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NUTRITIONAL ASSESSMENT OF PRESCHOOL CHILDREN IN AN URBAN ECUADORIAN COMMUNITY

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NUTRITIONAL ASSESSMENT OF PRESCHOOL CHILDREN IN AN URBAN ECUADORIAN COMMUNITY

THESIS

A thesis submitted in partial fulfillment of the requirements for the Master of Science in the College of Agriculture at the University of Kentucky

By

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Lexington, Kentucky

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Lexington, Kentucky

2015

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ABSTRACT OF THESIS

NUTRITIONAL ASSESSMENT OF PRESCHOOL CHILDREN IN AN URBAN ECUADORIAN COMMUNITY

Objectives: The goal of this project was to determine the nutritional needs of preschool age children to help guide intervention development. The research aims were 1) to examine and describe young child (ages one to five) nutritional status as it relates to key nutrients associated with stunting and wasting; 2) to determine what key macro- and micro-nutrient deficiencies (primarily iron and zinc) are associated with wasting and stunting.

Methodology:
Study sample: Sixty-seven families with children ages one to five who participating in routine health care clinic visits during the UK Shoulder to Shoulder Global health brigade visits.
Study design: A cross-sectional survey was conducted collecting demographic data, medical history, and dietary intake. Objective measures of height/length and weight were completed; and blood samples were drawn to measure serum micronutrient levels. Nutrition Data System for Research (NDSR) identified nutrient intakes for analytical comparison based on growth parameters. Nutritional and health status were compared to food security and World Health Organization growth reference points of standard deviations on Z-scores of height-for-age and weight-for-age.
Analyses: Chi Square, ANOVA, and binary logistic regression tests were run using Statistical Analysis System (SAS)
Results: Low serum levels of zinc and iron corresponded to low levels of dietary intake of zinc and iron, limited food security and moderate stunting z = -0 to 1.99 Standard Deviation.
Conclusion: This study will inform a comprehensive nutritional intervention for this population. The evidence that specific nutrients are limiting will focus the health promotion objectives.

Keywords: Undernutrition, nutrition intervention, stunting, micronutrient deficiencies

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July 8, 2015
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Chapter 1

International organizations addressing childhood poverty and under-nutrition now focus efforts on both rural and urban areas and those countries most in need, including Latin American countries. The United Nations Children’s Fund (UNICEF, 2012) released the State of the World’s Children 2012 reporting that poverty and child under-nutrition shifted over time from rural to urban areas. By 2050, Latin American countries are projected to be the third fastest growing urban population in the world (UNICEF State of the World’s Children, 2012, p.9). For example, the Santo Domingo, Ecuador community is experiencing growth due to a location between the coastal regions and highlands. The population of Santo Domingo consists of poor urban, peri-urban, and rural communities characterized by low and insecure income levels, impoverished housing and a general lack of services (i.e., piped water, reliable electricity, and sewage) (Lutter et al., 2008).

Between 2000 and 2009, 5% of the Ecuadorian population fell below the international poverty line of $1.25 US dollars per day with only 67% of the population urbanized in 2010 (UNICEF, 2012, p. 112). There are approximately 1.5 million children 5 years of age or younger in Ecuador (UNICEF, 2012, p. 112). Throughout Ecuador, urban poverty affects a total of 1.5 million people (World Bank, 1995) with causes varying from region to region. This means that there is approximately the same number of children in Ecuador as there are impoverished people.

In 2001 the Pan American Health Organization identified Santo Domingo, Ecuador as having a prevalence of stunting mirroring the national average of 24.6 (Lutter et al., 2008). In 2009, Ramakishnan, Nguyen, and Martorell (2009) estimated a prevalence of growth disturbances in young children stating that 20% are underweight,
32% are stunted, and 10% show wasting. Stunting is classified as children with a length-for-age Z-score <-2 SD compared to the median Z-scores for the World Health Organization’s (WHO, 2013) reference population and is an indicator of under-nutrition. Stunting becomes exacerbated by nutrient deficiencies and increases the risks of other biological and physiological ailments (UNICEF, 2012, p.19).

