) question	0.72 (0.46)	0.81 (0.40)	-0.63	0.53

Attitude Changes

Prior to the intervention, there were no statistical differences in the attitudes of women from the intervention and comparison groups' towards the three (3) nutrient categories, as shown in Table 4.10. The proportion of women reporting that the recommendations were 'extremely important' ranged from 20-45%, depending on the message and the group. As stated earlier, protein related attitude questions were not included due to an omission.

Table 4.10: Proportions of women from the intervention (n=22) and comparison (n=29) group rating nutrient categories as 'extremely important' before the cell phone messaging intervention in Naari, Kenya in 2017

	Women's group		
Nutrient categories	**Intervention N=22**	**Comparison N=29**	
	n (%)	**n (%)**	**p-value**
Iron-related questions	10 (45.5)	8 (27.6)	0.30
Vitamin A-related questions	7 (31.8)	6 (20.7)	0.56
Protecting all nutrients (deworming) question	10 (45.5)	10 (34.5)	0.61

After the cell phone intervention, there were significant differences between the groups in the proportion of women rating the nutrition messages relating to iron and protection of all nutrients (deworming) as 'extremely important'. Most (76%) of the women from the intervention group rated these two nutrient categories as 'extremely important' compared to the women in the comparison group (24-45%). Moreover, a higher number of women in the intervention group rated vitamin A messages as "extremely important" than in the comparison group, which was marginally significant (p=0.07) (Table 4.11).

Table 4.11: Proportions of women in the intervention (n=21) and comparison (n=29) groups rating nutrient categories as 'extremely important' after the cell phone messaging intervention in Naari, Kenya in 2017

	Women's group		
Nutrient categories	**Intervention N=21**	**Comparison N=29**	
	n (%)	**n (%)**	**p-value**
Iron-related questions	16 (76.2)	7 (24.1)	0.0008*
Vitamin A-related questions	12 (57.1)	8 (27.6)	0.07
Protecting all nutrients (deworming) question	16 (76.2)	13 (44.8)	0.05*

As shown in Table 4.12, the proportion of women in the intervention group who rated nutrition-related practices as 'extremely important' appeared to increase after the

intervention, at least marginally. For instance, the proportion of women rating all the nutrient categories as 'extremely important' increased from 31-46% before the intervention to 57-77% after the intervention. In addition, the positive changes in women's attitudes towards nutrition messages concerning iron and protecting all nutrients were approaching significance (p=0.08).

Table 4.12: Proportions of women in the intervention group rating nutrient categories as 'extremely important' before and after the cell phone messaging intervention in Naari, Kenya in 2017

	Time Period		
Nutrient categories	**Pre-intervention N=22**	**Post-intervention N=21**	
	n (%)	**n (%)**	**p-value**
Iron-related questions	10 (45.5)	16 (76.2)	0.08
Vitamin A-related questions	7 (31.8)	12 (57.1)	0.17
Protecting all nutrients (deworming) question	10 (45.5)	16 (76.2)	0.08

Practice Changes

Before the nutrition education session and cell phone intervention, there were statistically significant differences between the intervention and comparison groups in terms of their practices relating to improving iron and vitamin A content of food (Table 4.13). For both iron and vitamin A related practices, the proportion of women practicing the messages was higher in the intervention group than the control group. However, there were no statistically significant differences in practices related to protein or protecting all nutrients (deworming).

Table 4.13: Proportions of women in the intervention (n=22) and comparison (n=29) groups practicing nutrient-related messages before the cell phone messaging intervention in Naari, Kenya in 2017

	Women's group		
Nutrient categories	**Intervention N=22**	**Comparison N=29**	
	n (%)	**n (%)**	**p-value**
Protein-related questions	5 (22.7)	9 (31.0)	0.37
Iron-related questions	22 (100)	22 (75.9)	0.04*
Vitamin A-related questions	18 (81.8)	15 (51.7)	0.05*
Protecting all nutrients (deworming) question	17 (77.3)	18 (62.1)	0.26

Following the nutrition education session and the cell phone messaging intervention, there were significant group differences in the women's practices related to protein and vitamin A (Table 4.14). The proportion of women in the intervention group who reported implementing these two nutrient-related practices ranged from 95-100%, while that of the comparison group was 62.1%. On the other hand, there were no statistically significant differences in the two groups' practices regarding iron and protecting all nutrients (deworming), as shown in Table 4.14.

Table 4.14: Proportions of women in the intervention (n=21) and comparison (n=29) groups practicing nutrient-related messages after the cell phone messaging intervention in Naari, Kenya in 2017

	Women's group		
Nutrient categories	**Intervention N=21**	**Comparison N=29**	
	n (%)	**n (%)**	**p-value**
Protein-related questions	21 (100)	18 (62.1)	0.009*
Iron-related questions	21 (100)	28 (96.6)	1.00
Vitamin A-related questions	20 (95.2)	18 (62.1)	0.02*
Protecting all nutrients (deworming) question	18 (85.7)	26 (89.7)	0.43

There was a statistically significant increase in the proportion of women in the intervention group who practiced the protein-related messages (Table 4.15). There was an observed increase in the proportions of women practicing the vitamin A and deworming messages, but the differences were not significant. All women in the intervention group practiced the iron-related messages before and after the intervention.

Table 4.15: Proportion of women in the intervention group practicing nutrient-related messages before and after the cell phone messaging intervention in Naari, Kenya in 2017

	Time period		
Nutrient categories	**Pre-intervention N=22**	**Post-intervention N=21**	
	n (%)	**n (%)**	**p-value**
Protein-related questions	5 (22.7)	21 (100)	<.0001*
Iron-related questions	22 (100)	21 (100)	n/a
Vitamin A-related questions	18 (81.8)	20 (95.2)	0.37
Protecting all nutrients (deworming) question	17 (77.2)	18 (85.7)	1.00

Summary of Chapter 4

The results of the study showed that the two study groups were essentially the same. First, the only recorded socio-economic difference between the intervention and comparison groups was ownership of exotic cattle, whereby women from the intervention group had more of these cattle as compared to women from the comparison group. There were no other significant differences in socio-demographic factors between the women from the two groups. Finally, there were no statistical differences in the ownership and use of cell phones between the women from both groups.

Regarding the cell phone messaging intervention, all women in the intervention group confirmed that they had received the nutrition-related text messages. Moreover, the women had positive ratings of how informative and understandable the text messages were. A

majority of these women also said that receiving the text messages motivated them to implement the nutrition information that the texts contained.

Results of the intervention suggest that, in terms of knowledge, women from the intervention group were more knowledgeable than the comparison group before the intervention with regards to the iron and vitamin A messages. Knowledge levels remained high after the intervention. Specifically, they knew more about the value of soaking maize and beans, in addition to taking a fruit before or after meals. They also understood the importance of using greens in *githeri*, and adding the greens late in cooking, as well as adding orange-fleshed vegetables in *githeri*, *mukimo*, and *chapati*.

Regarding attitudes, although there were no differences between women in the two groups before the intervention, there were significantly higher proportions of women in the intervention group rating two nutrient categories as 'extremely important' versus the comparison group after the messaging intervention. A large majority of the intervention group women regarded taking fruits with meals and deworming children/grandchildren as 'extremely important'.

Similar to the knowledge results, the practices relating to vitamin A were higher in the intervention group before and after the intervention relative to the comparison group. However, the most striking change in practices by the women in the intervention group was related to protein: 100% of women in the intervention group were putting equal portions of maize and beans into *githeri,* versus 61% for the comparison group.

This chapter mainly addressed the quantitative impact of the cell phone messaging on the intervention group, before and after the intervention, and as compared to the comparison group. The next chapter includes findings from the qualitative component of this research study and presents the findings from the individual interviews and focus group discussions

regarding the cell phone messaging intervention.

Chapter 5: Qualitative Findings

This chapter presents the qualitative findings of this research study. It aims to answer the study's overall research questions but specifically the following: What are the benefits and challenges of using cell phones as a supplement to face-to-face peer-led training? The individual interviews and focus group discussions (champs and non-champs FDG) used to collect the qualitative data were conducted in the local dialect, Kimeru. Therefore, the 'voice' heard in the transcripts was that of the translator. The major themes identified in these data were the intervention's group learning experiences, beneficial aspects, person-to-person interactions, challenging aspects, and improvement recommendations for the intervention.

1. Learning Experiences

The analysis of the individual interviews and the focus group discussions (FDG) provided insight into the women's cell phone messaging experience. The three significant experiences of focus are the women's ability to understand the messages, the content of the messages, and the messaging process.

Ability to Understand Messages

Several women interviewed individually agreed that the messages were easily understandable mainly because they were in Kimeru language.

> (She asked for help reading the messages because of eyesight problems, but did not ask for help understanding the messages)…*because she could understand the messages since they were in Kimeru.* (J37)

> *She just needed help reading the messages (*because of eyesight problems*), but she could understand the messages.* (J49)

> *The messages were in a language that she could understand easily*. (J39)

The messages were in Kimeru, which was more understandable than English. (J48)

She had the ability to understand all the messages. (J52)

Despite the positive statements about the use of Kimeru language, some women argued that the dialect used in the text messages was somewhat different from the one spoken in the locality.

She felt that the Kimeru on the messages was a bit different from the one that is spoken here. (J42)

(She did not ask for help understanding the messages)…*because she had not fully understood. After re-reading the messages slowly, she was able to understand. She said that the Kimeru on the messages was different and a bit difficult to read*. (J50)

In brief, because the messages were in the local dialect, the majority of the women said that the messages were easily understandable. Some women asked for help reading the messages because of three reasons: they shared their phone with a family member; had eyesight problems; and had difficulties with phone functionality. Otherwise, the women's level of understanding was high although some argued that the dialect used was slightly different.

Message Content

Women in the intervention group had varied views regarding their perceptions towards the content of the cell phone messages, which were related to the five key nutrition-related messages. Some identified some text messages, which contained information they not only liked but also practiced.

Liked everything because every message had a separate intention or message that it was conveying. (J43)

She liked the content of the messages – especially the one about soaking maize and beans as well as deworming children/grandchildren. (J45)

> *She liked the content of the messages – especially the one about taking a fruit immediately before or after meals as well as the one about recording when you give deworming medicine to children.* (J46)

One of the women expressed concern with the content of one of the messages.

> *She had a question about having a fruit immediately after meals. She had earlier heard in a nutrition seminar that fruits should be eaten independently. She handled the concern herself by deciding to follow the message regardless.* (J46)

Among the five key nutrition-related messages, some of the messages that the women referred to frequently in the interviews and FDG were: soaking maize and beans; deworming children and/or grandchildren; taking fruits before or after meals; and using equal portions of maize and beans for githeri.

Messaging Process

Before the cell phone messaging intervention, the women had been told that they would start receiving the messages after the peer-led education session for a period of five weeks.

> *They had been told that they would receive messages during the champs workshop and cooking session.* (J43)

> *No* (she did not have any questions/concerns about the number of messages), *because she was expecting the messages – During the champs workshop and cooking session, they had been told that they will be receiving some messages.* (J35)

However, the messaging application was from a company called AFRICASTKING. The message indicating this company as the sender created some confusion.

> *She was not sure where the messages were coming from. The messages indicated AFRICASTKING as the sender. Since the messages were related to food, she was*

interested. (J46)

When asked about their opinion about receiving two messages per week (Wednesdays and Sundays), both the champs and non-champs agreed that they were okay with that.

There was a debate as to whether messaging should be sent before or after the face-to-face training.

> *They gave a suggestion that those messages, they do not have to wait for them to be taught something first so that they can be sent messages after. They can be taught of things before being trained so that they can be having a rough idea of what is ahead of them or what is …* (FDG: Champs)

> *They are in support of being taught first—train first then the messages come after. Yeah, so the messages to act as a reminder.* (FDG: Champs)

Moreover, when asked what they liked about the intervention, the majority of the women said they liked both the messages themselves and the messaging process.

In conclusion, the women knew they were to receive the cell phone messages. However, they had not been given finer details such as the sender of the messages, which caused some confusion among some women. The women also expressed their preference for the method used in incorporating the technological training aspect; traditional training then the technological booster.

Summary

From the women's learning experiences, it is evident that use of the local language had a positive impact in improving the overall ability to understand the messages. In relation to the content of the messages, the women laid particular focus on the messages relating to taking a fruit immediately before or after a meal as well as using equal portions of maize and beans in githeri. Finally, the women had received prior communication about the messaging

intervention and were satisfied with the overall process.

2. Beneficial aspects of cell phone messages

The qualitative data analysis process indicated that there were four beneficial aspects of the cell phone messages. These were the benefits of the messages as reminders, the increased knowledge and understanding, practicability of the messages, and easy accessibility of information. These four aspects are addressed in the following sections.

Reminders

The participants made more than ten (10) mentions in the interviews and FGDs that the cell phones acted as reminders. Below are some extracts from individual interviews of Joy women:

> *Did not have any questions because the messages acted as a reminder about what she had already been taught.* (J35)

> *... she continued getting more messages or more reminders.* (J42)

> *They things on the messages were things they had been taught before – Would have wanted to give thanks for the reminder.* (J30)

> *... it was easy because it was a reminder of what they had been taught.*(J32)

> *She had been taught before then she received the messages – the messages acted as a reminder.* (J40)

> *... liked being reminded in the 'rikana' or 'remember to' message.* (J34)

The women also noted that being reminded of the nutrition messages taught during the peer-education session was both a benefit and the thing that distinguished learning in the year 2016 and 2017, as shown below.

Okay, it was of value for them to receive messages after training because they acted as a reminder of whatever they had been taught… (FDG: Champs)

In fact, to them, they were very happy because they were being reminded about it.

There was a difference in learning between 2016 and 2017 and in 2017 the learning was way better because the messages acted as a reminder... (FDG: Champs)

... the messages acted as a reminder of what they had been taught and they appreciated that. (FDG: Non-champs)

... yes, there is a difference between 2016 and 2017 in her learning because with the messages, they acted as a reminder of what she had been taught. (FDG: Non-champs)

For her, there is a difference and… between 2016 and 2017 because of the messages, she can go back and read them, refer to them and remember what she had forgotten. (FDG: Non-champs)

Messages acting as reminders was one of the most beneficial aspect of the cell phone messaging to Joy women. The women cited this aspect as the primary factor that distinguished their present learning from the previous year whereby traditional training methods had been used solely.

Increased Knowledge and Understanding

The women also pointed out that the messages had a positive impact on their knowledge about the nutrition information conveyed to them in the face-to-face peer-led training. According to the women, the messages not only increased their knowledge but it also reinforced what they had been taught in the peer-led education sessions:

She learnt new things that were easy to practice. (J31)

... and it (message) *had more information so used it…* (FDG: Champs)

> *... so the information that they had received was reinforced and became better…it stuck more to their minds.* (FDG: Champs)

> *First, she said there is a difference between 2016 and 2017 because when the messages were sent, you understood more—she understood more on her case.* (FDG: Non-champs)

> *For her, yes there was a difference in that between 2016 and 2017 with the message in that things that she did not get previously, with the message she was able to grasp them now because that was evident in the message.* (FDG: Non-champs)

One of the non-champs noted that she gained more knowledge herself and that she was able to share what she learnt with others.

... after receiving messages this year, she was able to get more information that she could even share with others and they acted also as a proof about what she had been teaching to the others (FDG: Non-champs)

In brief, the technological addition enhanced learning not only increased their knowledge but also reinforced what they knew from the training sessions. The knowledge gave some women the confidence to share the information with other community members.

The Practicality of the Messages

According to the women, the information conveyed by the messages was practical. Therefore, they were able to implement what the cell phone messages required of them.

> *... learnt new things that were easy to practice.* (J31)

> *The messages were so helpful so she had no challenge implementing them. For example, the one about soaking dry maize and beans in water was very helpful because it made her use less fuel.* (J37)

There was a great determination among the women to read and practice the messages:

... , if she doesn't have spectacles, the moment she gets where they are, the first thing to do was check the message and they would follow it. Yes, so practice it. (FDG: Champs)

They said they had enough time to read and practice it… (FDG: Champs)

So, what they are trying to say is that lack of enough food to implement the messages was not (a challenge) *because if you have no*(t) *enough, for instance, if you have no*(t) *enough… equal portions of maize and beans, they would opt either you go to the shop and buy the beans to get the equal portions or if not, get an alternative meal to prepare that day till the next time when you have enough… equal portions then you can continue doing that.* (FDG: Non-champs)

The women not only read the messages but they also practiced the messages. Some of the messages that the women were keen to practice were soaking maize and beans, as well as using equal portions of maize and beans in githeri.

Accessibility to Information

The women from the group seemed to agree that the mobility of cell phones made the information contained accessible to everyone and at any time.

