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Nutritional Deficiencies During the Harvest Season According to Household Consumption and Level of Nutritional Knowledge: A Case Study of Northern Mozambique

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Nutritional Deficiencies During the Harvest Season According to Household Consumption and Level of Nutritional Knowledge: A Case Study of Northern Mozambique

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Abstract

Mozambique is classified as a low income country, the lowest development classification defined by the World Bank. It is underdeveloped in food security, agricultural production, and nutritional status, and research shows its residents are not foreign to poverty and malnutrition. Low protein, starchy foods (maize, rice, wheat, cassava) comprise the majority of the Mozambican diet; these starchy foods are the most available for consumption. Although availability impacts diet, educational barriers may also threaten the knowledge of nutrition and perceptions of healthy foods. Illiteracy and lack of education are extreme challenges to disseminating nutritional education efforts in the rural Nampula region. New Horizons, a for-profit poultry company located in the rural Nampula region, provides local villagers with employment opportunities that provide increased income and ultimately lead to increased quality of life (which may affect employees' diet and food choices). This study assessed the nutritional status of New Horizons employees and nonemployees and their knowledge and perceptions of nutrition. When reporting daily food consumption, grains represented the highest percentage of caloric intake for both groups, followed by beans and tubers. Respondents could not consistently provide a definition of nutrition, but employees were able to provide a definition more often than nonemployees. When reporting healthy foods, leaves, maize flour, and bananas were chosen most often. When reporting preferred foods to consume, employees chose luxury goods and nonemployees chose starchy foods. Respondents could not provide a consistent answer of where they learned about healthy foods. Implications for practice include incorporating nutrition and healthy foods lessons with school lunch programs. Future research should assess respondents during the harvest, post-harvest, and hungry seasons to account for seasonality, and measure foods consumed by providing measuring utensils for respondents.

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Words cheapen the experience of graduate school, and I am thankful to be stretched, molded, refined, humbled, and matured through this process. I truly wish this fulfilling experience for every graduate student who wonders if it's worth it. It's more than worth it.

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Dedication

This thesis is dedicated to my husband, Will, for his selfless support, humor, and devotion to my dream – and also for marrying me in the middle of graduate school. You're a brave man. To Tank, who stayed up with me every late night spent writing and barked at any slight breeze or potential burglar. To Jim Croce, for writing the soundtrack to every late night spent writing (wish you could've written more). Finally, and most importantly, this thesis is dedicated to the graceful participants, who taught me more about living a full, selfless, humble, and intentional life through answering a few questions about nutrition than they will ever know. You are the reason for this thesis and have guided my life's purpose. Special shout out to the family who gave us at least 1,000 peanuts, then raced to pick each individual peanut up when we dropped them everywhere.

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Chapter 1

Introduction

Mozambique endured a civil war from 1977 to 1992 that brought destruction to the livelihood of citizens, infrastructures, agricultural production, and economic development (FAO, 2011). Although Mozambique is a “successful example of post conflict economic recovery”, it remains underdeveloped in terms of food security, agricultural production, and nutritional status (FAO, 2011, p. 3). The World Bank has classified Mozambique as a low income country, the lowest development classification (World Bank, 2016a). In 2015, Mozambique was ranked by Global Finance Magazine as the seventh poorest country in the world based on per-capita gross domestic product (GDP) (Pasquali, 2015). The rural population in Mozambique in 2010 was 61.6% (Trading Economics, 2015). The Food and Agriculture Organization of the United Nations (FAO) published that 39% of Mozambicans were malnourished between 2010 and 2012 (FAO, 2012). The same report ranked the top 10 commodities available for consumption in 2011: cassava, maize, rice, wheat, sugar cane, sorghum, sweet potatoes, pulses, beans, and palm oil (FAO, 2012). The Mozambican diet mainly consists of a low protein, starchy root called cassava, followed by maize and wheat. Consumption of micronutrient-rich foods is low, and cereals and starchy roots comprise 80% of the diet in northern Mozambique (FAO, 2011). Even as food consumption levels have increased in Mozambique, there has not been a decline in chronic malnutrition in many areas (Fox, 2008). The poor spend a greater share of income on health expenditures, such as food or medical care (Fox, 2008). Since 2009, the poverty rate in Mozambique has remained at 54% (International Monetary Fund [IMF], 2014; World Bank, 2015a).

Background to the Study

"Seasonality highlights how consumption varies throughout the seasons, often depending on cropping patterns, seasonal variations in food and crop prices, and timing of harvests" (Fox, 2008, p. 158). In the central provinces of Mozambique, food consumption is 40% higher in the June and July months, or postharvest season, than in the January and February months, or dormant season (Fox, 2008). Starchy, filler foods account for nearly 80 percent of the daily caloric consumption, maintaining a low dietary diversity present in Mozambique for 40 years (FAO, 2011).

Micronutrient deficiencies are most prevalent in low-income countries where diet lacks variety (Kennedy, Nantel, & Shetty, 2003). Previous research shows Mozambicans to possess three specific micronutrient deficiencies: iodine deficiency disorders (IDD), vitamin A deficiencies (VAD), and iron deficiency anemia (IDA) (FAO, 2011). High levels of IDD could be contributed to a lack of iodine-rich foods and iodine availability in the soil; however, cassava contains goitrogens that can worsen IDD (FAO, 2011). Although salt is required to be iodized, it is not common, and iodized salt is rarely available at the rural markets (J. de Jong, personal communication, March 17, 2016). Vitamin A is crucial to all body tissues to normally grow and repair, and is present in eggs, milk, fish, yellow fruits and vegetables, green leafy vegetables, and red palm oil (Kennedy et al., 2003); however, only one of these products (oil) fall into the top 10 foods consumed by Mozambicans (FAO, 2012). In Mozambique, 69% of Mozambican children under five are deficient in vitamin A (United Nations International Children's Emergency Fund [UNICEF], n.d.a.). Iron deficiency is the most common cause of anemia, which is defined as "a reduction in the oxygen-carrying capacity of red blood cells" (Kennedy et al., 2003, p. 9). IDA is most prevalent in women and children (Kennedy et al., 2003) and ranks as one of the most severe nutritional deficiencies worldwide (WHO, 2001).

New Horizons, a for-profit poultry company, was established in Nampula, Mozambique in 2005. The company provides employment to local villagers through two main programs: the outgrower program and the employee program, and averages about 340 employees annually. The outgrower program contracts individuals build their own chicken houses to raise chicks to maturity. The company provides feed for the outgrowers, limiting outgrower incurred costs to time and labor. All outgrowers and employees live in the Nampula region of Mozambique, primarily in rural areas. The employee program offers a wide range of employment opportunities, such as transportation, construction, veterinary practice, egg selecting, packaging, and management roles. New Horizons offers training sessions on health practices that might influence consumption and purchasing decisions, as well as knowledge of nutrition and healthy foods (A. Davidson, personal communication, April 11, 2015). Common outcomes for New Horizons employees and outgrowers are building multiple-room homes, adding electricity and metal roofs, reporting improved health and increased technical skills, and consuming more meat (Davidson, 2014). New Horizons offers monthly training sessions for outgrowers and employees that guide financial responsibility, family commitments and relationships, spirituality, and health and hygiene (A. Cunningham, personal communication, May 28, 2015). With reports of increased quality of life among these outgrowers and employees, in addition to higher income and monthly training sessions, nutritional deficiencies could also be improved within households.

In 1990, the United Nations International Children’s Emergency Fund (UNICEF) developed the conceptual framework of malnutrition, which describes two immediate causes of malnutrition as inadequate dietary (nutritional) intake and infectious disease, or unsatisfactory health (Gross, Schoeneberger, Pfeifer, & Preuss, 2000). According to the framework, "malnutrition and child death are viewed as two of the manifestations of a multisectoral development problem that can be analyzed in terms of the immediate, underlying and basic causes" (Pelletier, 1990, p. 2). Household food insecurity, inadequate maternal and child care, and inadequate health services and environment are the underlying causes of the development problem (Pelletier, 1990). The basic causes include political, ideological, and economic structures; formal and non-formal institutions; and potential resources (Pelletier, 1990). This framework is primarily used in the context of under nutrition in rural areas of developing countries (Gross et al., 2000). The Social-Ecological Model is a theoretical framework used to evaluate nutrition education within the five levels of social influence (Gregson et al., 2001). This model proposes nutritional education dissemination at the three broadest levels of social influence to create a large, sustainable behavioral change at the individual level (Gregson et al., 2001).

Purpose of the Study

The purpose of this study was to assess the nutritional status of residents in the rural Nampula region of Mozambique and to assess knowledge and perceptions of nutrition. This was achieved by evaluating the presence of caloric and micronutrient deficiencies and knowledge of nutrition to determine the need for an educational health campaign. Two groups were surveyed: employees of New Horizons and nonemployees of New Horizons. This study considered employment and both caloric and nutritional intake, which can bring a deeper understanding of 1) the current nutritional status in the Nampula region, 2) existing presence of various nutritional deficiencies, and 3) level of knowledge and perceptions of nutrition among respondents.

Problem Statement

Although research has been conducted on the nutritional deficiencies of specific regions in Mozambique, there is little research focusing on the rural Nampula region of Mozambique. Specifically, there is no research to assess nutritional intake between two specific groups within the region: employees of New Horizons and nonemployees. New Horizons' employees have been exposed to a large increase in income and overall quality of life, which may affect their diet. Educational barriers and availability of food may pose a threat to knowledge of nutrition and information about healthy foods, which can ultimately guide food choices. Additionally, there is little research on nutrition educational campaigns in the rural Nampula province of Mozambique. This study will take into consideration an increase of quality of life, including income, with the New Horizons employees and estimate potential differences in nutritional deficiencies and knowledge of the two groups.

Research Objectives

The following objectives guided this study:

1. Quantify nutritional deficiencies among respondents,
2. Assess caloric and specific food intake of respondents,
3. Estimate potential differences in nutritional deficiencies between employees of New Horizons and nonemployees, and
4. Gather knowledge of nutrition and perceptions of healthy foods among respondents.

Limitations and Assumptions of the Study

One obvious limitation to this study was the language barrier. The official language of Mozambique is Portuguese, but Makhuwa was also spoken widely throughout the region. It was also a challenge to gather information about year-round food consumption when the researcher was only present during the harvest season. However, there was still a need for research on seasonality and food consumption in the rural Nampula region. Rose, Strasberg, Jeje, and Tschirley (1999) found that micronutrient deficiencies were present year-round, with variability in the seasons due to availability of food items. Other limitations impacted the data collection and analysis, including availability of resources and translators, limited literature on similar studies, time in-country, and inability to assess individual family members' caloric intake rather than household consumption. Other limitations to data collection include the lack of adequate time, funding, researchers, and equipment to fully assess micronutrient deficiencies, such as retinol measurements for vitamin A, hemoglobin levels in blood samples for iron, and urinary iodine presence. These limitations did not undermine the need for an exploratory study into nutritional deficiencies and knowledge of nutrition in the rural Nampula area.

This study included the following assumptions prior to the study: 1) the household food providers will have an accurate account of food consumed by all members; 2) the data collected will quantify nutritional deficiencies among respondents; 3) data interpretation accurately portrays caloric and specific food intake among households; and 4) household food providers' knowledge of nutrition and perceptions of healthy foods will accurately represent the household family members. This study included the following assumptions after the study: 1) the household food providers provided the most accurate account of food consumed by household members possible; 2) the data collected accurately portrays percentage of household food consumption per food groups; and 3) knowledge of nutrition and perceptions of healthy foods were reported by the household food provider and representative of all household family members.

Key Terms

Body mass index (BMI): BMI is an inexpensive and easy method to measure body fat. BMI also is measured by standard weight categories to determine weight status of individuals. BMI is measured by the following formula: weight (lb) / [height (in)]^2 x 703 (Centers for Disease Control and Prevention [CDC], 2015).

Calcium: Calcium, a mineral necessary for life, builds healthy bones, helps blood clot, assists in nerve messaging and contracts muscles. It is important to eat calcium-rich foods to replace the calcium lost daily (National Osteoporosis Foundation, n.d.a.).

Calories: Calories are "a unit of energy in food" (U.S. National Library of Medicine, 2015, ¶4).

Carbohydrates: Carbohydrates are converted into glucose, or blood sugar, in the digestive system and are used for energy. The two types of carbohydrates are simple (natural and added sugars) and complex (whole grain breads, cereals, starchy vegetables, legumes) (U.S. National Library of Medicine, 2015).

Cholesterol: Cholesterol is needed to create vitamin D, hormones, and digestive substances. Although the human body makes all needed cholesterol, cholesterol is also found in many foods. High levels of cholesterol can lead to increased risk of heart disease (U.S. National Library of Medicine, 2015).

Chronic Malnutrition: "Chronic malnutrition, or stunting, is another form of growth failure. Chronic malnutrition occurs over time…a child who is stunted or chronically malnourished often appears to be normally proportion but is actually shorter than normal for his/her age" (UNICEF, n.d.b., ¶1.)

Dietary diversity: is a "qualitative measure of food consumption that reflects household access to a variety of foods, and is also a proxy for nutrient adequacy of the diet of individuals" (Kennedy, Ballard, & Dop, 2013, p. 5).

Employee: Employees typically come from a higher socioeconomic status than outgrowers, with an estimated average literacy rate of 60 percent (Davidson, 2014; J. de Jong, personal communication, March 17, 2016). In this study, all New Horizons outgrowers and employees are collectively referred to as employees for the sake of readability and the overall income received from New Horizons. Respondents 1-5 were technically employees, while 6-30 were outgrowers.

Fat: Total fat (referred to as fat throughout this thesis) is a nutrient needed in certain amounts for health, because it gives energy and assists in absorbing vitamins; however, consumed in excess raises the risk for heart disease (U.S. National Library of Medicine, 2015).

Fiber: Dietary fiber (referred to as fiber throughout this thesis) is a type of carbohydrate that aids digestion and makes one feel fuller, longer (U.S. National Library of Medicine, 2015).

Food security: "Food security means access by all people at all times to enough food for an active, healthy life" (United States Department of Agriculture [USDA], 2015, ¶1).

Health-o-meter digital measuring tape: A digital measuring tape allows one to measure body part circumferences in inches or centimeters. The digital display shows the measurements as well as stores measurements from previous readings. It is also portable and easy to carry from one location to another (Health o meter, n.d.a.).

Iodine and iodine deficiency disorders (IDD): "Iodine is an essential mineral required by the body to synthesize thyroid hormones… Seaweed and seafood, in general, are good dietary sources of iodine. Eggs, meat, milk and cereals also contain small amounts of iodine… The most devastating consequence of iodine deficiency is reduced mental capacity" (Kennedy et al., 2003, p. 10).

Iron and iron deficiency anemia (IDA): Iron is found in two dietary forms: heme and non-heme iron. Heme iron is found in animal-source foods including meat, poultry, and fish; non-heme iron is found in cereals, pulses, fruits, and vegetables (Kennedy et al., 2003). "Anemia is defined as a reduction in the oxygen-carrying capacity of red blood cells, which occurs as a result either of decreased hemoglobin or of a reduction in the total number of red blood cells (i.e. a decline in red blood cell mass). Iron deficiency is the most common cause of anemia" (Kennedy et al., 2003, p. 9).

Low-income country: Low-income countries are defined by economies with a gross national income (GNI) per capita of $1,045 or less in 2014, calculated according to the World Bank Atlas method. A middle-income country has a GNI per capita between $1,045-$12,736, and a high-income country has a GNI per capita of or above $12,736 (World Bank, 2016b). Mozambique's GNI per capita was $600 in 2014 (World Bank, 2016a).

Macronutrient: "Macronutrients are nutrients that provide calories or energy. Nutrients are substances needed for growth, metabolism, and for other body functions. Since 'macro' means large, macronutrients are nutrients needed in large amounts. There are three macronutrients: carbohydrate, protein, and fat" (McKinley Health Center, 2015, ¶1).

Malnutrition: "Malnutrition is a complex phenomenon. Broadly defined, malnutrition refers to the condition of inappropriate nutrition" (Rice, West, & Black, 2004, p. 212).

Mid-upper arm circumference (MUAC): is the circumference of the left upper arm and is measured at the mid-point between the shoulder and elbow. This method is used to assess nutritional status and, in some studies, predict childhood mortality; it has often proved more effective than weight-for-height when indicating mortality risk for children (Collins, Duffield, & Myatt, 2000; WHO & UNICEF, 2009).

Micronutrient: "Called micronutrients because they are needed only in minuscule amounts, these substances are the "magic wands" that enable the body to produce enzymes, hormones and other substances essential for proper growth and development. As tiny as the amounts are, however, the consequences of their absence are severe. Iodine, vitamin A and iron are most important in global public health terms; their lack represents a major threat to the health and development of populations the world over, particularly children and pregnant women in low-income countries" (WHO, 2015, ¶1).

Moderate acute malnutrition: Moderate acute malnutrition is defined as a mid-upper arm circumference measurement between 11.0 – 12.5 cm. Moderate acute malnutrition is easier to treat than severe acute malnutrition; however, it still increases children's risk for morbidity and mortality (Chang et al., 2013; WHO & UNICEF, 2009).

Nampula (city): The city of Nampula included 471,717 inhabitants, according to the 2007 census. It is the capital of the Nampula province (Geohive, 2016).

Nampula (province): is the highest-populated province in Mozambique, with nearly 4 million citizens reported in the 2007 census. It is the fourth-largest province in land area, at only 79,010 square kilometers (Geohive, 2016).

Nonemployee: In this thesis, a nonemployee is defined as someone who does not work for New Horizons but resides in the rural Nampula region.

Nutrient: "Nutrients are chemical compounds in food that are used by the body to function properly and maintain health. Examples include proteins, fats, carbohydrates, vitamins, and minerals" (U.S. National Library of Medicine, 2015, ¶21).

Nutrition: Simply stated, nutrition is “the process of eating the right kind of food” for one to grow properly and healthily (Merriam-Webster, n.d.a.). “Nutrition is about eating a healthy and balanced diet. Eating healthy foods in the right amounts gives your body energy to perform daily activities… maintain a healthy body weight, and can lower your risk for certain diseases” (U.S. National Library of Medicine, 2015, ¶1-22).

Outgrower: An outgrower is a contract worker who raise poultry to maturity. Outgrowers live in the rural Nampula region and an estimated average literacy rate of 30 percent (Davidson, 2014; J. de Jong, personal communication, March 17, 2016).

Ozeri Precision digital scale: This bathroom scale provides measurements of weight up to 400 pounds (Ozeri, n.d.a.). The kitchen scale converts from U.S. to international metric systems to weigh food items (Ozeri, n.d.b.).

Portable stadiometer: A portable stadiometer is a lightweight device that can be easily set up and broken down to measure height at a variety of locations.

Protein-energy malnutrition (PEM): “is an energy deficit due to chronic deficiency of all macronutrients. It commonly includes deficiencies of many micronutrients. PEU can be sudden and total, in the form of starvation, or gradual. Severity ranges from subclinical deficiencies to obvious wasting (with edema, hair loss, and skin atrophy) to starvation” (Merck, 2007, p. 1).

Protein: Protein is crucial for the body to develop and maintain bones, muscles, and skin. Protein is found in meat, dairy products, nuts, and certain grains and beans. Unlike carbohydrates and fats, protein is not stored in the body and should be consumed daily (U.S. National Library of Medicine, 2015).

Seasonality: Seasonality is "how consumption varies throughout the seasons, often depending on cropping patterns, seasonal variations in food and crop prices, and timing of harvests" (Fox, 2008, p. 158).

Severe acute malnutrition: Severe acute malnutrition can be measured as a weight-for-height measurement of 70% or less below the median or a mid-upper-arm circumference of less than 110 mm in children age 1–5 years (Collins et al., 2006).

Sodium: assists with nerve and muscle functions and balancing fluids in the body (U.S. National Library of Medicine, 2015).

Sugars: A type of simple carbohydrate, sugars are found naturally in fruits, vegetables, and milk, and can also be added to foods. Sugars are broken down into glucose and used for energy in the body (U.S. National Library of Medicine, 2015).

Vitamin A and vitamin A deficiencies (VAD): Vitamin A (retinol) is crucial to all body tissues to normally grow and repair, and is present in eggs, milk, fish, yellow fruits and vegetables, green leafy vegetables, and red palm oil (Kennedy et al., 2003). "Vitamin A is an essential nutrient required for maintaining immune function, eye health, vision, growth and survival in human beings. Over the years, numerous studies have been conducted to identify the biological functions of vitamin A, the health consequences associated with deficiency, and the mechanisms that explain these relationships" (Rice, West, & Black, 2004, p. 212).

Vitamin C: With antioxidant attributes and ability to assist in immune function, vitamin C has been promoted to prevent and/or treat health conditions. It is found in many fruits and vegetables, and is often taken as a supplement (National Institutes of Health, 2016).