In 2000, the United Nations (UN) identified eight Millennium Development Goals (MDGs) to be completed by 2015. These goals were established in an effort to better the livelihood of all people across the world (UN, 2013). According to the MDGs Report 2013 (2013), progress has been made toward reducing world hunger. However from 2010 to 2012, one in every eight people worldwide still were unable to consume adequate dietary intake to meet their recommended dietary needs each day (UN, 2013, p.11). Children require more calories for growth and when they are unable to meet dietary requirements, the result is below average weight-for-age as determined by the WHO. In 2011, the MDGs Reports 2013 (2013) stated that one in every six children under five years of age were underweight and the progress toward the 2015 goal and target was insufficient. The data show that children living in impoverished households are more likely to have stunted growth than non-impoverished households.

The eight MDGs are: 1) Eradicate extreme poverty; 2) Achieve universal primary education; 3) Promote gender equality and empower women; 4) Reduce child mortality; 5) Improve maternal health; 6) Combat HIV/AIDS, malaria, and other diseases; 7) Ensure environmental sustainability; 8) Global partnership for development (UN, 2013). While all of the MDGs are of equal importance there are two goals in which the focus is on children. Those goals are:
**Goal 1:** Eradicate extreme poverty

*Target 1.C:* Halve, between 1990 and 2015, the proportion of people who suffer from hunger (UN, 2013, p.10)

**Goal 4:** Reduce child mortality

*Target 4.A:* Reduce by two thirds, between 1990 and 2015, the under-five mortality rate (UN, 2013, p.24).

Goal 4 is the most focused on children of the MDGs. However, a primary cause of child mortality is directly related to poverty and under-nutrition falling under the broad topic in Goal 1 (Keating, Chock, & Fischer, 2011). In a perspective article by Patwari (2013), it is claimed that perhaps Target 1.C is not the only location to emphasize the importance of child under-nutrition. In fact, child under-nutrition could fall under the aims of Goal 4, which focuses primarily on child health.

While there are current interventions in place directed toward stunting and other nutritional indices, the MDGs Report 2013 (2013) recognizes a need for expansion of the interventions focusing specifically on children under 2 years of age. Patwari (2013) poses the question of how necessary and effective child nutritional health interventions can be delivered to children who need them the most. The MDGs were constructed to be manageable and achievable goals for the world population, however resolving child under-nutrition is not a specific target of the goals. There is a need to focus attention directly onto this overwhelming issue plaguing children in countries throughout the world (Patwari, 2013). The need is related to the importance of nutrition in the first 1,000 days
of life because it is critical and may impact child growth and development (U.S. Government, 2014)

**Problem Statement**

Zinc and iron deficiencies are linked to stunted growth in children five years and under. Limited intake of zinc and iron bearing foods is identified in young children in an urban area of Santo Domingo, Ecuador by the University of Kentucky’s Shoulder to Shoulder Global organization. If nothing is done to intervene in the nutrition status of these children, zinc and iron deficiency related to food insecurity will persist, growth and development will slow even further, and chronic health issues may emerge.

**Purpose Statement**

The purpose of this study was to examine dietary patterns associated with the nutritional deficiencies of iron and zinc among preschool aged children, one to five years old, in order to provide key insights for the development of a nutrition intervention.

**Research Hypotheses**

1. There will be a deficiency in iron and zinc among preschool age children relative to WHO reference standards.

2. School aged children of urban Ecuador with diarrhea are more likely to be zinc deficient and anemic than those without diarrhea.
3. There will be no significant differences in the zinc and iron status of school aged children of urban Ecuador who are food insecure compared to those who are food secure.