*She has no time to read the written messages (*hand-out from the face-to-face training*), but the phone is easily accessible and easy to go around with.* (J41)

Having the two types of cell phone messages, which are 'did you know' and 'remember to' increased their information base.

… after receiving messages this year, she was able to get more information that she could even share with others and they acted also as a proof about what she had been teaching to the others. (FDG: Champs)

During the champ FDG, one of the women while comparing audio recorded messages and

text messages said that the former way of messaging would be less effective in the teaching the group than the later:

> *...most of them first of all, they are not very conversant with them. Number two, most of the cell phones that they have cannot support that. Then, number three, it is difficult for them to use that.* (FDG: Champs)

> *The* (text) *messages are accessible to everyone*. (FDG: Champs)

Therefore, the technological enhancement increased access to information because of three reasons: women could access the information anytime and anywhere; additional information was provided; and, accessing text messages was easier than other technological applications.

Summary

In summary, most women in the intervention group greatly valued the cell phone messages because they acted as a reminder of what they had been taught in the face-to-face peer-led education sessions. They compared their learning in 2016 when they received face-to-face training only and learning in 2017, which had an additional cell phone booster. According to them, the knowledge gain was higher in 2017. Regarding practices, the women said that the nutrition messages were practical, making it easier for them to implement them as part of their daily nutrition practices. Finally, the women also appreciated the ease in information accessibility brought about by the cell phone messages.

3. Person-to-person Interactions

During the five (5) weeks of the cell phone messaging intervention, the women interacted considerably with both family and other group members.

Family involvement

The level of family involvement was high, with each family member playing different roles. Phone sharing was evident among family members, resulting in the women receiving help reading the messages.

> *She shares her phone with the daughter – so, she thought that she might have received all the messages, but some got displaced. … Her daughter was available to find, read, and explain the messages.* (J45)

> *The grandchild helps in reading the messages. Her sim-card and the grandchild's are on the same phone. The grandchild who most times has the phone can tell when she receives a message.* (J30)

Other family members assisted the women who had technical issues with their phone.

> *Her phone got spoilt (it hanged). Her husband had taken the phone to a phone expert. So, she received the messages but had not read the last two messages because her husband still has the phone.* (J47)

> *She could not tell when she received the messages. She relies on children to help her make phone calls. Therefore, the children could see messages after she requested them to help in making phone calls.* (J49)

Other women discussed the information on the cell phone messages with family members.

> *She was not sure where the messages were coming from (The messages indicated AFRICASTKING as the sender.* (How did she handle this concern?)*… She discussed with her daughter (who is a nutritionist) about the messages.* (J46)

> *For _____ (one of the non-champs), she went ahead and wrote her messages in a book but she has given the book to the children to read, and she has also in one instance*

given to a friend who came to visit to check out the messages. (FDG: Non-champs)

One of the champs suggested that family members can remind the women to read the cell phone messages.

… even if you are not near your phone, another family member can remind you (that)*your phone rang so you check your messages.* (FDG: Champs)

During the five weeks of cell phone messaging, there was a relatively high involvement of family members. Each member played a significant role in supporting the Joy women. It is assumed that through this involvement, the other family members learnt about some of the key nutrition messages. Therefore, technological teaching methods could be one way of reaching the women's families.

Within-group support

The women offered each other support and advice especially for those who experienced challenges with the cell phone messaging platform.

She talked to _____ (one of the champs who was receiving messages herself), who contacted _____ (author) about why her fellow champ was not receiving the messages. They re-send her number, which they were informed was okay in the records. (J43)

So they said, most of the people did not complain because … or have any issues because they used to do check-ups – did you receive this message that had this information? So, those that did not have could receive the message, they were not able to get exactly why you did not receive messages. But there is one instance whereby one gave the wrong number initially so she couldn't get the messages but it was rectified. (FDG: Champs)

Moreover, as the non-champs made their arguments, they continually suggested the women requiring assistance in reading and manoeuvring through the technological platform could ask for help from other women in the group.

> *So she gave an example, she would still stick to the hand-outs so that she can be able, if she cannot read herself she can be able to take it to someone else who can be able to read for her and get the message.* (FDG: Non-champs)

> *When they are meeting (group meeting) you can go to your partner or women and ask them, "did you receive a text message, what was it saying?" so that they can explain to you if you did not get it or were unable to access it.* (FDG: Non-champs)

The women expressed their support for each other within the group. The support was crucial in ensuring that challenges were identified among the group members. It also ensured that the women worked collaboratively in solving some of the problems encountered during the messaging period.

Summary

The level of interaction between the women and other people was high as they discussed the cell phone messages and the messaging process. There was an exceptionally high interaction between the women and their family members. These family members all seemed to play a role in improving the women's cell phone messaging experience. There were also interactions and support within members of the women's group especially when one had a challenge.

4. Challenges of Cell Phone messages

When directly asked about the challenges they encountered during the five (5) weeks of cell phone messaging, the majority of women asserted that they had none. Moreover, they said that they had no challenges implementing the information on the messages since food

was available. People living in the locality mainly rely on agricultural produce and therefore, availability of food depends on the whether a particular household has had a good or poor harvest.

There was availability of food in her household for her to practice the messages. (J30)

She had enough food so it was possible to implement the messages. (J31)

It was easy to implement since the food was available. (J38)

Despite the fact that most women stated that food was available, some women provided contradicting information about their ability to implement the content of some of the messages. For instance, four women said it was challenging putting into practice the message concerning taking fruits before or after meals. Some even wanted to know what could substitute for fruits.

Then, the other thing is on fruits, what supplements (substitute) *of fruits they would get because at times fruits are very expensive especially when they are not on season. Yeah, so it becomes very difficult to access them so what other supplements can they get especially for those foods that they were taught about? Yeah, to use on those time.* (FDG: Non-champs)

In addition to that, while women highlighted that using equal portions of maize and beans was a challenge, several of them said that they not only gained new knowledge about it but it was also easy to implement it.

… she says learnt well and two, they were able to understand how to get the right portions when it comes to cooking especially for githeri to get the right portions and equal sizes of maize and beans. (FDG: Champs)

Even the portion sizes, they did it, they are doing it. So, they are following it. It was easy

to implement too. (FDG: Champs)

So, what they are trying to say is that lack of enough food to implement the messages was not because if you have no(t) *enough, for instance, if you have no*(t) *enough… equal portions of maize and beans, they would opt either you go to the shop and buy the beans to get the equal portions or if not, get an alternative meal to prepare that day till the next time when you have enough… equal portions then you can continue doing that.* (FDG: Non-champs)

However, the analysis of all aspects of the interviews and FDGs indicated three challenges namely: technical issues, preference for non-technological learning, and eyesight problems as discussed in the following sections.

Technical issues

During the individual interviews, some women highlighted some technical issues with their phones that made it difficult to read all the messages they received during the five (5) week period.

Her phone memory was full so (some of) *the messages did not enter (her phone could not accommodate more messages).* (J43)

Her phone got spoilt (it hanged). Her husband had taken the phone to a phone expert. So, she received the messages but had not read the last two messages because her husband still has the phone. (J47)

She could not tell when she received the messages. She relies on children to help her make phone calls. Therefore, the children could see messages after she requested them to help in making phone calls. (J49)

One of the Joy women said that she only recalled having received eight (8) other than all the ten (10) messages. Therefore, I decided to suggest that we go through her messaging application together. This check revealed that she had received all the messages, but some were in the inbox folder and some in the drafts folder. She gave this explanation:

> *She recalls to have received only eight messages. She shares her phone with the daughter – so, she thought that she might have received all the messages but some got displaced. She did not know where the messages where stored on her phone.* (J45)

On one occasion, the women received one message from a different sender. Due to internet connectivity issues encountered when using the application for sending messages, this application did not indicate that that particular message had been delivered to the women. Therefore, I used my personal phone to resend the message, which resulted in the women receiving multiple text messages that had similar contents.

> *Just to clarify, hizo za double (the ones received twice) it was sometimes we send and it doesn't show that the message has gone so like we resend again then we notice that it is double but that was not our intention.* (Author)

The multiple texts caused technical confusion among some women.

> *On one occasion, she got a message from a new number*. (J40)

> *One of the messages that she received was from a different number (a Safaricom number), which was different from the others.* (J50)

These women handled the confusion themselves.

> *She read the message and it coincided with the rest, so she was okay with that.* (J40)

> *She was okay with that since she suspected that it was from one of us.* (J50)

There major technical complications, which ranged from a spoiled phone to full phone memory to displaced text messages, resulted in the three women experiencing these issues fail to read a few text messages. These women involved other individual's especially family members in helping to solve these problems. The rest of the issues did not hinder the women from receiving all the messages. The women demonstrated an ability to counter these challenges themselves.

Preference to non-Technological learning

Although the Joy women gave lots of positive feedback about the cell phone messaging intervention on their learning, some expressed their preference for non-technological learning like hand-outs as compared to technological learning. The non-champs had discussed the issue at length primarily focussing on some of the women's unfamiliarity with other phone apps, phone loss, and provision of wrong phone numbers.

> *And then, when they clarified that there are those people who have cell phones but they do not use the message app on it, they only use their phones for calling and receiving calls. So, there should be a channel for them to be able to get the messages in a way that they can get someone else who can read it. Because if their phone is for calling and receiving calls, they hardly check their messages.* (FDG: Non-champs)

> *…she gave an example, she would still stick to the hand-outs so that she can be able, if she cannot read herself she can be able to take it to someone else who can be able to read for her and get the message. To add on it, she also extended it that if you have no phone the messages, for instance, if your phone gets lost, it gets lost with the messages, but with the hand-out, you still have it.* (FDG: Non-champs)

> *From what they have said, for instance, in instances where a number was confused and she did not get the messages, if she had the hand-out, she would have received the*

messages because she would have gone and gotten a copy of the message from the script. So, I would conclude that technologically, it is becoming difficult to take that. So they would prefer…because if we check we will see that whether you have the script or the messages, the messages can be deleted or lost where you lose your messages. You can misplace the paper, but you do not lose the message. (FDG: Non-champs)

One of the non-champs argued that, as with hand-outs, if the women are experiencing these challenges they could ask for help from group members.

…so what can help with the cell phone issue is if you cannot be able to read or check your messages, you should go to your…When they are meeting you can go to your partner or women and ask them, "did you receive a text message, what was it saying?" so that they can explain to you if you did not get it or were unable to access it. (FDG: Non-champs)

On a different perspective, both the champs and non-champs were asked how they would educate fellow women in Naari. While the champs said that they would use both technological and non-technological means of learning, the non-champs were more inclined towards the non-technological methods.

… in this question to reach out to the women in Naari, to them they (cell phone messages) *think should come after the actual training because the moment you sent a message to an individual, it doesn't… who is not aware of what you are talking about, the most probable thing they would do, they would reject or ignore the message. But if it is after learning and going through a training session of what is going about, when they receive the message, they will be keen to get to know about it. What… more details from the message.* (FDG: Champs)

> *They are saying with hand-outs, they can hand out written materials and phones are there, yes, but they can be used but they still insist on the hand-outs because not very many people are technologically advanced for the phones, for the use of cell phones. And she gave an example, for instance in church whether you have a phone or… you have two people there, one who has a bible and other who has a phone but in most instances those people with the bible whether you have the phone or not, you tend to go back to the bible and read from the bible. So, most of the people with written materials would reach to more people.* (FDG: Non-champs)

The intervention group's non-champs had a greater preference for non-technological means of learning as compared to the champs although there were no age differences among the women. They constantly suggested that having hardcopy hand-outs would work better than any technological methods. However, the champs acknowledged that some of the women in the intervention group were technologically challenged but it was a good learning method that they could use if given the opportunity.

Eyesight problems

Several women from the group also complained of eyesight problems that made reading the messages a challenge. One of the women indicated that this problem hindered her from reading the messages.

> *She cannot use her phone herself because of eyesight problems. She says she did not get glasses when there was a free distribution because she was away…* (She did not read all the cell phone messages) *Because she could neither tell when she had received a message nor read the messages because of eye-sight problems.* (J49)

Other women experienced the same problem, but she got assistance with the phone messages.

Because of eyesight problems but her daughter was available to help in reading the messages. (J37)

Her daughter helped find and read the messages (she was present to help). (J45)

During the FDG involving the intervention group's champs, one of the women leaders pointed out this challenge, but expressed her determination to read and practice the information on the messages despite this challenge.

... for her she has a problem with her eyesight, if she doesn't have spectacles, the moment she gets where they are, the first thing to do was check the message and they would follow it. (FDG: Champs)

Owing to age, some women experienced eyesight problems but this did not deter them from reading and practicing the information contained in the cell phone messages. However, eyesight problems would likely also make it difficult to see hard copy materials, unless they were printed in a large font.

Summary

During the five-week messaging period, the women experienced a few challenges. The two major technical problems were a spoiled phone and full phone memory that resulted in the women not receiving some messages. There were also minor issues like receiving multiple texts that were similar and receiving a message from an unfamiliar number. On a different note, some women perceived themselves as technologically challenged and therefore, highlighted their preference for non-technological means of learning. Finally, eye problems also stood out among some women.

5. Improvement recommendations

Some improvement suggestions were noted from the interviews and focus group discussions with Joy women. Some of them included having an interactive technological platform, increasing the information, and diversifying the content, as well as some considerations on the period and timing of the messages.

Interactive technological platform

Several women in the individual interviews expressed their desire to have replied to the messages, but they were unsuccessful in their quest. The women mainly highlighted that the main reason why they wanted to reply was to pass their gratitude for receiving the text messages.

> *Wanted to know how they would reply. When trying to reply, she saw that the option for replying was to stop the messages, so she did not reply.* (J30)

> *She had wanted to reply to the message just to give thanks although she did not have any questions to ask. She was unable to reply but continued receiving the messages.* (J31)

> *She wanted to text or call back to give thanks. She was unsuccessful, so she abandoned that since she continued getting more messages or more reminders.* (J42)

Both champs and non-champs also highlighted that an inability to reply despite their attempts to do so.

> *Some of them really wanted to reply to the messages and say thank you but they couldn't. Yes, they are okay that they can have a platform where they are able to reply to the messages and maybe even ask questions*. (FDG: Champs)

> *She is explaining, she tried, the moment she received the message, she wanted to confirm the sender the message, she wanted to know who it was. So, she tried to call but it did not*

go through. (FDG: Non-champs)

The champs further suggested the need for having a technological platform that was more interactive.

So, if they have a platform where they can respond back, most of them would choose, would opt for calling back because most of them can read the messages, but replying is … And they have cell phones, by using them when it comes to texting messages is a little difficult so most of them would opt for calling, thus it is easier calling to them. (FDG: Champs)

A number of women said that they would have wanted to reply to the messages they received. Although some of them pointed to this as a challenge, a majority of them pointed out that they just wanted to pass their gratitude but did not have any issues they wanted to address. However, they pointed out that an interactive application would enable them to ask questions and communicate more closely with the sender.

More information

The women recommended that additional messages be sent to them so that they could receive more information.

She said that she would have liked to be receiving more messages even on issues that (they) *had not been taught (new knowledge).* (J50)

… whether the messages are added, they are very okay and they should not be reduced. They said they are okay. (FDG: Champs)

…they would like to receive more messages and they would like to learn more about nutritional values, and everything… (FDG: Champs)

Joy women expressed a high desire to learn more from both the face-to-face sessions and the cell phone messaging intervention. The additional suggestions to learn ranged from nutrition-related to lifestyle topics. Both champs and non-champs suggested that they wanted to receive additional information though the cell phone messaging platform.

Diversity in Content

In addition to receiving additional information, the women discussed at length the need to expose them to diverse content.

> *So, they went ahead and explained that for them, they have some kind of restriction…they have been restricted on* (to) *some kind of foods, for instance, githeri, ugali and rice and chapatti. So if there are other meals because of the diversity, you as the students are aware of and not diversify their… they are confined in that scope they would appreciate if they got information on those other different kinds of meals. Because for them, what they know about is the mukimo, the githeri, the rice and chapatti. So, anything else other than that they are open to it.* (FDG: Champs)

They emphasized on receiving new information on additional ways of utilizing the locally available foods.

> *…for instance, they have potatoes available – There are so many things that can be done with potatoes. It doesn't have to be included in githeri or in mukimo. So, what could be easier is getting the alternative, you know, work with the available ingredients and get those other different kinds of meals that can come out of it.* (FDG: Champs)

In fact, the champs went forward to give an analogy of being in school and receiving the same training time and again.