Chapter 2

Literature Review

Country Status

In 1992, Mozambique signed a peace deal that ended 16 years of civil war (Mozambique Country Profile, 2015). The war caused destruction to citizens' livelihood, infrastructures, agricultural production, and economic development (Food and Agriculture Organization [FAO], 2011; Mozambique Country Profile, 2015). Mozambique is described as a "successful example of post-conflict economic recovery" (FAO, 2011, p. 3) – in fact, the World Health Organization (WHO) described the country's transition from a civil war to one of Africa's leading economies as impressive (WHO, 2014). However, agricultural production, food security, and nutritional status all remain underdeveloped (Collier, 2006; FAO, 2011). In the past twenty years, the country has experienced extreme economic expansion largely due to foreign direct investments into the energy and natural resources industries (WHO, 2014).

This economic expansion has moderately contributed to poverty reduction, and has not changed the geographical distribution of poverty (WHO, 2014). Along with poverty, Mozambique also faces other social challenges, including human development, literacy rate, life expectancy, and malnutrition. Life expectancy in Mozambique is 49.9 years, with an adult literacy rate of 50.6% between 2008-2012 (UNICEF, 2015). In 2014, the United Nations Development Programme (UNDP) ranked Mozambique as 178 out of 187 countries in the human development index (HDI), up eight spots from ranking 185 out of 187 in 2013 (UNDP, 2014). HDI serves as a summary measure for "assessing long-term progress in three basic dimensions of human development: a long and healthy life, access to knowledge, and a decent standard of living" (UNDP, 2014, ¶5). Mozambique's 2013 HDI value fell at 0.393, which is below the 0.493 average for countries that fall in the low human development group and the 0.502 average for Sub-Saharan African countries (UNDP, 2014). The UNDP also evaluated the multidimensional poverty index (MPI) for Mozambique in the 2014 Human Development Report, which evaluates multiple deprivations in education, health, and living standards in the same households (UNDP, 2014). These indicators are weighted to figure a deprivation score per household (UNDP, 2014). For a household, and all the individuals in it, to be classified as multi-dimensionally poor, the household deprivation score should fall at 33% or greater (UNDP, 2014). The most recent data for MPI estimation in Mozambique refer to 2011, where 70.2% of the population were classified as multi-dimensionally poor, and the average of deprivation scores experienced by households that experience multidimensional poverty was 55.6% (UNDP, 2014).

The poverty rate in Mozambique has remained at 54.7% since 2009 ([IMF, 2014; World Bank, 2015a; World Food Programme, 2015). Poverty and vulnerability are largely impacted by gender (FAO, 2011). Men have more income-earning opportunities than women, and female-headed households are most likely to be poor, particularly in rural areas (FAO, 2011). Women in rural areas tend to work in agriculture and have primary responsibility over food crops (FAO, 2011). In 2010, 61.6% of Mozambique's population resided in rural areas (Trading Economics, 2015).

The Mozambican government's strategy for implementing its 2010-2014 five-year plan is to promote inclusive economic growth and reduce poverty and vulnerability within the country (IMF, 2014). The government defined objectives to meet the goal: increase production and productivity of the agriculture and fisheries industries, promote employment, and increase human and social development (IMF, 2014). The key goal of the 2011-2014 Poverty Reduction Strategy Paper "is to reduce the poverty rate from its level of 54 percent in 2009 to 42 percent in

2014" (IMF, 2014, p. 3). Although most of the population works in agriculture, low agricultural production contributes to the persistent poverty (Mozambique Country Profile, 2015; World Food Programme, 2015). "The main challenges facing Mozambique still relate to increasing production and productivity in the agriculture and fishery sectors" (IMF, 2014, p. 15). Only 10 percent of the total arable land in Mozambique is cultivated, leaving agricultural potential extremely underutilized (FAO, 2011).

Nutritional Status in Mozambique

Nutrition is defined as "the process of providing of obtaining the food necessary for health and growth" (Merriam-Webster, n.d.a., ¶1). In simpler terms, nutrition is described as eating a healthy and balanced diet that provides needed energy and nutrients for healthy growth (U.S. National Library of Medicine, 2015). "Inadequate intake of nutrients is a serious problem in Mozambique" (Republic of Mozambique, 2010, p. 20). In Mozambique, "limited progress has been achieved in improving water and sanitation and alleviating hunger and malnutrition" (WHO, 2014, ¶8). The FAO estimated that 39 percent of Mozambicans were malnourished between 2010 and 2012, while almost half of all children in Mozambique are currently suffering from chronic malnutrition (FAO, 2012; World Food Programme, 2015).

Malnutrition is a result of a multiple components such as insufficient protein, energy, and micronutrients; frequent infections or disease; poor feeding and caretaking; unavailable or inadequate health services; and unsafe water and sanitation (UNICEF, n.d.a.). Chronic malnutrition is caused by maternal malnutrition before and during pregnancy and lactation, and child malnutrition during the first two years of life (Republic of Mozambique, 2010). Chronic malnutrition is most prevalent in the rural northern provinces, along with chronic food insecurity and limited health services, water, sanitation, and education (FAO, 2010). Stunting, a low height-for-age ratio, refers to a stunted growth in children and is caused by long-term insufficient nutritional intake (UNICEF, n.d.a.). Delayed motor development and impaired cognitive development are side effects of stunting, and in developing countries, nearly one-third of children under five years old suffer from stunting (UNICEF, n.d.a.). Wasting, a low weight-for-height ratio, is a sign of acute malnutrition and is a result of significant food shortage and/or disease (UNICEF, n.d.a.). Wasting is also a strong warning sign for child mortality for children under five years old (UNICEF, n.d.a.).

The relationship between malaria and malnutrition is considered complex and controversial; however, it is true that malaria and malnutrition are most prevalent in developing countries (Alexandre et al., 2015). The relationship between the two is widely recognized. UNICEF's conceptual framework of malnutrition describes malnutrition's two immediate causes as inadequate nutrition and infectious disease, and malaria is an infectious disease (Gross, Schoeneberger, Pfeifer, & Preuss, 2000). It is argued that undernutrition may prevent malaria, particularly in children (Alexandre et al., 2015); however, WHO (2005) reported that malnutrition increases the risk of death for children who become infected with disease, especially malaria. In 2013, 100% of the population was at risk for malaria, while the estimated annual malaria deaths in 2012 were 71 out of every 100,000 populations (President's Malaria Initiative, 2015). In 2011, approximately one in 10 children died before their fifth birthday (President's Malaria Initiative, 2015).

Seasonality is another contributing factor to dietary diversity and nutritional intake in Mozambique. "Seasonality highlights how consumption varies throughout the seasons, often depending on cropping patterns, seasonal variations in food and crop prices, and timing of harvests" (Fox, 2008, p. 158). In the central provinces of Mozambique, food consumption is

40% higher in the June and July months, or postharvest season, than in the January and February months, or hungry season (Fox, 2008). Although micronutrient deficiencies may vary depending on the season, it is apparent that food consumption and nutritional intake during the harvest and postharvest seasons will be higher than in the hungry season, where less food is available. In 1995-1996, maize—the most important food source during harvest season—supplied 60 percent of caloric intake, but dropped to 35 percent of caloric intake during the hungry season (Rose et al., 1999). Additionally, drastic decreases in protein and caloric intakes occurred during the hungry season (Rose et al., 1999). This study is the most recent report of household food consumption in rural areas of northern Mozambique.

Mozambican Diet

The FAO listed the top 10 food commodities available for consumption in Mozambique in 2011: cassava, maize, rice, wheat, sugar cane, sorghum, sweet potatoes, pulses, beans, and palm oil (FAO, 2012). Cassava is the main product in the Northern provinces, while maize is most prevalent in the central and southern regions (FAO, 2011). Cassava accounts for 30.2 percent of average daily calorie consumption, followed by maize (20.4 percent) and rice and wheat (9 percent each), while animal products comprise 4.1 percent of calorie intake (FAO, 2013). "With the exception of green leafy vegetables which often accompany the staples, the supply of micronutrient-rich foods (other vegetables, fruit, and foods of animal origin) is dramatically low" (FAO, 2011, p. 3). The Mozambican diet is influenced by the most prevalent crops grown regionally. Cassava is the largest crop grown in Mozambique, and is the main component of the diet in the northern provinces of Mozambique, including Nampula (FAO, 2010). Luxury goods, such as milk, beef, and apples, are among the least consumed items in the Mozambican diet (Langer & Taimo, 2014; FAO, 2011).

Cereals and starchy roots, referred to as filler foods, supply almost 80 percent of the dietary energy consumption, representing an extremely low level of dietary diversity that has not changed in 40 years (FAO, 2011). Diets in northern Mozambique remain very limited (Rose et al., 1999). Rose et al. (1999) found that out of over 75 individual food items in a nutrient database, the average household only consumed four different foods per day. A main constraint to food security in the rural areas is physical access to food, because markets and roads were both destroyed in the civil war (FAO, 2011). Food security does not necessarily equal food consumption levels. Food security is built on three pillars: food availability, food access, and food use (WHO, n.d.a.). Higher food consumption may refer to a greater total caloric consumption and not necessarily a diversified diet (Republic of Mozambique, 2010). The prevalence of malnutrition in Mozambique has slowly decreased since 1999. Between 2010 and 2012, 39 percent of Mozambicans were malnourished; between 1999 and 2001, 45 percent of Mozambicans were malnourished (FAO, 2011). An increase in food consumption and chronic malnutrition are not necessarily correlated; even as food consumption levels increase in Mozambique, there has not been a decline in chronic malnutrition in many provincial areas (Fox, 2008).

Micronutrient deficiencies.

"When people cannot afford to diversify their diets with adequate amounts of fruits, vegetables, or animal-source foods that contain large amounts of micronutrients, deficiencies are inevitable" (Kennedy, Nantel, & Shetty, 2003, p. 8). WHO defines micronutrients as "magic wands" that support the human body's development of enzymes and hormones essential for physical and mental growth and development (WHO, 2015, ¶1). Iodine, vitamin A, and iron are the most important micronutrients in terms of global public health; the lack of these micronutrients is a strong threat to health and development, especially in pregnant women and children in low-income countries (WHO, 2015). Dietary diversity contributes to micronutrient deficiency status. Micronutrient deficiencies are strongest in low-income countries where diet lacks diversity and focuses on staple starches and cereals (Kennedy et al., 2003).

The three most common micronutrient deficiencies among Mozambicans are iodine deficiency disorders, vitamin A deficiencies, and iron deficiency anemia (FAO, 2011). Iodine presence in plant foods depends heavily on if iodine is present in the soil or growing environment (FAO, 2011; Kennedy et al., 2003). Iodine is essential for regulating metabolism because it synthesizes thyroxine – an important thyroid hormone (FAO, 2001). In general, seaweed or seafood are the best dietary sources of iodine; however, eggs, milk, meat, and cereals contain small amounts of iodine (Kennedy et al., 2003). Iodine deficiencies are determined by the swelling of the thyroid gland, or goiter presence, and can also be determined by measuring urinary iodine presence or assessing thyroid function (Kennedy et al., 2003). Urinary iodine is a more sensitive measurement than the presence of goiter because it reflects the current dietary iodine intake (FAO, 2011). Reduced mental capacity remains the most destructive outcome of iodine deficiency (Kennedy et al., 2003).

Cassava, a starchy root, is the main staple food in northern Mozambique, and it contains goitrogens, which are substances that inhibit iodine intake by suppressing the function of the thyroid (FAO, 2011). In 2000, legislation was approved to make iodization of salt mandatory in Mozambique; however, effective enforcement has not occurred (FAO, 2011). Additionally, iodized salt is typically sold in shops in urban areas, while rural residents buy non-iodized salt in rural markets (J. de Jong, personal communication, March 17, 2016). Salt companies across the country have begun iodizing salt, but many consumers continue consuming non-iodized salt

(UNICEF, 2010). Challenges to using iodized salt include a lack of consumer awareness and ignorance of health benefits of iodine, as well as cultural beliefs (UNICEF, 2010). Previous research found that iodine deficiency affected 68% of school-age children in Mozambique, with marked differences by residence and province (FAO, 2011).

All body tissues demand vitamin A for normal growth and repair, while both the visual and immune systems need vitamin A for normal function (Kennedy et al., 2003). The retinol form of vitamin A is present in foods such as eggs, milk, and fish; the precursor carotene form of vitamin A is present in yellow fruits and vegetables, leafy green vegetables, and red palm oil (FAO, 2002). Vitamin A deficiencies are usually determined clinically by assessing signs affecting the eye, but subclinical deficiency can be determined by measuring retinol and has gained more importance than clinical measurements (SanJoaquin & Molyneux, 2009). This measurement can also classify the severity of the deficiency (Kennedy et al., 2003; SanJoaquin & Molyneux, 2009). Vitamin A deficiency is the leading cause of preventable child blindness (WHO, 2016a).

Vitamin A deficiency affected 68% of Mozambican children between six and 59 months of age in all provinces except Nampula (FAO, 2011). This level is exceedingly higher than the WHO cut-off point of 20% that defines a severe public health problem (FAO, 2011; WHO, 2011). Children living in rural areas were more affected than children in urban areas, which probably is due to lower socio-economic status of households residing in rural areas and to poorer diets regarding vitamin A (FAO, 2011). Previous research shows that children consuming vitamin A-rich fruits and vegetables was lowest in the Nampula region (FAO, 2011; USAID, 2005). Papaya, mango, pumpkin, carrots, orange flesh sweet potatoes, and pineapple are produced in Mozambique, but are limited by seasonality and often sold for income rather than kept for household consumption (FAO, 2011). Animal-source foods have high amounts of vitamin A in retinol form, and consumption of these foods in Mozambique is limited (FAO, 2011). It can be inferred that widespread poverty in Mozambique hinders consumption of animal-source foods due to price and availability (FAO, 2011).

Iron deficiency is recognized as the most common cause of anemia (FAO, 2011). Anemia is a reduction in the ability of red blood cells to carry oxygen through the body (Kennedy et al., 2003). Iron deficiency is the most common nutritional disorder worldwide, and the most widespread (WHO, 2016b). The most common indicator to screen for iron deficiency anemia is measuring the amount of hemoglobin in the blood (Kennedy et al., 2003). The most common cause of iron deficiency comes from nutritional intake (WHO, 2016). Iron is found in two dietary forms: heme and non-heme iron. Heme iron is found in animal-source foods including meat, poultry, and fish; non-heme iron is found in cereals, pulses, fruits, and vegetables (Kennedy et al., 2003). However, iron absorption is impeded by phytate, which is present in grains, seeds, nuts, legumes, tea, coffee, and red wine (Kennedy et al., 2003). Iron deficiency anemia is most common in women, who are subject to pregnancy and menstrual loss; however, growth and parasitic infections, including malaria and hookworm, also contribute to iron deficiency anemia (Kennedy et al., 2003). It is one of the most severe nutritional deficiencies worldwide, gravely impacting cognitive development of children and increasing the mortality risk of women during childbirth (WHO, 2001; Kennedy et al., 2003).

According to a 2001-2002 survey, iron deficiency anemia affected 75% of children ages six to 59 months in all provinces except Nampula (FAO, 2011). This surpasses the 40% anemia-presence threshold determined by WHO as the cut off for a severe public health problem (WHO, 2001). Children living in rural areas were more affected than children in urban areas, and prevalence decreased with age (FAO, 2011). The 2001-2002 survey found that anemia affected 48% of mothers of children ages six to 59 months; however, urban and rural disparities were not determined (FAO, 2011). Additionally, iron deficiency and vitamin A deficiency were strongly associated among anemic mothers (FAO, 2011).

Measuring Nutritional Status

Measuring malnutrition and nutritional deficiencies can be administered in a variety of ways, including the most effective micronutrient deficiency measurements previously discussed. However, these techniques are expensive and require resources, staff, and time that were not available for this study. Additional techniques include the food recall method used by Rose and Tschirley (2003), where deficiencies were determined based on a 24-hour food recall on two nonconsecutive days in each season (harvest, post-harvest, dormant). Mid-upper arm circumference (MUAC) and body-mass index (BMI) are two techniques also used to assess nutritional status. MUAC is the circumference of the left upper arm and is measured at the mid-point between the shoulder and elbow. This method is used to assess nutritional status and, in some studies, predict childhood mortality; it has often proved more effective than weight-for-height when indicating mortality risk for children (Collins, Duffield, & Myatt, 2000). In this study, MUAC and BMI were chosen to support the food recall technique due to the low cost and little equipment required for administration. To determine if an adult or child is malnourished with the MUAC method, the measurements (usually taken in centimeters) are compared to the indicators to place the individual into four categories: well nourished (MUAC > 13.5 cm), at risk for acute malnutrition (MUAC = 12.5-13.5 cm), moderate acute malnutrition (MUAC = 11.0-12.5 cm), and severe acute malnutrition (MUAC < 11.0) (WHO & UNICEF, 2009). As a direct measurement, MUAC is not subject to mistakes as wasting ratios, such as BMI measurements

(Collins et al., 2000). BMI is another inexpensive and easy method to administer when assessing body fat, or a lack of body fat (Centers for Disease Control and Prevention [CDC], 2015). BMI also is measured by standard weight categories to determine weight status of individuals. BMI is measured by the following formula: weight (lb) / [height (in)]^2 x 703 and typically reported as just a standard number, although technically measured as p/in^2. These categories include: underweight (BMI < 18.5 p/in^2), normal/healthy weight (BMI = 18.5-24.9 p/in^2), overweight (BMI = 25.0-29.9 p/in^2), and obese (BMI > 30.0 p/in^2) (CDC, 2015).

Communicating Nutritional Information

Community-based initiatives (CBIs) employ strategies encompassing policy and education to "address physical, social, and cultural factors that contribute to healthy eating" (Pettman et al., 2015, p. 2). However, CBIs can lack quality and effectiveness when not equipped with strong communication strategies (Pettman et al., 2015). Evidence-informed approaches to the public strengthen CBIs' impact on individual behavior change (Pettman et al., 2015). In Mozambique, the society still suffers from a lack of trust of CBIs, and there are few in rural areas except religious organizations (Low et al., 2005). This lack of trust is still rooted in displacement and suffering from the civil war (Low et al., 2005).

Knowledge of nutrition among Mozambican household food providers is not directly linked to formal education (Burchi, 2010). In 2005, Low et al., reported results of a nutrition intervention program in rural Mozambique, where 61% of female caregivers never attended school, while only one-fifth had more than two years of formal education. Burchi (2010) found that formal education has a minimal impact on child's nutrition; mothers with high levels of nutrition knowledge acquired knowledge outside of school. These mothers were able to provide a more diversified diet for their children and effectively utilize food (Burchi, 2010).

One of the largest rural health training institutes in Mozambique, the Instituto de Ciencias e Saude (ICS) of Nampula employs over 350 health professionals throughout the Nampula province to improve health in rural communities (World Bank, 2015b). This institute is financed through the World Bank's Health Service Delivery Project, which trains health workers to reach rural areas (World Bank, 2015b). However, there seems to be a lack of programs and outreach of ICS professionals in the rural Nampula area, according to New Horizons leadership, who are extremely active in the majority of rural Nampula villages where employees reside (J. de Jong, personal communication, May 28, 2015). Mozambique has the fifth-lowest ratio of health workers to population of African countries (World Bank, 2015b). The rural Nampula region faces a shortage of health professionals, presenting a lack of quality and availability of health care services for residents (Honda & Vio, 2015).

Before residents of the rural Nampula area can learn about nutritional information and dietary diversity, trust of CBIs must be ensured, as well as disseminating nutritional information and availability of services through communication strategies. Although television is the most popular media outlet in urban areas of Mozambique, this luxury is not available to the majority of the rural Nampula area (British Broadcasting Company [BBC], 2013). Rural areas face a challenge of lacking mass media to disseminate nutritional information. Development of effective communication strategies that are population and geographic-based is needed before knowledge can be established, including insurance that these communication methods and services offered are consistent and reach the most vulnerable populations (Department of Health, 2013). This South African study claimed that communication campaigns are needed for behavior change regarding nutrition education and information on healthy eating choices, as well as health risks associated with poor diets (Department of Health, 2013). Strategic objectives for

South Africa to provide nutrition services include: 1) incorporating messages on core nutrition practices in various government communications with households and communities and 2) develop nutrition messages to reach opinion leaders regarding the focus of a nutrition strategy and its potential to contribute to national development, prosperity, and healthier citizens (Department of Health, 2013).

Theoretical and Conceptual Framework

This study presents a theoretical framework for administering and evaluating nutritional education efforts or programs for a low-income population. This framework addresses the need for nutritional education in the rural Nampula province of Mozambique. The Social-Ecological Model describes individual change within the context of social change (Gregson et al., 2001). This theory describes the social world in five levels of influence: social structure, policy, and systems; community; institutional/organizational; interpersonal; and individual (Gregson et al., 2001). Theoretical constructs for each level can be used to identify and evaluate change at each level. Behavioral and dietary changes exist at the individual level; however, nutrition educational campaigns at the three broadest levels (society, community, institutional) create changes that can enable and strengthen individual changes (Gregson et al., 2001). Figure 1 shows the social-ecological model for nutrition evaluation adapted from McLeroy, Bibeau, Steckler, and Glanz (1988).

Figure 1. Social-Ecological Model for nutrition evaluation and levels of influence. Adapted from McLeroy et al. (1988).