Research Questions

1. Will preschool children in a community near Santo Domingo, Ecuador show inadequate levels of the protective micronutrients iron and zinc?
2. Does the occurrence of diarrhea relate to anemia and zinc deficiency in school-aged children in Santo Domingo, Ecuador?
3. Is food security a predictor for zinc and iron status in pre-school aged children in Santo Domingo, Ecuador?
4. Are growth and developmental delays related to zinc deficiency and anemia present in young children, ages one to five years, in Santo Domingo, Ecuador?

Limitations

- This study focused on a specific community within Ecuador, therefore the sample was limited to mothers visiting a clinic who were willing to have their child participate in the study.
- The study relied on self-reporting of food consumed by the child over a one-week period.
- There was no lab for blood analysis in the clinic in Santo Domingo, Ecuador so blood samples were transported to a Kentucky lab; therefore, cost of analysis limited sample size.
Assumptions

- All assessment criteria (i.e. weight, height, head-circumference) are accurate.

- The blood work will be properly analyzed and accurately recorded by patient number.

- This research project uses Food Frequency Questionnaires as a tool for collecting data therefore it is assumed that the survey was understood and answered truthfully by participants.

- Finding the most accurate tool for analyzing data is a limitation to this research project as there is not a global database at this time. Without a global database many practitioners use analysis software from a country and modify it to incorporate the nutritional value of food items from other countries; however, the compilations may not accurately reflect the nutritional values (Summer et al., 2013). Therefore when the survey responses are entered into the Nutrition Data System for Research (NDSR) for nutritional analysis it is assumed that the NDSR contains accurate and equivalent nutritional information about the foods reported by the participants.
Chapter 2
Review of Literature

Under-nutrition is characterized by an inadequate diet and frequent infections that lead to macro- and micro-nutrient deficiencies (WHO, 2002). Indirect factors leading to child under-nutrition are poverty and food security (WHO, 2002). These two factors are intangibly linked because poverty disables a household’s ability to secure enough goods and services for a good quality of life. This in turn causes a family to lose their food security, or the ability to obtain adequate amounts of food to meet daily nutritional needs (WHO, 2002).

Nutritional status is not only based upon the living conditions of the household and the individual, but is more directly based upon the dietary quality of the individual’s food intake. Regardless, if a child has enough food to eat, the nutrient content of the food plays a critical role in the nutritional status. When inadequate nutrient-dense foods are unavailable, micronutrient deficiencies become more prevalent. While there are many nutrients of concern, iron and zinc are two specific micronutrients that can affect a child’s growth and cognitive development (WHO, 2002).

Dietary Assessment

Dietary assessments are an integral tool in studying the dietary behaviors and habits of individuals and groups. The most commonly used dietary assessment tools are the Food Frequency Questionnaire (FFQ), 24-hour recall, and estimated-diet records. The FFQ is used to determine the amount of a particular food item a person has consumed over a specified period of time. For instance, FFQs may ask a subject to recall the
‘average eaten in the past (week, month, year)’. Two FFQs whose validity has been tested are the Oxford and Cambridge questionnaires. Nutrient intake based on reported consumption can then be calculated because the serving size is identified (Bingham et al., 1994).

Estimated-diet records are similar to FFQs, however they are more of a checklist for the subject to fill out. The subject receives a list of foods and is asked to check off the foods consumed each day. Each of the food items are coded for nutrient analysis based on a large or small portion as reported by the subject (Bingham et al., 1994).

There are two types of 24-hour recalls, unstructured and structured. An unstructured recall is when a subject is given a blank paper and asked to write down the foods consumed in the past 24-hours. A structured 24-hour recall is when a subject is given a survey with meals broken down and questions about specific types and amounts of food eaten over the past 24-hours (Bingham et al., 1994).