> *They are saying like when you went to school, when you starting… to you it is the*

kindergarten, elementary level, there are those things that you are taught. For example the sounds, how to do the sounds, pronounce your sounds. So, if you continue being told the same thing, it will become boring, but the fact that you are learning something when you get to maybe standard one, you get … you know (the) *excitement and desire to know what is ahead of you. So, they are trying to put it in the same line we have put. They are so used to these meals, they want something different. And they said, for instance, when they have the Christmas period, whatever foods they have available is what they will be cooking. So, it doesn't look any special on that day. So they want something that is very different from what they are used to or what they can…what is easily available so that they can see a difference. Even if it is that day, they can celebrate fully knowing that they are doing something different. It is totally different, it is a celebration day. Yeah.* (FDG: Champs)

There was a great need from both the champs and non-champs to get diverse content. For the last two years the nutritional messages have focused on local foods, which include githeri, mukimo, and chapati. The women expressed their desire to acquire diverse knowledge in both the peer-led nutrition education training and cell phone messaging.

Period and timing of messaging

The women in the intervention group had mixed feelings about the period and timing of the cell phone messages. Some agreed that the timings and period were sufficient.

They said they had enough time to read and practice it (the information contained in the messages). (FDG: Champs)

They have no issue with the messages so whether the period is added… They said they are okay. (FDG: Champs)

…that period—first of all, the five weeks were okay to them and they would want it added.

(FDG: Non-champs)

On the other hand, others gave various recommendations about the same.

> *'... one of them is for the option of doing, sending messages during the day. Then, the other one gave between 8 to 9 pm because everyone at that time is settled and they are having you know... that family time so even if you are not near your phone, another family member can remind you your phone rang so you check your messages. So, one is for the recommendation of between 8 to 9 pm in the evening that is pm and others are in for the daytime.* (FDG: Non-champs)

The women also gave suggestions for the intervals between the messages.

> *She is explaining and saying, messages, if they are speaking about the same thing, or they are in the same line, like for instance, today you are teaching me how to avoid taking tea with my meals, the importance. What I should take instead of tea, they should come—they should follow each other. So, the spacing should not be that big. So, it is able to happen like could be once in a week or twice in a week so that the consistency can be there. It will be easier for the information to be received and practiced and implemented. But if there is large spacing, the most probable thing, I will forget what I learnt by the time the next message comes or by the time I receive the next piece of information.* (FDG: Non-champs)

The women's need for more information translated to the women's recommendation for an increased period for sending the messages. The involvement of family is also exhibited in the women's selection of the best timing for sending the cell phone messages. Finally, strategic intervals between the messages would ensure that there is a proper flow of information.

Summary

The women gave suggestions on improving the technological intervention. There was great emphasis on the need for a platform that was interactive. The women had a high readiness to learn and therefore, would have wanted more information as well as diversity in the nutritional information provided. Finally, women in the intervention group also suggested that the preferable time of the day to receive the messages was in the evenings.

Summary of Chapter 5

In this chapter, I presented the qualitative findings of this research study with the aim of exploring the benefits and challenges of a cell phone messaging enhancement received by women in the intervention group only. The major themes identified from the transcripts and field notes collected in the individual interviews and FDG focused on their experiences, interactions, benefits and challenges of the intervention, and suggestions for improvement. In the next chapter, the quantitative and qualitative findings of this study are discussed in the context of existing literature on the same.

Chapter 6: Discussion

In this chapter, the results and findings of the study are placed in the context of existing research studies in order to answer the two main research questions. These include 1) how do knowledge gain, attitudes, and nutrition practices of women in the self-help group receiving cell phone enhanced nutrition education compare with those of women from the self-help group who receive face-to-face peer-led trainings only? And 2) what are the benefits and challenges of using cell phones as a supplement to traditional nutrition education methods? In answering these questions, the chapter provides an overview of cell phone ownership and use in the study area, the knowledge, attitudes, and practices of the women belonging to the two self-help groups, and finally, the benefits and challenges of the cell phone messaging intervention.

Cell Phone Ownership and Use

Results revealed that a majority of the women (more than 90%) in the intervention and comparison group owned a personal cell phone. This ownership rate coincides with the latest quarterly report from the Communications Authority of Kenya (CAK), which reveals that the mobile penetration rate has risen from 88.7% between April and June 2017 to 90.4% between July and September 2017 (Communications Authority of Kenya, 2017). Although previous research indicates that cell phone ownership is lower in rural areas, especially among the women (Crandall et al., 2012; Wesolowski, Eagle, Noor, Snow, & Buckee, 2012), my research study revealed that the ownership rate is high in these women in rural areas.

The majority of these study women had basic phones, which are perceived as easier to use, and they retain power better as compared to smart phones. This is significant, since lack of power is a major problem in rural areas (Crandall et al., 2012). Phone sharing was evident among a few women who shared their phones with a family member. This phenomenon is

consistent with the Wesolowski et al., (2012) study that depicted that 57% of rural residents have access to a shared phone, which either belongs to a family member's or friend's phone.

In regards to phone use, similar to the study by Crandall et al. (2012), all the respondents in this research study stated that they used their phone for making and receiving calls. The second top use of the phones in this study was for money transfer. In fact, research shows that Kenyans utilize this service more than other African countries (Winsor, 2015a). Additionally, the proportion of women who said that they used their phones for sending and receiving text among the intervention group was higher (81%) than the comparison group (27%). This high texting in the intervention group was a positive factor since the cell phone messaging intervention targeted them. Despite the differences in the overall percentages of use of their phone for texting, there were no significant differences in the individual frequencies of receiving, sending, or reading texts between women in the two groups. The two groups' frequency of receiving and reading the texts were higher than sending texts. In the individual interviews, some women argued that they receive but filter the messages to read, depending on the information they contain. For instance, one of them said they read the messages sent in the five-week intervention period because she was interested in nutrition and health. This finding is consistent with the study by DeSouza, Rashmi, Vasanthi, Joseph, and Rodrigues (2014) that highlighted that 99% of their respondents were willing to receive health-related information on their phones and did not find this intrusive to their personal life. About 85% of the intervention group women read the nutrition-related texts messages, suggesting that the information therein was of interest to them. In fact, a research study conducted in Kenya revealed that the most desired information on technological platforms concerns health, followed by educational and agricultural information (Crandall et al., 2012).

Knowledge

Before the cell phone messaging intervention, the intervention group's knowledge about iron and vitamin A was significantly higher than the comparison group. It is not clear why the knowledge of the intervention group was higher than the comparison group before the intervention. Women from both groups had received face-to-face peer-led trainings focusing on the two nutrients the previous year (2016) with the support of FHF. Further, there was no difference between groups in age or education level.

There were no differences in the women's knowledge of the protein message, which focused on using equal portions of maize and beans for *githeri*, or the protecting all nutrients through deworming message. These were new key nutrition messages that had been introduced to the women for the first time in 2017. Therefore, it is not surprising that the knowledge levels of both groups for these two new messages were similar at baseline.

After the intervention, all women in the intervention group scored more than 80% in the iron-related questions, which mainly pertained to soaking maize and beans for *githeri* and taking a fruit immediately before or after meals to enhance iron absorption. Moreover, there was a statistical significant difference in the mean knowledge score regarding iron the with the intervention group having a higher mean score than the comparison group. In the FDG, the women discussed at length that the group had readily accepted these two messages and that they were very practical and beneficial. For instance, the women stated that soaking maize and beans resulted in their using less fuel in cooking. The women also seemed knowledgeable about why they should take fruits with their meals despite low availability of fruits: in the focus group discussion, women said that some fruits were either expensive or not available year round, and thus requested for information on alternatives. In addition to iron, there was also higher mean knowledge scores for knowledge pertaining to vitamin A and protecting all nutrients (deworming) among the intervention group than the comparison

group. Since the knowledge of the women from the intervention group about vitamin A was already high at baseline, it consequently remained high after the intervention. Regarding protection of all nutrients through deworming, some women in the individual interviews noted that they liked this cell phone message since they not only learnt the frequency of deworming but also about recording when they should deworm their children/grandchildren. The comparison group's knowledge of the nutrients also improved during the study, reflecting the fact that they received a second peer led nutrition education intervention but no cell phone booster messages. In addition, there may have been some "contamination" of knowledge spreading from the intervention group to the comparison group within the Naari community. While this may be seen as a threat to the validity of the study, spreading of knowledge is unavoidable in these small close-knit communities, and can be seen as a benefit for overall women and children's health.

Although there were no significant differences in knowledge of the intervention group before and after the cell phone messaging intervention, previous studies evaluating the impact of text messages on nutrition knowledge revealed that they have a positive impact on the knowledge gain of the recipients (Brown, O'Connor, & Savaiano, 2014; Mehran et al., 2012). In addition to that, a study to investigate the retention rates of medical students showed that repeat exposure to core medical principles using an electronic intervention improved competency and retention of knowledge leading to higher test scores (Jason Matos, Camille R Petri, Kenneth J Mukamal, & Anita Vanka, 2017). A meta-analysis research study investigating the efficacy of text-messaging interventions also show that the use of cell phones in nutrition education has the ability to increase the retention rates by 68% (Head, Noar, Iannarino, & Harrington, 2013). Likewise, a study evaluating the effectiveness of cell phones in breastfeeding counselling among postpartum mothers in Cameroon revealed that intervention promoted new learning on infant and young child feeding (Achanyi-Fontem,

2013). However, in this study, women in the intervention group who participated in the FDG felt that the cell phone messages enhanced their knowledge and reinforced the information gained in the peer-led education sessions, making learning in 2017 easier than in the previous year.

Attitudes

In this study, attitudes were assessed by having women indicate how important it was to them to implement the key nutrition messages. This assessment is crucial in the process of education since positive attitude changes contribute to achievement of the desired practices (Goodarzi, Bora, & Farajollahi, 2015). Before the intervention, the proportion of women from both groups regarding the nutrition messages as "extremely important" were relatively low (ranging from 20-46%). However, after the intervention, there were significant differences between groups in the attitudes relating to iron in the intervention group. For example, a relatively high proportion of the women in the intervention group felt it was important to have a fruit immediately before or after a meal in order to enhance of non-heme iron (Dieticians of Canada, 2016), which is the iron obtained from plant sources like beans in *githeri*. Due to the high value they had placed on the message on protecting iron in food, there was an extensive discussion during the FDG of other fruits or food that they could consume when certain fruits are not on season.

There was also a statistically significant difference between the intervention group's attitude towards protecting all nutrients through deworming and the comparison group. Most of the women in both the intervention and comparison group stated that they had dewormed their children occasionally, but they did not do it consistently. In Kenya, other than the national school-based deworming programme that trains teachers on deworming (GoK, 2014), only new mothers are taught about deworming during the post-natal care visits. After the intervention, more women in the intervention group regarded this practice as 'extremely

important', and with a higher proportion than the comparison group. In fact, during the FDG, one of the women pointed out that, because of the cell phone intervention, she had known that recording the last time she dewormed her children was vital in keeping track on when to deworm next.

Practices

Assessing the women's nutrition-related practices was of utmost importance since these practices are ultimately what impacts nutrition status and overall health. The research study focussed on practices relating to protecting iron in the food (increasing absorption and utilization in the body), consuming vegetables rich in β carotene, which is the form of vitamin A in plants, increasing the amount of protein in meals relative to starchy foods, and protecting all nutrients by deworming. Practising the actions of the messages relating to protein, iron, and vitamin A would result in the women and their families consuming more nutritious diets, while deworming would increase nutrient utilization.

Like knowledge, the intervention group's practices relating to iron and vitamin A were significantly higher than the comparison group's before the intervention. As stated earlier, the reason for this difference is difficult to determine since there were no significant differences in the women's socio-economic or education statuses and both had received a pilot intervention in 2016 as part of the larger project

After the intervention, the proportion of women in the intervention group practising the two key messages related to iron and vitamin A was significantly higher than the comparison group. More than 70 per cent of the intervention group women stated that they were motivated by the text messages to implement the key messages. Having the text messages to remind them to practise messages at home was perceived by women in the intervention group as beneficial. In fact, most of the women cited that messages acting as

reminders was the most beneficial aspect of the cell phone messaging process. Having cell phone reminder messages was also what made learning better for them in 2017 than in 2016. In fact, various research studies conducted in developing countries like Cameroon and Egypt have successfully utilized cell phones as reminders for maternal and child health issues (Achanyi-Fontem, 2013; Chetley, 2006). For instance, according to Achanyi-Fontem (2013), since most postpartum mothers in Cameroon do not leave their house for the first six weeks owing to their tradition, cell phones were used to offer such mothers consultation services for themselves and their infants. This study revealed that the cell phone intervention resulted in improvement in infant feeding. In Tanzania and Kenya, an "mNutrition" program, which is a program utilizing cell phone technologies to deliver nutrition information to pregnant and new mothers, was successful in reminding women through text messages about maternal topics on breastfeeding, immunization, and proper maternal nutrition (Viljoen & Sowah, 2015). The same study noted that the high uptake of the SMS service among both pregnant women and health workers led to significant reductions in maternal and infant deaths.

The findings of this study indicate that the proportion of women practising messages relating to proteins and vitamin A was significantly higher in the intervention group than the comparison group. Vitamin A-related practices included adding orange-fleshed vegetables as well as green vegetables in commonly consumed dishes like *githeri*, *mukimo*, and *chapatti*. The high acceptability of this message was partly because of FHF's involvement in promoting the growing of these foods in the women's kitchen gardens over the past 12-18 months.

The nutrition message relating to protein appeared to have had the greatest impact on the intervention group after their cell phone messaging intervention. This message encouraged the women to practice using equal portions of maize and beans in *githeri*. In the FDG, the women in the intervention group referred to this message numerous times,

expressing the practicality of the message and their determination to implement it. In fact, one of the women stated that she would opt to prepare a different meal when she did not have equal portions of maize and beans. This message was crucial since it had been designed to enhance the protein content of an otherwise starch-based diet of the area. The intervention group's positive nutrition practices further coincides with other research studies that demonstrate the benefits of cell phones. In fact, Cole-Lewis and Kershaw's (2010) systematic review of literature of intervention studies using text messages for disease management and prevention indicated that text messages are widely acceptable, inexpensive and are a rapid way to create positive behaviour change.

Benefits and Challenges of Cell Phone Messaging

The intervention group received two kinds of messages per week: a 'did you know' message, and a 'remember to' message, over five weeks. The former kind of message largely aimed at reinforcing the women's knowledge about the health and nutritional benefits of the key message, while the latter was meant to enhance their practices. The majority of the women (71.4%) stated that they found it helpful to have received the two kinds of messages because one kind complemented the other. A study conducted in the United States that evaluated the impact of biweekly text messaging in promoting nutrition education and better dietary choices among college students. The results revealed that frequent texting improved the knowledge and dietary behaviours of the students (Brown et al., 2014). In this study, although only a small proportion of women in the intervention group (6%) stated that the 'remember to' message was helpful to them during the individual interviews, the majority of them discussed messages as reminders as the primary benefit of the cell phone messaging intervention. This finding was consistent with a study conducted in rural India, which revealed that use of cell phones as health reminders was beneficial and very appealing to the

respondents (DeSouza et al., 2014). In fact, the study showed that 98% of its respondents found the use of cell phones for drug adherence very acceptable to them.

The women indicated that the messages were informative and that they increased their understanding of what they had been taught in the peer-led training sessions. Their ability to understand was mainly because the messages were in the local dialect, Kimeru. In fact, all the women had stated that Kimeru was their main language of communication over the phone. The use of the language incorporated all the members of the group despite their age, education level attained, and socio-economic status. In fact, the use of indigenous languages in any form of education is the key to effective learning (Burhann & Trudell, 2007).

The intervention group also pointed out that accessibility to information was easier with the cell phone messages they were receiving because they could carry their phones around and thus have access to information anywhere and at any time. This finding is consistent with Kaplan's (2006) review of literature, which indicated that cell phones improve health outcomes in developing countries since they increase access to both health and nutrition information. This increased accessibility to information on the messages enlightened both the participants and other community members. The women noted that the messages were proof to others that they had received the information in the training sessions and this boosted their confidence when they shared the messages with others.

Besides the benefits, some women experienced some challenges during the five-week period. The most prominent challenge was technicalities relating to confusion about the sender, storage location of the messages, repeated messages, and a full phone memory. It was also evident that the women's technological skills were limited. Although a study conducted in Kenya to investigate cell phone ownership and usage revealed that rural women are disadvantaged in cell phone ownership as opposed to also being disadvantaged

technologically (Wesolowski et al., 2012), my research study revealed that all women had access to a phone even if they didn't own one and some of them had minimal technical skills. In fact, some of the non-champs or non-leaders, who were participants in the face-to-face peer-led training sessions, expressed their preference for non-technological means of learning due to reasons such as the fact that some of them were not conversant with the phone application. Despite this challenge, the closely-knit family setting in this community was clearly advantageous. Almost all the women experiencing either minor or major technical issues involved a member of the family in helping to resolve these problems. Involvement of other family members resulted in the entire family's general awareness of the key messages, although they were not directly targeted by the intervention. In addition to family members, there was within group support for the ones experiencing any of these challenges.