In 1990, UNICEF developed the conceptual framework of malnutrition, which describes two immediate causes of malnutrition as inadequate dietary (nutritional) intake and infectious disease, or unsatisfactory health (Gross et al., 2000). According to the framework, "malnutrition and child death are viewed as two of the manifestations of a multi-sectoral development problem that can be analyzed in terms of the immediate, underlying and basic causes" (Pelletier, 1990, p. 2). Household food insecurity, inadequate maternal and child care, and inadequate health services and environment are the underlying causes of the development problem (Pelletier, 1990). The basic causes include political, ideological, and economic structures; formal and non-formal institutions; and potential resources (Pelletier, 1990). This framework is primarily used in the context of under nutrition in rural areas of developing countries (Gross et al., 2000). Figure 2 shows UNICEF's conceptual framework of malnutrition.

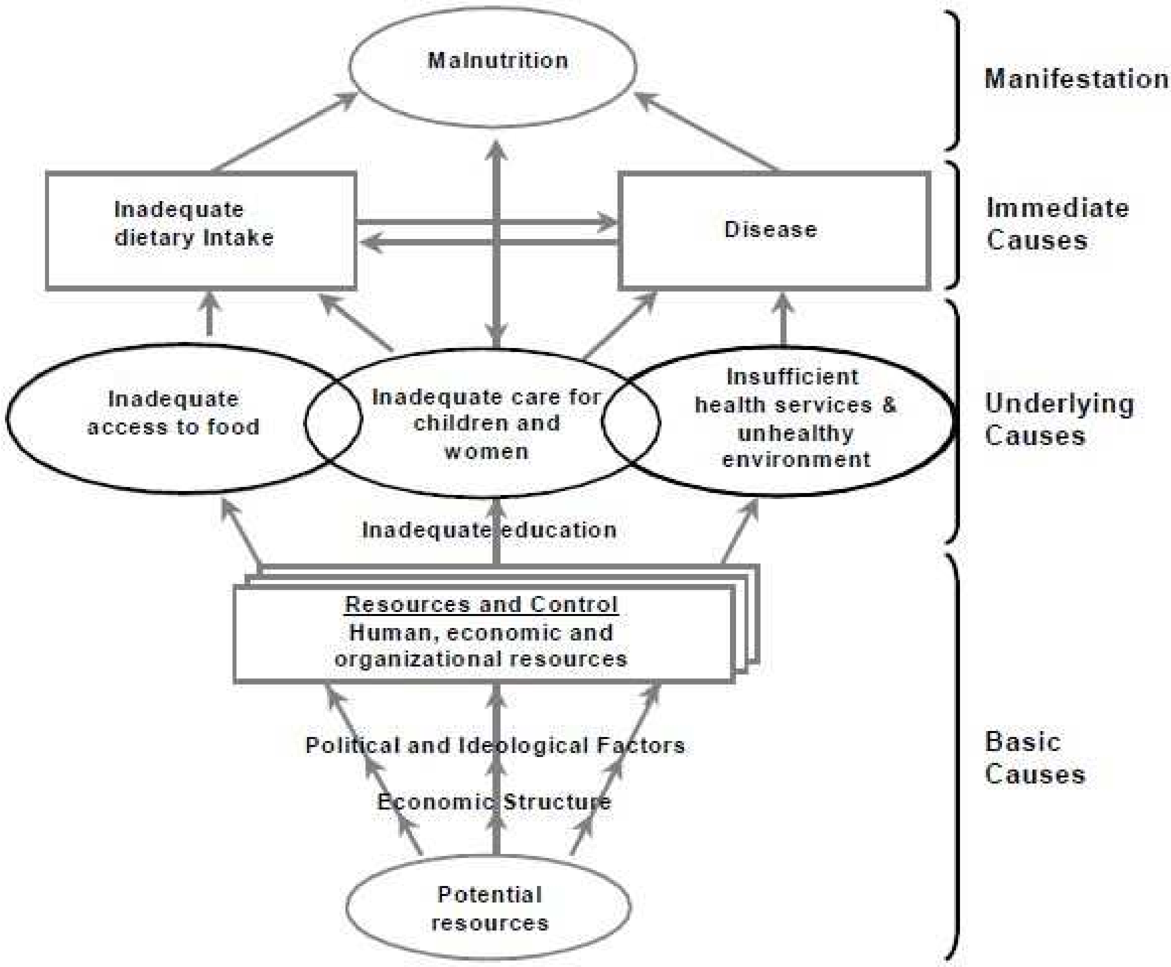

Figure 2. UNICEF's Conceptual Framework of Malnutrition (Gross et al., 2000). This framework shows the scope of malnutrition from a development perspective.

According to the framework, the causes affect different social and organizational levels (Gross et al., 2000). The immediate causes affect individuals, the underlying causes affect families, and the basic causes affect the community and country (Gross et al., 2000). The most specific causes affect a narrow population sector, while the most indirect causes affect a wider population sector (Gross et al., 2000).

New Horizons

New Horizons, a for-profit poultry company, was established in Nampula, Mozambique in 2005. The purpose of the business is to "nurture fruitful work through integrating markets, supplies, holistic training, and support" (J. de Jong, personal communication, March 17, 2016). It encompasses chicken breeding, raising, slaughtering, processing, packaging, and sales; feed mills, hatcheries, storage facilities, an outgrower program, and recycling (Hayler, 2009). The business continues to expand to meet needs of employees and to promote sustainable practices in the daily operations. The company provides employment to local villagers through two main programs: the outgrower program and the employee program. The outgrower program contracts individuals build their own chicken houses to raise chicks to maturity. The company provides feed for the outgrowers, limiting outgrower-incurred costs to time and labor. Wages are earned based on the mortality rate and feed conversion ratio of growing cycles, which last about six weeks (Davidson, 2014). The employee program offers a wide range of employment opportunities, such as transportation, construction, veterinary practice, egg selecting, packaging, and management roles. Davison (2014) conducted a study to determine the impact of employment with New Horizons. Common outcomes for New Horizons employees and outgrowers are building multiple-room homes, adding electricity and metal roofs, reporting improved health and increased technical skills, and consuming more meat. Additionally, the income shift for outgrowers is nothing short of a drastic increase. Before contracting with New Horizons, the average annual income of outgrowers was $132, and in 2014, the reported average cycle profit was $240; these amounts suggest that outgrowers earn over $100 more each six-week cycle than they previously earned annually (Davison, 2014). All of the outgrowers and employees live in the Nampula region of Mozambique, primarily in rural areas. Health improvements were also reported by respondents in Davidson's (2014) study, such as 92% of outgrowers reporting better health as a result of their employment, and 92% reporting a better ability to see a doctor when needed. Outgrowers reported meat consumption per week, with 28% consuming meat once per week prior to contracting with New Horizons, and 87% consuming meat once per week after contracting with New Horizons (Davidson, 2014). Similarly, 25% reported consuming three meals per day prior to contracting with New Horizons, and 87% reported consuming three meals per day after contracting with New Horizons (Davidson, 2014). Employees reported the following health improvements: 88% experienced improved health, 73% consumed more meat, 84% reported more dietary diversity, and 60% reported better ability to visit the hospital/doctor (Davidson, 2014). Employees were asked similar, but not duplicated, questions as the outgrowers because employees started at a higher socioeconomic status than outgrowers (Davidson, 2014). With reports of increased quality of life among these outgrowers and employees, nutritional deficiencies could also be improved within households.

Employee education and communication.

New Horizons has a strong influence on the surrounding Nampula region. With the increased business and traffic in the area, infrastructure improvements have been made, such as roads. Water access, electricity, and housing opportunities for employees are all results on the New Horizons influence, and part of the economic aspect the business aspires to build for the underdeveloped community (VerSteeg, 2010). A Christian ministry at heart, the organization is led by business-minded men who promote sustainable development of economic, social, and spiritual aspects of the individual employee, his/her family, and the community (VerSteeg, 2010). New Horizons has stated values that guide the organizational culture to develop "high performing teams that demonstrate:

> P – Purpose and values
> E – Empowerment
> R – Relationships and communication
> F – Flexibility
> O – Optimal productivity
> R – Recognition and appreciation
> M – Morale" (J. de Jong, personal communication, March 17, 2016).

Training sessions are held one Saturday a month that focus on using these values to guide financial responsibility, family commitments, and health and hygiene (A. Cunningham, personal communication, May 28, 2015). The estimated education rate for employees is over 60 percent completing 7nd grade, or going to school until they were 10 years old, with a literacy rate of 60 percent; the estimated education rate for outgrowers is 35 percent completing 7nd grade, with a literacy rate of only 30 percent (J. de Jonge, personal communication, March 17, 2016). Priorities for training sessions fall under the financial responsibility area for multiple reasons. First, employment with New Horizons is typically the first time a regular wage is earned for the average worker (A. Cunningham, personal communication, May 28, 2015). With the drastic increase in disposable income, New Horizons leadership values financial responsibility training so income is used to make sustainable improvements to the quality of life—and not wasted on unnecessary items, such as increased consumption of alcohol, leaving the family in the same poverty state prior to employment (A. Cunningham, personal communication, May 28, 2015). Second, it is important for outgrowers and employees to have monetary incentives for raising healthy poultry each cycle, so New Horizons can continue to sell poultry. Personal growth, family commitments, and a healthy self-awareness all fall under the second priority for training sessions, as New Horizons seeks to provide support for a healthy home and family life, especially while undergoing the change in quality of life that results from employment (A. Davidson, personal communication, April 11, 2015). Although nutritional status, dietary diversity, and healthy lifestyles are encouraged by New Horizons leadership, these topics are not always covered in the monthly training sessions due to a lack of time and intent to not overload employees and outgrowers with information.

Challenges exist for the success of these training sessions. First, New Horizons outgrowers cover the outer Nampula region, so having a centralized meeting place is difficult. Cars are extremely rare, and very few have motorcycles, so most of transportation is still by foot (J. de Jong, personal communication, May 28, 2015). This basically limits outgrowers to only attending training sessions in their own villages, which may only happen a handful of months each year. Finally, New Horizons faces challenges with employees' illiteracy and lack of awareness concerning nutritional needs, which has limited disseminating print materials to outgrowers to address nutrition (J. de Jong, personal communication, May 28, 2015). However, New Horizons does have weekly meetings with employees and outgrowers that focus on job training and productivity. Outgrowers typically receive daily visits by a variety of technical supervisors that help monitor chicken growth and provide any assistance outgrowers may need (J. de Jonge, personal communication, March 17, 2016). There is not an established program yet for growing crops while raising poultry; however, leadership has provided training for outgrowers on how to plant sustenance crops and use resources already used in raising chickens, such as litter and water, to grow crops for family consumption. New Horizons leadership has expressed the interest in beginning an extension program to support outgrowers in growing food items for family consumption (J. de Jong, personal communication, May 28, 2015).

Summary

Although Mozambique is considered a successful post-conflict recovery country, it remains classified as a low-income country with a GNI of $600 in 2014 (World Bank, 2016a), and is considered the seventh poorest country in the world based on GDP (Pasquali, 2015). Malnutrition and micronutrient deficiencies are most prevalent in low-income countries that are food insecure and lack dietary diversity (Kennedy et al., 2003). Between 2010-2012, 39% of Mozambicans were malnourished (FAO, 2012). The poverty rate has remained at 54% since 2009 (IMF, 2014; World Bank, 2015a).

Nutrition is described as eating a healthy and balanced diet that provides needed energy and nutrients for healthy growth (U.S. National Library of Medicine, 2015). Malnutrition may result from insufficient protein, energy, and micronutrients; frequent infections or disease; poor feeding and caretaking; unavailable or inadequate health services; and unsafe water and sanitation (UNICEF, n.d.a.). An additional factor contributing to food availability is seasonality, which leads to consumption levels varying between the harvest, post-harvest, and hungry seasons (Fox, 2008). Cassava, maize, rice, wheat, sugar cane, sorghum, sweet potatoes, pulses, beans, and palm oil are the top 10 commodities available for consumption, and starchy, filler foods comprise 80% of the diet in northern Mozambique (FAO, 2011, 2012). Cassava is the leading starch and accounts for the highest percentage of daily calorie intake, as it is the largest and most available crop grown in Mozambique (FAO, 2010, 2013).

The low education and literacy rates in Mozambique present challenges to disseminating health messages, as well as a lack of health care professionals in the area. Even though there are health care workers employed with CBIs, there remains a shortage of health care workers to cover the Nampula province. Formal education is not necessarily linked to nutrition, as reported by Burchi (2010). Instead, household food providers tend to acquire nutrition knowledge outside of school that help provide a diversified diet for families (Burchi, 2010). The lack of education, low literacy rates, and mass media dissemination create challenges for effective communication strategies. However, previous studies claim the Social-Ecological Model presents a framework for administering nutritional education efforts for a low-income population (Gregson et al., 2001). This model suggests that although behavior changes occur at the individual level, effective educational strategies occur at the societal, community, and/or institutional levels (Gregson et al., 2001).

Employment at New Horizons has resulted in benefits such as increased income, home additions, electricity and metal roof upgrades, improved health and technical skills, and higher meat consumption. Monthly training sessions administered by New Horizons additionally provide financial-management lessons; family relationship advice; spiritual, emotional, and mental growth and development; and information on good health and hygiene practices (Davidson, 2014). Because financial responsibility, family life, and spiritual/mental growth are priorities for these sessions, health and nutrition information is often not covered in the monthly sessions. Additional challenges to health and nutrition message dissemination at these sessions include location, transportation, and literacy (J. de Jong, personal communication, May 28, 2015), creating the need for a new strategy to address nutrition and health.

Chapter 3

Methodology

Design of the Study

This study utilized both quantitative and qualitative methods through survey interview administration. This study was conducted in the rural Nampula region of Mozambique between May 17 and June 5, 2015. This region was purposively selected because it is the region where New Horizons employees live. Employees and nonemployees of New Horizons (and their family members) were surveyed to assess their nutritional status and evaluate the presence of caloric and nutrient deficiencies. The purpose of this study was to assess the nutritional status of residents in the rural Nampula region of Mozambique and to assess knowledge and perceptions of nutrition. This was achieved by evaluating the presence of caloric and micronutrient deficiencies and knowledge of nutrition to determine the need for an educational health campaign. This study considered employment and both caloric and nutrient intake, which brings a deeper understanding of: 1) the current nutritional status in the Nampula region, 2) existing nutritional deficiencies, and 3) perceptions and level of knowledge of nutrition among respondents.

Restatement of Objectives:

The following objectives guided this study:

1. Quantify nutritional deficiencies among respondents,
2. Assess caloric and specific food intake of respondents,
3. Estimate potential differences in nutritional deficiencies between employees of New Horizons and nonemployees, and
4. Gather knowledge of nutrition and perceptions of healthy foods among respondents.

Institutional Review Board

The researcher received institutional review board (IRB) approval from the University of Arkansas review committee in April 2015. The protocol #15-04-645 was approved for 400 participants between April 13, 2015 and April 12, 2016. Respondents were given their informed consent, including required identification and contact information, purpose of the research, duration and description of the survey, risks and benefits, confidentiality, and voluntary refusal to continue. The protocol is located in Appendix A.

Selection of Participants

Two groups were surveyed: employees and nonemployees of New Horizons. Annually, New Horizons employs an average of 340 individuals (A. Davidson, personal communication, April 11, 2015); however, due to time restraints and fluctuation of employment, this study surveyed 30 employee families and 30 nonemployee families, with a total of 254 respondents accounting for family members present during the interview. Family members' height, weight, and upper arm circumference were measured. Participants were selected by convenience sampling due to limitations regarding time, transportation, and availability (particularly limited employment during the data collection period). Convenience sampling is often chosen with hard-to-reach populations, primarily in rural, underdeveloped international communities (Magnani et al., 2005). This sampling method allows introductory studies in hard-to-reach populations to be administered in a cost-effective way, while also determining the need for future probability sampling studies. One limitation to convenience sampling is that results are not suitable to generalize to larger populations (Magnani et al., 2005); this study does not seek to generalize results outside the sample. It is important to note that because the researchers have no way of knowing the criteria used to select the group of employees prior to employment, the results of the present study are associational, allowing for observations to be made without attribution of causality to status as an employee or nonemployee. Other limitations influenced the sampling method, such as hired drivers and translators, so accessibility during the work day hours also influenced the sample. Additionally, this study was completed as part of a community development program, creating high demand and competition for resources in a short amount of time available with New Horizons leadership and staff. The transportation time to each village ranged from 30 minutes to one hour, which affected the number of interviews completed each day. The status of New Horizons employees fluctuates during growing cycles, which limited the amount of employees who were home at the time of data collection.

Instrumentation

A survey was developed to assess the nutritional status of respondents and determine the need for an educational health campaign. The survey consisted of quantitative questions to measure the first three objectives and qualitative questions to meet the objective of gathering nutritional knowledge. Following the Nampula/Cabo Delgado (NCD) study, household heads, or food provider, were asked to report household food consumption through a series of questions inquiring about the most common foods available in Mozambique (Rose & Tschirley, 2003). The household head was asked about consumption of specific food items in eight food groups on a weekly and daily basis throughout the year. The food items represented in the survey were adapted from a previous study by Rose et al. (1999), and modified based on the study's results and after review from a panel of experts in food availability in rural Mozambique (n = 3). Content validity was assessed by a panel of experts in agricultural economics (n = 2) and agricultural communications (n = 2). Table 1 displays the food groups and items represented in this survey, as well as the unit of measurement used by respondents to report consumption.

Table 1

Food Groups and Items Included in Consumption Reporting

Food Group	Food Item	Unit of Measurement
Grains	Maize flour	Kilogram
	Sorghum	Cup
	Sorghum flour	Cup
	Bread	138 grams
	Rice	Cup
	Pasta	400 grams
Tubers and Beans	Fresh cassava	683 grams
	Dried cassava (flour)	Cup
	Fresh beans	Cup
	Dried beans	Cup
	Fresh peas	Kilogram
	Dried peas	Cup
Nuts and Seeds	Peanuts	Cup
	Coconut	100 grams
	Cashew nuts	Cup
Animal Products	Dried fish	86 grams
	Fresh fish	Kilogram
	Beef	Kilogram
	Chicken	Kilogram
	Eggs	55 grams
Vitamin A-Rich Foods	Spinach leaves	Gram
	Cassava leaves	Gram
	Bean leaves	Gram
	Sweet potato leaves	Gram
	Sweet potato	Gram
Vitamin C-Rich Fruits	Mango	207 grams
	Pineapple	2337 grams
	Papaya	977 grams
	Orange	222 grams
	Lime/Lemon	20 grams
	Guava	55 grams
Other Fruits and Vegetables	Tomato	60 grams
	Onion	15 grams
	Apple	182 grams
	Banana	55 grams
	Passion fruit	121 grams
	Okra	Kilogram
	Cabbage	1908 grams
	Eggplant	323 grams
Other Foods	Vegetable oil	Liter
	Sugar cane	Kilogram
	Salt	n/a[b]

Note: Respondents answered based on their comfort level with measurements, which often varied between kilograms and cups. The use of kilogram, cup, and liter represent one unit of measurement. For items such as fruits, bread roll, dried cassava, etc., respondents answered based on how many items (ex. four mangoes) were consumed.
[b] Respondents were unable to measure how much salt they consumed, but answered it was consumed at most or all meals.

The survey was divided into three parts. Part I addressed all 42 food items, with follow up questions if respondents' answered yes to consuming a food item. Follow up questions included how many times per week the family consumed the food item; if the food item was purchased at the market, grown, both purchased and grown, or other (gifted); and how much of the food item was prepared for each meal. Part II addressed knowledge of nutrition, how respondents learn about healthy foods, what foods are considered healthiest and why, and what foods would respondents purchase more of without money limitation. These questions are open ended to encourage honest feedback and to avoid researcher bias by providing response options. Part II also included an additional question for employees at the request of New Horizons leadership, which addressed barriers to growing more or different food items for family sustenance. Part III asked demographic information, including age, gender, height, weight, mid-upper arm circumference, number of household members, employment status, religion, and frequency of malaria. Income was not addressed because, for New Horizons employees, income is received in cycles at the end of each growing cycle, and participation in each growing cycle varies among employee.

