Effects of a Combined Horticultural and Peer-led Nutrition Education Intervention on Diet Diversity and Food Related Practices among Rural Kenyan Women One-Year Post Intervention

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A thesis submitted in partial fulfillment of the requirement of the Honours Program in the

Department of Applied Human Sciences

This Thesis is Accepted

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Dean of Science

University of Prince Edward Island

April 2019

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Title of paper: Effects of a Combined Horticultural and Nutritional Intervention on Diet Diversity and Food Related Practices among Rural Kenyan Women One-Year Post Intervention

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Degree: Food and Nutrition

Year: 2019

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ABSTRACT

Food insecurity is an ongoing concern in Sub Saharan Africa, including Kenya, and has been associated with micronutrient malnutrition (MM). Since low levels of diet diversity and a monotonous starchy based diet are thought to contribute to MM, a combined horticulture and nutrition education intervention was implemented in a women's group in 2016 and 2017; a comparison group did not receive the intervention. Although initial results were promising, there is little research conducted on the longer term efficacy of these strategies. This project therefore assessed the impacts of a combined horticulture and peer-led nutrition education on diet diversity and food related practices among rural Kenyan women one-year post intervention. Diet diversity was assessed using a 24-hour recall; a questionnaire was used to assess food related practices.

Women in the intervention group had higher diet diversity scores in 2018, one year after the intervention, compared to levels in 2017 ($p=0.025$). There was no significant difference in diet diversity between the comparison group and the intervention group in 2018, or in the comparison group from 2017 to 2018. Food related practices found to be significantly higher in the intervention group than the comparison group in 2018 included adding an orange vegetable to chapati ($p=0.01$), doubling greens to mukimo (mashed potato dish) ($p=0.002$), adding whole grain maize to uji (porridge) ($p=0.001$), and adding an orange vegetable to githeri (maize and bean stew) ($p=0.015$). In contrast, women in the intervention reported adding an orange vegetable to mukimo less frequently in 2018 than in 2017 ($p=0.01$). Results suggest that the intervention continued to positively impact diet diversity and food related practices among rural Kenyan women one-year later.

ACKNOWLEDGEMENTS

This research was made possible due to the Canadian Queen Elizabeth II Diamond Jubilee Scholarships Program funding along with the partners involved with the "Integrating Innovative Research & Training Methods for Improved Sustainable Livelihoods of Smallholder Dairy Farms" project: the University of Prince Edward Island, Kenyatta University, University of Nairobi, and the Naari Dairy Cooperative Society Cooperative Society. As well, the support and partnership with the Prince Edward Island non-government organization Farmers Helping Farmers (FHF) was invaluable in the completion and success of this project. Their long history working with Kenyans and existing positive relationships provided a strong foundation for the work and my entry point into the community. The agricultural work with the women farmers and provision of critical inputs were paramount to the success of the research and the combined intervention. The assistance and guidance provided by FHF's staff, Steven Mwenda, Salome Ntinyere and Douglas Gikundi, our collaborator, Jennifer Murogocho, and my housemates, Remmy Mugambi, George Zalego and Boniface Kiogora in Kenya were crucial to my ability to conduct this important research. I will be eternally grateful for all of the guidance, wisdom, and support that you provided me during my time in Kenya. These professional relationships developed into friendships that I hope to maintain through the years to come. As well, the support of the Naari Dairy Cooperative Society and the cooperation of two women's groups as well as women dairy farmers in the Naari area made it all possible.

I cannot begin to express my gratitude towards my honours supervisor, Dr. Jennifer Taylor, and committee members, Dr. Misty Rossiter and Dr. Charlene VanLeeuwen. Without their constant support, encouragement and feedback, this project would not have been nearly as successful as it was. To my friend and mentor, Sarah Muthee, I will forever cherish the time that we spent together in Kenya, working together completing data collection. To my travel companions, Madison Brauer, Lee Wesselius and Ashley Kroyer, thank you for filling my time in Kenya with smiles and laughter, again, we share a bond that will last a life time.

Finally, I would like to express my deepest gratitude to my friends, Julia Macdonald and Leigh Ball, and parents, Eben Creaser, Heather Harris-Jones, Sheena Dougan and Brian Jones, for the patience, encouragement and support during this entire process. Without your unconditional and unwavering love, I would not have travelled to Kenya or finished a project of this magnitude.

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1.0 INTRODUCTION

Food insecurity and malnutrition continue to be major problems globally. Food insecurity is when physical, social and economic access to sufficient, safe and nutritious food is lacking or uncertain (WFS, 1996). Countries in Sub-Saharan Africa are considered among the most food insecure in the world. In Kenya, 2.7 million individuals are considered severely food insecure, making this issue a significant public health concern (FAO, 2017). When households are food insecure, individuals are more likely to suffer from malnutrition and more specifically, micronutrient malnutrition (Stamoulis & Hemrich, 2016). Prevalent micronutrient deficiencies in non-pregnant women include zinc, iron, folate, vitamin B_{12} ,and iodine (The Kenya National Micronutrient Survey, 2011). Long-term malnutrition has been associated with issues related to physical growth, morbidity, mortality, cognitive development, reproduction, physical work capacity and higher risks for several adult-onset chronic diseases (FAO, 2014).

Efforts to address food insecurity and micronutrient malnutrition in developing countries often include agricultural interventions, which may include farm inputs such as seeds, water and irrigation supplies, along with education sessions on topics such as cattle nutrition and horticulture. When farmers grow a greater variety of crops or are able to consume milk, eggs or meat from their own livestock, there is potential to improve the diet diversity of household members. Diet diversity is important as it has been identified as a key indicator of the quality of a person's diet (Arimond et al., 2006). If a person is consuming a larger variety of foods, they are more likely to be to be consuming a wider

variety of macro and micronutrients (Mirmiran et al., 2004). While, research has found that increasing agricultural biodiversity on local farms is an effective strategy to improve the nutritional status of the household, this is more effective when paired with nutrition education (Murendo et al., 2018).

In 2010, the University of Prince Edward Island partnered with Farmers Helping Farmers, a local non-governmental organization, to improve food security and nutritional status of rural Kenyans. In 2016, a combined horticultural and peer-led nutrition education intervention was initiated in two women's groups in the Naari region of Eastern Kenya, with a follow up nutrition education intervention in 2017. The horticulture intervention included installation of water tanks and drips, a seedling-sharing program and education sessions led by a trained agriculturalist. The nutrition intervention included education sessions on protecting key micronutrients such as iron, vitamin A and protein as well as cooking/tasting sessions which implemented the recommended cooking practices. Data collected five weeks after the initial study produced results that demonstrated that not only did women in the intervention group have a higher diet diversity score ($p=0.02$), they also had higher food related practice scores relating to improved sources and availability of iron , vitamin A and protein than the comparison group (Muthee et al., 2018).

Although the positive short term effects of the combined intervention on diet diversity and food preparation practices have been documented (Muthee et al, 2018; MacMillan et al, 2018), studies examining longer term effects, such as after a one-year period, are lacking. It is important to determine any longer term effects/impacts as they provide insight into the sustainability of such interventions. Therefore, this project will

examine the longer term effects of a combined horticulture and peer-led nutrition education on diet diversity and dietary practices among rural Kenyan women one-year post intervention.

2.0 OBJECTIVES

The overall aim of this project is to assess diet diversity and food related practices of women in rural Kenya one year after a combined horticultural and peer-led nutrition education intervention. Specifically, goals of this study are to:

1) Assess differences in diet diversity in 2018 between women who received a combined horticulture and peer-led nutrition education intervention and a comparison group, one-year post intervention.
2) Assess differences in diet diversity from 2017 (immediately after receiving a combined horticultural and peer-led nutrition education intervention) to 2018 (one year after the intervention) among women who received the intervention and a comparison group.
3) Assess differences in food related practices in 2018 between women who received a combined horticulture and peer-led nutrition education intervention and a comparison group, one-year post intervention.
4) Assess differences in food related practices from 2017 (immediately after receiving a combined horticultural and peer-led nutrition intervention) to 2018 (one year after the intervention) among women who received the intervention and a comparison group.