Other than technical problems, some women in the intervention group experienced eyesight problems but were still determined to read and practice the key messages. Given that the mean age was approximately 51 years, it is not surprising that this was an issue, but the family members were also available to help in reading the texts for them.

Strengths and Limitations of the Research

One of the primary strengths of this research study was the collaboration and support of Farmers Helping Farmers (FHF), which is the key partner on the larger project. This non-governmental organization has been working for three decades with women's groups and other community members in Kenya, aiming to improve the livelihoods of the smallholder farmers in the area. In 2016, FHF also partnered with the University of Prince Edward Island to implement a food-based agricultural intervention in Naari to improve the food security of the community. This study introduced a complementary 'booster' cell phone messaging intervention, which was the first technology based intervention in the project's study area. The technological component enhanced nutrition education, which is crucial for the success

of any food-based agricultural interventions (Thompson, 2014; Waswa, Jordan, Herrmann, Krawinkel, & Keding, 2015). Moreover, due to FHF operations in the area for three decades, identifying the two women groups used for this research study was not a challenge. The reason for this is the credibility of FHF such that women respected the organization and knew the benefits of the food-based agricultural intervention that had been put in place.

Another strength of this research study was its use of a mixed methods research design. While the quantitative aspect of the research assessed the women's level of knowledge, attitudes, and practices related to the intervention messages, the qualitative aspect of the research expounded on these data but also provided insight on the benefits and challenges of the cell phone intervention. These two components were crucial in answering the overall research question of this study: to what extent does the use of cell phone enhancements to a combined agriculture and nutrition education intervention improve the nutrition-related knowledge, attitudes, and practices of women belonging to self-help groups? In fact, Tariq and Woodman (2013) argue that mixed methods studies are beneficial since they comprehensively address research questions that neither quantitative nor qualitative methods can handle independently. In this research, using mixed methods allowed me to use a quantitative approach to determine how nutrition-related knowledge, attitudes, and practices of women receiving cell phone message-enhanced nutrition education compare with those of women who receive face-to-face peer-led training only; the qualitative component allowed me to understand the benefits and challenges of using cell phones as a supplement to face-to-face peer-led training.

Regarding limitations, since this research study was part of a larger project that began in 2014, there were numerous carry-over effects from previous interventions. For instance, the two women's self-help groups used for this research study had received a pilot nutrition education intervention without the technological enhancement the previous year (2016). As a

result, some of the nutrition messages (both in the face-to-face peer-led education sessions and the cell phone messages) included in this intervention study had also been taught to the same women in face-to-face sessions the previous year. Due to some of these carry-over effects, it was somewhat challenging to explicitly explain some findings in this research study such as the baseline levels of both knowledge and practices. In addition, language barriers was a limitation that resulted in lengthier interviews, and third-voice qualitative transcripts, as well as over-reliance on the translators. The interviewer statements had to be translated from English to Kimeru, while those of the participants from Kimeru to English. In some instances, Kiswahili was also used when the translators had difficulties with English translation.

Future Directions for Research

A majority of research studies have emphasized the need to incorporate nutrition education in food-based agricultural strategies in order to alleviate food insecurity and micronutrient deficiencies (Allen, 2003; Gibson & Hotz, 2001; Thompson, 2014). However, very few research studies have incorporated a technological component in such nutrition education interventions. Although this study investigated the effectiveness of enhancing face-to-face nutrition education with cell phone messaging, it did not relate the knowledge, attitudes, and practices (KAP) to diet diversity and food insecurity. Therefore, further research on whether there was a change in the women's diet diversity and food security status over the intervention is recommended. Moreover, a follow-up research on the women used for the study would be beneficial to assess their retention rates and practises of the women one or two years after this study. More research in different contexts, like urban areas where food insecurity also exists, is needed to determine the effectiveness of a technological addition in other settings.

In this research study, cell phone technology was used to boost nutrition education in a combined nutrition and horticulture intervention. Although the research study has clearly shown the positive effect of the cell phone booster on the women's knowledge, attitudes, and practices, there are still some unanswered questions. For instance, it is not clear what the impact of using two groups that had not received any previous intervention on the knowledge, attitudes, and practices would be? Further, what would be the effectiveness of an interactive messaging platform whereby the target group can ask questions, comment, clarify an issue, or even support a peer? It would also be important to replicate this study with larger sample size and in different women's groups. In fact, with increasing numbers of smart phones in the area, an intervention that is more interactive is an important consideration for future interventions. In the larger project, there is currently a smart phone cell phone application that has been developed but it has not been tested yet. In addition, since a 'one size fits all' kind of intervention may not meet the individual needs of every individual, what would be the impact of using cell phone messaging to offer individualized guidance and intervention to members of the target group especially those with conditions such as diabetes or hypertension? These questions would be worth investigating as well.

Final conclusions

This study provides a detailed exploration of the effectiveness of using cell phone messaging to enhance a combined nutrition and horticulture intervention on the knowledge, attitudes and practices of women belonging to two self-help groups in rural Kenya. The intervention group was more knowledgeable than the comparison group before but most importantly, after the cell phone intervention regarding conserving iron in local foods, consuming foods rich in vitamin A, and protecting all nutrients in the body. The high knowledge levels is consistent with various studies conducted in developed and developing countries using cell phone messaging to convey health and nutrition related information.

Moreover, similar to the few studies investigating the effectiveness of cell phone technology on nutrition education, this study found that the women who received cell phone booster messages in addition to the face-to-face peer-led education sessions had better attitudes towards two key messages as compared to the comparison group who received the face-to-face training only. The two messages were a) conserving iron present in local foods and b) protecting all the nutrients in their body through deworming.

Regarding nutrition-related practices, the results of the study also indicated that the intervention group was more likely to use foods rich in β carotene like orange-fleshed and green vegetables in their common meals as compared to the comparison group. Moreover, the intervention group was also more likely to increase the protein content of meals by using equal portions of maize and beans in comparison to the latter group.

The intervention group perceived the cell phone messaging intervention as beneficial. Some of the benefits that they highlighted were: the messages acted as reminders; they increased their knowledge and understanding of the information received in face-to-face sessions; information was easily accessible; and the messages were practical. The use of the local language in the messages made the women embrace the intervention readily since despite their walks of life, they could access the information easily. They also shared some challenges, such as having technical problems with their phones, some women preferring non-technological learning, and others having eyesight problems.

The study shows that in this sample, cell phone messaging has potential as a platform for nutrition education interventions in developing countries. It is hoped that this study will be important to educators, practitioners, and policy-makers in the health and nutrition sector as they strive to improve teaching and learning strategies and ultimately, reduce food insecurity and improve micronutrient malnutrition.

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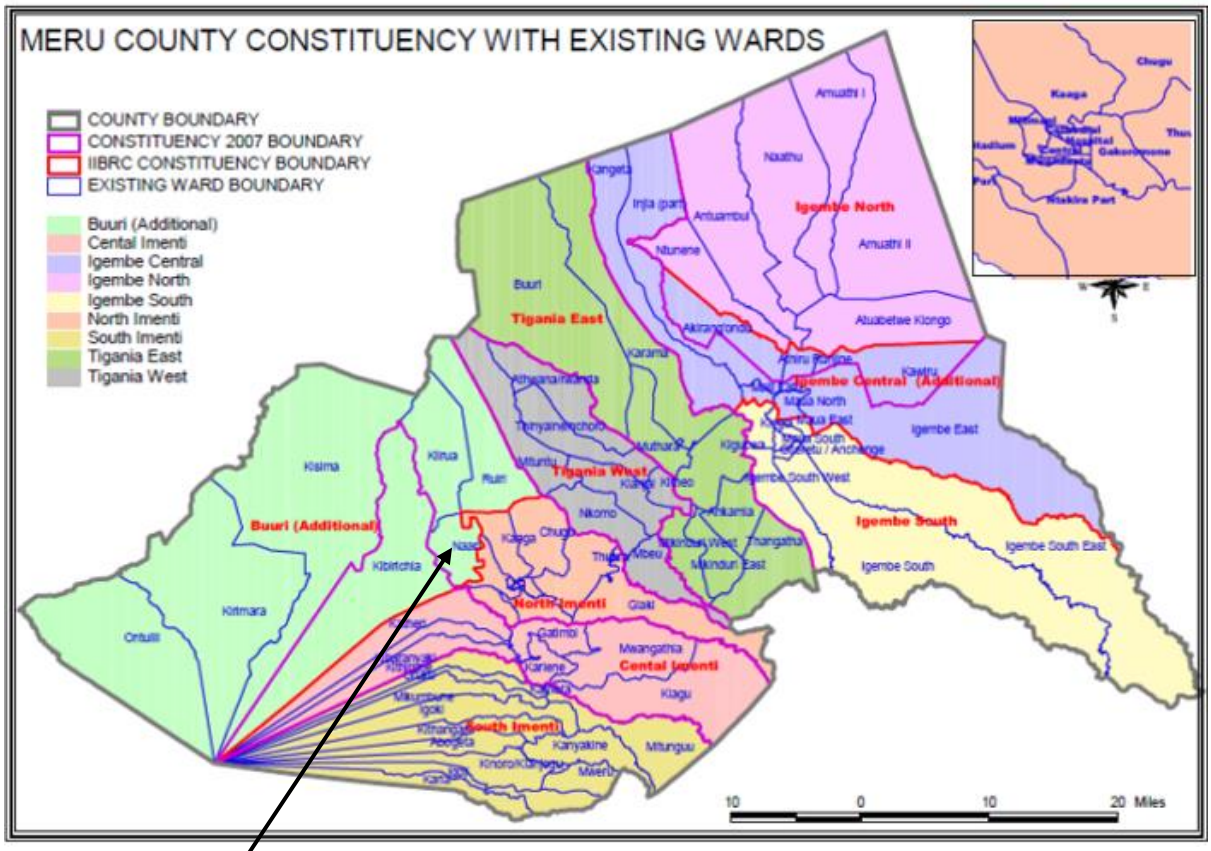
Appendices

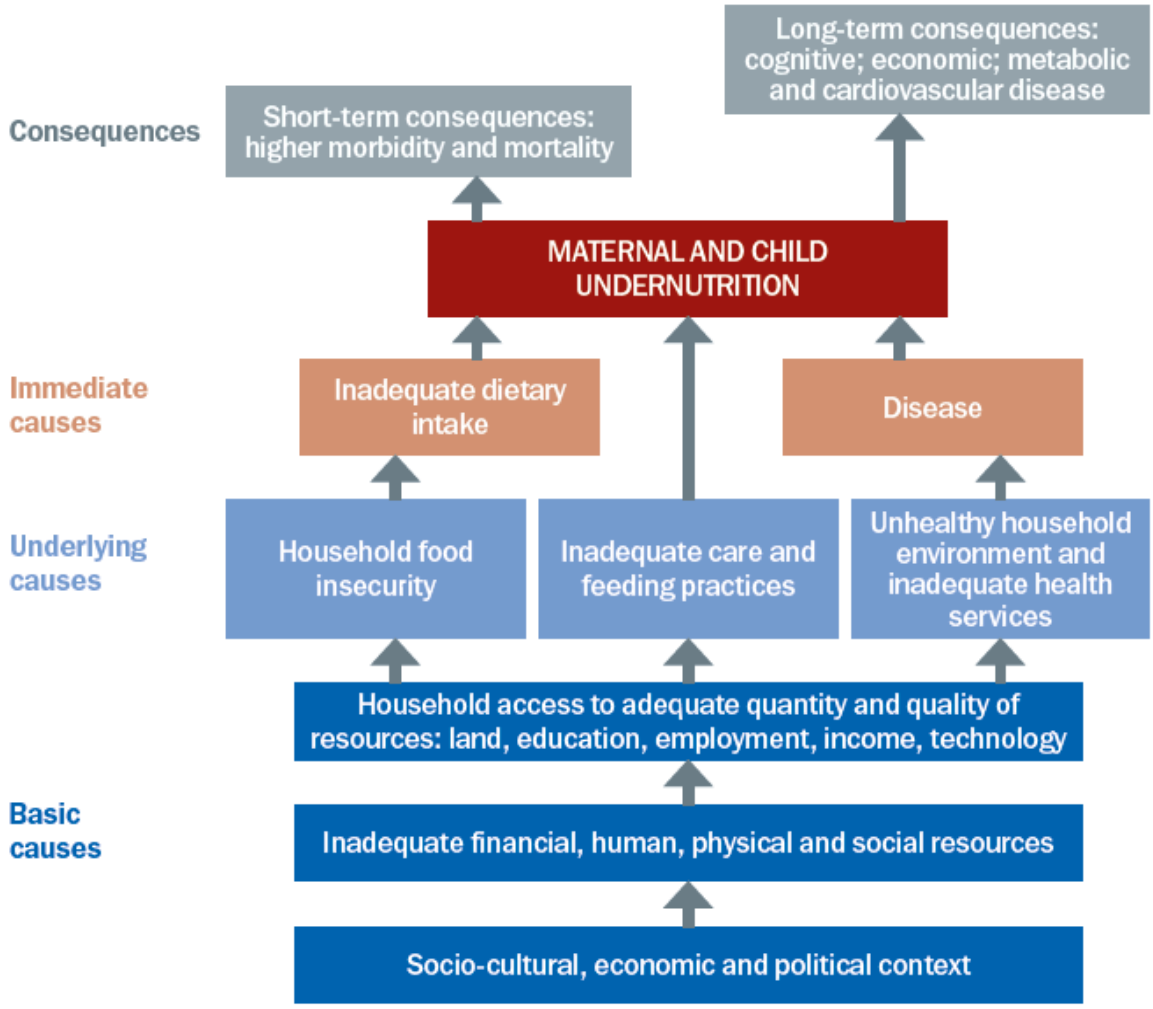
Appendix 1: Map of Meru County, Kenya



Naari Sub location, Buuri Constituency, Meru County

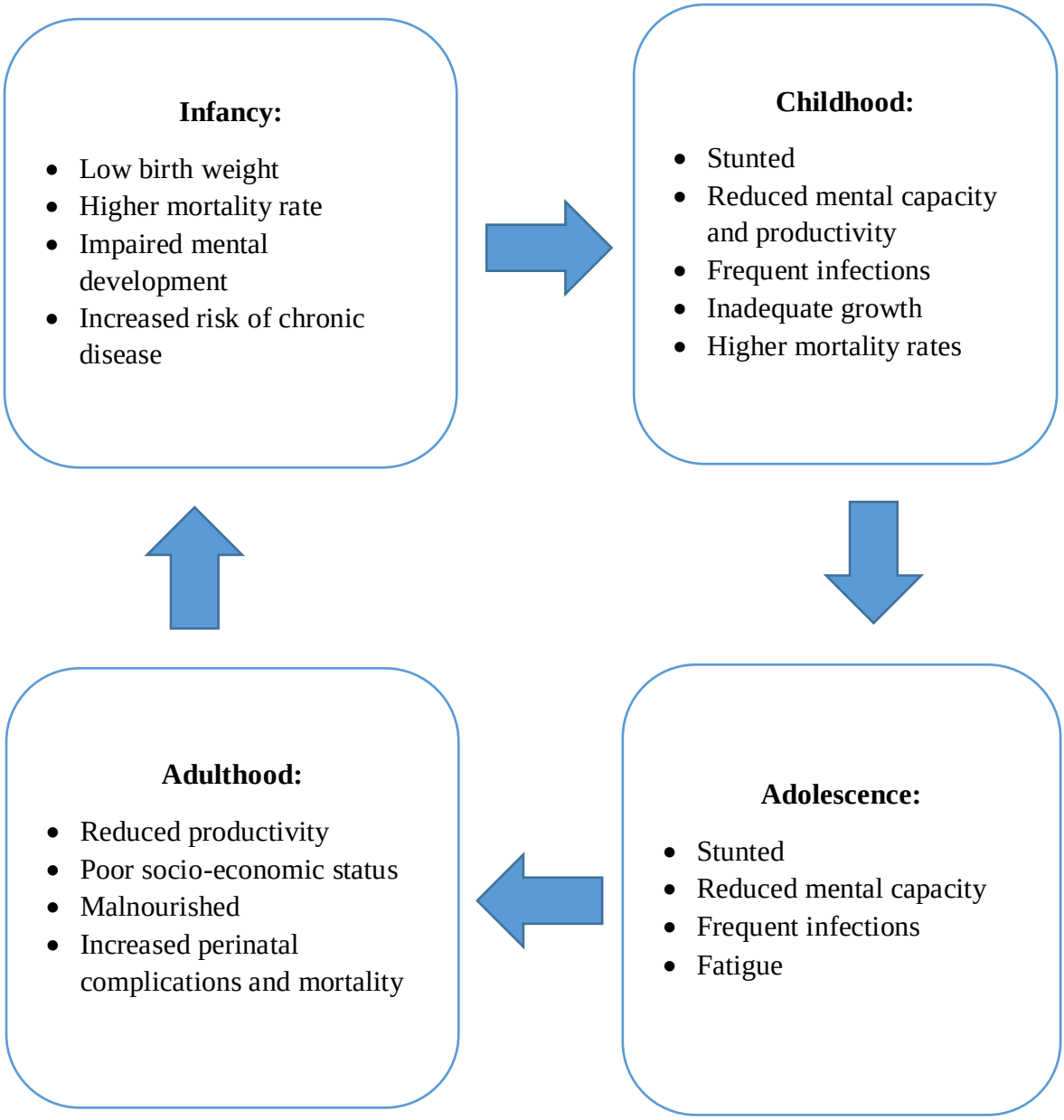
Adopted from the Meru County GIS Maps (County Government of Meru, n.d.)