Data Collection

Data collection occurred on iPads through the offline Qualtrics app and were uploaded into the online database at the end of each survey. Due to lack of Wi-Fi, responses were not downloaded until after the researcher returned to the U.S. Face-to-face interviews were conducted in Portuguese or Makhuwa, and one translator assisted in each interview so responses could be recorded in English. The researcher also used a voice recorder to record qualitative answers in order to transcribe and code the responses, and to serve as back-up in the case of a malfunction in the Qualtrics app. Field notes were taken by a second researcher to compare with the responses recorded on the iPads. The translator read the internal review board (IRB) approved informed consent (Appendix B) to each participant and each participant verbally stated agreeance to take the survey (Appendix C). Because of the low literacy rates in northern Mozambique, it is most appropriate to let participants verbally respond to account for the high number of participants who cannot sign their names. The participants were informed there were no incentives for taking the survey and were free to refuse participation. The informed consent also asked participants to answer as accurately and honestly as possible so researchers may understand exactly what was consumed, rather than what participants might want to portray. Each survey was conducted on an individual basis to encourage truthful answers that will not be overheard by anyone other than the researcher and translator. Responses were recorded anonymously and each respondent was assigned a number to ensure confidentiality. In this study, all New Horizons outgrowers and employees are collectively referred to as employees for the sake of readability and to represent the common connection of receiving income from New Horizons. Respondents 1-5 were employees, while 6-30 were outgrowers. However, all are classified as employees. Following data collection, survey responses were uploaded into an Excel spreadsheet and assigned a number based on interview order and labeled with an ER for employee (n_e) or an NR for nonemployee (n_n) status with New Horizons. During each interview, family members' height, weight, upper arm circumference, age, and gender were collected to determine any nutrition deficiencies and to understand body mass index (BMI) and malnutrition prevalence, which can be detected by the circumference of the mid-upper arm (MUAC). MUAC was measured with a Health-o-meter digital measuring tape, weight was measured with an Ozeri Precision digital scale, and height was measured with a portable stadiometer. Because the scale to weigh the respondents was nearly always on uneven earth (due to a lack of level pavement at respondents' homes), weight was configured by taking the average weight of a researcher five times every day at New Horizons (where there was level pavement available) to calculate the base weight. The same researcher was weighed five times at each survey location and the average weight at each location was used to determine the respondents' accurate weight. This accounted for inaccurate weight measurements resulting from varying survey locations. The formula (Base Weight/New Average) x Respondent Weight was used to calculate the accurate weight for each respondent. With over-reporting noted as a limitation to the study, these measurements provide support or disagreement with the food intake reported by respondents. BMI was later calculated in Excel by using the following formula:

$$\text{BMI} = \text{weight (lb)} / [\text{height (in)}]^2 \times 703$$

When reporting food consumption amounts, respondents either (a) weighed specific food items to show consumption amount, (b) looked at a food item to determine and report consumption amount, or (c) recalled consumption amount from memory. This method posed limitations when reporting consumption from memory, especially when considering the lack of education among respondents. Literature poses a strong argument for hypothetical bias, where "people will overstate their true valuation in hypothetical settings" (Harrison, & Rutstrom, 2008, p. 1). This was a limitation when reporting food consumption amounts, and it was likely for respondents to over-report what they actually consumed. Also, respondents answered based on their comfort level with measurements; for example, when reporting food item consumption, some would answer in kilograms and some would report in cups. At times, respondents reported in meticals (Mozambican currency) because this is how much they paid at the market for an item. Dried fish was reported in intervals of 10 meticals, because this is how respondents purchased it at the market. The researchers then went to the market and weighed the equivalent of 10 meticals, which resulted in 86 grams of dried fish. Consumption was then calculated by nutritional content of 86 grams of dried fish. Researchers used an Ozeri kitchen scale to weigh food items during the interview, as well as average size of other food items. One limitation that prohibited transporting all food items for respondents to measure was the short shelf life of food items, especially fruits and vegetables. Food items that were measured by respondents to report data include: spinach leaves, cassava leaves, bean leaves, sweet potato, and okra. Sugar cane, fresh cassava, bread roll, and package of pasta were used as examples for respondents to refer to when reporting serving sizes. It should be noted that while measuring food item consumption may result in more accurate reporting, it is likely respondents over-reported intake using this method. Finally, one unforeseen limitation was the prevalence of breastfeeding with children up to six years of age. Researchers found that if there were young children in the families, children ages four to six also were breastfed, usually after the youngest child had finished breastfeeding. This, in addition to dividing the total daily consumption amounts by all family members, led to the elimination of children under seven years old from the data set.

Data Analysis

Statistical analysis was conducted based on the dietary intake prediction model developed by Rose, Meershoek, Ismael, and McEwan (2003). The use of linear regression model provided a prediction model to link food group consumption to nutrient intake (Rose et al., 2003). Nutrient intake was compared to recommended intake (Appendix D) for each food group and micronutrient. Statistical analysis was reviewed for statistical conclusion validity by experts in agricultural economics (*n* = 3). Data analysis consisted of descriptive statistics (frequencies, means, standard deviations, and percentages). Data was analyzed in Statistical Analysis Software© 9.4 and Stata 14. Qualitative responses, such as personal definition of nutrition and justification of healthy food choices and food production, were coded following the constant comparative method to identify emergent themes (Creswell, 1998; Strauss & Corbin, 1998). An audit trail, transcription coding, and use of thick description provided trustworthiness, dependability, and confirmability of responses. Use of participants' definitions of nutrition and where they seek information provided credibility of the study's qualitative findings.

After data collection, responses were downloaded from the Qualtrics online database into an Excel file. To measure weekly consumption of food items per household, the researcher calculated all consumption measurements for each household in Excel, and divided the total daily consumption by number of household members. The results were formatted into an Excel spreadsheet which was used in Statistical Analysis Software© 9.4 to run linear regression models and t-tests to determine significance of food item consumption and percent of daily calories per food group or item. Limitations to the study included over-reporting consumption, which led to extreme outliers in the data set. Once the weekly consumption levels were determined, outliers that were above two standard deviations from the mean were replaced with the original mean, following the empirical rule that 95% of the data fall within two standard deviations of the mean (University of Leicester, n.d.a.). These replacements occurred 101 times in the dataset.

To determine deficiencies among respondents, a daily recommended intake was established based on the Dietary Reference Intakes series established by the National Academies of Sciences (Cengage, 2004). These values are goals for nutrient intake set as recommended dietary allowances (RDA), adequate intakes (AI), and estimated energy requirements (EER). This model considers gender and age group to determine recommended nutritional intakes. Appendix D shows the DRIs established for this study based on values determined by the National Academies of Sciences (Cengage, 2004).

Because only one family member was interviewed and some of the independent variables (New Horizons, household size) are identical for each family unit, the error terms have the potential to be heteroskedastic and family correlated. Therefore, standard errors were clustered by family unit to account for this correlation. Two logit regression models were used to measure the probability of deficiencies among families and individuals. These models followed the logit model as stated by Kmenta (1986):

$$\text{Prob}(Y_i = 1|X_i) = 1/(1 + \exp(-\alpha - \beta X_i))$$

This formula allowed the researcher to determine probability functions for deficiencies in both family clusters and individual respondents.

Chapter 4

Results and Findings

Originally, in this research, the total number of respondents (*N* = 254) represented all ages; however, respondents ages six and under were omitted from the data analyses for multiple reasons, including the strong reliance of young children on breastfeeding and most importantly, accounting for inaccuracy of assuming children eat the same amount as adults. This modification resulted in the elimination of 68 family members from the data set with a new total of 186 respondents. However, all respondents are reported in data representing weight, height, and upper arm circumference.

Demographic information is reported in Table 2. The average household size for employees (n_e = 100) was 6.8 family members, while the average household size for nonemployees (n_n = 86) was 6.5, with an overall average of 6.6 family members. Respondents noted as employees worked for New Horizons on average for 4.23 years, with a range from one to 11 years of employment. Respondents' (*N* = 186) gender was 54.3% female (*n* = 101) and 45.7% male (*n* = 85). Respondents were asked their religion; 54.3% were Christian (*n* = 101) and 45.7% were non-Christian (*n* = 85). Of the non-Christian respondents, 44.1% identified as Muslim (*n* = 82). Respondents' (*N* = 186) age ranged from seven to 55 years old, with an average age of 22.1 years.

Table 2

Demographics and Number of Crops Grown by Respondents

	Employees (*n* = 100)		Nonemployees (*n* = 86)		Total [a] (*N* = 186)	
Variable	*n*	%	*N*	%	*N*	%
Age						
7-9[b]	7	7.0	18	20.9	25	13.4
10-19	40	40.0	27	31.4	67	36.0
20-29	22	22.0	16	18.6	38	20.4
30-39	23	23.0	15	17.4	38	20.4

Demographics and Number of Crops Grown by Respondents (cont.)

	Employees (*n* = 100)		Nonemployees (*n* = 86)		Total [a] (*N* = 186)	
Variable	*n*	%	*N*	%	*N*	%
40-49	4	4.0	8	9.3	12	6.5
50-59	4	4.0	2	2.3	6	3.2
Gender						
Male	50	50	35	40.7	85	45.7
Female	50	50	51	59.3	101	54.3
Religion						
Christian	59	59	42	48.8	101	54.3
Muslim	38	38	44	51.2	82	44.1
Other	3	3	0	0	3	1.6

[a] Total respondents (*N* = 186) account for individuals ages seven and older.

Weight, height, and upper arm circumference were taken for all family members present during the interview (*N* = 250), including children under seven years old. Although children under seven years old are removed from the majority of data analyses, body measurements are reported for these respondents (*n* = 68), because these measurements provide insight to children's physical health in spite of the inability to measure their nutrient consumption. Body mass index (BMI) was calculated for respondents (*N* = 250) and 52% (*n* = 130) were at a normal BMI or above, while 48% (*n* = 120) of respondents were underweight. The average BMI for all respondents (*N* = 250) was 19.59, barely above the threshold for a normal weight (18.5); the average BMI for respondents seven years old and above (*n* = 186) was 20.58, which is considered a normal weight. Only 34% (*n* = 64) of respondents seven years old and above were underweight. However, it is important to note the average BMI for children under seven years old (*n* = 68) was 16.65, with 84% (*n* = 57) of children considered underweight. The low BMI measurements for children serve as indicators of possible malnutrition. Mid-upper arm circumference (MUAC) was also taken for all respondents. The at risk of malnutrition category includes MUAC between 125-135 mm and the moderate acute malnutrition category includes MUAC between 110-125 mm. One child fell into the at risk of malnutrition category with a

MUAC measurement of 132.08 mm. One child fell into the moderate acute malnutrition category with a MUAC measurement of 119.38 mm. MUAC measurements were also taken for respondents seven years old and above (*N* = 186). Of these respondents, 20 fell into the moderate level of undernutrition, defined as a MUAC of 160-185 mm. No respondents fell into the severe level of undernutrition based on MUAC measurements.

When reporting each food item, respondents indicated if each item was bought, grown, or gifted to the family. Respondents often answered that certain food items were both bought and grown. On average, families (*N* = 60) grew 13.4 food items, with employees averaging 15.1 food items and nonemployees averaging 11.6 food items. However, when considering food items that are solely grown by families and not also purchased, families grew 12.2 food items on average, with employees growing 12.9 and nonemployees growing 11.4 food items. Table 3 represents the crops grown by participants. This number does not represent crops grown for complete family sustenance; only that they grew between 0 and 25 difference crop varieties.

Table 3

Number of Food Items Grown by Families (N =60)

	Employees (*n* = 30)		Nonemployees (*n* = 30)		Total [a] (*N* = 60)	
Items Grown	*n*	%	*n*	%	*n*	%
0	0	0	2	6.7	2	3.3
1-5	4	13.3	5	16.7	9	15.0
6-10	3	10.0	7	23.3	11	18.3
11-15	4	13.3	6	20.0	10	16.7
16-20	14	46.7	8	26.7	22	36.7
21-25	5	16.7	2	6.7	7	11.7

[a] Number of food items grown were assessed by each family unit (*N* = 60).

It is important to note that when considering chicken, all New Horizons employees either grow, receive as a gift, or both grow and receive as a gift. If employees only answered “gift” for chicken, it was assumed that this was their weekly reward for work attendance and not equally considered as grown. It cannot be considered as growing chicken as a food item because employees must pay for any chickens they consume, even if they are raising them in their chicken houses. There was one employed family that did not grow any food items, with the exception of chicken, which was answered as both grown and purchased. There were two nonemployee families who did not grow any food items. Cassava leaves, bean leaves, spinach leaves, mango, and sweet potato leaves were grown most often by respondents. Bread and pasta (wheat), dried fish, fresh fish, onions, cabbage, eggplant, apples, vegetable oil, and salt were not grown by any respondents. Table 4 shows each food item and the frequency of food items grown by respondents.

Table 4

Frequency and Type of Food Items Grown by Families (N =60)

	Employees (*n* = 30)		Nonemployees (*n* = 30)		Total [a] (*N* = 60)	
Food Item	*n*	%	*n*	%	*N*	%
Banana	6	20.0	6	20.0	12	20.0
Bean leaves	26	86.7	26	86.7	52	86.7
Beef	1	3.3	0	0.0	1	1.7
Cashews	21	70.0	15	50.0	36	60.0
Cassava leaves	29	96.7	27	90.0	56	93.3
Chicken	17	56.7	2	6.7	19	31.7
Coconut	4	13.3	1	3.3	5	8.3
Dried beans	13	43.3	1	3.3	14	23.3
Dried cassava	19	63.3	18	60.0	37	61.7
Dried peas	13	43.3	18	60.0	31	51.7
Eggs	3	10.0	2	6.7	5	8.3
Fresh beans	20	66.7	5	16.7	25	41.7
Fresh cassava	20	66.7	20	66.7	40	66.7
Fresh peas	21	70.0	23	76.7	44	73.3
Guava	8	26.7	8	26.7	16	26.7
Lime/lemon	19	63.3	11	36.7	30	50.0
Maize flour	5	16.7	4	13.3	9	15.0
Mango	26	86.7	22	73.3	48	80.0
Okra	10	33.3	7	23.3	17	28.3
Orange	7	23.3	2	6.7	9	15.0
Papaya	19	63.3	18	60.0	37	61.7
Passion fruit	2	6.7	0	0.0	2	3.3
Peanuts	23	76.7	17	56.7	40	66.7

Frequency and Type of Food Items Grown by Families (N =60) (cont.)

Food Item	Employees (n = 30) n	%	Nonemployees (n = 30) n	%	Total [a] (N = 60) N	%
Pineapple	5	16.7	3	10.0	8	13.3
Rice	8	26.7	4	13.3	12	20.0
Sorghum	11	36.7	9	30.0	20	33.3
Sorghum flour	12	40.0	9	30.0	21	35.0
Spinach	25	83.3	24	80.0	49	81.7
Sugar cane	4	13.3	7	23.3	11	18.3
Sweet potato	15	50.0	14	46.7	29	48.3
Sweet potato leaves	26	86.7	20	66.7	46	76.7
Tomato	12	40.0	6	20.0	18	30.0

[a] Food items grown were assessed by each family unit (N = 60).

Families were asked how often the household head becomes ill with malaria, as well as how many times per year a family member has malaria. Malaria and malnutrition have a complex relationship, however, malaria does have a direct relationship with a person's health status. On average, employee household heads (n = 30) will get malaria 2.8 times per year, while a family member will get malaria 4.4 times per year. Nonemployee household heads (n = 27) will get malaria 2.7 times per year, while a family member will get malaria 3.6 times a year. Three nonemployee household heads were unable to quantify how often they or their family members get malaria on an annual basis; however, one of the three respondents said it was many times per year for both household head and family members.

Nutritional Deficiencies

Specific food intake.

The following foods were consumed by all family units (N = 60): maize flour, rice, pasta, fresh cassava, peanuts, dried fish, spinach leaves, mango, tomato, onion, banana, sugar cane, and salt. Only 10 respondents from this research (n_e = 5, n_n = 5) consumed all 42 food items. On average, employees consumed 91% of food items, while nonemployees consumed 89% of food items. Some families never consumed specific food products. Fewer employed families consumed passion fruit (n_e = 8), eggplant (n_e = 10), and apples (n_e = 17); while fewer nonemployee families consumed eggplant (n_n = 9), passion fruit (n_n = 12), apples (n_n = 17), and sorghum (n_n = 17).

The first food category, grains, consisted of maize flour, sorghum, sorghum flour, bread, rice, and pasta. On average, family units (*N* = 60) consumed 2.83 loaves of bread per day and 0.49 packages of pasta. Families (*N* = 60) consumed an average of 2.25 cups of other grains (maize flour, sorghum, sorghum flour, and rice) per day. These foods represent starches; however, starchy fresh and dried cassava were included in the tubers and beans food group. In addition to fresh and dried cassava, this food group included fresh and dried beans and fresh and dried peas. Family units (*N* = 60) consumed an average of 1.98 cups of grains and tubers per day. The third food group, nuts and seeds, consisted of peanuts, coconut, and cashew nuts. On average, family units (*N* = 60) consumed 1.08 cups per day. Peanuts had the highest consumption, while cashews had the lowest consumption. Animal products included fresh and dried fish, beef, chicken, and eggs. Respondents were unable to give a measurement for dried fish consumption other than how much they paid for it at the market in meticals (Mozambican currency), therefore, nutritional information was recorded by 86 grams, the weight of 10 meticals of dried fish. Chicken was consumed by families (*N* = 60) on average of 0.14 kilograms per week, with employee families consuming 0.20 kilograms and nonemployee families consuming 0.07 kilograms. On average, family units (*N* = 60) consumed 0.41 cups of leafy greens per day. Nonemployee families (*n* = 30) consumed 10.22 mangos per day, while employed families (*n* = 30) consumed 1.69 mangoes per day. Beef had the lowest frequency of consumption among families (*N* = 60) at an average of 0.64 times per week, with employees and nonemployees consuming beef 0.65 and 0.63 times per week, respectively. Apples were only consumed 0.92

times per week on average. Tomatoes and onions were consumed most frequently at 13.88 and 12.46 times per week, respectively. Peanuts and maize flour were also consumed frequently at 9.48 and 9.38 times per week, respectively. Table 5 notes the averages of daily consumption of food items.

Table 5

Daily Food Item Consumption for New Horizons Employees and Nonemployees

		Employees (*n* = 100)		Nonemployees (*n* = 86)			
Food Item	Unit of Measurement	*M*	*SD*	*M*	*SD*	*t*(58)	*p*
Apple	182 g	0.072	0.117	0.064	0.102	-0.27	0.785
Banana	55 g	0.744	0.615	0.419	0.332	-2.55	0.014***
Bean leaves	1 g	11.203	9.277	11.583	12.914	0.13	0.896
Beef	1 K	0.012	0.011	0.007	0.008	-1.91	0.061*
Bread	138 g	0.525	0.278	0.433	0.331	-1.16	0.252
Cabbage	1908 g	0.037	0.034	0.032	0.026	-0.61	0.547
Cashews	1 c	0.087	0.090	0.091	0.113	0.14	0.886
Cassava leaves	1 g	30.662	19.451	27.768	36.952	-0.38	0.706
Chicken	1 K	0.037	0.032	0.013	0.010	-3.96	<0.001***
Coconut	100 g	0.050	0.053	0.027	0.043	-1.88	0.065*
Dried beans	1 c	0.163	0.106	0.090	0.062	-3.25	0.002***
Dried cassava	1 c	0.298	0.280	0.388	0.445	0.94	0.353
Dried fish	86 g	0.271	0.230	0.095	0.058	-4.06	<0.001***
Dried peas	1 c	0.094	0.077	0.110	0.091	0.73	0.466
Eggs	55 g	0.267	0.212	0.161	0.154	-2.22	0.031**
Eggplant	323 g	0.018	0.036	0.011	0.025	-0.87	0.389
Fresh beans	1 c	0.143	0.123	0.120	0.180	-0.54	0.569
Fresh cassava	1 c	0.331	0.283	0.378	0.308	0.63	0.534
Fresh fish	1 K	0.039	0.024	0.024	0.020	-2.64	0.011***
Fresh peas	1 K	0.056	0.050	0.064	0.084	0.48	0.635
Guava	55 g	0.624	0.822	0.214	0.270	-2.60	0.014***
Lime/lemon	67 g	0.163	0.104	0.176	0.146	0.38	0.708
Maize flour	1 K	0.239	0.161	0.218	0.188	-0.46	0.651
Mango	207 g	1.669	2.334	0.283	0.321	-3.22	0.003***
Oil	1 L	0.044	0.046	0.019	0.014	-2.84	0.008***
Okra	1 K	0.023	0.016	0.025	0.030	0.32	0.751
Onion	15 g	0.746	0.481	0.477	0.409	-2.33	0.023**
Orange	222 g	0.356	0.313	0.187	0.134	-2.72	0.010***
Papaya	977 g	0.133	0.172	0.106	0.127	-0.67	0.506

Daily Food Item Consumption for New Horizons Employees and Nonemployees (cont.)

Food Item	Unit of Measurement	Employees (*n* = 100)		Nonemployees (*n* = 86)			
		M	*SD*	*M*	*SD*	*t*(58)	*p*
Passion fruit	121 g	0.015	0.035	0.023	0.042	0.77	0.443
Pasta	400 g	0.102	0.108	0.069	0.051	-1.50	0.140
Peanuts	1 c	0.385	0.267	0.340	0.292	-0.62	0.540
Pineapple	2337 g	0.058	0.052	0.040	0.050	-1.34	0.187
Rice	1 c	0.375	0.278	0.268	0.205	-1.70	0.094*
Sorghum	1 c	0.033	0.067	0.036	0.058	0.20	0.846
Sorghum flour	1 c	0.190	0.357	0.128	0.190	-0.84	0.405
Spinach	1 g	21.229	12.910	16.124	25.976	-0.96	0.341
Sweet potato	100 g	1.410	2.039	0.630	0.566	-2.02	0.052**
Sweet potato leaves	1 g	8.052	6.327	6.493	6.223	-0.96	0.340
Sugar cane	1 K	0.194	0.161	0.247	0.194	1.14	0.258
Tomato	60 g	2.640	1.326	1.640	0.977	-3.32	0.002***

Note. *$p < .10$. **$p < .05$. ***$p < .01$.