3. LITERATURE REVIEW

3.1 Food Security and Micronutrient Malnutrition

Household food insecurity and malnutrition continue to be a major issue in Africa, and, in particular, Eastern Africa. Food insecurity is when physical, social and economic access to sufficient, safe and nutritious food is lacking or uncertain" (WFS, 1996). Unfortunately, food insecurity is extremely prevalent in Kenya, where in 2017, 2.7 million individuals were considered severely food insecure (FAO, 2017). Factors affecting food security in developing nations include the continuing growth of the population, land degradation, water scarcity and climate change (Predanandh, 2011).

The nutritional status of an individual is impacted by the level of food insecurity of their household due to insufficient food intake or an intake of a monotonous diet which fails to include a variety of micronutrients. Long-term malnutrition has been associated with issues related to physical growth, morbidity, mortality, cognitive development, reproduction, physical work capacity and higher risks for several adult-onset chronic diseases (FAO, 2014). From 2010 to 2012, 870 million individuals globally did not consume enough food to fill their minimum energy requirements (FAO, 2014). Of those 870 million individuals, 98% are from developing countries (FAO, 2014). Africa is the only region in the world where the prevalence of stunting has increased from 50.6 to 58.7 million children between the years 2000 through 2017 (UNICEF, 2018). The prevalence of malnutrition and stunting are the highest in Eastern Africa.

Micronutrient deficiencies are extremely prevalent in Kenya. The Kenya National Micronutrient Survey that was published in 2011 assessed blood samples of Kenyans

living in both rural and urban settings to determine micronutrient levels. When looking at non-pregnant women only, 79.9% were zinc deficient, 21.3% were iron deficient, 30.9% were folate deficient, 34.7% were vitamin B_{12} deficient and 25.6% were iodine deficient (The Kenya National Micronutrient Survey, 2011). These micronutrient deficiencies can lead to significant health concerns as they can increase a person's susceptibility to infection and disease, while also increasing the severity of illnesses and slowing healing times (The Kenya National Micronutrient Survey, 2011).

3.2 Diet Diversity

Diet diversity has been shown to be an effective indicator of micronutrient status of individuals (Arimond et al. 2009). FANTA's Women's Dietary Diversity Project (WDDP) created twenty-one food groupings which reflected the type of nutrients available in the foods (Arimond et al. 2009). Diet diversity information is collected in order to calculate a diet diversity score (dds), which is then used to predict the likelihood of micronutrient deficiencies. DDS is the preferred method to assess diet adequacy versus looking at a person's diet quality solely based on caloric intake as this second method does not account for the quality of foods consumed (Sabroni et al, 2014). This is especially important when gathering information in a developing country like Kenya where low quality, monotonous diets are the norm. For example, it has been documented that rice, maize and wheat make up approximately 60% of the traditional Kenyan diet (M'kaibi et al., 2015).

There are several different factors which influence diet diversity. A study conducted in Tanzania by Powell and colleagues (2017) found that while diet diversity was important to participants in enhancing appetite over longer term periods, there were several factors that affected their ability diversify their diet. Some of the factors reported by participants included indicators of household income including cash resources, agrobiodiversity, the quality of the plot of land (water inputs, healthy soil), and livelihood diversity (Powell et al., 2017). Not all factors reported were related to household income. Seasonality, household size, and gender were other factors mentioned by participants, confirming that while increased nutrition knowledge can improve diet diversity, other factors can affect diet diversity scores (Powell et al., 2017).

One factor which greatly influences the foods that an individual consumes is culture. As mentioned earlier, factors influencing diet diversity include household income (livestock ownership, cash resources, bank account ownership) as well as gender, household size and seasonality (Powell et al., 2017). However, culture and deeply embedded traditional knowledge play a significant role in determining what and how we eat (Fieldhouse, 1995; Briones, 2015). Planning and implementing interventions that aim to change traditional food habits can be a challenge as "every culture resists change; food habits, though far from fixed are also far from easy to change" (Fieldhouse, 1995). Often dietary interventions that target certain cultural groups aim to encourage cultural groups to enhance traditional dishes and retain their healthful cooking practices (Satia et al, 2002).

3.3 Interventions Used to Improve Food Security

Agricultural interventions on smallholder farms have been identified as a key component of interventions to address food insecurity (Murendo et al., 2018; Frison et al., 2006). A smallholder or a small-scale farm is characterized by "farmers owning small-based plots of land on which they grow subsistence crops and one or two cash crops relying almost exclusively on family labour" (DAFF, 2012). These interventions typically target farm inputs, cattle nutrition and horticultural educations and can impact food insecurity in three distinct ways. Firstly, people consume the food that they produce, so effective agricultural practices can increase the amount of food available in their household. Secondly, more productive farmers are able to sell the extra produce that they grow, which in turn, leads to more money in the household which can be spent on either food that cannot be grown in the garden, or on other essentials needed in the household (ie. medicine, school fees). Research conducted by Walton and colleagues (2012) found that individuals who are members of a local dairy had higher dietary diversity scores, as well as higher energy intakes and a higher percentage of energy from animal foods. In addition, this study also found that owning more livestock (cows and chickens) increased the likelihood that more milk and more eggs were available for either the family to consume themselves, or to be sold to neighbors or at the market, increasing family income (Walton et al, 2012). Thirdly, when women are empowered as part of the intervention, yields increase by 20-30%, which translates into more food available in the house as well as more to sell (Murendo et al., 2018).

Research conducted by Frison et al. found that increasing agriculture biodiversity on smallholder farms is an effective strategy to improve nutritional status in those living in developing nations (Frison et al., 2006). Murendo and colleagues also found that even producing one additional crop or acquiring one additional livestock species led to an increase in diet diversity scores of 3-4% (Murendo et al., 2018). However, increasing and diversifying agricultural outputs alone does not lead to better nutrition; it is important to also provide nutrition education to improve overall health (Li, 2016). Farm diversity alone is less effective than when paired with nutrition education, and to be effective agriculture interventions require greater crop and livestock diversity (Murendo et al., 2018).

3.4 Combined Nutrition and Horticulture Intervention in Kenya

Multiple national and international not for-profit organizations have worked to improve food insecurity and combat micronutrient malnutrition in developing countries (FAO, 2018; GAIN, 2018; USAID, 2018). One organization based out of Prince Edward Island is Farmers Helping Farmers or FHF (http://www.farmershelpingfarmers.ca/). This organization has worked with farmers in Kenya over the past 35 years to help improve agriculture and dairy outputs. Since 2010, FHF has partnered with the University of Prince Edward Island and local dairy cooperatives to improve food security and dietary intakes in the Meru region. In 2016 and 2017, a combined horticulture and peer-led nutrition education intervention was implemented among women who belonged to local

women's self-help groups in the area. The impact of the intervention on diet diversity, food related knowledge, attitudes, practices, and food security was assessed through in-home interviews. The participants of this research included members of a women's self-help group and a comparison group randomly selected from members of the Naari Dairy Cooperative Society.