Dietary assessments are used to satisfy determination of: assessing a group’s dietary intake, frequency of inadequate intake, and comparing dietary intake to laboratory results (Winichagoon, 2008). Dietary assessment tools like 24-hour recalls and FFQs are valid tools in identifying food and nutrient intake within a population rather than for an individual (Herbert et al., 2014). According to Herbert et al. (2014), when using these tools in research the major limitation is self-reporting. This is due to frequent under-estimation of the amount of food and portion sizes consumed which relates to an individual’s need for social approval. Although these pose questions among the scientific community about validity an increased understanding of the errors have improved 24-hour recalls and FFQs as measurement tools (Herbert et al., 2014).
An increased interest in diet and health worldwide prompted the introduction of health surveys to monitor dietary intake and to analyze the resulting nutritional status of particular population groups. In 1999, the Centers for Disease Control and Prevention (CDC) began to continuously survey the United States population to identify food and nutrient intakes and measure for nutritional sufficiency in order to aide in public policies concerning food and nutrition (Hebert et al., 2014).

**Dietary Assessment of Micronutrient Intakes.** Diet is related to external factors like culture, financial security, and physical location. Some cultures have very specific dietary habits that may include a wide range of foods while some people may be reliant on seasonal food items due to where they live. Diets in these areas can become monotonous and pose difficulty when assessing serum levels of micronutrients. This is because of the amount of micronutrients being present in those food items or the bioavailability of micronutrients being concentrated within certain foods (Winichagoon, 2008).

Micronutrients, such as iron and zinc, can be found in high concentration in animal products (i.e. red meat, poultry, fish, eggs, and milk) and in some plant products. When an individual relies on seasonal items or consumes a monotonous diet, due to poverty or limited access, many high concentration food items may not be consumed regularly. This makes identifying specific micronutrient intake levels more challenging and reiterates the need to compare reported dietary intake to laboratory levels of micronutrients (Winichagoon, 2008).
Micronutrient Deficiencies

An estimated 2 billion people worldwide are affected by hidden hunger, a chronic deficiency in essential vitamins and minerals that are also known as micronutrients (Muthayya et al., 2013). Micronutrients are so called because the body only needs them in small amounts, however they are an integral part of the body’s systems. Without micronutrients the body would be unable to produce enzymes, hormones, and other essential substances needed for proper growth (WHO, 2013). These conditions can lead to micronutrient deficiencies: inadequate ingestion, absorption or utilization; increased excretion or elevated requirements. When an individual has diarrhea, the rate of excretion increases which inhibits the absorption of the ingested nutrients (Herbert, 1973). While the body needs micronutrients, the amount absorbed is dependent on bioavailability. Only a small amount of trace minerals, including iron and zinc, is absorbed for utilization because of dietary interference. This inability to fully utilize ingested micronutrients is a leading cause of deficiencies (Winichagoon, 2008). Globally, 293 million children (47.4%) under 5 years old suffer from iron deficiency anemia (McLean et al., 2009).

Effect of Nutrient Deficiencies. Deficiencies affect many people but children and pregnant women in low-income countries are at the highest health risk (WHO, 2013). Iron and zinc are two important micronutrients relating to growth and development. Sufficient access to food, and health care are recognized as necessities to ensure optimal growth and development, yet the interventions addressing these causes have not proved successful on a large scale (Lutter et al., 2008). For example, during an economic crisis in 2000 Ecuador launched the National Food Nutrition Program (PANN 2000) an intervention to combat malnutrition in children and improve both diet quality and feeding
behaviors. The program aimed to provide the participants with a specifically designed fortified complimentary food (FCF). The FCF dry product, known as Mi Papilla, contained 275 kcal/d with an energy density of 1.2 kcal/d when properly prepared. Along with vital macronutrients, 100% of the DRI for iron and zinc were included, as well as a mixture of other essential vitamins and minerals.

The intervention targeted infants and children from birth to 24 months living in extreme poverty during the most vulnerable period of their growth and development. This intervention chose not to include children between 2 and 5 years old with low weight-for-age because they felt these individuals were already stunted irreversibly. The results of the PANN 2000 intervention showed that the FCF was highly effective in reducing underweight and anemia in participants and improved overall diet quality. Although, data showed that while there was a significant positive effect on hemoglobin and anemia, the increased dietary zinc did not improve the participant’s zinc status.