Calorie consumption.

The total average daily caloric intake consumed by the sample ($N = 186$) was 3,054.0 calories. Employees ($n = 100$) reported consuming on average 3,235.9 calories per day, while nonemployees ($n = 86$) reported consuming on average 2,842.5 calories per day. Respondents' caloric intake was figured for each food group. The majority of caloric intake was in the grains category for both employees and nonemployees. Significance at the $p < .01$ level occurred between employees and nonemployees for calories from animal products, vitamin A-rich fruits and vegetables, vitamin C-rich fruits and vegetables, and other fruits and vegetables, as shown in Table 6. Significance at the $p < .01$ level also occurred for specific food items and other food groups noted as the top caloric intakes in previous studies (FAO, 2011, 2012). Employees (M = 169.3) consumed more daily calories from meat products than nonemployees (M = 92.8), with standard deviations of 91.2 and 54.0, respectively, at the $p < 0.001$ significance level.

Employees ($M = 252.2$, $SD = 301.1$) also had a higher daily calorie consumption from fruits than nonemployees ($M = 57.4$, $SD = 52.2$), at a significance level of $p < 0.0001$. Calories from cassava were significant at the $p < 0.1$ level with nonemployees ($M = 463.1$, $SD = 335.8$) consuming more than employees ($M = 383.1$, $SD = 223.5$). Calories from rice were also significant at the $p < 0.1$ level with employees ($M = 66.7$, $SD = 47.7$) consuming more than nonemployees ($M = 54.9$, $SD = 38.3$). The top 10 foods for consumption in Mozambique as reported by the FAO (2012) accounted for 2,168.4 (66.9%) calories per day for employees and 2,094.9 (72.7%) calories per day for nonemployees. Table 6 details daily calories consumed per food group and Figures 3 and 4 show the percentage of daily calories consumed per food group.

Table 6

Daily Calories Consumed per Food Group by New Horizons Employees and Nonemployees

	Employees ($n = 100$)		Nonemployees ($n = 86$)			
Food Group	M	SD	M	SD	$t(184)$	p
Animal products	183.9	96.6	103.7	59.6	-6.90	<0.001***
Beans and tubers	468.4	247.7	535.3	373.1	1.42	0.159
Grains	1269.5	633.5	1239.3	733.4	-0.30	0.766
Nuts and seeds	352.8	230.8	355.9	301.7	0.08	0.939
Other foods	329.8	259.4	258.7	139.4	-2.37	0.019**
Other fruits, vegetables	79.9	38.0	57.1	24.3	-4.96	<0.001***
Vitamin A-rich foods	126.5	106.5	87.1	64.6	-3.10	0.002***
Vitamin C-rich foods	378.7	325.6	154.2	91.5	-6.60	<0.001***
Individual Foods						
Top 10 foods[a]	2168.4	842.2	2094.9	867.0	-0.59	0.559
Beans[f]	63.0	32.4	49.1	42.8	-2.47	0.015**
Cassava[b]	383.1	223.5	463.1	335.8	1.88	0.062*
Maize	844.3	526.6	891.0	687.7	0.51	0.608
Oil	263.7	260.9	159.3	110.6	-3.64	<0.001***
Pulses[e]	22.3	16.6	23.1	20.3	0.30	0.761
Rice	66.7	47.7	54.9	38.3	-1.87	0.062*
Sorghum[d]	88.1	124.7	80.1	105.4	-0.47	0.637
Sugar cane	66.0	46.1	99.4	76.8	3.52	<0.001***
Sweet potatoes	100.7	107.3	61.5	56.0	-3.18	0.002***
Wheat[c]	270.4	136.5	213.3	145.6	-2.75	0.007***

Note. *$p < .10$. **$p < .05$. ***$p < .01$. [a] Top 10 foods consumed in Mozambique as determined by FAO (2012). [b] Cassava included fresh cassava and cassava flour. [c]Wheat included bread and pasta. [d] Sorghum included sorghum and sorghum flour. [e] Pulses included dried peas. [f] Beans included fresh and dry beans.

Respondents (*N* = 186) consumed the highest percentage of calories from the grains group (40.8%), followed by the beans and tubers group (17.1%), and nuts and seeds group (11.8%). Respondents consumed the lowest percentage of calories from the other fruits and vegetables group (2.5%) and vitamin A-rich fruits and vegetables (3.5%). Grains accounted for the highest percentage of caloric consumption, with 39.6% of daily calories consumed by employees and 42.0% of daily calories consumed by nonemployees. Employees consumed a higher percentage of daily calories from vitamin C-rich foods (11.9%) than nonemployees (6.0%). Animal products accounted for 5.8% of employees' daily calories and 3.8% of nonemployees' daily calories. The other foods category, consisting of sugar cane and oil, accounted for 10.5% of employees' daily calories and 10.3% of nonemployees' daily calories; however, it is important to note that oil alone (one of two food items in the other foods category) accounted for 8.2% of employees' daily calories and 6.5% of nonemployees' daily calories, while sugar cane made up the remaining 1.8% and 3.5% of employees and nonemployees calories, respectively.

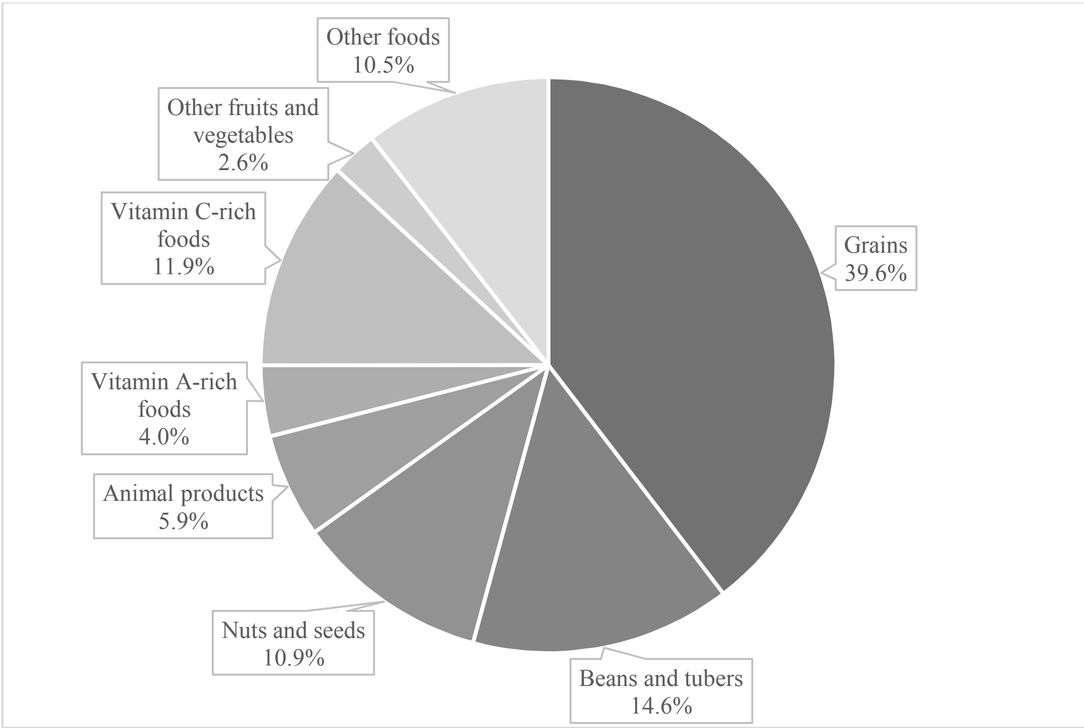

Figure 3. Employees' ($N = 100$) percentage of daily calories per food group.

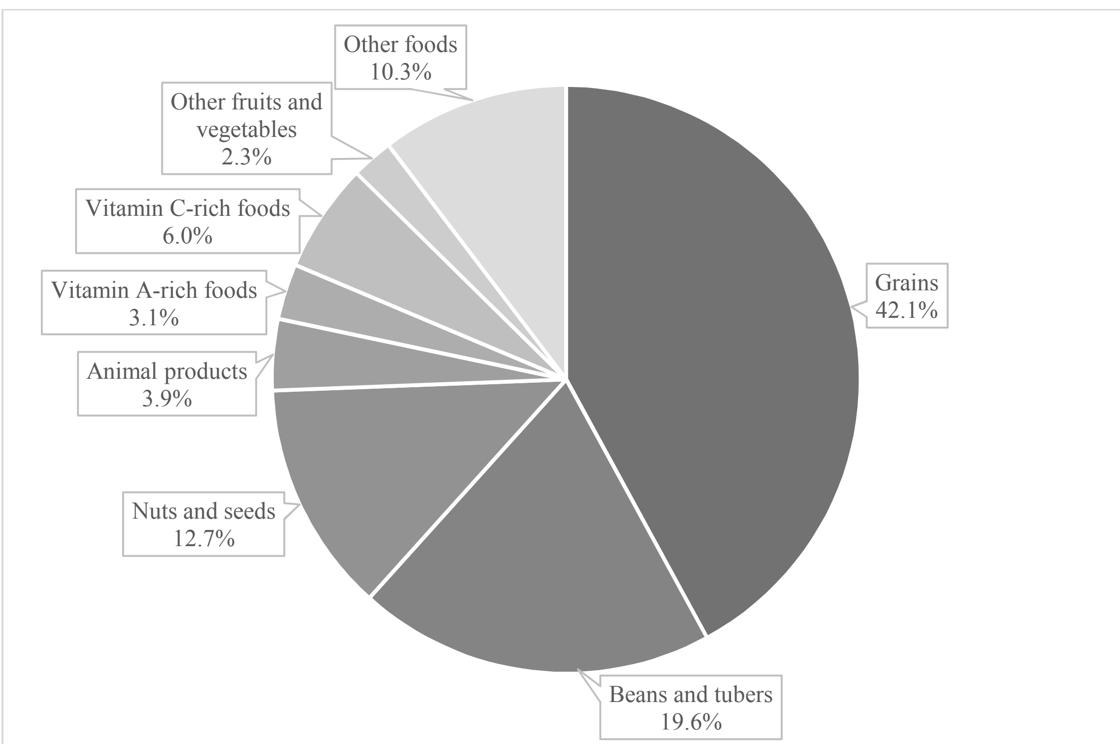

Figure 4. Nonemployees' ($N = 86$) percentage of daily calories per food group.

The following percentages look beyond the eight food groups established for this study and were considered based on previous literature about food item consumption in Mozambique (FAO, 2011, 2012). Cassava (both fresh and dried) accounted for 11.7% of employees' daily caloric consumption and 16.6% of nonemployees' daily caloric consumption, or 13.8% of all respondents' (*N* = 186) daily calories. Maize accounted for 25.9% of employees' daily caloric consumption and 28.4% of nonemployees' daily caloric consumption. Rice accounted for 2.1% of employees' daily calories and 2.0% of nonemployees' daily calories; wheat accounted for 8.6% of employees' daily calories and 8.2% of nonemployees' daily calories. Starches (all food items in grains and beans and tubers categories) comprise 54.9% of employees' daily caloric consumption, while accounting for 62.5% of nonemployees' daily calories. Leafy greens, typically accompanying staple foods, accounted for 0.8% of the respondents' (*N* = 186) daily caloric consumption.

Deficiencies.

There were 58 caloric deficiencies (31.2%) among respondents (*N* = 186). Respondents were most deficient in cholesterol (96.2%) and calcium (82.8%). There were no deficiencies for vitamin A, vitamin C, sugar, iron, or carbohydrates. Table 7 shows the number of micro and macronutrient deficiencies present in employees and nonemployees (*N* = 186).

Table 7

Deficiencies as Present in New Horizons Employees and Nonemployees

	Employees (*n* = 100)		Nonemployees (*n* = 86)	
Nutrients [a]	*n*	%	*n*	%
Cholesterol	93	93.0	86	100.0
Calcium	81	81.0	73	84.9
Calories	28	28.0	30	34.9
Fiber	10	10.0	12	14.0
Fat	7	7.0	1	1.2
Protein	0	0.0	2	2.3
Carbohydrates	0	0.0	0	0.0

Deficiencies as Present in New Horizons Employees and Nonemployees (cont.)

	Employees (n = 100)		Nonemployees (n = 86)	
Nutrients [a]	*n*	%	*n*	%
Sugar	0	0.0	0	0.0
Vitamin A	0	0.0	0	0.0
Vitamin C	0	0.0	0	0.0
Iron	0	0.0	0	0.0

[a] Sodium was eliminated because household heads (N = 60) could not quantify salt intake. Iodine was eliminated because it could not be measured by caloric intake; however, foods containing iodine are located in Appendix E.

Three variables showed significance: employment with New Horizons, years of employment, and household size. Four deficiencies were further examined based on the variance in the data set: calorie, fat, fiber, and calcium. Figures 5—11 break down the probability of these deficiencies based on years of employment at New Horizons.

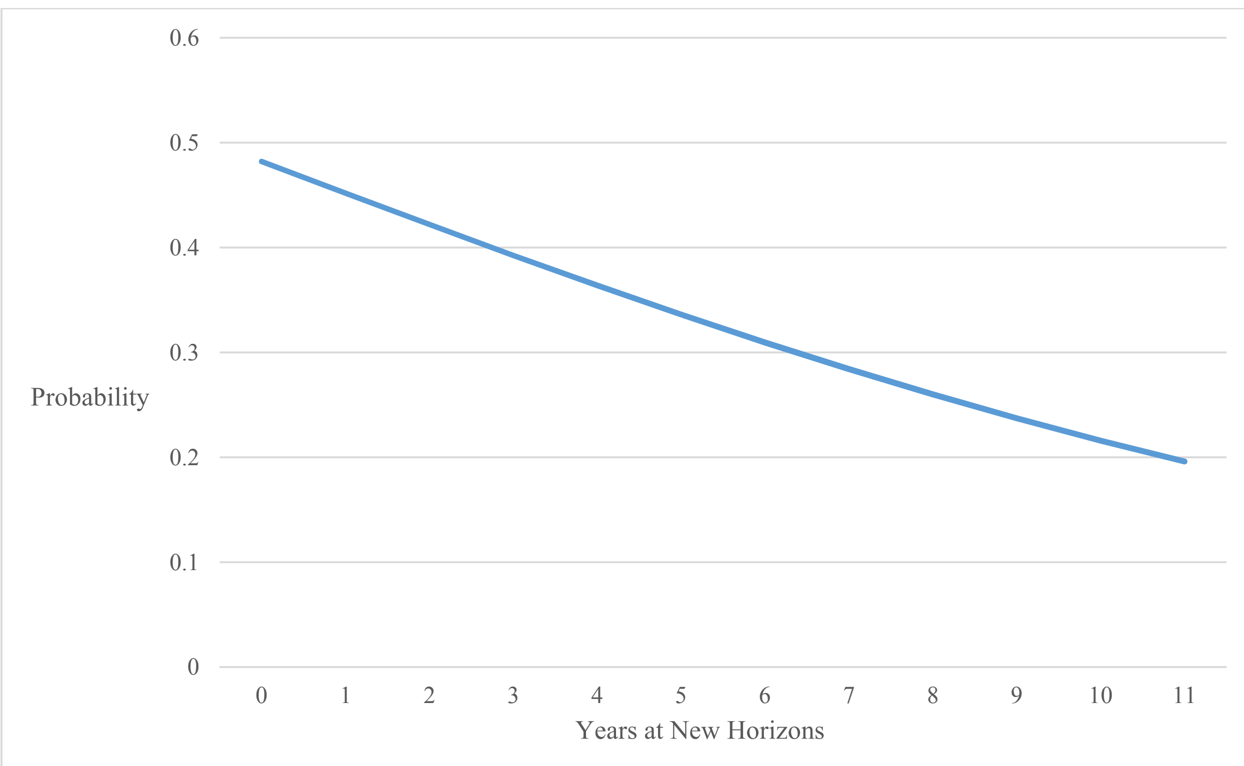

Figure 5. Probability of family calorie deficiency as a function of years at New Horizons. For each year of employment at New Horizons, families were less likely to be deficient in calories at an average probability of 0.026.

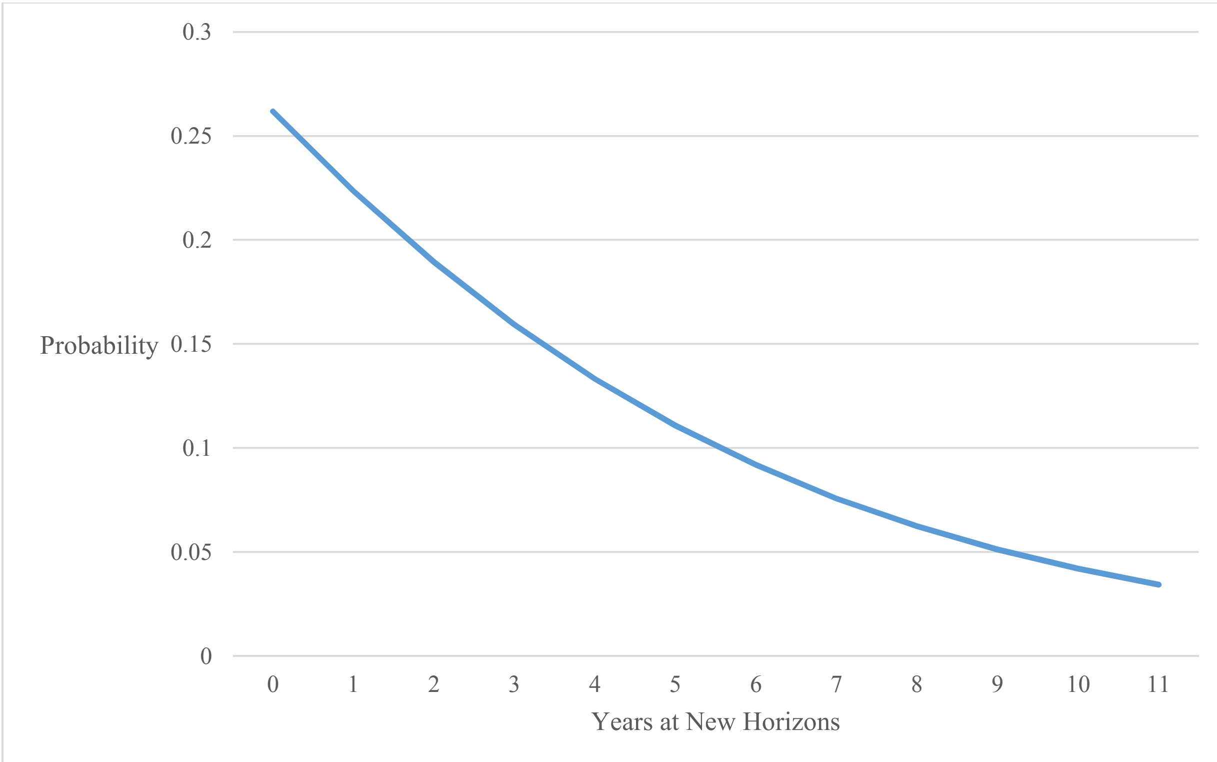

Figure 6. Probability of family having fat deficiency as a function of years at New Horizons. For each year of employment at New Horizons, families were less likely to be deficient in fat at an average probability of 0.021.

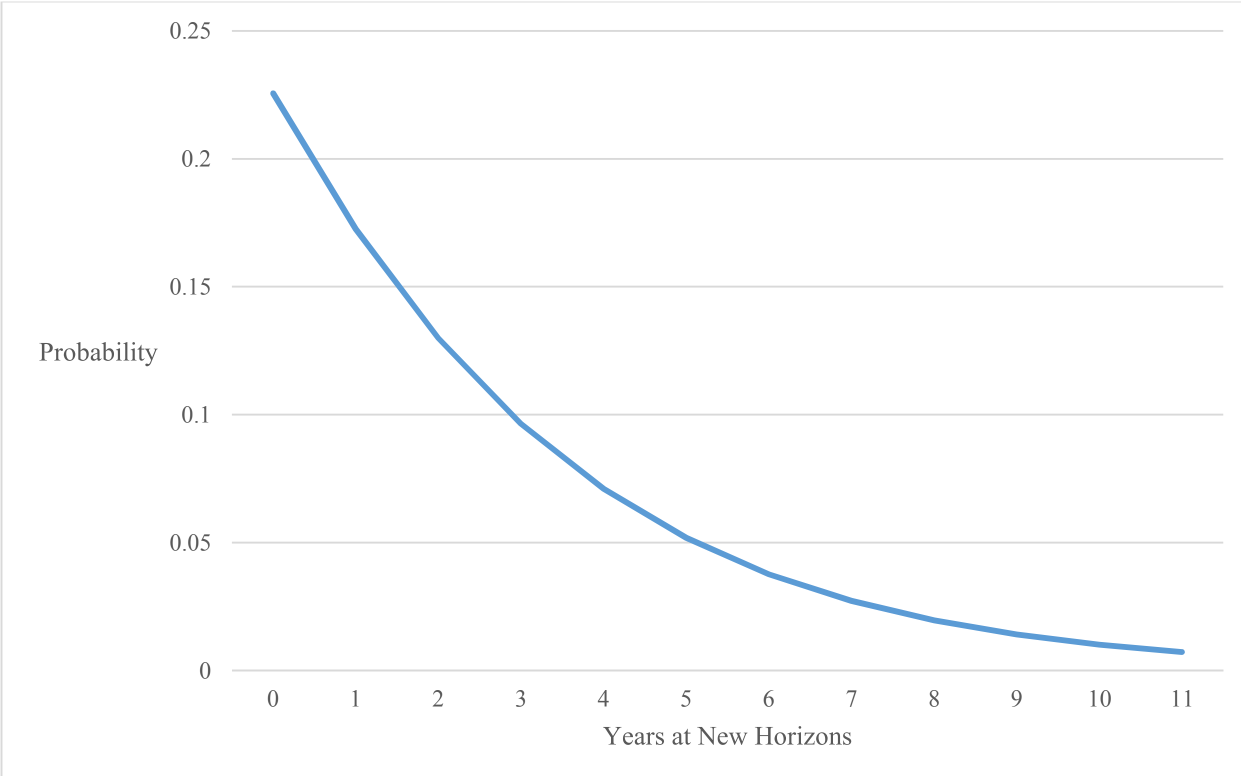

Figure 7. Probability of family having fiber deficiency as a function of years at New Horizons. For each year of employment at New Horizons, families were less likely to be deficient in fiber at an average probability of 0.019. Employees who work for New Horizons for one year reduce their chance of being fiber deficient by a probability of 0.053. After five years of employment, employees reduce their chance of being fiber deficient by a probability of 0.014.