The nutrition education component of the intervention used a peer-led education model. The nutrition research team asked the women's group to choose six members to be "nutrition champions" or "champs", based on their leadership, farming and food preparation skills (Muthee et al., 2018). During the time in which the nutrition team worked with the women, there was a translator present translating messages from English to Kimeru. These champs were taught nine nutrition messages (Appendix A) which were developed in response to the nutritional needs of the population, such as prevalent micronutrient deficiencies and household food insecurity. These messages were created to either protect or increase the consumption and absorption of iron, zinc, vitamin A and protein, which, in turn, could prevent micronutrient deficiencies. For example, the nutrition messages recommended the use of a 1:1 ratio of maize and beans to increase protein intake, consuming vitamin A rich vegetables to increase intake of β-carotene, consuming fruit at meal times to enhance iron absorption and avoiding tea at meal times to improve iron and zinc absorption. The champs were taught how to incorporate the messages when preparing their traditional dishes such as uji which is porridge, mukimo which are mashed potatoes, maize and beans often mixed with other vegetables, and githeri which is a maize and bean stew. Incorporating healthy foods into traditional dishes has been found to be more effective than introducing new foods (Satia et al, 2002).

Following their training, these six women then went on to teach a combined cooking and educational session to the rest of the women in the self-help group. The comparison group received a single, 60-minute presentation on how to improve the nutritional quality of family meals in 2016 only.

The horticultural intervention included the installation of a water tank and irrigation drips in individual home gardens. This was coupled with education sessions on best practices for gardening led by a trained agriculturalist. A seedling-sharing program was also initiated within the group. The comparison group did not receive any horticultural intervention.

Previous researchers (MacMillan, 2018; Muthee, 2018; Williams, 2017) have explored the short term nutritional impact of the combined nutrition and horticulture intervention. One month after the peer-led nutrition education intervention, Muthee and researchers found that although the intervention group had higher rates of food insecurity ($p=0.01$) than the comparison group, the women had more diverse diets, as indicated by higher diet diversity scores ($p=0.02$). The intervention group also had implemented recommended food preparation practices relating to iron ($p=0.01$), vitamin A ($p=0.04$), and protein ($p=0.04$) more often than the comparison group (Muthee et al., 2018).

3.5 Research Gap

Studies have evaluated the short-term effectiveness of nutrition education interventions (Murendo et al., 2018; Frison et al., 2006). There is, however, little research on the longer term efficacy of nutrition education interventions in the developed world, with even less in developing countries. It is important to determine the longer term efficacy of combined horticulture and peer-led nutrition education interventions in order to assess their sustainability and make recommendations to policy makers. Interventions can then be tailored and adjusted so that long term retention of practices can be maintained, ultimately having a positive impact on micronutrient malnutrition and overall health. Therefore, the overall aim of this project is to assess the longer term impact of combined horticultural and peer-led nutrition education intervention on diet diversity and food preparation practices of women in rural Kenya.

4.0 METHODS

4.1 STUDY DESIGN

This study is part of a five -year project implemented by Farmers Helping Farmers and the University of Prince Edward Island, which aimed to improve the livelihoods, diet diversity and food security of women farmers in Eastern Kenya by providing food related nutrition education paired with a horticultural intervention. The research included survey data gathered in 2018, one-year after the combined horticulture and peer-led nutrition intervention conducted in 2017 and two years after a similar 2016 intervention. Informed consent, using a translator, was obtained from all participants prior to data collection (Appendix B).

The 2017 intervention used a pre-post quasi-experimental design and included an intervention and comparison group. The intervention group (n=29) received a horticultural and a nutrition education intervention using a peer-led education model. The comparison group (n=20) received a single nutrition education session with no cooking demonstrations, no food tastings and no nutrition education materials during a pilot study conducted in 2016. Pre-intervention data was collected from both the intervention and the comparison groups prior to the implementation of the intervention. Post intervention data was collected from the intervention group only.

After consent was given (Appendix B) by the participant, data for the project was collected using two different assessment tools. All interviews were approximately 60

minutes in length and took place at the participant's home. In-home interviews were conducted with the aid of a paid translator. As a token of gratitude, a one-litre bottle of fortified vegetable oil was given to each participant at the end of the interview.

The data for this project was collected one-year post-intervention, from May to July 2018. In-home interviews lasting approximately an hour were conducted with each participant (n=49) using the same assessment tools used in 2017, which included a 24-hour recall (Appendix C) to calculate diet diversity, and a food related practices questionnaire (Appendix D). The other measures collected in previous years were not repeated in 2018 as the focus was on dietary behaviours only. All other data collection protocols were identical to the 2017 interventions.

4.2 Study Area

This study took place in the small community of Naari, Kenya. Naari, which is in central Kenya at approximately 8000 feet of elevation in a region with fertile land (Socio-Economic Atlas of Kenya, 2016). The local language spoken in Meru County is Kimeru, as well as some Swahili and English (Socio-Economic Atlas of Kenya, 2016). The predominant religion in the country is Christianity; followed by Muslim and Judaism faiths (Socio-Economic Atlas of Kenya, 2016). There are two growing seasons in Kenya, which are linked to the rainy seasons which are from March to May and October to December (Climate, 2018).

4.3 Participants

There were a total of 48 participants in this study: 29 in the intervention group and 19 in the comparison group. The participant retention rate for this study was 100% across the three year study periods. These women were all farmers and residents of the Naari region. The intervention group were all members of a women's self-help group. Originally there were 30 women in the intervention; however, the leader of the group was excluded from the study as she worked as the translator for the project. A total of 29 women were in the intervention group. The 19 women in the comparison group were randomly selected and recruited from a pool of 200 farmers from the Naari Dairy Cooperative Society.

4.4 Assessment Tools

The first tool was a 24-hour recall (Appendix A) which was conducted using the triple pass method to ensure accuracy (Weismann et al, 2009). The 24-hour recall data was used to compute diet diversity (Arimond et al., 2009). The second assessment tool was a Food Practices Questionnaire which was adapted by the researchers from the 2017 version (Appendix B). The Food Practices Questionnaire aimed to assess the changes of targeted practices which were promoted as a part of this project. The updated version included questions which assessed the frequency that the women implemented the food related practices. This was used to assess the extent to which the women were

implementing recommendations made during the education component of the project and was used to make comparisons between the groups in 2018.

4.5 Data Analysis

The data collected from the home interviews was coded and entered into a Microsoft Excel spreadsheet while in Kenya and was checked for accuracy and extreme values. Foods recorded in the 24-hour recall were categorized into one of the 21-food groupings created by FANTA (Arimond et al., 2009). Information on which of the 21-food groups were consumed in the past 24 hours was recorded. The total number of different food groups consumed each day was then summed for each participant to yield a diet diversity score. Descriptive statistics including means, standard deviations and range were generated for the number of food groups consumed by the intervention and comparison group in 2018. A Wilcoxon rank sum test, the non-parametric alternative to the independent t-test, was also used to assess differences in the mean of total food groups consumed between the intervention and comparison group in 2018. The Wilcoxon signed rank test for paired comparisons was used to assess differences in the mean of total food groups consumed between 2017 and 2018 within the intervention and comparison groups.

For the food related practices questionnaire, a score was created based on how frequently each practice was performed by the participant. To calculate the average daily frequency of the food related practices a method adapted from Evers et al. (2001) was

used as follows: ‘once a day’ was recorded as 1; ‘two to three times a day’ was recorded as ‘2.5’ (the midpoint between 2 and 3); ‘more than six times a day’ was recorded as ‘6’; ‘once a week’ was recorded as ‘0.14’ (1/7 days), ‘two to four times a week’ was recorded as 0.36 (3/7 days, with 3 being the midpoint between two and four), ‘five to six times a week’ was recorded as 0.79 (5.5/7 days, with 5.5 being the midpoint between five and six) and ‘Never’ was recorded as 0 (Evers et al., 2001).