Appendix II: UNICEF Conceptual Framework of Malnutrition



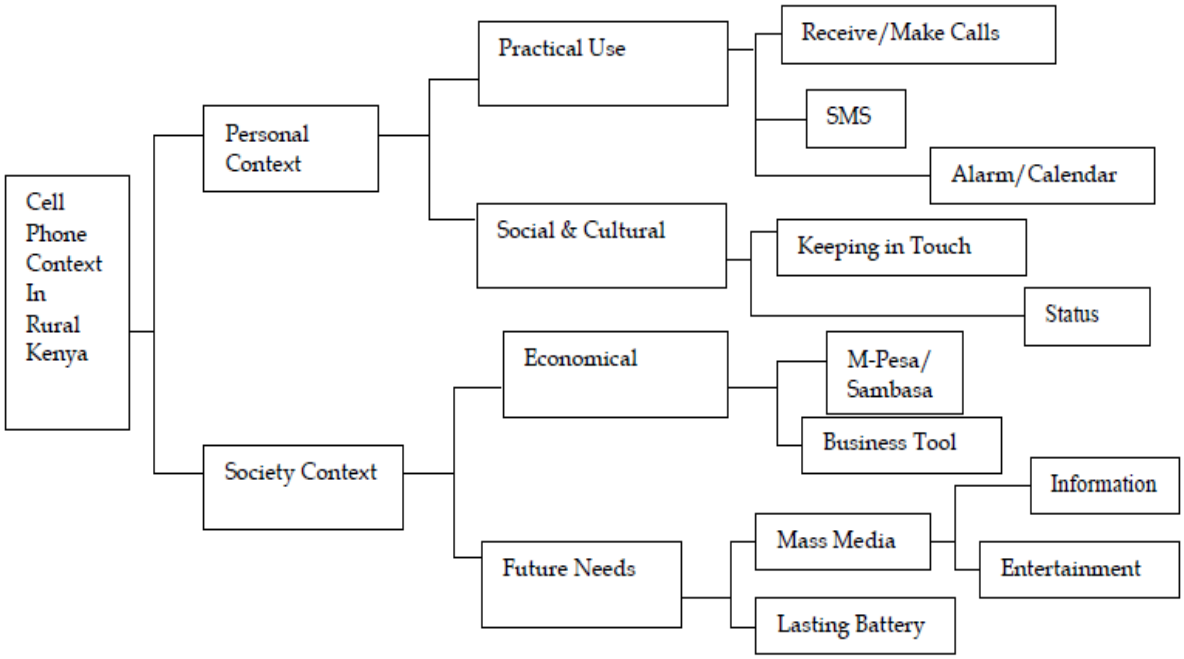
Adopted from the 2013 UNICEF Conceptual Framework for Malnutrition (UNICEF, 2013)

Appendix III: Cycle of the effects of Micronutrient Malnutrition across the Lifespan



Adopted from the Conceptual Framework for the Cycle of Micronutrient deficiencies across the lifespan (Bailey et al., 2011)

Appendix IV: Uses of Cell Phones in the Kenyan Rural Areas Context



Adopted from the context structure of cell phone use in rural Kenya (Eriksson, 2008)

Appendix V: Champs Comprehensive training hand-outs

Champs Family Nutrition and Cooking Tips 2017

Githeri Messages:

Make Super Star Githeri! Making githeri this way will make you and your family healthier and give more energy.

Ruga Kithere gikithongi. Kuruga muthere uju gugatuma ugwe na njaa yaku bugia ugima bubwega bwa mwiri na jubwe inya.

1. Use **mpempe (whole grain) maize** to obtain more nutrients like B vitamins and fibre. Muthakore maize is not as nutritious. Whole grains are an excellent source of B-vitamins. They are beneficial for growth and energy.

1. Tumira mpempe itikonyori kenda ikwaa nutrients ja vitamin B na Fibre. Muthikore jutina into bionthe . Mpempe itikonyori cithairwa cijuri B vitamins. Nietethagiria kiri gukura na inya.

2. Use **equal amounts** of maize and beans to get more protein for strength. Always maintain the 1 to 1 ratio for a healthy pot! Beans are body building foods.

2. Tumira ithimi binganene bia mpempe na mung'au kenda wona protein inyingi yagukwaa inya. Igita rionthe tumira ithimi bia imwe na imwe nontu bwa ugima bubwega bwa nyongu. Mung'au ni jwa gwaka mwiri.

Soak maize and beans overnight before cooking. Drain water to remove the substances that cause stomach problems. Use enough water so that you can discard some soaking water and get rid of those substances. Do not use the soaking water as it could cause stomach problems. Use it for your crops. Cover with fresh water and proceed to cook. Soaked maize and beans will cook more quickly (2-3 hours).

Rinda mung'au na mpempe utuku bunthe mbere ya kuruga. Itura ruuju ruria urarindite naru gwita into biria bituretaga thina cia kiu. Ukirinda tumira ruuju rwa kung'ana kenda wona ruuju rwa gutwura wita into biu. Ugatumira ruuji ruria urarindite naru nontu rwomba gukwajithia kiu. No urutumire gwikira imera biaku. Ikira ruuju rungi na uruge. Mung'au na mpempe birindi bikaya haraka nkuruki (mathaa jairi gwita jathatu)

Soaking:
Kurinda:

- ✓ reduces the cooking time

Nikunyiagia igita ria kuruga

- ✓ reduces use of fuel

Nikunyiagia utumiri bwa nkuu kana makara

- ✓ improves the digestibility

Nigutethagiria irio kithiwa

- ✓ improves the nutritional quality of the food

Nigutethagia kwongera inya iria yonoraga irione

3. **Add at least two vegetables** in addition to tomatoes and onions. The more the better for a healthy pot! Naari vegetables are delicious!

Ongera vegetables iji amwe na nyanya na matunguru. Ouria ukongera inyingi nou nyongu ikethirwa na ugima bubwega. Vegetables cia Naari ni ibuu mono.

- Use one green and one orange vegetable in your githeri as often as you can: daily is best.

Tumira nyani muthemba jumwe na vegetable cia orange mutherene jamaingi uria ukomba. Ntuku cionthe ni bubwega nkuruki

- Greens give you iron and vitamin A which are important for energy, strength, good eyesight and to prevent illness. Green leafy vegetables such as kales, spinach, swiss chard or cowpea leaves are rich in nutrients such as iron, folate, and vitamin A. These nutrients are very important for growing children and women.

Nyani ikwejaga iron na vitamin A iria ciricia gitumi gukwaa inya, metho kwona bwega na kurigiria mirimo. Nyani ja sukuma, spinach kana nthoroko ciujuri nutrients ja iron, folate, na vitamin A. Nutrients iji nicia gitumi mono kiri aana baria bagukura na ekuru.

- Orange vegetables (orange fleshed sweet potatoes, carrots, pumpkin, butternut) are a rich source of vitamin A which is important for good eyesight and to prevent illness.

Vegetables cia orange ka ikwacii bia mukuo bia orange, karati, marenge, butternut ciujuri vitamin A iria iri ya gitumi kiri kwona bwega na kurigiria mirimo.

4. Add vegetables **on the top** near the end of cooking time to protect vitamins.

Ongera vegetables iguru na uri akua gutegura irio kumenyerea vitamins

5. When eating githeri, **add vitamin C rich foods** to your meal to protect iron found in beans and cereals. Iron in food is needed for energy and strength.

Riria ukuria muthere, ongera into biria birina vitamin c kiri irio kurigiria iron itikaure iria yonoraga kiri mung'au na into bibiumu. Iron kiri irio niyejanaga inya.

- Tomatoes, pili pili ho ho, paw paw and oranges are good sources of Vitamin C.

Nyanya, pilipili hoho, mbabai na machukwa ni into bithagirwa na vitamin C.

<u>Mukimo Messages:</u>
Ntumwa cia Mukimo:

Make Super Mukimo: preparing mukimo this way will make you and your family healthier and stronger.
Ruga mukimo super: kuruga mukimo uju gugakwaa ugwe na njaa yaku ugima bubwega na kubwaa inya.

1. Use mpempe maize

Tumira mpempe iti konyori

2. Use equal amounts of maize and beans as is recommended when preparing githeri

Tumira ithimi bing'anene bia mpempe na mung'au oja uria ukwathi ukithuranira muthere

3. Soak and cook the maize and beans the same as is recommended when preparing githeri.

Rinda mpempe na mung'au oja uria uthithirie kiri kuthuranira muthere

4. Double the amount of greens such as kales, spinach, swiss chard, stinging nettle (thaa) or cowpea leaves. These are rich in nutrients such as iron, folate, and vitamin A which are important for energy, strength, good eyesight and to prevent illness.

Ikira mainda jairi uria urekaira nyani ja sukuma, spinach, thaa kana nthoroko. Into bibi biujuri nutrients ja iron, folate, na vitamin A iria iri cia gitumi kiri gukwaa inya, kwona bwega na kurigiria mirimo.

5. Add pumpkin or butternut squash to the Irish potatoes and mash. Pumpkin is high in vitamin A good for eyesight and to prevent illness.

Onera marenge kana butternut kiri ikwacii bia ithungu na ukime. Marenge jethairwa na vitamin A iria ibui kiri metho na kurigiria mirimo.

6. When eating mukimo, add vitamin C rich foods to your meal to protect iron found in beans and cereals. Iron in food is needed for energy and strength.

Riria ukuria mukimo, ongera into biria birina vitamin C kiri biakuria baku kumenyera iron iria nonoraga kiri mung'au na into bingi bibiomu. Iron irione niendekaga nontu bwakwaa mwiri inya

- Tomatoes, pili pili ho ho, paw paw and oranges are good sources of Vitamin C.

Vitamin C ni yonoraga kiri into ja nyanya, pilipili hoho, mbabai na machunkua

<u>Uji Messages:</u>
Ntumiri cia Ucuru

Make Super Uji: preparing uji this way will make you and your family healthier and stronger.
Ruga ucuru super: kuruga ucuru uju gugatuma ugwe na njaa yaku bugie ugima bubwega bwa mwiri na bwithire na inya.

1. Use **<u>mpempe</u> (whole grain) maize** to obtain more nutrients like B vitamins and fibre. Flour from muthikore maize is not as nutritious.

Tumira mpempe itikonyori kenda ikwaa nutrients inyingi ja B vitamins na fibre. Mutuu jwa muthikore jutithairwa na into bionthe

2. Add at least two grain ingredients for more energy and strength.

Ongera into biiri kenda bikwaa inya ya mwiri

- Mix mpempe maize +

Ungania mpempe itikonyori+

- finger millet or

Ugimbi kana

- amaranth or

Terere kana

- sorghum

Mwere

3. Add other nutritious ingredients to maize flour:

Ongera into bingi biria bijuri wega kiri mutuu jwa mpempe

- dried orange flesh sweet potato or

ikwacii bia mukuo bia orange biumitue kana

- terere seeds or

Mpindi cia terere kana

- dried arrowroot or

Matuma jomitue kana

- dried cassava or

mwanga jumitue kana

- dried yams

ikwaa biumitue

4. Take the ingredients to a posho mill to be ground into flour

Ikia into buu kithiine uthie mutuu

Kana ungrate ikwacii bia mukuu bia orange, karati kana marenge uruganirie na ucuru.

OR grate orange fleshed sweet potatoes, carrots or pumpkin and cook with the uji.

5. Add milk for added nutrition. This provides calcium for strong bones and teeth.

Ongera iria wongera mawega. Rikwejaga calcium iria ikweja inya ya maruitu na maigo.

6. Avoid adding sugar and salt for a healthier uji.

Ebera kwongera sukari na sumbi

7. Add eggs to increase protein

Ongera nkara nontu bwa kwongera protein

8. Add vegetable oil to increase energy.

Ongera maguta ja ruuji kwongera inya

<u>Chapati Messages:</u>

Ntumiri cia Chapati

When you make chapatis, make them healthier!
Waruga chapati, tuma ekwee ugimaa bubwega

- Add orange fleshed sweet potatoes, carrots and/or pumpkin

Ongera ikwacii bia mukuo bia orange, karati na kana marenge

  - Peel and boil so that it is very soft. Mash and add it first

Ija na ibicamukie mwanka biinye. Bikime na wongere biri bia mbere

  - Grate raw carrots and then mix with flour

Kira karati na unganie na mutuu

  - Add 1 or 2 eggs to add protein for strength and to make them extra soft

Ongera nkara imwe kana ijiri kwongera protein iria yongagira inya mwiri na igatuma chapati ikainya

- Add oil rather than solid fat. Oils with added vitamins like Golden Fry are more nutritious.

Ongera maguta ja ruuji antua ja gitente. Maguta jaria jongeri vitamins ja Golden Fry ni jamega.

- Try to minimize the amount of oil used.

Geria gutaura maguta jaria ugutumira

Tea (Chai) messages:
Ntumiri cia Chai

- Drink tea one hour before or one hour after meals. Avoid tea at meals to protect iron.

Nyua chai ithaa rimwe mbere kana ithaa rimwe nyuma ya kuria biakuria. Geria kwebera kunyunyaniria chai na iron kurigiria iron itikaure

  - Substances in tea leaves make it difficult for your body to use the iron from foods

Into bimwe biria biri kiri majani bitumaga mwiri jwaku jukaremwe gutumira iron kuma kiri biakuria

  - Tea can still be enjoyed, but it is best to consume it before or after meals to prevent its interference with iron in your meal.

No ukenere chai, indi ni bwega kuminyua mbere kana nyuma ya biakuria kenda itigatonyere iron iria iri irione baku.

  - Replace tea at meals with hot milk or water.

Antua a kunyua chai na biakuria tumira iria rina mwanki kana ruuji

De-worming messages:
Ntumiri cia kuthiria minyoo

- Ensure that your child takes a dewormer once in every six months.

Akikisha mwana waku akunyua dawa cia minyoo nyuma ya mieri itantatu

  - Worms compete with your body for the nutrients in the food you eat and they make you sick.

Minyoo icindanagira na mwiri jwaku nutrients iria iri kiri biakuria biria urijaga na igakwajithia.

- Even if you give enough food to your children or grandchildren, worms can steal the energy and nutrients from the food. Eliminate these good for nothing parasites!

Inya waa aana kana bajuju baku biakuria biakung'ana, minyoo no ibatunye inya na nutrients kuma kiri biakuria. Eberia tuinto tu twotheri!

- To protect against worms:

Kwirigiria kumania na minyoo:

- Have your child take a de-worming medicine once in every six months. Keep record of the last time your child took the pill least you forget.

Wee mwana waku dawa cia minyoo rimwe kiri mieri itantatu. Ika record ya riamuthia riria mwana waku anyuire dawa utikorirue.

- Have your children wear shoes at all times except when sleeping.

Mwana waku nekaire iratu igita rionthe tiga igita riria amami.

- Everyone should wash their hands with soap and water after using the latrine and before preparing or eating food.

O muntu wonthe nathambe njara na ruuji na sabuni nyuma ya gwita kioro na mbere ya kuthuranira kana kuruga biakuria

Appendix VI: Baseline Data Survey Questionnaire

UPEI/Farmers Helping Farmers/ QE II Scholars
Food Frequency and Knowledge Attitudes & Practices Questionnaire 2017

I. Food Use

We are interested in the foods that you have eaten over the past month. I will read a list of foods and ask you how often you eat them. I will then ask the reason why do or do not consume them.