Iron. Iron deficiency is the most common nutritional disorder found in much of the developing world and is the only micronutrient deficiency that is also prevalent throughout industrialized countries. Over 30% of the world population is reported to have anemia most cases being related to iron deficiency (WHO, 2013). As illustrated by Figure 2.1, African and South American countries have the highest prevalence of anemia globally.
There are three types of iron deficiency (Lynch, 2013):

Iron deficiency - a lack of significant amounts of iron stores within the body;

Iron deficient erythropoiesis - a small supply of iron without the presence of anemia;

Iron deficiency anemia - a concentration of hemoglobin falling below the normal limits for a specific age and sex.

Iron deficiency, regardless of cause, falls into two main categories: 1) increased needs and 2) decreased intake and/or absorption (CDC, 1998).

Increased iron requirements vary according to age, gender, medical conditions such as periods of rapid growth, during pregnancy, and during times of heavy blood loss.
(i.e. during menstruation, frequent blood donation, and some stomach/intestinal conditions) (CDC, 1998). Infants and children have increased iron needs due to increased growth. Ensuring adequate dietary intake can be difficult during this time. With a decreased dietary intake of iron, absorption becomes a major focal point. Some dietary sources such as calcium, polyphenols and phytate inhibit iron absorption. These substances are found in food and drinks such as coffee, tea, whole grains, legumes, milk, and dairy products. Ultimately, the amount of iron absorbed is related to foods and drinks consumed at the same time as iron rich foods (CDC, 1998).

Due to the nutrient interactions of iron, iron deficiency anemia often exists concurrently with other micronutrient deficiencies such as zinc, Vitamin A, and folate. One way to improve the micronutrient status of a population is supplementation, however studies have shown inhibitory effects between iron and zinc absorption during fasting conditions. The mechanisms are not completely understood but are hypothesized to be competitive binding to the specific transporter protein by iron and zinc. The inhibitory effect depends on the molar ratio of zinc to iron and the amounts of each of the minerals in the lumen of the small intestine from dietary intake (Olivares, Pizarro, & Ruz, 2007). Other studies on the inhibition of iron absorption by zinc focus on the timing of supplementation and have found that the impairment of iron bioavailability is short lived. This knowledge is important for improving supplementation strategies when working towards ameliorating micronutrient status within a population (Olivares, Pizarro, Gaitan & Ruz, 2007). Ascorbic acid and other organic acids present in many foods have been shown to improve iron absorption due to a weak chelating property facilitating the ion uptake into the mucosal cells improving iron status (Lonnerdal, 2000).
Zinc. Zinc is a trace mineral that a function in gene expression and essential cell processes, i.e. development and replication. While the specific indicators of zinc deficiency are still being debated in the medical world, it has been characterized by short stature, hypogonadism, impaired immune function, skin disorders, cognitive dysfunction, and anorexia (Caulfield and Black, 2011). Mild to moderate zinc deficiencies are quite common globally and can be seen in approximately one-third of the world’s population (WHO, 2002). A study by Prasad (1991) observed individuals from different countries who exhibited these signs sparking further interest in the role of zinc in the body. The hypothesis that zinc deficiencies may cause growth retardation in humans was verified by studies in Egypt by greater growth rates, growth of pubic hair, and normalized genitalia in participants receiving a zinc supplement than those who were solely on an animal based diet.

Both zinc and iron are stored in the liver, absorbed in the proximal duodenum in small amounts with zinc three times as much as iron, and have common absorptive inhibitors. Along with the biological uses of these micronutrients, there are also similarities in chemical properties and oxidative states (Iyengar, Pullakhandam, and Nair, 2009). All of these similarities may help in accounting for competitive absorption between the two micronutrients even though the mechanism is not yet understood.