Descriptive statistics including means and standard deviations were generated for the frequency of implementation of each food related practice in the respective intervention and comparison groups in 2018. Chi-square analysis was used to assess differences in the proportion of women who implemented the practices between the intervention and comparison groups in 2018, as well as differences in the proportion of women in the intervention who implemented the practices post intervention in 2017 to 2018. A chi-square analysis was also used to assess the differences in the proportion of women who implemented the practices between 2017 to 2018 in both the intervention and the comparison group. All statistical analysis was conducted using SAS statistical software (SAS, Version 9.4).

5.0 RESULTS

5.1 Diet Diversity in 2018

The intervention group had higher rates of consumption than the comparison group for the majority of food groups in the diet diversity except for beans, soybeans, and vitamin C vegetables (Table 1). However, the only food group which was approaching significance between groups was the consumption of vitamin C rich vegetables, which includes cabbage, peppers and zucchini ($p=0.065$). In this instance, the comparison group actually had higher consumption than the intervention group (36.8% vs 10.3% respectively).

There was no significant difference in mean diet diversity scores between the intervention group relative to the comparison group (7.41 ±1.21, 7.37±1.07, respectively, $p=0.89$) (Table 2). Further, both the intervention and comparison group had the same range of diet diversity scores (6.0-10.0).

Table 1. Proportion of Women in the Intervention and Comparison Group who Consumed the 21 Food Groups in 2018

Commonly consumed food groups	**Intervention group (n=29) %**	**Comparison group (n=19) %**	**P value[1]**
1. Grains (maize)	100	100	-
2. Starchy staple	82.8	68.4	0.42
3. Beans	86.2	100	0.25
4. Soybeans	0	5.3	0.83
5. Eggs	10.3	5.3	0.93
6. Large animal	13.8	10.5	1.00
7. Vit. A green vegetable	96.6	84.2	0.33
8. Vit. A yellow/orange vegetable	55.2	47.4	0.82
9. Vit. A fruit	6.9	5.3	1.00
10. Vit. C vegetable	10.3	36.8	0.065
11. Vit. C fruit	65.5	63.2	1.00
12. Other vegetable	96.6	94.8	1.00
13. Other fruit	17.2	15.8	1.00

[1]Pearson Chi-square

Table 2. Mean and Range of Food Groups Consumed Between the Intervention and Comparison Group in 2018

Number of Food Groups Consumed	**Intervention Group (n=29)**	**Comparison Group (n=19)**	**P value[1]**
Mean (SD)	7.41 ±1.21	7.37±1.07	0.89
Range	6.0-10.0	6.0-10.0	

[1]Independent sample Wilcoxon test

5.2 Diet Diversity: 2017 Compared to 2018

Table 3 shows the number of women in the intervention group who consumed the food groupings in 2017 (immediately following a face-to-face peer-led nutrition education intervention) compared to 2018, one year following the intervention. Analysis indicated that the consumption of vitamin A containing yellow and orange vegetables (e.g. carrots, butternut squash, pumpkin or orange flesh sweet potato) was higher in 2018 ($p=0.0098$) than in 2017. More women in the intervention group also reported consuming eggs, starchy staples and vitamin A containing fruit in 2018 than in 2017, although differences were not statistically significant.

Within the comparison group, the number of women who reported consuming beans was significantly higher in 2018 compared to 2017 ($p=0.047$) as was "other fruit", with differences approaching significance ($p=0.089$) (Table 4). While it appeared that a higher number of women consumed vitamin A green vegetables and vitamin A yellow and orange vegetables in 2018, differences were not significant.

Differences in the mean number of food groups consumed (the diet diversity score) by women in the intervention group in 2017 and 2018 are shown in Table 5. Diet diversity scores were significantly higher in 2018 ($p=0.025$). Although the mean number of food groups consumed by the comparison group also increased between 2017 and 2018, differences were not statistically significant.

Table 3. Proportion of Women in the Intervention Group Who Consumed the 21-Food Groups Immediately Following and One-year After a Face-To-Face Peer-Led Nutrition Education Intervention

Commonly consumed food groups	**Intervention Group Post-Intervention 2017 (n=29)**	**Intervention Group 2018 (n=29)**	**Z score**	**P value[1]**
	%	**%**		
1. Grains (maize)	100	100	1.0	-
2. Starchy staple	65.5	82.8	0.14	0.14
3. Beans	82.7	86.2	0.73	0.73
4. Milk	100	100	1.0	-
5. Eggs	0	10.3	0.08	0.087
6. Large animal	17.2	13.8	0.73	0.73
7. Vit. A green vegetable	89.7	96.6	0.32	0.32
8. Vit. A yellow/orange vegetable	**20.7**	**55.2**	**0.0075**	**0.0098**
9. Vit. A fruit	0	6.9	0.16	0.16
10. Vit. C vegetable	17.2	10.3	0.46	0.46
11. Vit. C fruit	65.5	65.5	1.0	-
12. Other vegetable	96.6	96.6	1.0	-
13. Other fruit	10.3	17.2	0.46	0.46

[1]Pearson Chi-square

Table 4. Proportion of Women in the Comparison Group Who Consumed the 21-Food Groups in 2017 Compared to 2018

Commonly consumed food groups	**Comparison Group 2017 (n=19) %**	**Comparison Group 2018 (n=19) %**	**Z score**	**P value[1]**
1. Grains (maize)	100	100	1.0	-
2. Starchy staple	68.4	68.4	1.0	-
3. Beans	**78.9**	**100**	**0.039**	**0.047**
4. Soybeans	10.5	5.3	0.57	0.58
5. Milk	100	100	1.0	-
6. Eggs	0	5.3	0.34	0.34
7. Large animal	21.1	10.5	0.39	0.39
8. Vit. A green vegetable	68.4	84.2	0.27	0.27
9. Vit. A yellow/orange vegetable	26.3	47.4	0.19	0.19
10. Vit. A fruit	10.5	5.3	0.57	0.58
11. Vit. C vegetable	26.3	36.8	0.50	0.51
12. Vit. C fruit	63.2	63.2	1.0	-
13. Other vegetable	94.7	94.7	1.0	-
14. Other fruit	0	15.8	0.08	0.089

[1]Pearson Chi-square

Table 5. Mean and Range of Food Groups Consumed By the Intervention and Comparison Group in 2017 Versus 2018

Number of Food Groups Consumed	**Intervention Group (n=29)**			**Comparison Group (n=19)**		
	2017	**2018**	**P value[1]**	**2017**	**2018**	**P value[1]**
Mean (SD)	6.7±1.0	7.4±1.2	**0.025**	6.74±1.45	7.37±1.1	0.23
Range	5.0-9.0	6.0-10.0	-	4.0-9.0	5.0-9.0	-

[1] Paired sample Wilcoxon test

5.3 Implementation of Food Related Practices one year post intervention (2018)

Four food related practices that were found to be significantly different between the intervention and comparison group one year post intervention include adding an orange vegetable to chapati, doubling greens added to mukimo, adding an orange vegetable to githeri and using whole grain maize when making uji (Table 6). The intervention group reported adding an orange vegetable to chapati more frequently than the comparison group (0.20±0.18, 0.08±0.13, respectively, p=0.01; paired sample Wilcoxon test). Similarly, the intervention group also added double greens when making mukimo more frequently than the comparison group (0.31±0.22, 0.12±0.2, respectively, p=0.002; paired sample Wilcoxon test). Furthermore, the intervention group added an orange vegetable to githeri more frequently than the comparison group (0.37±0.47, 0.29±0.26, p=0.015). Lastly, the intervention group used whole grain maize when preparing uji more frequently than the comparison group (0.57±0.57, 0.14±0.31, p=0.001; paired sample Wilcoxon test).