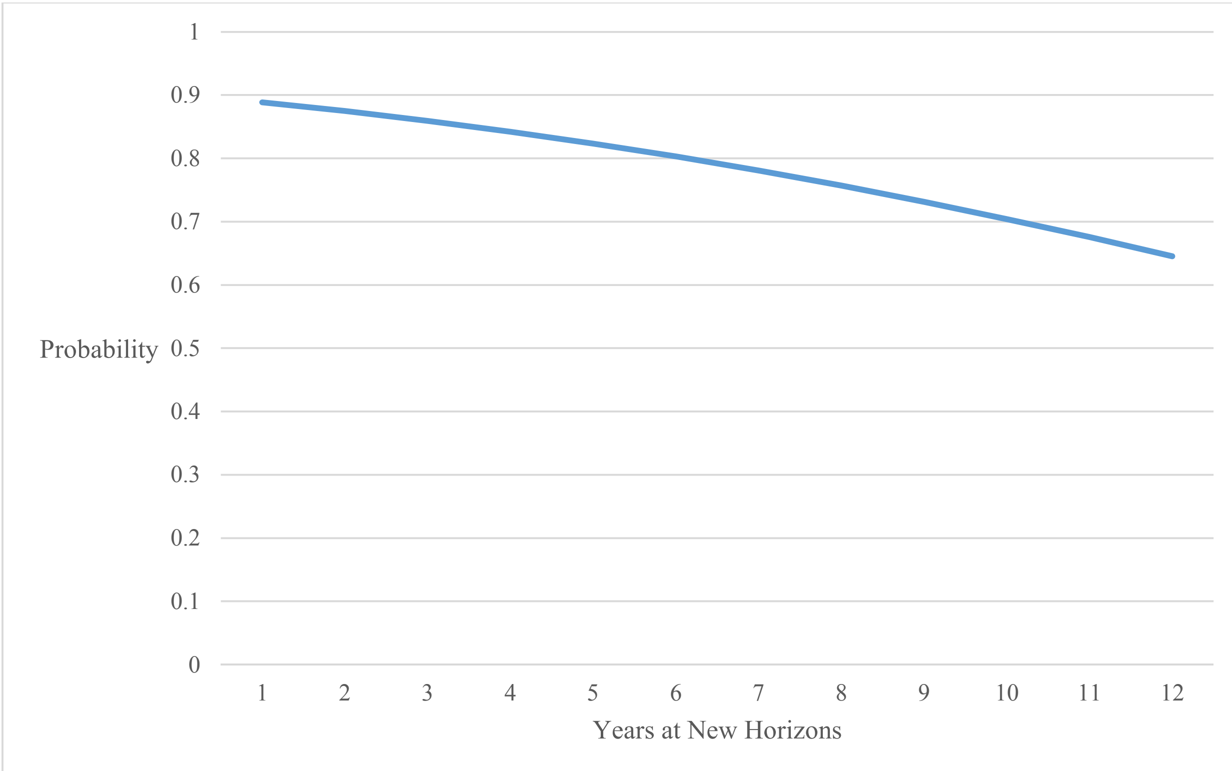

Figure 8. Probability of family having calcium deficiency as a function of years at New Horizons. For each year of employment at New Horizons, families were less likely to be deficient in calcium at an average probability of 0.022. Calcium at the family level is decreasing at an increasing rate; when employees work 10 years, their chances of being calcium deficient are reduced ($p = 0.030$).

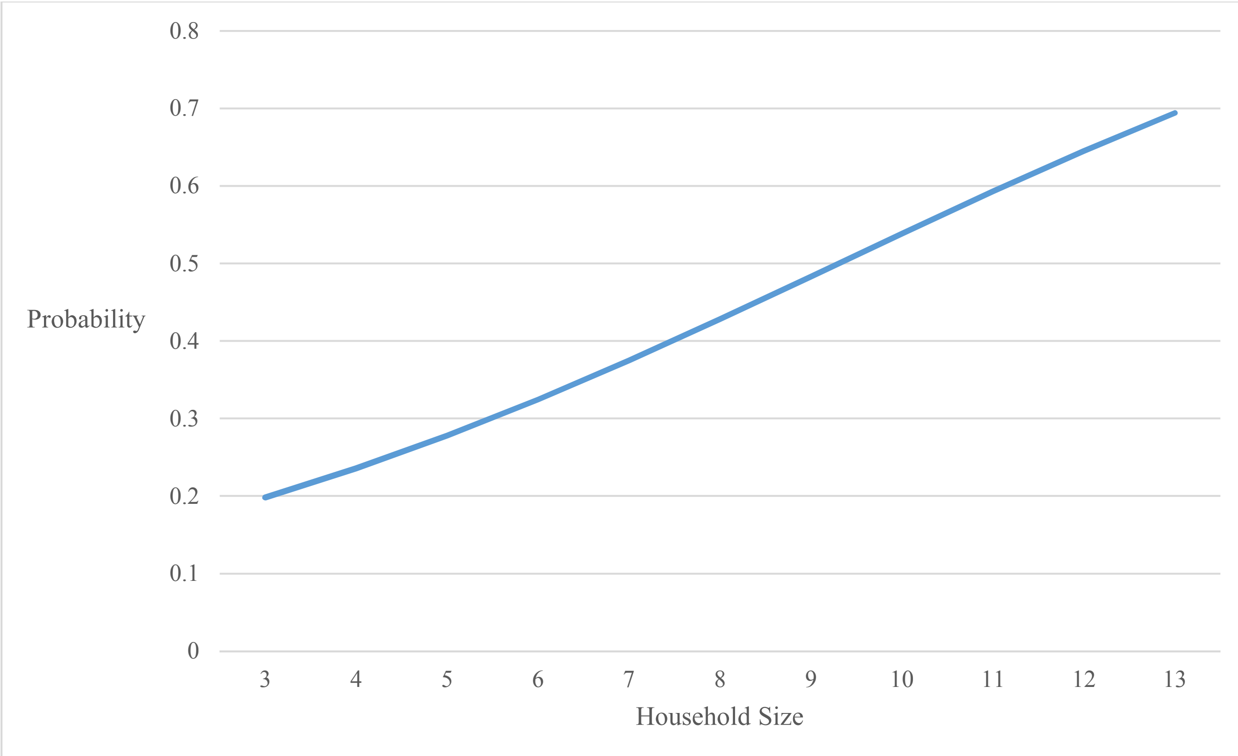

Figure 9. Probability of employees' calorie deficiency as a function of household size. For each additional household member, employees were more likely to be calorie deficient at an average probability of -0.050.

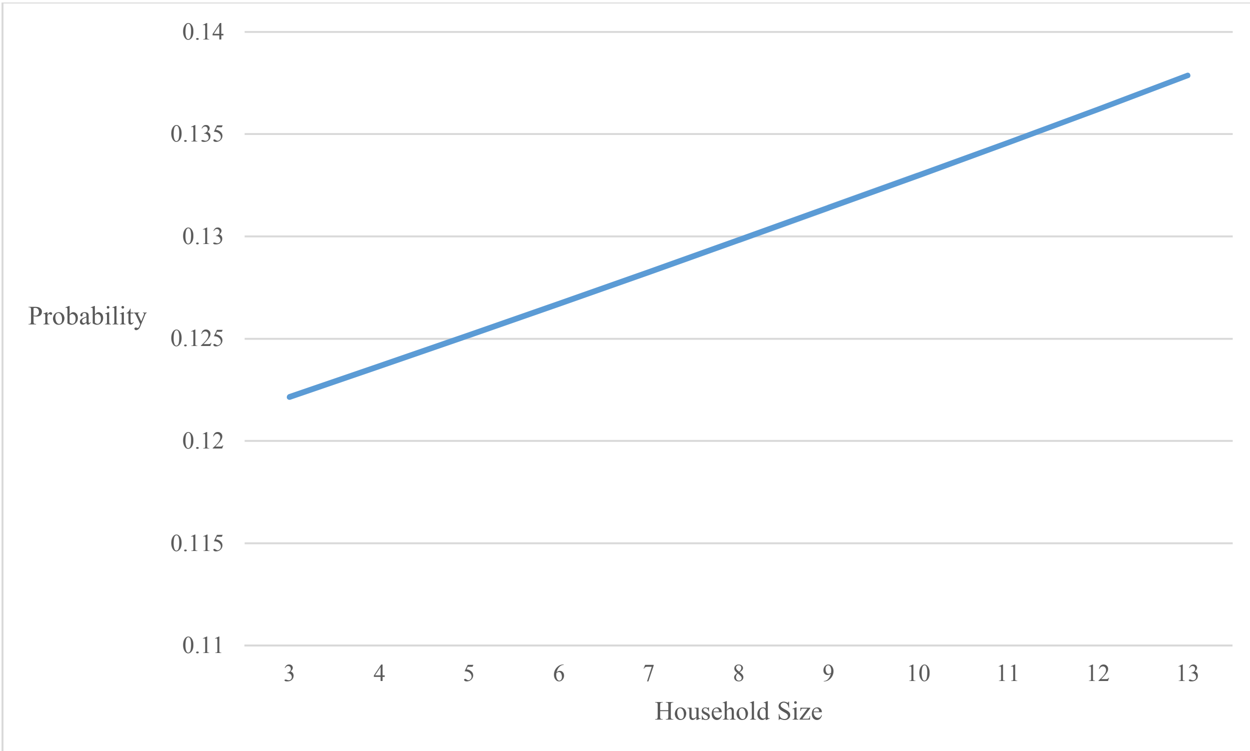

Figure 10. Probability of employees' fat deficiency as a function of household size. For each additional household member, employees were more likely to be fat deficient at an average probability of -0.002.

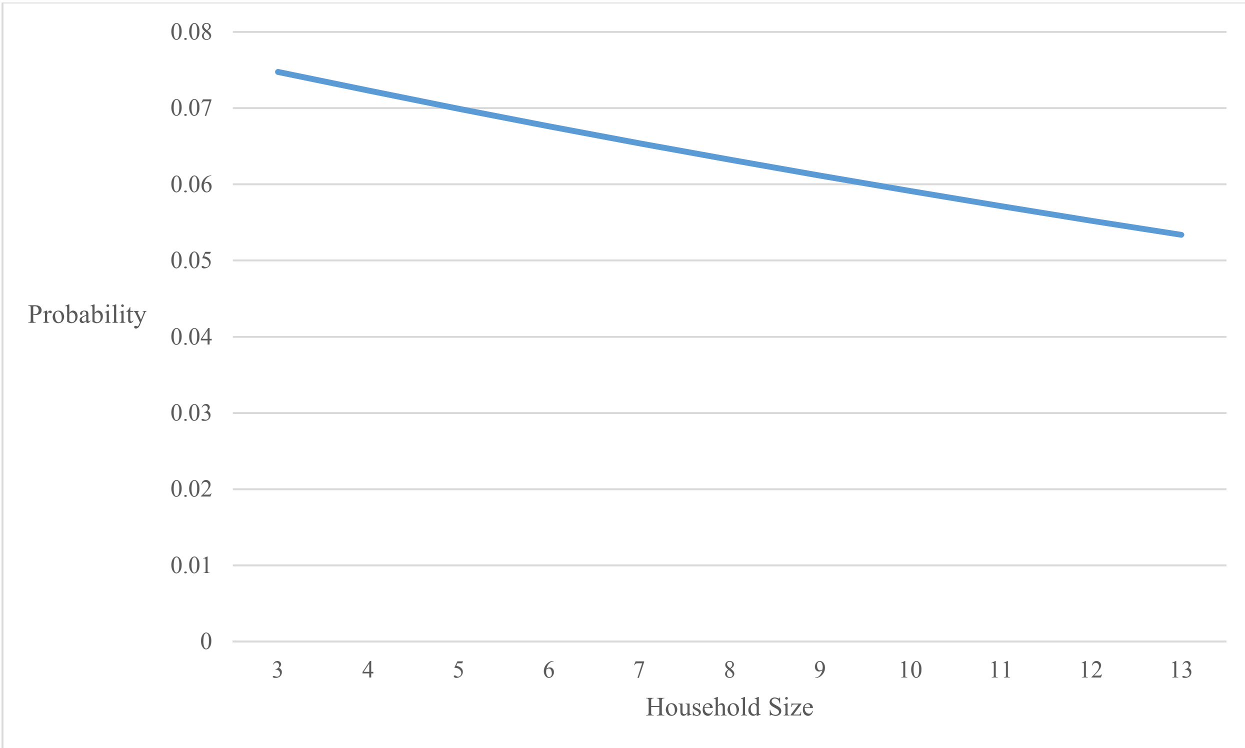

Figure 11. Probability of employees' fiber deficiency as a function of household size. For each additional household member, employees were less likely to be fiber deficient at an average probability of 0.002.

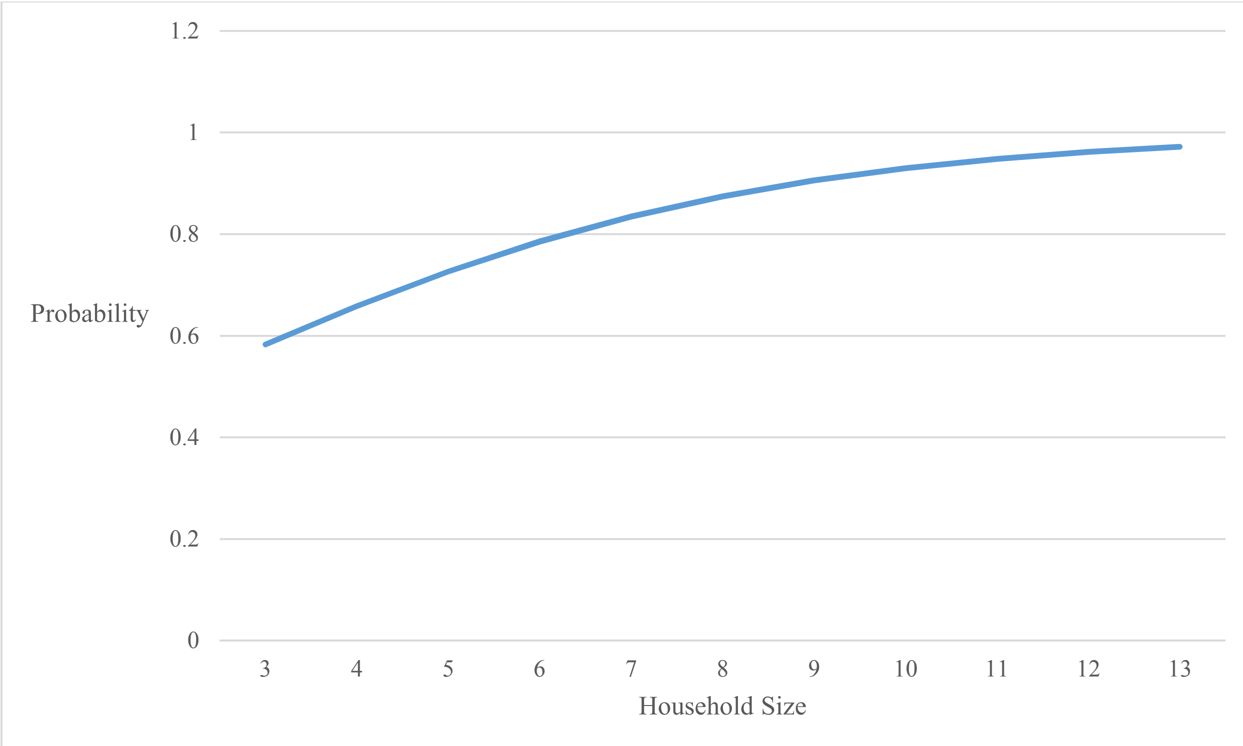

Figure 12. Probability of employees' calcium deficiency as a function of household size. For each additional household member, employees were more likely to be calcium deficient at an average probability of 0.039.

Two models were used to calculate the probability of calorie, fat, fiber, and calcium deficiencies. The first model represents robust clustered standard errors ($N = 60$), clustered by family; the second model represents individual observations ($N = 186$). Because nutrient intake was divided by the total household dependents, Model 1 with clustered standard errors is considered the most robust model as it looks at household intake. However, individuals ($N = 186$) were also considered. In the first model, significance at the $p < 0.10$ level occurred for calorie deficiencies as a function of household size ($p < 0.088$) and fiber deficiencies as a function of years of employment at New Horizons ($p < 0.092$). In the second model, significance at the $p < 0.01$ level occurred for calorie deficiencies as a function of household size ($p < 0.007$) and calcium deficiencies as a function of household size ($p < 0.007$). Significance at the $p < 0.05$ level occurred for calorie deficiencies as a function of years at New Horizons ($p < 0.024$) and calcium deficiencies as a function of years at New Horizons ($p < 0.030$). Significance at the $p < 0.10$ level occurred for fat deficiencies as a function of household size ($p < 0.051$). Table 8 displays two different models measuring probability of deficiencies as a function of years at New Horizons and household size.

Table 8

Probability of Calorie, Fat, Fiber and Calcium Deficiencies as a Function of Years at New Horizons (NH) and Household Size

Deficiency Category	Variable	Model 1[a] Coefficient	Model 1[a] *p*	Model 2[b] Coefficient	Model 2[b] *p*
Calorie	*Years at NH*	-0.121	0.149	-0.121	0.024**
	Household size	0.221	0.088*	0.221	0.007***
	Constant	-1.548	0.055*	-1.548	0.005***
Fat	*Years at NH*	-0.209	0.189	-0.209	0.013**
	Household size	0.013	0.912	0.013	0.051*
	Constant	-1.129	0.161	-1.129	0.104
Fiber	*Years at NH*	-0.334	0.092*	-0.334	0.180
	Household size	-0.035	0.797	-0.035	0.763
	Constant	-0.993	0.279	-0.993	0.202
Calcium	*Years at NH*	-0.134	0.219	-0.134	0.030**
	Household size	0.320	0.253	0.320	0.007***
	Constant	-0.059	0.969	-0.059	0.934

Note. *$p < .10$. **$p < .05$. ***$p < .01$.

[a] Model 1 represents robust clustered standard errors, with $N = 60$ clusters (clustered by family).

[b] Model 2 represents individual observations, with $N = 186$ individual respondents.

Table 9 displays two different models measuring probability of deficiencies as a function of employment with New Horizons and household size. No significance occurred for clustered standard errors ($N = 60$ families) concerning deficiencies. Significance at the $p < 0.05$ level occurred for individual respondents ($N = 186$) for the following deficiencies: caloric deficiency as a function of household size ($p < 0.026$), fat deficiency as a function of employment with New Horizons ($p < 0.054$), fiber deficiency as a function of employment with New Horizons ($p < 0.018$), and calcium deficiency as a function of household size ($p < 0.019$).

Table 9

Probability of Calorie, Fat, Fiber and Calcium Deficiencies as a Function of Employment with New Horizons (NH) and Household Size

Deficiency Category	Variable	Model 1[a] Coefficient	Model 1[a] *p*	Model 2[b] Coefficient	Model 2[b] *p*
Calorie	*Employment*	-0.455	0.383	-0.455	0.135
	Household size	0.172	0.141	0.172	0.026**
	Constant	-1.264	0.106	-1.264	0.022**
Fat	*Employment*	-0.734	0.341	-0.734	0.054*
	Household size	-0.046	0.684	-0.046	0.634
	Constant	-0.766	0.343	-0.766	0.257
Fiber	*Employment*	-1.030	0.152	-1.030	0.018**
	Household size	-0.103	0.421	-0.103	0.359
	Constant	-0.600	0.485	-0.600	0.426
Calcium	*Employment*	-0.445	0.511	-0.134	0.248
	Household size	0.267	0.312	0.320	0.019**
	Constant	0.165	0.912	-0.059	0.823

Note. $^*p < .10$. $^{**}p < .05$. $^{***}p < .01$.