Food Item	Last month		Each Week			Each Day			
Number of times	0	1-3	1	2-4	5-6	1	2-3	4-5	6+
1.Leafy green vegetables (kale, spinach, pumpkin leaves, cow pea, sweet potato, other dark green leaves)									
2.Pumpkin, carrot or squash									
3.Orange sweet potato									
4.Tomatoes									
5.Irish potatoes, white sweet potatoes, cassava									
6.Pawpaw, mango, guava									
7.Bananas									
8.Milk (in your tea)									
9.Milk as a drink									
10. Egg (whole egg e.g. Fried or boiled)									
11.Egg in cooking (e.g. Pancake)									
12.Beef (flesh)									
13.Beef liver/organ meats									
14.Chicken meat									
15.Chicken liver/organ meats									
16.Goat meat									
17.Goat liver/organ meats									

18.Rabbit									
19.Pork									
20.Sweets (candy, sugar cane, chocolate, cakes, pastries, soda, mandazi (fresh donut))									
21.Sugar in tea									

II. Nutrition Knowledge, Attitudes, and Practices:

We are interested in your thoughts about the food that you eat and how you prepare them.

22. As you know, the ingredients in githeri are maize and beans. Do you know what githeri helps your body with? Yes No

If yes, please explain.

23. a Do you measure maize and beans for your githeri? Yes No

(b) If yes, how much maize do you use for the githeri? _____

how much beans do you use for the githeri? _____

c) Why do you use these proportions of maize and beans in your githeri?

24. a) Are you familiar with the practice of soaking dry maize or beans in water before cooking? Yes No

b) If yes, how did you hear about this?

25. a) Do <u>you</u> soak maize in water before cooking? Yes No
b) Why or why not?

26. a) Do <u>you</u> soak beans in water before cooking? Yes No

b) Why or why not?

27. How long should you soak dry maize and beans?

28. What do you think should be done with the water used for soaking your dried maize and beans?

29. a) Do you use mpembe (whole grain) maize? Yes No

b) Why or why not?

30. a) Do you add **greens** to your githeri? Yes No

b) Why or why not?

c) When in the cooking process should one add greens to githeri? Early Late

d) Why should the greens be added at this time?

31. How important do you think it is to add greens to your githeri?

- Extremely important
- Very important
- Important
- Not very important
- Not important at all

32. Last May (2016), after the champ sessions, we interviewed you at home.

a) At that time, were you adding orange-fleshed sweet potato (OFSP), squash or carrots to githeri? Yes No

b) Why or why not?

c) At that time, were you adding OFSP, squash or carrots to chapati? Yes No

d) Why or why not?

e) At that time, were you adding OFSP, squash or carrots to mukimo? Yes No

f) Why or why not?

33. a) Currently (2017**),** are you adding OFSP, squash or carrots to githeri? Yes No.

b) Why or why not?

c) Currently (2017**),** are you adding OFSP, squash or carrots to chapati? Yes No.

d) Why or why not?

e) Currently (2017**),** are you adding OFSP, squash or carrots to mukimo? Yes No.

f) Why or why not?

34. How important do you think it is to add OFSP, squash or carrots to githeri, chapati or mukimo?

- Extremely important
- Very important
- Important
- Not very important
- Not important at all

35. How important do you think it is to add two different vegetables to githeri in addition to onions and tomatoes? For example, greens and OFSP OR greens and squash OR greens and carrots.

- Extremely important
- Very important
- Important
- Not very important
- Not important at all

36. a) Are you familiar with the practice of avoiding taking your **tea** at meal times? Yes No

b) Do you know why would this be recommended? Yes No.

If yes, please explain.

c) How important do you think it is to avoiding taking your **tea** at meal times?

- Extremely important
- Very important
- Important
- Not very important
- Not important at all

37. a) Do you ever eat **fruit** with or shortly after your meals? Yes No

b) Do you know why would this be recommended? Yes No.

If Yes, please explain.

c) How important do you think it is to eat fruit with or shortly after meals?

- Extremely important
- Very important
- Important
- Not very important

- Not important at all

38. Last May (2016), after the champ sessions, we interviewed you at home. At that time, how were you preparing your uji?

a)type of maize flour

- Used maize flour made from muthokore maize
- Used maize flour made from whole grain mpempe maize

b) uji ingredients

- Maize only
- Used maize flour and other grains. Please specify_____
- Added other ingredients. Please specify_____

(b) **Currently** (2017**),** how are you preparing your uji?

a)type of maize flour

- Used maize flour made from muthokore maize
- Used maize flour made from whole grain mpempe maize

b) uji ingredients

- Maize only
- Used maize flour and other grains. Please specify_____
- Added other ingredients. Please specify_____

c) Do you know why mpempe maize would this be recommended? Yes No.

If Yes, please explain.

d) How important do you think it is to use maize flour made from whole grain maize?

- Extremely important
- Very important
- Important
- Not very important
- Not important at all

39. a) How important do you think it is to deworm children?

- Extremely important
- Very important
- Important

- Not very important
- Not important at all

b) How often do your children receive deworming medicine?

- Monthly
- Every six months
- Every three months
- Once per year
- Less often
- Never
- Don't know

c) When was the last time that your children received deworming medicine?

Date:

- Don`t know

d) How frequently do you think one should deworm their children?

- Monthly
- Every six months
- Every three months
- Once per year
- Less often
- Never
- Don't know

40. a) Are there any barriers or difficulties that prevent you, your child or household member from taking deworming medicine more often than you would like to? Yes No

b) If yes, which of the following factors make it difficult to take deworming medicine? Check all that apply

- Cost of medicine
- Do not know where to get it
- Distance to where I can get medicine
- Other. Please specify _____

III. Cell phone Ownership and Use

We will ask you some questions about your cell phone ownership and use

41. Do you have a personal cell phone?

- Yes *If **yes**, skip to **question 45***
- No

42. Do you have access to any cell phone?

- Yes

☐ No *If **no** , thank the participant and **end** the interview session*

43. Whose phone do you have access to?

☐ Spouse's

☐ Child's

☐ Household member's

☐ Neighbour's

☐ Other, specify……..

44. How often do you have access to this phone?

☐ Daily

☐ 2 to 3 times weekly

☐ Once weekly

☐ Fortnightly

☐ Other, specify…….

45. What type of phone is it? *Check out the phone if readily available*

Specific brand name (If known) ……

☐ Basic feature phone

☐ Java enabled phone

☐ Smart phone

46. For how long have you had/ used that phone?

☐ Weeks, specify……..

☐ Months, specify……

☐ Years, specify……

47. Please describe all the things you use the phone for. Check all that apply.

☐ *Making or receiving calls*

☐ *Sending or receiving text messages*

☐ *Sending or receiving money*

☐ *Searching up things on the internet*

☐ *Listening to FM radios*

☐ *Others, specify……*

48. Of all the things that you use your cell phone for, what are the top two things that you do with your cell phone?

……

……

49. How frequently do you RECEIVE text messages?

- ☐ Often (daily, weekly)
- ☐ Sometimes (monthly)
- ☐ Never

50. How frequently do you SEND text messages?

- ☐ Often (daily, weekly)
- ☐ Sometimes (monthly)
- ☐ Never

51. How frequently do you read the messages received?

- ☐ Often
- ☐ Sometimes

} *If **often/sometimes**, skip to **question 54***

- ☐ Never *If **never**, proceed to **question 52***

52. a) Why do you never read messages received OR use the phone for receiving/sending text messages?

Probes:

- ☐ Language barrier
- ☐ Cannot understand
- ☐ Health concerns – eyesight
- ☐ Not interested
- ☐ Other, specify…….

53. Do you have someone that can help in reading the texting messages?

- ☐ Yes
- ☐ No

54. What language do you use for any kind of communication over the phone?

- ☐ English
- ☐ Kiswahili
- ☐ Kimeru

IV. Household Demographics

Finally, we have a few short questions on your household (SOCIAL ECONOMIC STATUS).

55. Does your household own this structure (house, flat, shack), do you pay rent, or do you live here without paying rent?	OWNS.....1 PAYSRENT/LEASE .....2 NO RENTW.CONSENTOF OWNER .....3 NO RENT,SQUATTING……4

56. Does your household own the land on which the structure (house, flat, shack) sits?	OWNS.....1 PAYSRENT/LEASE .....2 NO RENTW.CONSENTOF OWNER .....3 NO RENT,SQUATTING.....4
57. Does any member of this household own any agricultural land?	YES.....1 NO 2
58. How many acres or hectares of agricultural land do members of this household own?	ACRES.....1 HECTARES.....2 PLOT SIZE (SQ FT) .....3 DON'T KNOW 9
59. Does this household own any livestock, herds, other farm animals, or poultry?	YES.....1 NO 2
60. Do you own any of these animals?	YES NO a) LOCAL CATTLE..... 1 2 b) EXOTIC/GRADECATTLE ..... 1 2 c) HORSES/DONKEYS/CAMELS..... 1 2 d) GOATS ..... 1 2 e) SHEEP..... 1 2 f) CHICKENS..... 1 2
61. How many of the following animals does this household own? Enter number beside each animal	a) Local cattle (indigenous)? _____ b) Exotic/grade cattle? _____ c) Horses, donkeys, or camels? _____ d) Goats? _____ e) Sheep? _____ f) Chickens? _____
62. Do you own a bank account?	YES.....1 NO 2
63. DETAILS OF THE MOTHER	AGE MARITAL STATUS..... LEVEL OF EDUCATION.....highest level completed Specify highest level (standard/form)completed _____
64. DETAILS OF THE HUSBAND/ partner	AGE..... OCCUPATION .....you categorize as you

	prefer LEVEL OF EDUCATION …….. PRIMARY.....1 POST-PRIMARY/VOCATIONAL .....2 SECONDARY/'A'LEVEL.....3 COLLEGE(MIDDLELEVEL) .....4 UNIVERSITY.....5

Thank you for completing this questionnaire!

Appendix VII: Post-intervention Survey Questionnaire

UPEI/Farmers Helping Farmers/ QE II Scholars
Food Frequency and Knowledge Attitudes & Practices Questionnaire 2017

II. Food Use

We are interested in the foods that you have eaten over the past month. I will read a list of foods and ask you how often you eat them.

Food Item	Last month		Each Week			Each Day			
Number of times	0	1-3	1	2-4	5-6	1	2-3	4-5	6+
1.Leafy green vegetables (kale, spinach, pumpkin leaves, cow pea, sweet potato, other dark green leaves)									
2.Pumpkin, carrot or squash									
3.Orange sweet potato									
4.Tomatoes									
5.Irish potatoes, white sweet potatoes, cassava									
6.Pawpaw, mango, guava									
7.Bananas									
8.Milk (in your tea)									
9.Milk as a drink									
10. Egg (whole egg e.g. Fried or boiled)									
11.Egg in cooking (e.g. Pancake)									
12.Beef (flesh)									
13.Beef liver/organ meats									
14.Chicken meat									
15.Chicken liver/organ meats									
16.Goat meat									
17.Goat liver/organ meats									

18.Rabbit									
19.Pork									
20.Sweets (candy, sugar cane, chocolate, cakes, pastries, soda, mandazi (fresh donut))									
21.Sugar in tea									

II. Nutrition Knowledge, Attitudes, and Practices:

We are interested in your thoughts about the food that you eat and how you prepare them.

22. As you know, the ingredients in githeri are maize and beans. Do you know what githeri helps your body with? Yes No

If yes, please explain.

23. a) Do you measure maize and beans for your githeri? Yes No

b) If yes, how much maize do you use for the githeri? _____

how much beans do you use for the githeri? _____

c) Why do you use these proportions of maize and beans in your githeri?

24. a) Are you familiar with the practice of soaking dry maize or beans in water before cooking? Yes No

b) If yes, how did you hear about this?

25. a) Do <u>you</u> soak maize in water before cooking? Yes No

b) Why or why not?

26. a) Do <u>you</u> soak beans in water before cooking? Yes No

b) Why or why not?

27. How long should you soak dry maize and beans?

28. What do you think should be done with the water used for soaking your dried maize and beans?

29. a) Do you add **greens** to your githeri? Yes No

b) Why or why not?

c) When in the cooking process should one add greens to githeri? Early Late

d) Why should the greens be added at this time?

30. How important do you think it is to add greens to your githeri?

- Extremely important
- Very important
- Important
- Not very important
- Not important at all

31. a) Do you adding OFSP, squash or carrots to githeri? Yes No.

b) Why or why not?

c) Do you adding OFSP, squash or carrots to chapati? Yes No.

d) Why or why not?

e) Do you adding OFSP, squash or carrots to mukimo? Yes No.

f) Why or why not?

32. How important do you think it is to add OFSP, squash or carrots to githeri, chapati or mukimo?

- Extremely important
- Very important
- Important
- Not very important
- Not important at all

33. How important do you think it is to add two different vegetables to githeri in addition to onions and tomatoes? For example, greens and OFSP OR greens and squash OR greens and carrots.

- Extremely important
- Very important
- Important
- Not very important
- Not important at all

34. a) Do you ever eat **fruit** with or shortly after your meals? Yes No

b) Do you know why would this be recommended? Yes No.

If Yes, please explain.

c) How important do you think it is to eat fruit with or shortly after meals?

- Extremely important
- Very important
- Important
- Not very important
- Not important at all

35. a) How important do you think it is to deworm children?

- Extremely important
- Very important
- Important
- Not very important
- Not important at all

b) How often do your children receive deworming medicine?

- Monthly
- Every six months
- Every three months
- Once per year
- Less often
- Never
- Don't know

c) When was the last time that your children received deworming medicine?

Date:

- Don`t know

d) How frequently do you think one should deworm their children?

- Monthly
- Every six months
- Every three months
- Once per year
- Less often
- Never
- Don't know

36. a) Are there any barriers or difficulties that prevent you, your child or household

member from taking deworming medicine more often than you would like to? Yes No

b) If yes, which of the following factors make it difficult to take deworming medicine? Check all that apply

- ☐ Cost of medicine
- ☐ Do not know where to get it
- ☐ Distance to where I can get medicine
- ☐ Other. Please specify _____

III. Cell phone messages intervention

37. a) In the past five weeks, did you receive any cell phone messages from AFRICASTKING about food and how to prepare it? (Yes No)

b) We are interested in knowing how many messages that you received over the past five weeks, how many you read and how much of each message you read.

{Ask participants to check their phones}

	Dates	Received (check)	Read (check)	If read, how much of the message was read: 0 if read all of the message 1 if read most of the message 2 if read some of the message
1.	7th June 2017			
2.	11th June 2017			
3.	*14th June 2017*			
4.	*18th June 2017*			
5.	*21th June 2017*			
6.	*25th June 2017*			
7.	*28th June 2017*			
8.	*2nd July 2017*			
9.	*6th July 2017*			
10.	*9th July 2017*			

If the participant did not read all the messages, *go to question 38*

If the participant read any of the messages partially, go to question 39

If the participants read all the messages, *go to question 40*

38. Why did you not read all the ten (10) messages that were sent to you?

- ☐ I was busy
- ☐ Forgot to read them
- ☐ Can't read some words
- ☐ Only received _____ messages
- ☐ Others, specify _____

39. Why did you read the message(s) partially?

- ☐ I was busy
- ☐ Forgot to read the entire message after receiving it
- ☐ Can't read some words
- ☐ Others, specify _____

40. About the content of the messages:

a) How understandable were the messages to you?

- ☐ Very easy to understand
- ☐ Easy to understand
- ☐ Somewhat easy to understand
- ☐ Difficult to understand
- ☐ Very difficult to understand

b) How informative were the messages?

- ☐ Very informative
- ☐ Somewhat informative
- ☐ Informative
- ☐ Not very informative
- ☐ Not informative at all

41. How motivated were you to practically implement the nutrition messages concerning **putting equal portions of maize and beans** for your githeri?

- ☐ Extremely motivated
- ☐ Very motivated
- ☐ Somewhat motivated
- ☐ Not motivated
- ☐ Not motivated at all

42. How motivated were you to practically implement the nutrition messages concerning **soaking dry maize and beans in water** before cooking your githeri?

- ☐ Extremely motivated
- ☐ Very motivated
- ☐ Somewhat motivated
- ☐ Not motivated
- ☐ Not motivated at all

43. How motivated were you to practically implement the nutrition messages concerning **adding two more vegetables to your cooking pot in addition to onions and tomatoes**?

- ☐ Extremely motivated
- ☐ Very motivated
- ☐ Somewhat motivated
- ☐ Not motivated
- ☐ Not motivated at all

44. How motivated were you to practically implement the nutrition messages concerning **eating a fruit before or after a meal**?

- Extremely motivated
- Very motivated
- Somewhat motivated
- Not motivated
- Not motivated at all

45. How motivated were you to practically implement the nutrition messages concerning **your child(ren)/grandchildren taking a deworming medicine frequently**?

- Extremely motivated
- Very motivated
- Somewhat motivated
- Not motivated
- Not motivated at all

46. You received two messages… 'did you know/**anwiji**' and 'remember to/**rikana**'. Which of the two messages helped you more?