All women in the intervention group were practicing correct soaking methods, which was significantly different compared to the comparison group which 84% practiced correct methods (p=0.029) (Table 7). In the comparison group, 15.8% of women reported that they do not practice soaking their maize and beans (Table 7). Although not statistically significant, a larger proportion of women in the intervention group followed the recommended deworming practice for their children compared to the comparison group (86.2% vs. 68.4%). Although not significant, a higher proportion of

women in the comparison group reported adding a vitamin C rich fruit, bell pepper, into their traditional dishes (githeri or mukimo), than intervention group (47.4% vs 24.2%, p=0.099) (Table 7).

There were few significant differences in the number of women who were carrying out recommended food related practices one year following the intervention (Table 8). Fewer women in the intervention group reported adding an orange vegetable to mukimo in 2018 than in 2017 (65.5% versus 93.1% respectively, p=0.01). In contrast, more women reported implementing the recommendations concerning deworming their children or grandchildren in 2018 compared to 2017, although this did not reach statistical significance.

Table 6. Average Mean Frequency of Implemented Food Related Practices of Women in the Intervention and Comparison Groups in 2018

	Intervention Group	**Comparison Group**	**t value**	**P value[1]**
Dietary Practices	**Mean ±SD[2]**			
1. Whole Grain Maize	0.45±0.45	0.37±0.15	0.86	0.39
2. Whole Grain Flour	0.41±0.25	0.35±0.16	1.01	0.32
3. How Often Soak Maize	0.51±0.59	0.32±0.18	1.53	0.14
4. How Often Soak Beans	0.51±0.59	0.32±0.18	1.53	0.14
5. Add One Orange and Green Vegetable to Githeri	0.49±0.61	0.3±0.31	1.38	0.17
6. Orange Vegetable to Chapati	**0.20±0.18**	**0.08±0.13**	**2.54**	**0.01**
7. Double Greens to Mukimo	**0.31±0.22**	**0.12±0.2**	**3.24**	**0.002**
8. Orange Vegetable to Mukimo	0.14±0.22	0.13±0.19	0.05	0.96
9. Fruit with Meals	0.78±0.91	0.55±0.75	0.90	0.38
10. Avoid Tea with Meals	2.12±0.96	1.83±1.03	0.99	0.33
11. Whole Grain Maize for Uji	**0.57±0.57**	**0.14±0.31**	**3.43**	**0.001**
12. At least Two Grains in Uji	0.73±0.52	0.59±0.46	0.97	0.34
13. Orange Vegetable to Uji	0.12±0.21	0.5±0.14	1.42	0.16
14. Orange Vegetable to Githeri	**0.37±0.47**	**0.29±0.26**	**2.54**	**0.015**

[1]Paired sample Wilcoxon test
[2]Average daily intakes calculated by adding frequencies as follows:
0.0 = never, < 0.05 = 1-3/monthly
0.14 = 1/week, 0.36 = 2-4/week, 0.79 =5-6/week
1.0=1/day, 2.5 = 2-3/day, 4.5 = 4-5/day, 6 = 6+/day

Table 7. Proportion of Women Practicing Recommended Food Related Practices in the Intervention and Comparison Group in 2018

Reported Frequency of Deworming	**Intervention Group (n=29) %**	**Comparison Group (n=19) %**	**P value[1]**
1. Correct Deworming Practice	86.2	68.4	0.35
2. Added Peppers to Githeri or Mukimo	24.2	47.4	0.099
3. Correct Soaking Practice	**100**	**84.2**	**0.029**

[1]Pearson Chi-square

Table 8. Proportion of Women in the Intervention Group Who Reported Implementing Recommended Food Related Practices In 2017 and 2018

Reported Food Preparation Practices	**Intervention Group Post-Intervention 2017 (n=29) %**	**Intervention Group 2018 (n=29) %**	**P Value**
1. Soaking maize before cooking	100	96.6	0.33
2. Soaking beans before cooking	100	96.6	0.32
3. Adding an orange vegetable to githeri	93.1	89.7	0.64
4. Adding an orange vegetable to chapati	93.1	83.8	0.23
5. Adding an orange vegetable to mukimo	**93.1**	**65.5**	**0.01**
6. Consuming fruit with meals	100	96.6	0.32
7. Correct deworming practice	55.6	86.2	0.19

[1]Pearson Chi-square

5.4 Indicators of Household Income

The number of animals owned by the women in the intervention and comparison group in 2018 is shown in Table 9. Women in the comparison group reported owning a higher number of exotic dairy cows (p=0.035) and more chickens (p=0.0019) compared to the intervention group. There were no other significant differences.

Although not statistically significant, a higher proportion of women in the comparison group owned a bank account than in the intervention group (Table 10) (p=0.32).

Table 9. The Number of Animals Owned by the Intervention and Comparison Group in 2018

Number of Animals	**Intervention Group (n=29) %**	**Comparison Group (n=19) %**	**P value[1]**
No local cows	86.2	100	0.42
>1 local cow	10.3	0	
No exotic cows	**17.2**	**0**	**0.035**
1 exotic cow	34.5	26.3	
>1 exotic cow	48.3	73.7	
No goats	76.9	82.35	0.92
1-2 goats	15.4	5.9	
>2 Goats	7.7	11.2	
No sheep	48.3	63.2	0.39
1-2 sheep	24.1	15.8	
>2 sheep	27.6	21.1	
> 5 chickens	**44.5**	**10.5**	**0.0019**
5-10 chickens	31.03	21.1	
>10 chickens	24.1	68.4	

[1]Pearson Chi-square

Table 10. Proportion of Women Reported Having a Bank Account in the Intervention and Comparison Group in 2018

Owned a Bank Account	**Intervention Group (n=29) %**	**Comparison Group (n=19) %**	**P value[1]**
Yes	48.0	63.2	0.32
No	52.0	36.8	

[1]Pearson Chi-square

6.0 DISCUSSION

6.1 DIET DIVERSITY IN 2018

One food grouping which was approaching statistical significance was the consumption of vitamin C containing vegetables, which was found to be higher in the comparison group than in the intervention group in 2018. One possible explanation for the difference in consumption could be the time of year in which the interviews took place. The interviews for the intervention group were conducted from mid-May until late June whereas the interviews for the comparison group were conducted from Mid-July until the start of August. This could affect which crops were ready for consumption. This may reflect higher consumption of cabbage, which falls into this food group category and was often reported being consumed by women in the comparison group during August.

The mean diet diversity scores for both the intervention group and comparison group in 2018 were approximately seven food groups out of a maximum the 21 food groupings. This means that both groups were only consuming one third of the food groupings. This reflects a starchy, monotonous diet which is typical in Kenya (M'kaibi et al., 2015). Within both the intervention and comparison groups, there were no statistically significant differences in the diet diversity scores. Diet diversity and calorie intake has been positively correlated with household income (Walton et al, 2012). Food insecurity, though not assessed as part of this study, is linked to lower household income. Previous research found that the intervention group had a higher mean household food insecurity scores than the comparison group which could reflect lower socioeconomic status in the

former group (Muthee et al., 2018). Higher food insecurity rates and lower household income would negatively impact the diet diversity of the women in the intervention group.

The sum of food groups consumed can provide an estimate of nutrient adequacy and diet quality (Arimond et al., 2010). A potential limitation calculating a diet diversity score using the 21 food grouping system to predict diet diversity is the amount of each food required to qualify for a category, which is 15 grams (Arimond et al. 2009). This reflects the fact that while a person may be frequently consuming a particular food group, it is unlikely for their diet to be adequate in a particular micronutrient if only small amounts are consumed; unfortunately, this limitation is not stated in the literature. From the different diet diversity score grouping versions, which included six, nine or thirteen food groupings, the 21 food grouping system used in this study had the strongest correlation with micronutrient adequacy (Arimond et al., 2009). It is possible that this method may not be a sensitive enough measure to detect differences in food use between the intervention and the comparison groups. A more specific measure would be to quantify the amounts consumed; however, this was would be a challenge in terms of women's ability to estimate portion sizes and the amount of time needed to do this more detailed assessment.