[a] Model 1 represents robust clustered standard errors, with $N = 60$ clusters (clustered by family).

[b] Model 2 represents individual observations, with $N = 186$ individual respondents.

Nutrition perceptions and knowledge

Knowledge of nutrition.

The household heads (*N families* = 60), who reported food intake for the family unit, were asked about their knowledge of nutrition and perceptions of healthy foods. When asked to define nutrition in his/her own words, 73.3% of respondents ($n_e = 16$, $n_n = 28$) could not provide an answer. Many employees who provided a definition of nutrition used key words including:

consuming foods with many vitamins, a variety of foods, important/right foods, or foods that provide power/energy. However, definitions of nutrition varied widely among respondents. One employee (ER20) said nutrition was "when someone gets fat," while another (ER13) described it as, "to eat things like cabbage." One nonemployee (NR40) provided his definition in English as "good food which contributes to the wellbeing of the body and helps to produce blood." This respondent (NR40) was the only English-speaker interviewed. The variance in definitions led to three categories, or levels, of answers, denoted as three broad areas. Participant responses placed in area one related to specific or a variety of foods needed for health and growth; "providing the food necessary for health and growth". Area two was related to "vitamins, energy or health". Area three were responses that had no relationship to nutrition, indicating that participants were unsure of how to define nutrition. The first category was composed of seven definitions, including "variety of food which helps us to be healthy" (ER2). Seven responses were placed in the second category, including "to have good health" (NR41). The third category included two definitions: "eat things like cabbage" (ER13) and "when someone gets fat" (ER20). Of the employees who provided a definition of nutrition (n = 14), 12 had existing calorie deficiencies within their households, including five household heads. Out of the five household heads who were calorie deficient and provided a definition of nutrition, three were placed in the first category of nutrition definitions (showing they had an accurate definition of nutrition). The other two were placed in the second category, showing they had a related definition of nutrition. Two families with caloric deficiencies in family members (but not the household head) provided definitions that were placed in the first and second categories. Of the other employed families who had existing caloric deficiencies, six could not provide a definition of nutrition. One nonemployee family (NR40) provided a definition placed in the first category and also had caloric deficiencies among family members, while the other nonemployee family (NR41) who defined nutrition did not have calorie deficient family members.

Although the majority of respondents could not define what nutrition meant in their own words, most respondents were able to answer specifically where they had learned about healthy foods for their families. Employees (n_e = 16) reported they learned this information at the New Horizons training sessions. Employees (n_e = 11) and nonemployees (n_n = 11) reported they learned about healthy foods in school, while seven nonemployees found information at the hospital. Four nonemployees and one employee said they learned alone by observing what foods make them feel good or give power. Participants (n = 9) also learned from others including family and friends. Other respondents (n = 6) stated that this information is unavailable to them.

Perceptions of healthy foods.

Respondents were asked what foods they thought were healthiest for their family members and why. Overall, leaves, maize flour, and bananas were perceived as the healthiest foods. Although leaves only represented 0.8% of respondents' daily calories, leaves were mentioned the most often by both employees and nonemployees. Employees answered leaves (n_e = 20), maize flour (n_e = 19), and rice (n_e = 8) most often. Nonemployees answered bananas (n_n = 12), leaves (n_n = 12), and papaya (n_n = 8). Three respondents (ER12, NR31, NR57) said, "I don't know," when asked which foods were healthiest. Starchy, filler foods that belong to the grains and beans and tubers categories were mentioned 51 times. Vitamin-C rich foods (papaya, orange, pineapple, lemon) were mentioned 29 times. The perceived healthiest foods for respondents who provided a definition of nutrition (n = 16) were maize flour, leaves, and rice, while those who did not provide a definition (n = 44) chose leaves, bananas, and maize flour as the healthiest foods for family consumption. Table 10 shows the breakdown of perceived healthiest foods by respondents.

Table 10

Healthiest Foods as Stated by Respondents

Food Item	Sample (*N* = 186)	Employee (*n* = 100)	Nonemployee (*n* = 86)
Leaves [a]	32	20	12
Maize flour	25	19	6
Bananas	18	6	12
Papaya	12	4	8
Rice	11	8	3
Oranges	8	4	4
Pineapple	8	3	5
Peanuts	7	0	7
Eggs	6	3	3
Beans	6	1	5
Cabbage	6	1	5
Beef	5	3	2
Fish	4	3	1
Water	3	2	1
Pasta	3	3	0
Chicken	3	2	1
Oil	2	1	1
Cassava flour	2	2	0
Cassava	2	0	2

Note. Lemons and meal were mentioned once each by employees, and apples, sweet potato, sugar cane, sorghum, and okra were mentioned once each by nonemployees.
[a] Leaves included spinach leaves, bean leaves, cassava leaves, and leaves.

When reporting why these foods were healthiest, the provision of vitamins, energy, power, and/or proteins was mentioned often by respondents to justify their selection of healthy foods. Respondents described how foods protect the body from diseases and illnesses. Five respondents who chose bananas as a healthy food explained that the foods chosen "gives/increases/helps blood" in the body. All responses about blood were given when bananas were chosen, and bananas were also directly described as protecting from diseases. Eight respondents answered that the selected foods made him/her feel full or become fat. “Because when we prepare maize flour, the children feel satisfied” (ER9). Some respondents expressed that the three foods were chosen based on a hypothetical situation of being without other foods, while other respondents said their chosen foods made them feel well or happy when consumed. One respondent (ER24) said water, maize flour, and leaves were the healthiest, because “if we don’t eat anything else, those three foods are enough.” One respondent chose cassava leaves, fresh fish, and bean leaves because they “are natural” and “not mixed with anything” (ER21).

Next, respondents (n = 54) were asked what three foods they would like to buy more of for family consumption if money was not a limitation. Overall, rice had the most responses (n = 29), followed by beef (n = 18), and pasta (n = 17). Nonemployees preferred beans (n_n = 10) and maize flour (n_n = 9), while employees would purchase more milk (n_e = 7) and apples (n_e = 6). Only one nonemployee preferred milk and three nonemployees preferred apples, while no employees preferred beans, and only four preferred maize flour. Three of the top five foods preferred by employees (beef, milk, apples) are considered luxury goods in Mozambique, while only one luxury good (beef) was preferred by nonemployees. Four of the top five foods preferred by nonemployees (rice, pasta, beans, maize flour) are starchy, filler foods. Employees mentioned food items not referenced in the survey list, including milk, tomato sauce, turkey, mayonnaise, soft drinks, and cakes. Milk was the only outside food item nonemployees mentioned. Although Vitamin-C rich foods were mentioned frequently as healthy foods, they were not mentioned as often when discussing food purchasing preferences. Table 11 shows the food purchasing preferences of respondents without money as a purchasing limitation.

Table 11

Food Purchasing Preferences Without Money Limitation

Food Item	Sample (*N* = 186)	Employee (*n* = 100)	Nonemployee (*n* = 86)
Rice	29	11	18
Beef	18	9	9
Pasta	17	8	9
Maize flour	13	4	9
Beans	10	0	10
Apples	9	6	3
Milk	8	7	1
Potatoes	6	5	1
Fish	6	2	4
Pineapple	5	3	2
Chicken	5	0	5
Bananas	5	2	3
Oranges	5	1	4
Oil	5	2	3
Cabbage	4	2	2
Eggs	3	0	3
Eggplant	2	2	0

Note. Cassava flour, sorghum, tomato sauce, turkey, mayonnaise, soft drinks, and cakes were mentioned once each by employees, and leaves, cassava, sugar cane, and coconut were mentioned once each by nonemployees.

Employees' perceived barriers to growing crops.

New Horizons leadership requested the survey ask employees and outgrowers about barriers to growing more or different food items for family consumption. When employed families (*n* = 30) were asked what kept them from growing more or different crops, over half (*n* = 11) answered time as the reason. Two of the respondents specifically mentioned the limited time as a result of their employment with New Horizons. Five respondents expressed the biggest barrier was the lack of arable land or proper soil. A lack of space, water, and seed were mentioned often as reasons why employees did not expand growing more or different crops. Other respondents simply said it was too difficult to grow crops or run a farm. One respondent said he/she had tried to grow more crops for family consumption but had failed to yield crops. Other answers included never considering growing more or different crops before, laziness, risk of thieves, and already growing enough crops for family consumption.

Chapter 5

Conclusions and Recommendations

This study achieved the first and second objectives to quantify nutritional deficiencies among respondents and assess caloric and specific food intake of respondents. Although there were 10 micro and macronutrients measured in addition to calories, calories, fat, fiber, and calcium were the only deficiencies with variances among respondents. This may be a result of over-reporting, which was noted as a limitation to the study. Educational barriers may have led to unintentional over-reporting, especially considering that 101 replacements were made because the reported consumption was above the 95% confidence level. Also, many vitamin A-rich foods are seasonal, which may mean these results are an inaccurate representation of year-round consumption. Although respondents' consumption of green leafy vegetables, eggs, and fish are likely a positive contribution to vitamin A consumption year-round, the percentage of daily calories from these categories was not remarkably high. It is important to note that although there are obvious errors in reporting, the percentage of food group consumption should be referred to when looking at this sample's diet as a whole. Considering the over-reporting present in the data set, high starch consumption percentages, and low consumption percentages in vitamin C-rich foods, vitamin A-rich foods, and other fruits and vegetables, it can be concluded that vitamin-rich foods are a minority in this sample's diet.

Respondents were unable to measure how much salt they consumed per meal, so this question was eliminated during the pilot tests in-country. Although salt is technically required to be iodized in Mozambique, it is not common and the iodized salt is sold in shops in the urban areas (J. de Jong, personal communication, March 17, 2016). Because respondents buy their salt at rural markets, it can be deducted that all respondents were deficient in iodine, supporting previous research concerning high levels of IDD (FAO, 2011; J. de Jong, personal communication, March 17, 2016). Additionally, the amount of cassava consumption among respondents may worsen IDD, as iodine intake is inhibited by substances found in cassava (FAO, 2011). Cassava accounted for 13.8% of respondents' daily calories, the second-highest food consumption after maize flour. This is less than half of the 30.2 percent of average daily calorie consumption reported by FAO (2013); however, this could be a resulting offset of higher maize consumption than reported by FAO (2013). Respondents were not deficient in iron intake, which could be a result of consuming grains, beans, and tubers, all which contain one to five milligrams of iron per 100 grams. However, it is important to note that phytate, a cyclic acid present in grains, nuts, and legumes, hinders the absorption of iron in the body, which can ultimately cancel out the iron intake as reported by food consumption (Kennedy et al., 2003). Respondents were not deficient in carbohydrates (with the exception of dietary fiber) and sugars, which are highly present in the most consumed foods, including grains, beans and tubers, and vitamin C-rich fruits and vegetables. This is not surprising, as a high percentage of daily calories resulted from starchy, filler foods (54.9% for employees and 62.5% for nonemployees), and 10.5% of employees' and 10.3% of nonemployees' daily calories consisted of sugar cane and oil.

Although starchy food intake supports literature as the highest percentage of consumed foods, the intake reported by these participants was not as high as literature reported (FAO, 2011). Maize flour represented the highest daily calorie consumption at 27.2% of all respondents' calories, landing slightly higher than previously reported (FAO, 2013). Similar to vitamin A consumption, vitamin C-rich foods consumption may be over-reported as a result of seasonal fruits and vegetables that are not available year-round, such as pineapple, papaya, mango, and guava (Fox, 2008). These vitamin C-rich foods were in season during the time of data collection, which may relate to the employees' reporting this food group as the third-highest of daily caloric intake—after grains and beans and tubers—at 11.9% of daily calories. Respondents were not deficient in protein, which is likely a result of the high maize consumption. Dried maize was reported in kilograms by respondents, and one kilogram of dried maize contains 93 grams of protein. Cabbage, fresh fish, and chicken were also consumed by all respondents and contain high amounts of protein per serving.

Respondents were most deficient in cholesterol, which is likely linked to the absence of cholesterol in food items with the exception of fish, beef, chicken, and eggs. Animal products only comprised 5.9% of employees' daily calories and 3.9% of nonemployees' daily calories, therefore, cholesterol intake was limited. The consumption of animal products supports previous literature (FAO, 2013). Next, respondents were deficient in calcium, which can be linked to the lack of milk consumption. Milk is considered a luxury item in Mozambique and is typically imported due to the lack of dairy farmers and local availability (FAO, 2011; Langer & Taimo, 2014). Calorie and fat deficiencies also existed among respondents, which may be a result of a variety of factors, including general low food consumption, large household sizes, and seasonality. Cashews, coconut, and peanuts have the highest fat content per 100 grams; however, these are seasonal and expensive foods. Fiber deficiency also existed among respondents. This is potentially a result of general low food consumption and large household sizes, in addition to the lack of fiber in staple foods including rice, pasta, bread, cassava, bean, sweet potato, and cassava leaves. Limitations to food reporting are related to seasonality, which is described by Rose and Tschirley (2003) as "complex" and "should not be underestimated" (p. 8). In addition to seasonality and potential over-reporting, it is difficult to average consumption on a monthly basis throughout an entire year, and respondents likely base answers on the most recent consumption amounts (Rose & Tschirley, 2003). Finally, over-reporting was a strong limitation, yet is not surprising with this type of study (Harrison & Rutstrom, 2008). Although caloric and fat deficiencies did not exist in the majority of the study, it is impossible to not question over-reporting when comparing reported consumption levels to demographics, such as BMI. For example, one family (ER13) reportedly consumed 7,190.8 calories per day; however, demographics for this family included a 21-year-old male who weighed 99.35 pounds and had an underweight BMI of 17.74, as well as an 18-year-old breastfeeding woman who weighed 112.1 pounds and had a normal BMI of 21.35. Other families reported consuming 3,762.0 or 4,762.2 calories, yet were underweight. It is unrealistic to assume over-reporting did not occur in this data collection. The average BMI for all respondents (N = 250) was 19.59; however, the average BMI for respondents seven years old and above (n = 186) was 20.58. The average BMI for children six years old and younger (n = 68) was 16.65, which is well below the normal weight threshold of 18.50.

This study achieved the third objective to estimate potential differences in nutritional deficiencies and food consumption between employees of New Horizons and nonemployees by exploring associational differences without attributing causality to employment. The majority of calories came from grains, followed by beans and tubers, for both employees and nonemployees; however, calories consumed in the other food groups varied. Employees consumed significantly more daily calories from animal products, vitamin A- and vitamin C-rich foods, other fruits and vegetables, and other foods, than nonemployees. Nonemployees consumed a higher percentage of daily calories than employees in grains, beans and tubers, and nuts and seeds. Nonemployees consumed significantly more daily calories from cassava and sugar cane than employees. Employees consumed significantly higher amounts of rice, dried beans, and coconut. Employees also consumed significantly higher amounts of all meat products and eggs. Mango, sweet potato, tomato, orange, guava, onion, banana, and vegetable oil were all consumed significantly more by employees than nonemployees. There was very little variation between employees and nonemployees in how many food items were consumed, supporting previous literature that an increase in income does not necessarily equal a more diversified diet (Fox, 2008). Employees' chicken consumption was significantly higher than nonemployees (p = <0.001), which is not surprising because employees raise chickens and are given a kilogram of chicken weekly as a reward for showing up to work every day. The most expensive foods were consumed less frequently while affordable foods were consumed most often (FAO, 2011; Langer & Taimo, 2014).

There were three factors that were significant among individuals when measuring deficiencies: (a) years at New Horizons, (b) employment at New Horizons, and (c) household size. Considering clustered standard errors (clustered by family) in Model 1, a larger family is more likely to be calorie deficient. Although Model 1 is the preferred, robust model, significance occurred more often when measuring at the individual level in Model 2. However, marginal effects of Model 1 showed that for each year of employment at New Horizons, respondents were less likely to be deficient in calories, fat, fiber, and calcium. This supports New Horizons' aim to increase the quality of life of employees, including nutritional status and health (A. Cunningham, personal communication, May 28, 2015). A higher percentage of nonemployees were deficient in calories, fiber, calcium, cholesterol, and protein. Employees' were more likely to be calorie deficient, fat deficient, and calcium deficient for each additional member of the household; however, they were less likely to be fiber deficient for each additional household member. This could be a result of reliance on fiber-rich foods, such as maize flour and beans, which may increase per additional family member. Limitations to this include the assumption that household consumption is evenly divided between all household members, which is why grouping family members into clustered standard errors (clustered by family) was the most robust model to use for these measurements. This assumption is also one reason why children six years and under were omitted from the models. Another limitation was children up to the age of six were still breastfeeding, even if there was a younger sibling who also needed breast milk. This limitation was not realized until data collection was underway and was why children ages six years and under were omitted from the models. Significance of household size, employment, and years at New Horizons, along with other demographics collected, could have been more accurate had individual food consumption levels been measured rather than consumption as families.

This study achieved the fourth objective to gather knowledge of nutrition and perceptions of healthy foods among respondents. Participants could not consistently provide a definition of nutrition, with the majority of respondents unable to provide a definition at all. If respondents were able to provide an answer, it was counted as providing their own definition; however, responses varied. Fourteen of the 16 total definitions provided were related to nutrition and fell into the first and second categories, while two definitions were unrelated. Nearly all employees who provided a definition of nutrition had existing calorie deficiencies in their households, and five of those household heads were deficient, questioning if knowledge of nutrition is directly related to nutrient consumption. Additionally, this raises questions if knowledge of nutrition enables employees to change their nutrient intake. The lack of education could strongly impact their knowledge of nutrition, because most adults in the rural Nampula region did not attend school past the third grade (J. de Jong, personal communication, May 28, 2015). Employees were able to provide a definition more often than nonemployees, which could be a result of the monthly training sessions offered by New Horizons. However, these sessions do not cover health and nutrition each month, and participation among employees and outgrowers is low (J. de Jong, personal communication, May 28, 2015). Although participants often answered training sessions, this could be because the researchers were often accompanied by New Horizons leadership to interviews to assist in translating and communications, and to show support of the researchers to the employees. Although school was the most frequent answer of where respondents learned about healthy foods, this is not supported by the education rate. Respondents also learned about healthy foods at the hospital; however, the rural Nampula region faces a lack of health professionals, which pose extreme challenges to health service availability and quality (Honda & Vio, 2015). When discussing healthy foods, respondents chose leaves, maize flour, and bananas most often. Maize flour was described as filling, leaves were described as providing vitamins, and bananas were described as helping or giving blood and protecting from disease. The most frequent choice of maize flour, along with the mention of starchy foods 51 times, supports previous research that people facing hunger challenges look for fulfillment when choosing foods, which may often be a result of inadequate access to a variety of foods (Gross et al., 2000). Vitamin-C rich foods were mentioned 29 times, and often, respondents chose more than one vitamin C-rich food as the three healthiest foods. However, vitamin C-rich foods were not mentioned as frequently when respondents discussed food purchasing preferences without money limitations. Rice, beef, and pasta were preferred most; rice and pasta are fillers, while beef is considered a luxury good due to affordability and availability. Apples and milk are also luxury items that were preferred, mostly by employees. Only one nonemployee preferred milk and three nonemployees preferred apples. Out of the top five preferred foods for employees (rice, beef, pasta, milk, apples), three items were luxury goods. Of the top five preferred foods for nonemployees (rice, beans, beef, pasta, maize flour), four were considered fillers and were in the food group with the highest percentage of daily calories. No employees preferred beans, and only four preferred maize flour. Employees mentioned food items that were not included in the survey, and are often found in urban shops (soft drinks, tomato sauce). This trend suggests that the change in quality of life for employees influences their food preferences and potentially encourages implementing diet diversification after increased income.

Nonemployees contracted malaria fewer times per year than employees. This question is related to malnutrition because of the weakened immune system that accompanies malaria (WHO, 2005); however, it was incorporated into the study at the request of New Horizons leadership to understand how often disease impacts workers. Malaria is known to keep people from work for four days to two weeks, so this not only impacts the nutritional status and health of employees, but also the productivity of their work.

This study had limitations that impacted the data collection and analysis. Perhaps the most influential limitation was the international barrier, whether it be language, education rate, resources for data collection, availability of respondents and translators, limited literature on similar studies in the area (and those limitations), seasonal availability of foods, or limited time in-country. To fully perform this study and truly represent year-round consumption, it would require the researcher to be present for data collection during the harvest, post-harvest, and hungry seasons. This study was conducted during the harvest season, so respondents automatically consumed more than they consume in the hungry season (Fox, 2008; Rose et al., 1999).

Impact of Study

This study has the impact to influence how nutrition campaigns are approached in low-income countries like Mozambique. The insights provided by the respondents in the study show a gap of knowledge and inconsistency in acquiring knowledge. Remote, underdeveloped communities such as the rural Nampula region face a serious lack of education among adults; however, this study's findings provide recommendations for promoting knowledge of nutrition and healthy eating habits among these types of communities.