- 'Did you know/anwiji' message
- 'Remember to/rikana' message
- Both messages equally
- None of the messages

47. Did you have any questions or concerns relating to the number of messages received during the five weeks?

Yes No

a) What are some of the questions and concerns that you had?

b) How did you handle these questions and concerns?

48. Did you have any questions or concerns relating to the content and understandability of the messages during the five weeks in which you were receiving the messages?

Yes No

a) What are some of the questions and concerns that you have?

b) How did you handle these questions and concerns?

Probes:

i. Did you ask for help reading the messages? Why?

ii. Did you ask someone to help you understand what the message said? Why?

c) Did you find any of the messages difficult to understand? Yes No

i. Which of the messages were difficult to understand?

ii. What made the messages difficult to understand?

d) Did you find any of the messages unclear? Yes No

i. Which of the messages were not clear?

ii. What made the messages seem unclear to you?

49. Please tell me any challenge that you encountered during the five (5) weeks of cell phone messaging.

If no challenge, what made it easy for you?

{Then probe,}

Did you encounter any of this challenges and how much that any of the following were challenges during the five (5) weeks of cell phone messaging

a) i. I didn't know who to call/text back when I had questions and concerns

Minimally challenging Extremely challenging

ii. How much did this challenge make it difficult to implement the nutrition messages?

Minimally challenging Extremely challenging

b) i. Messages were too many

Minimally challenging Extremely challenging

ii. How much did this challenge make it difficult to implement the nutrition messages?

Minimally challenging Extremely challenging

c) i. Messages were too long

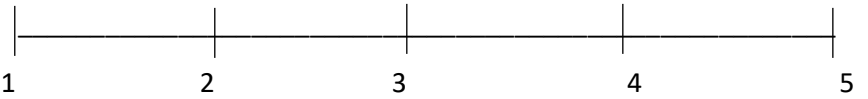
Minimally challenging Extremely challenging

ii. How much did this challenge make it difficult to implement the nutrition messages?

Minimally challenging Extremely challenging

d) i. Messages were not clear

Minimally challenging Extremely challenging



ii. How much did this challenge make it difficult to implement the nutrition messages?

Minimally challenging Extremely challenging

e) i. Could not put into practice messages because of lack of enough food

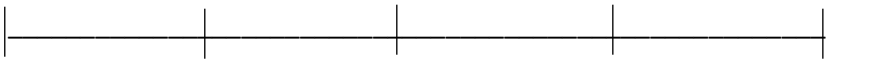
Probe:
Which of the messages were difficult to implement because of lack of enough food?

a) Message about ……..

Minimally challenging Extremely challenging

b) Message about ……

Minimally challenging Extremely challenging



c) Message about ……

Minimally challenging Extremely challenging

ii. How much did this challenge make it difficult to implement the nutrition messages?

Minimally challenging Extremely challenging

f) i. Had problems with my cell phone. Specify…….

Minimally challenging Extremely challenging

ii. How much did this challenge make it difficult to implement the nutrition messages?

Minimally challenging Extremely challenging

g) i. Others. Specify……

Minimally challenging Extremely challenging

ii. How much did this challenge make it difficult to implement the nutrition messages?

Minimally challenging Extremely challenging

50. a) What did you like about receiving the cell phone messages?

b) What did you not like about receiving the cell phone messages?

Thanks for responding to this questionnaire!

Appendix VIII: Focus Group Discussions (FDG) Interview Guide (Champs)

JOY CHAMPS Questions:

PART A: Champs workshop (note that we will ask about the cell phone messages later)

Section A: Champs training session

1. The nutrition students first met with you and other champs to review, learn the messages and discuss how to teach the seminar.
   i. **What worked well** about that meeting? (Time, location etc.).
   ii. **How** could it be **improved**? (Time, location etc.).
   iii. After the meeting, **did you understand what you needed to do in order to teach the women**? {What did you understand that your roles would be?}
2. You also met the students to decide **what to cook** and **how much to cook. What worked well about deciding that with you?** (**Probe:** had enough/too much to serve etc.).

   i. How did you **decide** which champ **bought** which ingredients for cooking? (**Probe:** how did you divide up the responsibilities?).

   ii. Were there **any challenges** or problems that **came up** when you **were planning? (Probe: what** to cook? **How** much to cook? **Where** to cook from? Transportation? Time?).

3. On the day of the **cooking**, **what went well and what were some challenges**? (**Probe:** students being present (good or bad!), foods chosen, amount of time to cook, facility?)

Section B: Formatting / Physical Teaching Aids

4. We provided **laminated** hand-outs for each Champ with the nutrition messages and cooking tips during the training:
   i. **What was good or bad about providing the information this way**? (**Probe:** Would you prefer charts, booklets or binders etc.?).

Section C: Champs Workshop

5. How could we make the champs **training** and champs **workshops work better** in the future? (**Probes: Do not** read the probes, they are provided as a guide). Please explain

i. Combine cooking tips with nutrition messages rather than having them separate
ii. Adding more messages/shortening list of messages/ provide each woman with copy of laminated messages and cooking tips
iii. Train more champs/ increasing the number of champ's workshops
iv. No cooking
v. provide cooked food for tasting only
vi. Provide audio recorded messages
vii. Other (**record**)

6. Are there things or questions that **you heard or were asked during or after** the Champs session that **should be included in future messages**? *(**If yes**, please explain).*

Section D: Peer Education

7. After the training, **how confident did you as champs** feel teaching your peers about making healthy meals? Please explain.

i. In your opinion, **what made it easy or difficult** to train your peers (Joy women)?

8. In your opinion, **what** made it **easy or difficult** for you as Champs to share these messages. (**Probes: Do not read**. The list is a guide for possible responses).

i. Availability /lack of laminated messages and cooking tips
ii. Cost of food (people were not willing to cover cost of food)
iii. People are available/unavailable/time to teach is a challenge
iv. Confidence/fear of questions asked that don't relate to the messages
v. Can read/can't read
vi. Too many messages/hard to recall all the messages
vii. Didn't understand all the messages
viii. Confident because of champs training/teaching other people other than my peers is uncomfortable)
ix. **Others**?

9**. In your opinion,** was this experience **helpful to the champs and their families**? (Yes/No)

i. Describe how it was helpful or was not helpful.

Probe: (change level of confidence, respect from community/family members, knowledge)

10. In your opinion, **how did you feel working with both Kenyan and Canadian students** on this project? Did this have any effect on you? Or on the training itself? How? (Did you **notice that there were both** undergraduate and graduate students working on the champs sessions and interviews. How did you feel about this?

Section E: Implementation of messages

11. Was it **easy or difficult** for you to implement the changes that you learnt during the champ session? (For example, soaking maize and beans, eating vitamin C rich fruits and vegetables with meals, adding greens close to serving time etc.?). How long have you been doing these practices?

i. **Are there things** you would like to **change about your current diet that you learnt during the champ session that you have not been able to change?** (Yes/No) (Probe but do not read: Portion sizes, too much starch, taking tea at meal times)
Which ones?

Section F: Knowledge Dissemination

12. Did you as Champs do any teaching sessions **with anyone other group else after** the champ's workshop? (Yes/ No) Who?

13. Did you **informally** share/ speak to anyone about the messages after the champ's workshop? (Yes/No)

i. **Who** have you shared the messages and cooking tips with? (**Do not Probe,** wait for

them to answer-husband, children, neighbour (s), church, schools, other women's group etc.?)

Section G: Sustainability

14. Right now we have **project funding** to pay for the food for the champ sessions. The funding ends next year. **Do you think women would pay a small amount of money to cover the cost of food so that Champ sessions could continue in the future?** If yes, how much do you think each woman would be willing to pay per session? (**Probe:** 50-100, 150-200, 250-300) {Would you obtain the money through merry-go-round or table banking}

15. In your opinion, **what needs to be provided to support future champs to help them be better peer-educators**?

PART B: Cell Phone Messages

Section H: Cell Phone Messaging Good and Bad Parts

16. Benefits:

In your opinion, was it of any value to you to have received the cell phone messages after the champs education and training session? {Yes/No}

Why or why not?

17. Knowledge retention and transfer:

a) Last year (2016), you received a champs education and cooking session and no messages but this year (2017) you got both the champ session and the cell phone messages.

In your opinion, was there a difference between 2016 and 2017 in terms of your learning? {Yes/No}

Please explain

b) Did you share the messages with others? *{Did you tell others about the messages/ did you forward the messages to others/ did you write the messages to give others to read?}*

18. Challenges:

Were there any challenges that you or other members of Joy women's group encountered during the five (5) weeks of cell phone messaging? (Probe, do not read)

i. Could not reply to the messages by calling or texting
ii. Shared by phone with others
iii. Lack of enough food to implement the messages
iv. Did not have enough time to read and practice each message
v. Had problems with cell phone {charge, full phone memory, etc.}
vi. Number of messages
vii. Others, specify

19. Timing:

You received the cell phone messages from AFRICASTKING for a period of five (5) weeks.

a) Were the five (5) weeks of receiving messages enough or would you have wanted more or less? Please explain.

b) *{If they reply that they would have wanted to receive more messages in Question 15a, ask}* What else would you have liked to learn about through the cell phone messages?
Probe: {Which nutrition topics? Which other topics?}

Section I: Cell Phone Messaging Recommendations

20. I**mprovements:**

a) How best do you think that receiving cell phone messages through your phone could be improved?

b) If we had ample funding to educate women in Naari, what would you recommend?

Appendix IX: Focus Group Discussions (FDG) Interview Guide (Non-champs)

JOY NON-CHAMPS Questions

PART A: Champs workshop (note that we will ask about the cell phone messages later)

Section A: Peer Education

1. In your opinion, **how did you like the experience of being taught by the champs** on how to prepare healthy meals?
2. **In your opinion,** was this experience **helpful to Joy women and their families**? (**For example**, build confidence, earn respect from community/family members, become better cook, know how to improve health, know how different foods benefit your health?).
   i. Describe how it was helpful or was not helpful:
3. In your opinion, **how did you feel working with both Kenyan and Canadian students** on this project? Did this have any effect on you? Or on the training itself? How?

(Did you **notice that there were both** undergraduate and graduate students working on the champs sessions and interviews. How did you feel about this?

Section B: Champs Workshop

4. Are there things or questions **you have heard or were asked during or after** the Champs session that **should be included in the future messages**? *(**If yes**, please explain).*

5. During the champ's workshop, you met the nutrition students who helped in the preparation, cooking and serving of mukimo, chapati, uji, stew etc. **What worked well about their involvement?**

6. How **easy or difficult** was it for you to do the things recommended in the champ session, which included. changing your cooking methods and the foods you eat (For example, soaking maize and beans, eating vitamin C rich fruits and vegetables with meals, adding greens close to serving time etc.?).

   ii. **Are there things** you would like to **change about your current diet that you learnt during the champ session that you have not been able to change?** (Yes/No) (Probe but do not read: Portion sizes, too much starch, taking tea at meal times)

Which ones? **Why?**

7. Are there things or questions **you have heard or were asked <u>during or after</u>** the Champs session that **should be included in the future messages**? ***(If yes**, please explain).*

8. **What would you suggest to make the future champ's workshops work better?** (**Probes: <u>DO NOT</u> <u>read the probes, they are provided as a guide</u>**). <u>And why do you make that suggestion?</u>
    i. Adding more messages
    ii. Shortening list of messages
    iii. Provide each woman with copy of laminated messages and cooking tips
    iv. Train more champs/ increasing the number of champ's workshops
    v. No cooking
    vi. Provide cooked food for tasting only; small portions rather than a meal
    vii. Provide audio recorded messages when? Not clear. Instead of having students?

<u>Section C: Knowledge Dissemination</u>

9. We are interested to **know if you have shared or spoken to any other groups** about these messages after the champ's workshop. **Who have you shared these messages and cooking tips with**? (**Probe:** at the church, with other women's group, parents meeting at schools or at chief baraza?).

10. Did you **informally** share/ speak to anyone about the messages after the champ's workshop? (Yes/No)

    i. **Who** have you shared the messages and cooking tips with? (**<u>Do not probe</u>,** wait for them to answer-husband, children, neighbour (s), church, schools, other women's group etc.?)

11. Did you **informally** share/ speak to anyone about the messages after the champ's workshop? (Yes/No)
    i. **Who** have you shared the messages and cooking tips with? (**<u>Do not probe</u>,** wait for them to answer-husband, children, neighbour (s), church, schools, other women's group etc.?)

12. **If you have shared the workshop messages, what made it easy or difficult for you to share them** with other community members? ***(*Probe, <u>do not read</u>).**

i. Paper copies rather than laminated messages and cooking tips
ii. People are available/unavailable-but time to teach is the challenge
iii. Fear of questions asked that I can't answer
iv. Can read/can't read
v. Few messages/too many messages to recall
vi. Didn't understand all the messages
vii. Confidence in teaching others/ teaching other people other than my peers is uncomfortable
viii. Other?

Section D: Sustainability

13. **Right now** we have **project funding** to pay for the food for the champ sessions. The funding ends next year**. Do you think women would pay a small amount of money to cover the cost of food so that Champ sessions could continue in the future?** If yes, how much do you think each woman would be willing to pay? (**Probe:** 50-100, 150-200, 250-300) {Would you obtain the money through merry-go-round or table banking}

14. In your opinion, **what needs to be provided to support future champs to help them be better peer-educators**?

PART B: Cell Phone Messages

Section E: Cell Phone Messaging Good and Bad Parts

15. Benefits:

In your opinion, was it of any value to you to have received the cell phone messages after the champs education and training session? {Yes/No}

Why or why not?

16. Knowledge retention and transfer:

a) Last year (2016), you received a champs education and cooking session and no messages but this year (2017) you got both the champ session and the cell phone messages.

In your opinion, was there a difference between 2016 and 2017 in terms of your learning? {Yes/No}

Please explain

b) Did you share the messages with others? *{Did you tell others about the messages/ did you forward the messages to others/ did you write the messages to give others to read?}*

17. Challenges:

Were there any challenges that you or other members of Joy women's group encountered during the five (5) weeks of cell phone messaging? (Probe, do not read)

viii. Could not reply to the messages by calling or texting
ix. Shared by phone with others
x. Lack of enough food to implement the messages
xi. Did not have enough time to read and practice each message
xii. Had problems with cell phone {charge, full phone memory, etc.}
xiii. Number of messages
xiv. Others, specify

19. Timing:

You received the cell phone messages from AFRICASTKING for a period of five (5) weeks.

c) Were the five (5) weeks of receiving messages enough or would you have wanted more or less? Please explain.

d) *{If they reply that they would have wanted to receive more messages in Question 15a, ask}* What else would you have liked to learn about through the cell phone messages?
Probe: {Which nutrition topics? Which other topics?}

Section F: Cell Phone Messaging Recommendations

18. I**mprovements:**

a) How best do you think that receiving cell phone messages through your phone could be improved?

b) If we had ample funding to educate women in Naari, what would you recommend?

Appendix X: Information letter and Consent form for Survey Participants

Information letter for Survey Participants

Dear participant,

My name is …….. I am part of a nutrition research team comprising of two undergraduate students and two graduate students from UPEI. Our research is part of a larger project led by Farmers Helping Farmers (FHF), University of Prince Edward Island (UPEI), Kenyatta University, University of Nairobi, and Naari Dairy Co-operative Society. The goal of the project is improving nutrition, food security, and livelihoods of smallholder farmers in Naari. The information we collect will partly help in achieving this major objective. We would like to ask you some questions about the food you eat, the cell phone you use, and your household. The survey will take about one hour thirty minutes.

You do not have to participate in the survey, but we hope you answer the questions since your views are very important. We assure you of utmost confidentiality of all the answers we get from you. You are free to withdraw from the study whenever you want and there will be no negative consequences. If you have any questions about the study, feel free to ask us at any time (see our contacts below). If you have any concerns about the ethical conduct of this study, also feel free to contact the UPEI Research Ethics Board at (902) 620-5104, or by email reb@upei.ca.

Your assistance and cooperation is highly appreciated. You will receive one litre of cooking oil as a token of appreciation for participating in the study.

Sincerely,

Sarah W. Muthee
0728 917 017
smuthee@upei.ca

Grace W. Wanjohi
0720 098 969 / 0738 560 643
gwanjohi@upei.ca

You can also contact:

Dr. Jennifer Taylor - jtaylor@upei.ca

Dr. J. Tim Goddard - tgoddard@upei.ca

Consent form for Survey Participants

We invite you to participate in this research. Your signature or thumbprint on this consent form means:

- You have been informed about the research and you understand its details.
- You understand that participating in this research study is voluntary.
- You understand that you can withdraw from the study at any time and there will be no consequences.
- You understand that you can ask any questions, at any time, about the research study.
- You understand that there are minimal risks and benefits associated with the study.
- You understand that the answers you provide will be kept confidential.
- You understand that you can keep one copy of the signed or thumb printed consent form if you so wish.
- You understand that if you have any concerns about the ethical conduct of this study, you are feel free to contact the UPEI Research Ethics Board at (902) 620-5104, or by email reb@upei.ca.