6.2 Diet Diversity over time

In 2018, the intervention group had higher consumption of all of the food groups except large animal meat, vitamin C rich vegetables and 'other vegetables' which

includes onions. Food groups which were not consumed at all by the intervention group include nuts and seeds, cheese, organ meats, small whole fish, large fish and seafood, bird meat and other meat. These food groups may not be consumed by these populations due to the fact they are not commonly available in the area (ie. large fish and seafood) or may be expensive to purchase in supermarkets (ie. cheese). Potential implications of the low consumption of high quality protein and iron rich foods include zinc-deficiency and iron-deficiency anemia which can lead to symptoms such as lethargy, immunosuppression, anorexia and pallor (Krause et al, 2016).

Vitamin A-rich yellow and orange vegetables which includes carrots, pumpkin, squash and orange flesh sweet potato, were consumed significantly more frequently in 2018 versus post-2017. This is a positive finding as one of the target micronutrients of the nutrition messages was promoting the consumption of vitamin A fruits and vegetables. Research conducted by our research group in 2017 found that 37.9% of women consumed orange flesh sweet potato and 65.5% of women consumed pumpkin, carrots or butternut squash on a weekly basis (MacMillan et al, 2018). Farmers Helping Farmers has supported a portion of the women in the intervention group to grow orange fleshed sweet potato providing cuttings to the intervention group for their kitchen gardens. This could have contributed to the increase in consumption reported. MacMillan and colleagues also reported that in 2017, the climate was fairly dry, whereas in 2018, the rainy season was longer than typical. This, in addition to variation in temperatures could also have affected crop production.

The intervention group consumed more eggs in 2018 than in post-2017, although differences were not statistically significant. One of the key messages taught to the

intervention group was to add eggs to uji (porridge) in order to incorporate more protein into the women's and their family's diets. Although not included in this project, it would be interesting to compare the number of chickens owned by members of the intervention group in 2017 and 2018 to see if there was a difference which would lead to the contribution of more eggs.

The mean number of food groupings consumed by women in the intervention group increased significantly from measures taken immediately after the 2017 intervention to 2018. This suggests that a combined horticulture and peer-led nutrition education intervention may be associated with sustained increases to diet diversity among rural Kenyan women. A limitation of comparing the post-2017 data to the 2018 measures is the inability to consider factors which influence the type and quantities of produce available due to variations in climate and harvest conditions. Another reason that the diet diversity scores may have increased is an increase in household income; however, income was not directly assessed in this study. As stated previously, these factors could affect diet diversity and the different food groups consumed.

The comparison group had higher consumption in all of the previously consumed food groups except soybeans, large animal meats, and vitamin A fruit. Food groups which are still not being consumed by the comparison group at all include nuts and seeds, cheese, organ meats, small whole fish, large fish and seafood, bird meat and other meat. One food group which was found to be significantly different from 2017 to 2018 was beans. In 2018, all women consumed beans in the 24-hour recall, versus the 79% who consumed beans in 2017. It is promising to see an increase in the number of women consuming beans as they are high in iron, zinc and protein (Bennion & Scheule, 2012).

There are two reasons why bean consumption may be higher in 2018 than in 2017. As mentioned earlier, the dry season was longer in 2017 than in 2018. Beans need sufficient amounts of water while growing in order to be successful. The crop in 2018 may have produced more beans than in 2017, leading to higher rates of consumption. The other reason may relate to socioeconomic status. As beans were more expensive to purchase than maize at the time of the study, a household with insufficient funds may opt to buy more maize than beans. However, if a household has more expendable income, they may be able to purchase more beans. This cannot be confirmed as socioeconomic status measures were not collected in 2018, preventing a year to year comparison.

6.3 Food Related Practices in 2018

One year post intervention, more women in the intervention group reported implementing four of the food related practices than women in the comparison group, including adding orange vegetable to chapati, doubling greens to mukimo (mashed potato dish), adding whole grain maize to uji (porridge), and adding an orange vegetable to githeri (stew). Women in the intervention group reported adding orange vegetable to chapati an average of 1-2 times per week, where the comparison group only reporting adding it an average of 3-4 times a month. Further, women in the intervention group also reported adding double the amount of greens to mukimo an average of 1-2 times per week compared to the comparison group who averaged of 1 time per week . Other practices included using whole grain uji which was 4-5 times per week versus once per

week, adding an orange vegetable to uji 4-5 times per week versus 3-4 times per week, and orange vegetable to githeri 1-2 times per week versus 1-1.5 versus 1.5-2 per week. All four of these practices were found to be statistically significant.

The three practices which the intervention group implemented least frequently included adding orange vegetables to chapati, mukimo and uji. In addition to the possibility of low availability of orange vegetables at the time of the intervention, the lower frequency of implementation could be perhaps be due to the extra time needed to prepare the orange vegetables to add to the dishes. Preparing the orange vegetable for the dishes would include accessing an orange vegetable from the garden or market, washing, and peeling. Then, depending on the woman, she may cut the orange vegetable into small slices to incorporate in the dish, but she also may prefer to boil then mash, to incorporate it into the dish. If a woman has limited time to prepare a dish, she may choose not to incorporate these added steps to enhance the dish.

These practices may also be practiced less frequently due to the fact that the women may have had insufficient amounts of orange vegetables to incorporate into the dishes. Limited access to orange vegetables could be because they did not plant sufficient amount of orange vegetables, it was not at the peak season for orange vegetables to be ripe and available, or possibly because there were some potential crops spoiled by excessive amounts of rain.

Another possible reason why the women may not be practicing adding orange vegetables to chapati, mukimo or uji could be due to a taste preference for traditional dishes versus the modified dishes. Culture and embedded traditional knowledge and skills

play a significant role in determining what and how we eat (Fieldhouse, 1995; Briones, 2015). Therefore, it may be difficult to change food related cooking skills due to potential cultural resistance (Fieldhouse 1995).

It was promising to report that all of the women in the intervention group were correctly soaking their maize and beans for the recommended period of time (overnight), while only 84.2% of women in the comparison reported correctly soaking their maize and beans, with approximately 16% not soaking at all. Soaking maize and beans is essential to not only prevent gastrointestinal tract distress caused by the oligosaccharides in the maize and beans, but to also increase the absorption of iron and zinc which is inhibited by naturally occurring phytates (Bennion & Scheule, 2012). As a result, soaking helps ensure that the nutrients which these women are consuming are being absorbed as efficiently as possible to help assure adequate intakes of micronutrients.

Only half the number of women in the intervention group reported adding bell pepper to githeri or mukimo, in contrast to the comparison group. Possible reasons which could explain the higher consumption in the comparison group versus the intervention group could be limited or no access to seeds at planting time, lack of availability prior to harvest time due to immature fruit or the cost of purchasing peppers from the market. While information on the availability of water and the condition of the garden was collected, more detailed information on which crops were growing in the women's gardens at the time of data collection would be needed to draw clear conclusions. If this was a crop that women in the intervention group were not growing in their kitchen gardens, they would have to buy it from a local market, which would require a higher

household income. They may have substituted other foods from their kitchen gardens instead.