UNICEF's conceptual framework of malnutrition describes malnutrition in the context of three causes: immediate, underlying, and basic. In this framework, inadequate education is between basic and underlying causes, leading to inadequate access to food, care for women and children, and health services and unhealthy environment. It is proceeded by human, economic, and organizational resources, illustrating that these resources and controls lack effective messaging to target the underlying causes. The basic causes identified by UNICEF are potential resources, which fuel economic structure and political and ideological factors (Gross et al., 1999). When considering the Social-Ecological Model, which states that educational efforts must occur at the societal/political, organizational, and community levels, the conceptual framework of malnutrition should instead place educational efforts throughout the model, so they impact the country, community, families, and individuals. Rather than relying on educational efforts at the organizational level, as the conceptual model of malnutrition suggests, efforts should be layered throughout societal levels, because malnutrition cannot be addressed without support at the broadest level of society (the political structure) that imposes the most basic causes of malnutrition. Fusing the models appropriately combines the two frameworks to address malnutrition through educational efforts addressing all basic, underlying, and immediate causes to prevent the manifesto.

Additionally, these results can be used to guide future studies in rural, low-income countries on nutrition studies, especially studies that face challenges with illiteracy and language barriers. Particularly, this study should serve as a reference in areas where sustainable development and increased income are relatively new, because it could provide valuable awareness of a population adapting to employment, steady income, and a complete change of lifestyle. This study provides insight to more than what a sample of rural Nampula residents eat; it sheds light on their thought processes, preferences, and knowledge of nutrition. This study should guide future educational nutrition efforts in the Nampula region and serve as a reference for similar communities.

Finally, this study has the potential to impact the way New Horizons communicates with its employees about health, nutrition, and education, which can be extremely impactful on the rural Nampula community. The Social-Ecological Model argues that educational nutrition campaigns at the societal, organizational, and community levels will have the most impact in reaching and influencing individuals' dietary behaviors (Gregson et al., 2001).

Implications for Practice

The first implication for practice is the immediate need for an educational nutrition campaign in the rural Nampula schools. This information should be integrated into schools, based on respondents reporting they learned information at school. This not only allows children to learn about nutrition and healthy foods in school, but also may reach employees' and outgrowers' children, sparking interest and influence at home and at school. The key to integrating an educational campaign in schools is to provide an incentive for attendance, such as a school lunch program. Most schools in rural Nampula and other developing communities already provide lunch for students, which is a massive attendance incentive for both students and parents who would have to supply that meal otherwise. By integrating lessons on nutritional content and benefits of the provided lunch, children will learn about healthy foods and benefits of eating healthy, as well as gain a knowledge and understanding of nutrition and healthy foods they will carry into adulthood, when they make food choices for their families. Although these programs are currently administered by the United Nations World Food Programme, they should also be administered directly by the Mozambican government, including the Ministry of Education and Culture and Ministry of Health.

Information to include in the campaign includes promoting healthy foods, food pairing, and recommended foods based on age and gender nutritional needs. This nutrition educational campaign must consider the high illiteracy rate among adults and children in the rural Nampula area, and create visual materials that can be understood without requiring reading skills. It is recommended that New Horizons create and utilize these materials to begin educating employees and their families on healthy nutrition habits, and what different nutrients are required based on age and gender. In addition to visual materials, portion-sized utensils could be given to families after proper demonstration in measuring specific food items. There were many replacements made in the data set when reporting flour consumptions, leading to questions of over-consumption of these filler foods. Demonstrating serving sizes and giving employees the resources to change consumption behaviors may lead to healthier consumption patterns and dietary diversity. With the low average BMI among children under seven years old, it is important for education efforts to focus on nutritional needs for children, so they are not cognitively or physically damaged from a lack of education on what nutrients are most important. Because New Horizons prioritizes financial and personal responsibility in training sessions, these materials could be disseminated outside of training sessions, in small groups or personal interaction, which occur daily or weekly with employees. Outgrowers and employees are located in small villages all across rural Nampula, often over an hour drive from the New Horizons farm. By taking the educational efforts to the villages and into the schools, the impact of the campaign will reach more employees, and they will have opportunities to have personal interaction with the New Horizons leadership disseminating the materials. Additionally, this will likely reach more employees than the training sessions, due to the distance, transportation, and timing limitations placed on the monthly training sessions.

New Horizons leadership members have expressed the interest in creating an extension model to train employees and outgrowers on growing small, seasonal crops for family consumption in addition to raising poultry. Only one employed family did not grow any food items, while the average number of food items grown per employee was 13.4 items. Employees did grow more food items than nonemployees, which is a potential result of employment and training sessions recently implemented by New Horizons leadership. Employees grew leafy greens (which accompany staple foods); staple foods such as cassava, beans, and sweet potatoes; peanuts; peas, beans; mango; papaya; and lime/lemon the most. When asked what hindered them from growing more of their own food, employees responded not enough time or seed. Others said it was too much to keep up with, which was opposed by the New Horizons leadership team and explained as a lack of combining resources, such as watering crops while watering poultry (A. Cunningham & J. de Jong, personal communication, May 28, 2015). This creates the opportunity for New Horizons to educate and train employees on how to combine both farming practices by strategic use of resources, time, and outputs, to achieve increased nutrition year-round. Also, this creates an opportunity for employees to begin growing food items that are not traditional staple foods in Mozambique. Seasonal crops would allow more growth of vitamin C-rich and vitamin A-rich foods for family consumption. The extension training program should be combined with the educational health campaign, so employees understand the purpose of growing seasonal crops for a diversified and balanced diet year-round. Additionally, further research on food consumption among pregnant and nursing women could lead to trainings on what foods should be prioritized, and potentially grown by employees.

Recommendations for Future Research

This dietary survey was based on Rose and Tschirley's (2003) food recall instrument and is expected to predict "reasonable assessments of household dietary intake in Mozambique" (p. 8). Although this model was resourceful, it is recommended that future research accounts for seasonality and further accuracy by using the food recall survey at least three times per year. It was often difficult for respondents to provide measurements, potentially due to growing a crop or variance in amounts used per meal. To overcome this, it is recommended that intake is captured at the end of each day for a week during the different seasons. This can be achieved if measuring utensils are provided, and the recall can be continued as a daily survey or respondents can keep a week long food diary (although this would not be a likely solution due to the high illiteracy rate in Mozambique). By providing disposable cameras so respondents can take photos of each meal prepared in the serving size utensils, daily food recall can be administered without physically interviewing every respondent at the end of the day. Additionally, it is recommended that future studies take the food recall model further by accounting for what children eat, rather than assuming a two-year-old can eat the same amount as a 35-year-old. This will allow deficiencies to be accounted for more accurately at the individual level. The low BMIs among children six years old and younger show a need for future research to account for differences in food consumption by age.

Although seasonality should be considered in future studies, it is important to investigate integrating seasonal crops to provide nutrients that are typically out of season. New Horizons is currently evaluating implementing incentives for outgrowers to grow crops for family consumption while raising poultry. By integrating small, seasonal crop rotation for family consumption, employees may be able to provide nutritional diversity year-round, rather than relying on what is typically in season at the market. Before implementing such a program, surveys should be administered to gather feedback and willingness to participate.

The findings from this study present strong support for further exploration into perceptions of nutrition and healthy foods in the rural Nampula area. The majority of respondents were unable to define nutrition in their own words, and those who could provide an answer often did not grasp the basic concept of nutrition in their explanations. Future research could explore influences on and depth of nutritional knowledge by looking deeper into why foods are chosen for consumption, and what factors influence household providers' food purchasing decisions. A key recommendation is to understand how residents of rural Nampula apply what they know about nutrition to their household's daily diet – or if that is even an option, in the case food consumption is strictly limited by finances or availability. Future research should explore available resources at hospitals and schools about nutrition and healthy foods, and offer strategies for educational outreach. The primary researcher believes this mixed methods approach was beneficial, but should lead to future studies solely focused on communicating nutritional information, as the results from this study leave many questions about the depth of nutrition knowledge and influences on healthy food perceptions. Future research should study potential influencers, like religion, literacy, and education level, to understand the extent of nutrition knowledge and application to household daily diet.

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APPENDIX A

IRB APPROVAL

UNIVERSITY OF
ARKANSAS

Office of Research Compliance
Institutional Review Board

April 15, 2015

MEMORANDUM

TO:	Maggie Jo Pruitt Hansen Lawton Lanier Nalley Leslie Edgar
FROM:	Ro Windwalker IRB Coordinator
RE:	New Protocol Approval
IRB Protocol #:	15-04-645
Protocol Title:	*Micronutrient Deficiencies During the Harvest Season According to Household Consumption: A Case Study of Northern Mozambique*
Review Type:	☐ EXEMPT ☒ EXPEDITED ☐ FULL IRB
Approved Project Period:	Start Date: 04/13/2015 Expiration Date: 04/12/2016

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (https://vpred.uark.edu/units/rscp/index.php). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

This protocol has been approved for 400 participants. If you wish to make *any* modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 109 MLKG Building, 5-2208, or irb@uark.edu.

109 MLKG • 1 University of Arkansas • Fayetteville, AR 72701-1201 • (479) 575-2208 • Fax (479) 575-6527 • Email irb@uark.edu

APPENDIX B

INFORMED CONSENT

Participant Consent Form

In the present study we are interested in your food consumption to understand what foods your family consumes during the current harvest season to assess micronutrient potential deficiencies. This survey should require 10-15 minutes to complete. Your answers are important to us and we hope that you will take the time to accurately describe what foods you prepare for your household. **Risks and benefits:** your participation will assist in the advancement of knowledge of micronutrient deficiencies in your area. There are no anticipated risks to participating in this study. Your participation will not be compensated. **Voluntary participation:** your participation in the research is completely voluntary and you may terminate your participation at any time. **Confidentiality:** your responses on the survey will be recorded anonymously with the use of an assigned number. **Right to withdraw:** You are free to refuse to participate in the research and to stop the survey at any time. If you have questions or concerns about this study, you may contact llnalley@uark.edu. For questions or concerns about your rights as a research participant, please contact Ro Windwalker, the University's Compliance Coordinator, at 1+ (479) 575-2208 or by email at irb@uark.edu. Thank you for your participation!

I ___________________ have read this informed consent to ___________________

Translator signature *Participant ID*

and ____________________ was a witness to this reading.

Witness signature

If child consent is needed, complete following portion.

Child (under 18 years of age) Participation Consent Form

In the present study we are interested in your household food consumption. To gather demographic data, we would like to measure your child's height, weight, and upper arm circumference. The measurements should only last 1-2 minutes. Children will be weighed on a set of standard scales and a stadiometer will measure height. A tape measure will gather upper arm circumference. **Risks and benefits:** this information will assist in understanding general measurements, which could be a sign of malnutrition. There are no anticipated risks to participation. **Voluntary participation:** your child's participation is completely voluntary and he/she is able to quit participating at any time. **Confidentiality:** all information will be recorded anonymously with use of an assigned number. **Right to withdraw:** you are free to refuse your child's participation in the research or stop the measurements at any time. If you have questions or concerns about this study, you may contact llnalley@uark.edu. For questions or concerns about your rights as a research participant, please contact Ro Windwalker, the University's Compliance Coordinator, at 1+ (479) 575-2208 or by email at irb@uark.edu. Thank you for your participation!

I ___________________ have read this informed consent to ___________________

Translator signature *Participant ID*

and ____________________ was a witness to this reading.

Witness signature

IRB #15-04-645
Approved: 04/13/2015
Expires: 04/12/2016

APPENDIX C

SURVEY INSTRUMENT

Household Consumption: For each food item answered "yes", ask the following:

- How many meals per week does the household consume it?
- Do you purchase it at the market, grow it yourself, both, or other?
- Can you show me how much you prepare for each meal?

Food Group 1: Grains

- Maize flour
- Sorghum
- Sorghum flour
- Bread
- Rice
- Pasta

Food Group 2: Tubers and beans

- Fresh cassava
- Dried cassava
- Fresh beans
- Dried beans
- Fresh peas
- Dried peas

Food Group 3: Nuts and seeds

- Peanuts
- Coconut
- Cashews

Food Group 4: Animal products

- Beef
- Chicken
- Eggs
- Dried and fresh fish

Food Group 5: Vitamin A-rich foods

- Spinach leaves
- Cassava leaves
- Bean leaves
- Sweet potato leaves
- Fresh sweet potato

Food Group 6: Vitamin C-rich foods

- Pineapple
- Papaya
- Lime/lemon
- Mango
- Passion fruit
- Oranges
- Guava

Food Group 7: Other fruits and vegetables

- Tomato
- Onions
- Bananas
- Okra
- Cabbage
- Eggplant
- Apples

Food Group 8: Other foods

- Vegetable oil
- Sugar cane
- Salt

Knowledge and Perceptions of Nutrition

- In your opinion, what three foods are most important for good health?
- Why?
- If money was not a problem, what three foods would you like to buy more of for your family?
- Please give, in your own words, your definition of nutrition.
- How do you learn about healthy foods for your family?

Demographics and New Horizons Questions

- What hinders you from growing different crops or vegetables?
- Are you a New Horizons employee?
  - If yes, how many years have you been an employee?
- How many times per year do you get malaria?
  - How often does any member of the family get malaria?
- What is your religion?
- How many people live in this household, including you?

Note: Gender, age, height, and weight were also recorded for each participant

APPENDIX D

RECOMMENDED DIETARY REFERENCE INTAKES (DRI)

Dietary Reference Intakes (DRI) to Determine Nutrition Deficiencies Among Respondents

Age	Calories (kcal)	Fat (g)	Cholesterol	Sodium (mg)	Carbohydrates (g)	Fiber (g)
Males						
4-8 years	1742	30	300	1200	130	25
9-13 years	2279	30	300	1500	130	31
14-18 years	3152	30	300	1500	130	38
19-30 years	3067	30	300	1500	130	38
31-50 years	3067	30	300	1500	130	38
>51 years	3067	30	300	1300	130	30
Females						
4-8 years	1642	30	300	1200	130	25
9-13 years	2071	30	300	1500	130	31
14-18 years	2368	30	300	1500	130	38
19-30 years	2403	30	300	1500	130	38
31-50 years	2403	30	300	1500	130	38
>51 years	2403	30	300	1300	130	30

Note. Ages 0-4 were removed from the table as a result of removing respondents age 0-4 from the data set.

Dietary Reference Intakes (DRI) to Determine Nutrition Deficiencies Among Respondents (Cont.)

Age	Sugars (g)	Protein (g)	Vitamin A (IU)	Vitamin C (mg)	Calcium (mg)	Iron (mg)
Males						
4-8 years	12.5	19	400	25	1000	10
9-13 years	20.0	34	600	45	1300	8
14-18 years	37.5	52	900	75	1300	11
19-30 years	37.5	56	900	90	1000	8
31-50 years	37.5	56	900	90	1000	8
>51 years	37.5	56	900	90	1000	8
Females						
4-8 years	12.5	19	400	25	1000	10
9-13 years	20.0	34	600	45	1300	8
14-18 years	25.0	46	900	65	1000	3
19-30 years	25.0	46	900	75	1000	8
31-50 years	25.0	46	900	75	1000	8
>51 years	25.0	46	900	75	1200	8

APPENDIX E

FOOD ITEM NUTRITIONAL CONTENT

Nutritional Content of Food Items Included in Survey

Food Item	Calories (kcal)	Fat (g)	Cholesterol	Sodium (mg)	Carbohydrates (g)	Fiber (g)
Dried maize	3650	38	0	50	763	96
Sorghum	632	6.64	0	4	138.41	12.9
Sorghum flour	434	4.04	0	4	92.73	8
Bread (white)	430	2.38	0	3.12	113.88	3.744
Rice (white)	193	0.8	0	6.6	44.4	1
Pasta (spaghetti)	628	3.6	0	524	122.4	7.2
Fresh cassava	771	0	0	67.2	182.4	9.6
Dried cassava	452	0.4	0	6	105.8	2.6
Fresh beans	200	0.9	0	6.9	35.7	11.2
Dried beans	245	1.1	0	407	44.8	15.4
Dried peas	231	0.8	0	3.9	41.4	16.3
Fresh peas	840	2	0	30	156	55
Peanuts	854	72.5	0	8.8	31.4	11.7
Coconut	354	33.5	0	20	15.2	9
Cashew nuts	786	63.5	0	21.9	44.8	4.1
Fresh fish	2050	139	700	900	0	0
Dried fish	171	9	51	93.5	0	0
Beef	1450	40	3470	570	0	0
Chicken	1650	36	850	740	0	0
Eggs	71	5	311	70	0.4	0
Spinach leaves	0.23	0.0039	0	0.79	0.0363	0.022
Cassava leaves	0.38	0.0029	0	0.1	0.07	0.02
Bean leaves	0.74	0.011	0	0.09	0.14	0
Sweet potato leaves	0.35	0.003	0	0.09	0.064	0.02
Fresh sweet potato	90	0.2	0	36	20.7	3.3
Pineapple	1130	2.75	0	22.75	297.5	31.75
Guava	37	0.5	0	1.1	7.9	3
Orange	94	0.2	0	0	23.4	4.8
Passion fruit	97	0.7	0	28	23.4	10.4
Mango	135	0.6	0	4.1	35.2	3.7

Nutritional Content of Food Items Included in Survey (cont.)

Food Item	Calories (kcal)	Fat (g)	Cholesterol	Sodium (mg)	Carbohydrates (g)	Fiber (g)
Papaya	370	1.25	0	28.5	93.25	17
Lime	20	0.1	0	1.3	7.1	1.9
Tomato	11	0.1	0	3.1	2.4	0.7
Onion	6	0	0	0.6	1.3	0.2
Banana	48	0	0	0.55	12.65	1.65
Okra	220	2	0	60	49	25
Apple	95	0.3	0	1.8	25.1	4.4
Cabbage	477	0	0	343.44	114.48	57.24
Eggplant	106	0.646	0	771.97	26.163	8.075
Oil	8022	864	0	0	0	0
Sugar cane	375	0	0	0	100	0

Note. Iodine is found in eggs, bananas, spinach, sweet potatoes, and onions. All food items were based on mass listed in Table 1.

Nutritional Content of Food Items Included in Survey (cont.)

Food Item	Sugars (g)	Protein (g)	Vitamin A (IU)	Vitamin C (mg)	Calcium (mg)	Iron (mg)
Dried maize	6	93	30	0	1410	72
Sorghum	4.86	20.39	0	0	25	6.45
Sorghum flour	2.35	10.2	0	1	15	3.8
Bread (white)	0.468	18.72	0	0	106.08	2.652
Rice (white)	0	3.6	0	0	13.2	2.9
Pasta (spaghetti)	2.4	23.2	0	0	28	5.2
Fresh cassava	8.16	0	62.4	98.88	76.8	1.44
Dried cassava	4.5	3.6	0	6.5	193.5	7
Fresh beans	5.7	13.3	25.8	0.7	41.3	4.3
Dried beans	0.6	15.4	0	1.4	78.6	3.6
Dried peas	5.7	16.3	13.7	0.8	27.4	2.5
Fresh peas	59	54	8010	142	270	15
Peanuts	6.1	34.6	0	0	78.8	3.3
Coconut	6.2	3.3	0	3.3	14	2.4
Cashew nuts	6.9	21	0	0	61.6	8.2
Fresh fish	0	794	1670	4	120	16
Dried fish	0	21.9	45.9	1.8	24.6	1.3
Beef	0	251	0	503	120	394
Chicken	0	310	210	0	150	10
Eggs	0.4	6.3	244	0	26.5	0.9
Spinach leaves	0.004	0.0286	93.77	0.281	0.99	0.0171
Cassava leaves	0	0.04	100.5	2.15	2.15	0.0735
Bean leaves	0	0.058	80.9	0.45	2.24	0.04
Sweet potato leaves	0	0.04	10.28	0.11	0.37	0.01
Fresh sweet potato	6.5	2	19217	19.6	38	0.7
Pineapple	222.75	12.25	1312.5	1082.5	295	6.5
Guava	4.9	1.4	343	126	9.9	0.1
Orange	18.8	1.8	450	106.4	80	0.2
Passion fruit	11.2	2.2	1272	30	12	1.6
Mango	30.6	1.1	1584	57.3	20.7	0.3
Papaya	56	5.75	10392	587.5	228	1

Nutritional Content of Food Items Included in Survey (cont.)

Food Item	Sugars (g)	Protein (g)	Vitamin A (IU)	Vitamin C (mg)	Calcium (mg)	Iron (mg)
Lime	1.1	0.5	33.5	19.5	22.1	0.4
Tomato	1.6	0.5	516	7.9	6.2	0.2
Onion	0.6	0.2	0.3	1	3.2	0
Banana	6.6	0.55	35.2	4.785	2.75	0.165
Okra	24	19	2830	163	770	3
Apple	18.9	0.5	98.3	8.4	10.9	0.2
Cabbage	19.08	1869.84	686.88	772.74	0	0
Eggplant	10.336	2.584	119.51	4.199	19.38	0.969
Oil	0	0	0	0	0	0
Sugar cane	100	0	0	0	0	0

Note. Iodine is found in eggs, bananas, spinach, sweet potatoes, and onions. All food items were based on mass listed in Table 1.