…… ……..

Signature or thumbprint of participant **Date**

Researcher who obtained consent: I have explained this study to the best of my ability. I have invited questions and given answers to the participant. Therefore, I believe that the participant understands what is involved in being part of the research study.

…… ……..……

Signature of Researcher **Date**

Research contacts:

Sarah W. Muthee - 0728 917 017 or smuthee@upei.ca

Grace W. Wanjohi - 0720 098 969 / 0738 560 643 or gwanjohi@upei.ca

Dr. Jennifer Taylor (jtaylor@upei.ca)

Dr. J. Tim Goddard (tgoddard@upei.ca)

Appendix XI: Information letter and Consent form for FDG Participants

Study Information for Focus Group Participants

Dear participant,

You are invited to participate in this research. Below is some information about the research:

1. Who will be conducting the study? I, Grace W. Wanjohi, a Masters of Education student at the University of Prince Edward Island will be conducting this research. My research study is part of a project aimed at improving nutrition, food security, and livelihoods of farmers in Naari. Dr. J. Tim Goddard, Dr. Jennifer Taylor, and Dr. John Vanleeuwen from UPEI, as well as Dr. Joan Muriithi from Kenyatta University are supervising the study.

2. What is the purpose of this study? The purpose of this research is to evaluate whether and to what extent enhancing conventional nutrition training methods with cell phone messaging has an impact on the knowledge, attitudes, and practices of women organized in self-help groups in Naari, Meru County, Kenya.

3. What is the inclusion and exclusion criteria? The part of the research study will only focus on women from Joy women's self-help group who have, or have access to a cell phone.

4. What will participants do in this study, where will it take place, and how much time will it take? Six (6) champs and six (6) non-champs from the self-help group that receives cell phone messages for a period of five (5) weeks in addition to the face-to-face training sessions will be members of the focus group. In this part of the study, you will be asked to participate in a discussion about some selected topics. Other women who are part of the focus group will be listening and taking part in the discussion too. The focus group session will last for forty-five minutes only.

5. Is the study voluntary? Yes, participation within this study is voluntary.

6. Can participants withdraw from the study? Yes, you are free to withdraw from the study whenever they want. There will be no consequences for choosing not to participate in the study.

7. Are there any possible benefits and risks associated with the study? This research poses very minimal to no risks to all the participants. As for the benefits, you will receive one litre of cooking oil as a token of appreciation for participating in the study. The researchers have no benefits other than academic-related ones.

8. Will the data collected be confidential and anonymous, and how will it be stored? You are assured of utmost confidentiality and therefore, measures will be taken to ensure it. I will assign fictitious names to all members of the focus group to protect your identity. I will put all the notes written during the focus group discussion session in box files and store them in a locked cabinet. After entering the data into the computer, I will store it in password-protected files. Only, the supervisory committee team and I will have access to these data. Moreover, the cell phone numbers obtained from you will neither be shared nor used for any other purposes. The numbers will also be stored separately from the interview data and in a password-protected file.

9. Can the participants have access to the research findings? Yes. At the end of the research study in 2018, I will send a copy of the research findings to both Upendo and Joy women's group through your chair-ladies.

10. Whom can I ask if I have any questions? If you have any questions about the study, feel free to please ask me at any time, (see my contact details below). If you have any concerns about the ethical conduct of this study, also feel free to contact the UPEI Research Ethics Board at (902) 620-5104, or by email reb@upei.ca.

11. If I want to participate in the study, what do I do? If you want to participate in this study, sign or put a thumbprint on the two (2) consent forms that will be presented to you. One consent form will remain with me and you can keep the other copy if you so wish.

Your assistance and cooperation is highly appreciated.

Sincerely yours,

Grace W. Wanjohi

Phone: 0720 098 969/ 0738 560 643

Email: gwanjohi@upei.ca

You can also contact:

Dr. Joan Muriithi (Kenya) - 0722 225 500 or muriithi.joan@ku.ac.ke

Dr. J. Tim Goddard - tgoddard@upei.ca

Dr. Jennifer Taylor - jtaylor@upei.ca

Dr. John Vanleeuwen - jvanleeuwen@upei.ca

Utility of Augmentation of Human Nutrition Training with Cell Phone Messaging among Women Organized in Self-help Groups in Kenya

Focus Group Consent Form

Dear participant,

We invite you to participate in this research. Your signature or thumbprint on this consent form means:

- You have been informed about the research and you understand its details.
- You understand that participating in this research study is voluntary.
- You understand that you can withdraw from the study at any time and there will be no consequences.
- You understand that you can ask any questions, at any time, about the research study.
- You understand that there are minimal risks and benefits associated with the study.
- You understand that the information you provide will be kept confidential and anonymous.
- You understand that you can keep one copy of the signed or thumb printed consent form if you so wish.
- You understand that if you have any concerns about the ethical conduct of this study, you are feel free to contact the UPEI Research Ethics Board at (902) 620-5104, or by email reb@upei.ca.
- You agree that the researcher can use specific quotes from the interview transcripts in potential conference presentations and publications.

…… ……..

Signature or thumbprint of participant **Date**

Researcher who obtained consent: I have explained this study to the best of my ability. I have invited questions and given answers to the participant. Therefore, I believe that the participant understands what is involved in being part of the research study.

…….…. ……

Signature of Researcher **Date**

Research contacts:

Grace W. Wanjohi - 0720 098 969 / 0738 560 643 or gwanjohi@upei.ca

Dr. Joan Muriithi (Kenya)- 0722 225 500 or muriithi.joan@ku.ac.ke

Dr. J. Tim Goddard - tgoddard@upei.ca

Dr. Jennifer Taylor - jtaylor@upei.ca

Dr. John Vanleeuwen - jvanleeuwen@upei.ca

Appendix XII a: UPEI Research and Ethics Board clearance certificate

UPEI
UNIVERSITY of Prince Edward ISLAND
550 University Avenue
Charlottetown
Prince Edward Island
Canada C1A 4P3

To: Grace Wanjohi

Faculty of Education

Protocol Number: REB Ref # 6007172

Title: Evaluating the impact of augmenting conventional human nutrition training with cell phone messaging on the dietary knowledge, attitudes, and practices of women organized in self-help groups in rural Kenya

Date Approved: May 24 2017

End Date: May 23 2018

This research proposal has been reviewed and approved by the UPEI Research Ethics Board. Please be advised that the Research Ethics Board currently operates according to the Tri-Council Policy Statement 2: Ethical Conduct for Research Involving Humans (2014) and applicable laws and regulations.

It is your responsibility to ensure that the Ethics Renewal form is forwarded to Research Services prior to the renewal date. The information provided in this form must be current to the time of submission and submitted to Research Services not less than 30 days prior to the anniversary of your approval date. The Ethics Renewal form can be downloaded from the Research Services website (http://www.upei.ca/research/forms).

Any proposed changes to the study must also be submitted on the same form to the UPEI Research Ethics Board for approval.

The Research Ethics Board advises that **IF YOU DO NOT** return the completed Ethics Renewal form prior to the date of renewal:

- Your ethics approval will lapse
- You will be required to stop research activity immediately
- You will not be permitted to restart the study until you reapply for and receive approval to undertake the study again.

Lapse in ethics approval may result in interruption or termination of funding.

Notwithstanding the approval of the REB, the primary responsibility for the ethical conduct of the investigation remains with you.

Sincerely,

Lyndsay E. Moffatt, Ph.D.
Chair, UPEI Research Ethics Board

Appendix XII b: UPEI Research and Ethics Board amendment certificate

UPEI
UNIVERSITY of Prince Edward ISLAND
550 University Avenue
Charlottetown
Prince Edward Island
Canada C1A 4P3

To: Grace Wanjohi

Faculty of Education

Protocol Number: REB Ref #6007172

Title: Evaluating the impact of augmenting conventional human nutrition training with cellphone messaging on the dietary knowledge, attitudes, and practices of women organized in self-help groups in rural Kenya

Date Approved: August 15 2017 *(amendment)*

End Date: May 23 2018

The amendment of this research proposal has been reviewed and approved by the UPEI Research Ethics Board. Please be advised that the Research Ethics Board currently operates according to the Tri-Council Policy Statement 2: Ethical Conduct for Research Involving Humans (2014) and applicable laws and regulations.

It is your responsibility to ensure that the Ethics Renewal form is forwarded to Research Services prior to the renewal date. The information provided in this form must be current to the time of submission and submitted to Research Services not less than 30 days prior to the anniversary of your approval date. The Ethics Renewal form can be downloaded from the Research Services website (http://www.upei.ca/research/forms).

Any proposed changes to the study must also be submitted on the same form to the UPEI Research Ethics Board for approval.

The Research Ethics Board advises that **IF YOU DO NOT** return the completed Ethics Renewal form prior to the date of renewal:

- Your ethics approval will lapse
- You will be required to stop research activity immediately
- You will not be permitted to restart the study until you reapply for and receive approval to undertake the study again.

Lapse in ethics approval may result in interruption or termination of funding.

Notwithstanding the approval of the REB, the primary responsibility for the ethical conduct of the investigation remains with you.

Sincerely,

Lyndsay E. Moffatt, Ph.D.
Chair, UPEI Research Ethics Board

Appendix XIII: Contributions provided to the Queen Elizabeth II Diamond Jubilee Scholarships (QES) project led by the University of Prince Edward Island (UPEI), and contributed by the QES partners:

This appendix provides details of the contributions of the five main partners associated with the QES project led by UPEI and located in Kenya. The UPEI contributions were partially supported by QES funding ($499,842). Canadian Queen Elizabeth II Diamond Jubilee Scholarships are managed through a unique partnership of Universities Canada, the Rideau Hall Foundation (RHF), Community Foundations of Canada (CFC) and Canadian universities. This program is made possible with financial support from the Government of Canada, provincial governments and the private sector.

A. University of Prince Edward Island (UPEI) resources provided to the QES project

UPEI is a small but growing university in the province of Prince Edward Island in eastern Canada with a reasonably broad array of tertiary education programs, including programs in the Department of Health Management at the Atlantic Veterinary College, and in the Department of Applied Human Sciences in the Faculty of Science. From 2015 to 2018, UPEI provided the following resources to the QES project. These resources, in conjunction with other resources from other QES project partners, helped to achieve the QES project objectives.

Resources to Naari Dairy Farmers Cooperative Society Ltd. and members

- Training on cattle health management, in general, and in dairy cattle nutrition, reproduction and cow comfort specifically
- Training on cattle health management, medicine and surgery with Naari Dairy veterinary technician
- Arranged for interactions between QES interns and Scholars in Naari and Veterinarians without Borders veterinarians and interns from various locations including Wakulima Dairy
- Motorcycle for Naari Dairy veterinary technician, cost-shared with Naari Dairy
- Veterinary medicine and equipment and bonus for the Naari Dairy veterinary technician
- Leguminous shrub seedlings for augmenting cattle nutrition to Naari Dairy farmers
- Semen and semen storage equipment for Naari Dairy, cost-shared with Naari Dairy
- One silage chopper, cost-shared with Naari Dairy, and silage materials
- Dairy Health Management Handbooks (content)

Resources to Two Naari Women's Groups

- Face-to-face training on family nutrition
- Trained peer-nutrition trainers called "Champs"
- Provided nutrition training resources

- Cell phone text messaging on family nutrition
- Honoraria (maize, beans, cooking oil, cattle dewormer) for members participating in research projects
- Solar lights (with capacity to charge cell phones) to 24 members of a Naari women's group
- Funding for a tree seedling greenhouse and resources to grow leguminous shrub seedlings for augmenting cattle nutrition to Naari Dairy farmers

Resources to nine Naari area schools

- Nutritional quality assessment of school meals
- Reports for schools regarding the nutritional quality assessment of school meals, and recommendations and goal setting for nutritional enhancement of the school meals
- Nutrition education seminars for parents

In addition to these specific funds for the Naari Dairy, two Naari women's groups, and 9 Naari schools, UPEI also funded, either through QES funding or UPEI funding, general project costs.

- Selection of QES Scholars
- Training of QES Scholars and Interns
- Orientation and supervision of QES Scholars and Interns
- Management of the QES project
- Transportation costs to and from Kenya, and in Kenya for QES Scholars, Interns and supervisors
- Accommodation and food costs in Kenya for QES Interns and supervisors
- Living stipend costs in Canada and in Kenya for QES Scholars
- Tuition and other registration fees for QES Scholars

B. Farmers Helping Farmers (FHF) resources provided as part of the QES project

FHF is a Canadian based non-profit organization based in Prince Edward Island with a longstanding presence working with Kenyan farmer groups. From 2015 to 2018, FHF provided the following resources to the QES project. These resources, in conjunction with other resources from other QES project partners, helped to achieve the QES project objectives.

Resources to Naari Dairy Farmers Cooperative Society Ltd. and members

- Regular training on milk quality and milk production by FHF staff : Stephen Chandi and Leah Kariuki
- Training on bookkeeping with Dairy directors and groups
- Arranged for guidance from Wakulima Dairy on setting up a Savings and Credit Cooperative (SACCO)
- Two silage choppers, cost-shared with Naari Dairy
- Computers and printer to prepare monthly income statements for members of Naari Dairy

- Funds for a revolving cow loan program to lend money for a cow to needy youth and women
- Dairy Health Management Handbooks (content and printing)

Resources to Two Naari Women's Groups

- Horticultural extension support including:
  - Training on how to install and manage drip irrigation
  - Training in composting and soil tillage
  - Training in the use of recommended inputs, including establishing a small nursery to grow seedlings
  - Training in disease and insect control, etc. in gardens
- Training in book-keeping and provided book-keeping booklets
- Dairy production extension support from Leah Karioki and Stephen Chandi, including agronomy and milk quality
- Water tanks, drip irrigation and inputs for a vegetable garden for 45 women's farms
- Solar lights (with capacity to charge cell phones) for 35 members of a women's group in the Naari area

Resources to seven Naari area schools

FHF has established healthy school lunch programs at each of the following schools. School vegetable gardens and water tanks were funded and installed by FHF. Horticultural supports were provided by FHF staff in Kenya. With maize and beans from parents with children attending the school, and food from the school garden, lunches were prepared in a new cookhouse. The cookhouse and a gardener were funded by the Souris Village Feast in PEI.

In addition to these specific funds for the Naari Dairy, two Naari women's groups, and 7 Naari schools, FHF also assisted in:

- Selection of QES Scholars and Interns
- Training of QES Scholars and Interns
- Orientation and supervision of QES Scholars and Interns
- Management of the QES project
- Transportation costs in Kenya for QES Scholars, Interns and supervisors

C. Naari Dairy Farmers Cooperative Society (NDFCS) resources provided for the QES project

NDFCS is a cooperative located in Naari within Meru County of Kenya. It purchases milk from cooperative members, and sells the milk either retail or to a processor, either chilled or not chilled. From 2015 to 2018, NDFCS provided the following resources to the QES project. These resources, in conjunction with other resources from other QES project partners, helped to achieve the QES project objectives.

- Orientation and supervision of QES Scholars and Interns
- Providing board members to help locate farms
- Training of QES Interns
- Management of the QES project
- Training of farmer members on cattle health management, medicine and surgery, through the veterinary technician
- Cost-sharing of the motorcycle for the veterinary technician
- Cost-sharing of semen and semen storage equipment and silage choppers

D. University of Nairobi (UoN) resources provided for the QES project

UoN is a large university in Nairobi, Kenya, with a broad array of tertiary education programs, including veterinary medicine in the Faculty of Veterinary Medicine. From 2015 to 2018, UoN provided the following resources to the QES project. These resources, in conjunction with other resources from other QES project partners, helped to achieve the QES project objectives.

- Selection of QES Scholars
- Training of QES Scholars and Interns
- Orientation and supervision of QES Scholars and Interns
- Management of the QES project

E. Kenyatta University (KU) resources provided for the QES project

KU is a large university in Nairobi, Kenya, with a broad array of tertiary education programs, including programs in the Department of Community Resource Management and in the Department of Foods and Nutrition, both in the School of Applied Human Sciences. From 2016 to 2018, KU provided the following resources to the QES project. These resources, in conjunction with other resources from other QES project partners, helped to achieve the QES project objectives.

- Selection of QES Scholars
- Training of QES Scholars and Interns
- Orientation and supervision of QES Scholars and Interns
- Management of the QES project