Although not measured as part of this project, Muthee et al. found that food security was higher in the comparison group than in the intervention group in 2017 (Muthee et al., 2018). Other indicators of household income collected in 2018 were the number of animals owned and whether or not a member of the household reported owning a bank account. Although not significant, more household in the comparison group reported owning bank accounts in comparison to the intervention group. Analysis indicated that comparison group owned significantly more exotic cows and chickens than the intervention group in 2018. The intervention group reported owning more local cows than the comparison group. Since local cows are typically cheaper to purchase than exotic cattle, this suggests that the intervention group had lower household income than the comparison group. This could reflect the fact that all women in the comparison group were members of the local dairy group, whereas in the intervention group this was not necessarily the case. The additional number of cows and chickens in the comparison group means that there is a chance that more milk and more eggs is available for either the family to consume themselves, or for sale to neighbors or at the market, thereby increasing family income (Walton et al, 2012). Potential differences in household income could also affect the diet diversity of the groups and should be considered when making comparisons of diet diversity between the intervention group and the comparison group. Walton and colleagues found that women who are members of a local dairy had higher energy intakes, percentage of energy from animal foods and dietary diversity scores (Walton et al, 2012) compared to those who were not members.

6.4 Food Related Practices in the Intervention Group Over Time

In the intervention group, the food preparation practice which was significantly different from post-2017 to 2018 was the practice of adding an orange vegetable to mukimo, which decreased by approximately 18%. All practices, except one, saw some decrease in the percentage of women who indicated that they had completed the recommended practice in the last 30 days; however, this was not statistically significant. As mentioned earlier, incorporating an orange vegetable into mukimo, a mashed potato and greens dish, requires additional preparation time, which is important given that this dish is already time consuming to prepare. This may have discouraged women from incorporating this practice into their day-to-day routine. Overall, these results suggest that there was strong retention of food related practices which continued after the initial 2016 and follow up in 2017 from the research team.

6.5 Deworming

One practice that increased significantly from post-2017 to 2018 was the correct deworming practice for children. Proper deworming practices for both children and adults are important to ensure that nutrients being consumed in the diet are not lost to parasites residing in the host (FAO, 2018). If individuals are not dewormed frequently enough, parasites ingested from poor hygiene practices can reduce nutrient utilization, leading to micronutrient deficiencies in a population already vulnerable to them (FAO, 2018). In recent years, significant efforts have been made by the Kenyan government and non-

governmental organizations to promote deworming of children to prevent micronutrient deficiencies (Ciff, 2017; Poverty Action Lab, 2017). Public health also sends nurses to local primary schools to provide deworming services. Due to the messages being promoted by the Kenyan government as well as during school parent seminars, it is not possible to determine the relative impact that this intervention may have had on knowledge of proper deworming methods.

7.0 LIMITATIONS

There were several limitations in this project due to the nature of type of study, the location of the participants and the tools used to collect the data. Firstly, all of the interviews were conducted with the use of a local translator. Though the translator was trained to use proper interview skills (probing or not probing where applicable), the interviews were conducted in a different language, thus creating some potential for misinterpretation between the researchers and the participant (Kapborg & Bertero, 2002).

There were also different undergraduate students conducting research in Kenya between 2017 and 2018, which could have led to some differences in data collection and data coding. Training was consistent between both years; however, the Kenyan graduate student did not participate in data collection for the comparison group that was collected for this study in 2018. Ideally, it would have been beneficial to have the same individuals starting and ending the project.

Another limitation to this research pertains to the timing of the 2018 vs 2017 interviews. Seasonality determines what foods are available to households and the price of produce in the local markets. The post-intervention 2017 data used in this project would have been collected later in the year, mid to late July and early August, compared to the 2018 data which was collected in late May to mid-June. The difference in timing could have led to differences in food intake.

As mentioned earlier, when using the 21 food groupings method developed by Arimond and colleagues to calculate diet diversity, researchers must be cognizant of the

limitations of the tool. This method only requires the individual to consume a 15-gram portion to qualify as a food group being consumed. Consequently, this small portion size may not be large enough to recognize specific differences between the groups for the diet diversity score. Ideally, it would be beneficial to not only collect data on the types of foods being consumed in the 24-hour recall, but also the quantity. However, collecting such data presents logistical challenges including longer interview times for women who are already busy on their farms as well as more intrusive data collection methods.

As this project was created following the 2017 intervention, the frequency of the food related practices data collected during the 2018 the home interview sessions was not collected during the post-intervention 2017 home interviews. This limited the number of comparisons that could be made between the two time periods. Another limitation pertains to how the frequency of food related practices was assessed. An example of this would be participants being asked how frequently they soak their maize before cooking: if a participant only cooked maize three times per week, but they soaked every time they cooked maize, they would still be recorded at completing the practice three times per week. In the future, it would be helpful to ask "when cooking maize, how often do you soak your maize" and change the response "Always, most times, sometimes, or never". This would better reflect how often participants were implementing practices when the prepared the food of interest. Further, nutrition knowledge was not re-assessed in 2018; therefore, this project can only hypothesize that the retention of practices is due to retained knowledge obtained in 2017.

Lastly, as mentioned earlier, there was possible knowledge contamination in the comparison group with the parent seminars and also within the context of residing in the same small village. As a part of a separate project, the nine nutrition messages which were developed as a result of this project were also taught at nine Farmers Helping Farmers partner schools in the local Naari community. It was noted that at least three of the women in the comparison group were either deputy head teachers or were audience members at the school seminars where they would have received a translated handout outlining the nine messages and a small sample of githeri which incorporated the nutrition message. This may have led to increased frequency of practices in the comparison group in 2018. The other reality is that Naari is a small community which provides numerous opportunities for participants to connect with each other at local churches, schools or markets. This may also lead to knowledge contamination. It is important to comment that, although in the context of this research project, knowledge contamination is a limitation; it is a very positive outcome within the context of the larger project and considering its developmental goals. The overall goal of Farmers Helping Farmers and international food security development work is the spread of knowledge throughout the community, thus turning this limitation into a very positive consequence.

8.0 FUTURE RESEARCH

There are several areas where future research is needed. Firstly, it would be very informative to follow up with participants in the intervention group to determine why women were not practicing the addition of an orange vegetable to chapati, mukimo or uji. The responses from this could be used to either tailor future nutrition messages or provide more insight into the cultural context of food.

Collecting data on which specific vegetables are being grown in the participant's home gardens and whether the plants are healthy at the time of the interview would be helpful when making comments on diet diversity and some of the food related practices. As well, more specific information on the health of specific crops rather than garden health as a whole would be useful. This information would also help explain or disprove seasonal effects on diet diversity between groups when interviews are conducted at different times of the year.

Lastly, due to the nature of funding, human resources and time, this intervention was implemented with a relatively small intervention and comparison group. It would be beneficial to repeat this intervention with a larger sample to not only create more statistical power, but to also see if it is as effective on a larger scale.

9.0 Conclusion

The aim of this project was to examine effects of a combined horticulture and peer-led nutrition education on diet diversity and dietary practices among rural Kenyan women one-year post intervention.

Objective #1

Assess changes in diet diversity in 2018 between women belonging to a self-help group and a comparison group, one-year post intervention.

There was no significant difference in the diet diversity score between the intervention and comparison group, as well as no significant differences in the consumption of individual various food groups within the 21 food groupings. This could reflect the fact that there are many different factors affecting diet diversity scores apart from knowledge, including seasonality, weather and household income. Further, while the diet diversity assessment method measures whether foods were consumed within a 24-hour period, it cannot assess whether there were differences in quantities of foods consumed between the groups.

Objective #2

Assess changes in diet diversity from 2017 (immediately after receiving a combined horticultural and peer-led nutrition intervention) to 2018 (one year after the intervention) among a women's self-help group and a comparison group.

The intervention group had significantly higher diet diversity scores in 2018 compared to 2017. The comparison group also saw an increase in diet diversity scores

from 2017 to 2018, although differences were not statistically significant. This suggests that the combined horticulture and peer-led nutrition education intervention is associated with higher diet diversity scores; however, limited conclusions can be made as many different factors other than nutrition knowledge influence diet diversity. These conclusions may lack generalizability to other settings due to the intervention being implemented twice, once in 2016 and again in 2017.

OBJECTIVE #3

Assess changes in food related practices in 2018 between women belonging to a self-help group and a comparison group, one-year post intervention.

There were four practices found to be significantly different between the intervention and comparison groups in 2018, one year post-intervention. These included adding an orange vegetable to chapati, doubling greens to mukimo, adding whole grain maize to uji, and adding an orange vegetable to githeri. These results demonstrate that nutrition knowledge has likely been retained from 2017 to 2018 and this translated into retained food related practices.

OBJECTIVE #4

Assess changes in food related practices from 2017 (immediately after receiving a combined horticultural and peer-led nutrition intervention) to 2018 (one year after the intervention) among a women's self-help group and a comparison group.

This study found that all except one food related practice was retained from 2017 to 2018 in the intervention group, with an increase in the proportion of women reporting

that they used correct deworming practices. This suggests that the nutrition messages taught in 2016 and 2017 were retained among the intervention group.

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11.0 APPENDICES

11.1 APPENDIX A

Champs Family Nutrition and Cooking Tips 2017

A. Githeri:

1. Use **mpempe (whole grain) maize** for more nutrients.
2. Use **equal amounts** of maize and beans to get more protein for strength.
3. **Soak** maize and beans overnight before cooking.
   - ✓ reduces the cooking time
   - ✓ reduces use of fuel
   - ✓ improves the digestibility
   - ✓ improves the nutritional quality of the food

4. **Add at least two vegetables** in addition to tomatoes and onions.
   - Use one green and one orange vegetable in your githeri as often as you can: daily is best.
5. Add vegetables **on the top** near the end of cooking time to protect vitamins
6. When eating githeri, **add vitamin C rich foods** to your meal to protect iron found in beans and cereals. Tomatoes, pili pili ho ho, paw paw and oranges are good sources of Vitamin C.

B. Mukimo:

1. Use mpempe maize
2. Use equal amounts of maize and beans as is recommended when preparing githeri
3. Soak and cook the maize and beans the same as is recommended when preparing githeri.
4. Double the amount of greens such as kales, spinach, swiss chard, stinging nettle (thaa) or cowpea leaves.
5. Add pumpkin or butternut squash to the Irish potatoes and mash.
6. When eating mukimo, add vitamin C rich foods to your meal to protect iron found in beans and cereals. Tomatoes, pili pili ho ho, paw paw and oranges are good sources of Vitamin C.

C. Uji

1. Use **mpempe (whole grain) maize** to obtain more nutrients like B vitamins and fibre. Flour from muthakore maize is not as nutritious.
2. Add at least two grain ingredients for more energy and strength.
    - Mix mpempe maize + finger millet or amaranth or sorghum
    - Add other nutritious ingredients to maize flour: dried orange flesh sweet potato or terere seeds or dried arrowroot or dried cassava or dried yams
3. Take the ingredients to a posho mill to be ground into flour OR grate orange fleshed sweet potatoes, carrots or pumpkin and cook with the uji.
4. Add milk for added nutrition. This provides calcium for strong bones and teeth.
5. Avoid adding sugar and salt for a healthier uji.
6. Add eggs to increase protein
7. Add vegetable oil to increase energy.

D. Chapati

- Add orange fleshed sweet potatoes, carrots and/or pumpkin
    - Peel and boil so that it is very soft. Mash and add it first
    - Grate raw carrots and then mix with flour
    - Add 1 or 2 eggs to add protein for strength and to make them extra soft
- Add oil rather than solid fat. Oils with added vitamins like Golden Fry are more nutritious.
- Try to minimize the amount of oil used.

E. Tea

- Drink tea one hour before or one hour after meals. Avoid tea at meals to protect iron.
    - Substances in tea leaves make it difficult for your body to use the iron from foods
    - Replace tea at meals with hot milk or water.

F. De-worming

- Ensure that your child takes a dewormer once in every six months.
    - 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!
- To protect against worms:
    - Have your child take a de-worming medicine once in every six months.
    - Have your children wear shoes at all times except when sleeping.
    - Everyone should wash their hands with soap and water after using the latrine and before preparing or eating food.

11.2 APPENDIX B

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

Dr. Jennifer Taylor
jtaylor@upei.ca

11.3 APPENDIX C- 24-HOUR RECALL

Name: _____ **Date**: _____

ID #:_____ **Interviewer**: _____

Women's group: _____

Time/location	**Food**	**Ingredients (for diversity)**	**Comments**

Was yesterday a normal day for you or was it special (i.e. a funeral or visitor)?Yes/No (circle one)

Explain:_____
_____

11.4 APPENDIX D

UPEI/Farmers Helping Farmers/ QE II Scholars

Food and Food Practices Questionnaire 2018

Full Name _____ ID _____

I. Food Use:

First, we are interested in how often you eat common foods.

Food Item / Number of times	Last month		Each Week			Each Day			
	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									
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+
18.Rabbit									
19.Pork									
20.Sweets [candy, sugar cane, chocolate, cakes, pastries, soda, mandazi (fresh donut)]									
21.Sugar in tea									

II. Nutrition Practices:

We are interested in how you are preparing food in your home.

How often do you do the following practices?

Practice	Never	Last month		Each Week			Every Day
		0	1-3	1	2-4	5-6	
22. Use mpembe (whole grain) maize							
23. Use maize flour made from whole grain maize							
24. Soak dried maize before cooking							
25. Soak dried beans before cooking							
26. Add one green and one orange vegetable to githeri							
27. Add pumpkin, carrot, squash or OFSP to githeri							
28. Add pumpkin, carrot, squash or OFSP to chapati							
29. Add double greens to mukimo							
30. Add OFSP, pumpkin, carrot, or squash to							

mukimo							

Practice	Never	Last month		Each Week			Every day
		0	1-3	1	2-4	5-6	
31. Eat fruit with or shortly after meals containing maize and beans (e.g. githeri, mukimo)							
32. Avoid taking tea at meal times							
33. Use mpempe maize flour to make uji							
34. Use at least two grains (mpempe + one other) when making uji							
35. Add orange fleshed sweet potato, carrot or pumpkin to uji							

36. 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? _____

Ratio: _____

37. If you soak, how long do you soak dry maize and beans?

a) a few hours
b) overnight
c) all day
d) other (specify: _____)

38. If you soak maize or beans, what do you do with the soaking water?

a) use it for cooking
b) put on shamba plants
c) give it to the animals
d) other (specify: _____)

39. When in the cooking process do you add greens to githeri? Early Late

40. Do you add pili pili ho to your githeri or mukimo?

41. Currently, how are you preparing your uji?

- Used maize flour made from muthokore maize
- Used maize flour made from whole grain mpempe maize
- Used maize flour and other grains. Please specify _____
- Added other ingredients. Please specify _____

42. a) How often do your children or grandchildren receive deworming medicine?

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

b) When was the last time that your children or grandchildren received deworming medicine?

Date:

___ Not applicable

Finally, we have a few short questions on your household.

43. Does this household own any livestock, herds, other farm animals, or poultry?	YES .....1 NO 2
44. Do you own any of these animals?	YES NO a) LOCAL CATTLE..... 1 2 b) EXOTIC/GRADE CATTLE..... 1 2 c) HORSES/DONKEYS/CAMELS..... 1 2 d) GOATS ..... 1 2 e) SHEEP……. 1 2 f) CHICKENS..... 1 2
45. Do you own a bank account?	YES .....1 NO 2

Thank you for completing this questionnaire!