Unlike iron deficiency, researchers have been unable to isolate a clear clinical indicator (i.e. biomarker or syndrome) specifically linked to zinc deficiency. Growth retardation is a general sign of zinc deficiency but can also be related to other causes (Weiringa, F.T. et al., 2015). In the study by Prasad (1991), zinc deficiencies were not observed as a single deficiency but in conjunction with other deficiencies. He observed a
21 year-old male who resembled a 10 year-old boy with severe growth retardation and anemia. Prasad and colleagues attributed the patient’s zinc deficiency and anemia to insufficient iron in the diet as a result of eating bread from only wheat flour and negligible amounts of animal protein. The anemia was treated by and responded to an oral iron supplement but did not play a role in the increased growth in the patient.

Iron and zinc supplementation have been used to help combat anemia and zinc deficiency however diet also plays a critical role in micro-minerals absorption. The quantity of zinc consumed at each meal can cause absorptive inhibition by over-saturating zinc transport mechanisms. A study by Istfan, Janghorbani, and Young (1983) on this theory have led the assumptions that a low zinc diet will ultimately increase zinc absorption. The researchers found that zinc absorption under fasting conditions was higher in the participants who were given a low dose of zinc compared to those given a high dose.

Many of the staple foods in developing countries are sources of zinc (i.e., corn, cereals, and vegetables), but may also be significant sources of phytates. High phytate foods (i.e., rice, corn, legumes, and cereals), which form a large percentage of the diet in Ecuador, inhibit zinc by forming an insoluble complex thus increasing excretion via stool. The physiochemical similarities between zinc and iron show that iron may complex with phytates also which ultimately frees up zinc for absorption (Miller, Krebs, and Hambridge, 2013). A significant increase in zinc absorption was observed when phytate was removed from food products; therefore, reductions in total dietary phytate content may result in increased absorption (Lonnerdal, 2000).
While phytate inhibits zinc absorption certain animal proteins (i.e. beef, eggs, and cheese) and methods of reducing phytate content in foods (i.e., leavening bread, fermentation, germination, and milling) have proven to lessen the problem (Lonnerdal, 2000). Unfortunately many poor urban families have limited access to these products or chose to eliminate them from their diet due to cost (Ruel et al., 2010) and as a result consume foods with higher phytate content (i.e., rice, legumes, and corn) for the same reason. Similar to iron, zinc absorption can be increased by increasing dietary organic acid consumption (Lonnerdal, 2000).

Factors Affecting Nutrition Status

Nutrition status is primarily assessed using quantitative measures showing macro- and micro-nutrient deficiencies, growth disturbances, and cognitive development. However, it is important to look at the external environmental factors that can negatively affect a child’s nutritional status such as poverty, socioeconomic factors, food security, and presence of diarrhea to name a few (WHO, 2002).

Socioeconomic Factors. Child under-nutrition remains a public health concern in developing countries. Defining nutrition can be a challenge because most people identify nutrition wholly with food intake, however this is not always the case (Schiff & Valdes, 1990). There are many potential external factors that can cause under-nutrition; however, major risk factors can be traced back to the socioeconomics within the family unit (Owoaje, E., Onufade, O., & Desmennu, A., 2014). In a study looking at family and socioeconomic risk factors for under-nutrition by Owoaje, Onufade, and Desmennu (2014), the significant risk factors included: household monthly food income, maternal
education of less than secondary level, sub-optimal breastfeeding practices, recent episodes of diarrhea, homes with more than four children, and living in a one-room residence. Of these risks identified in the study two were found to be associated when discussing child under-nutrition. The researchers found that with multi-children homes the quality of care given is sacrificed due to limited time available to devote to each child, which then corresponded to suboptimal breastfeeding for the younger siblings in the family (Owoaje, E., Onufade, O., & Desmennu, A., 2014).

The risk factors identified in the study by Owoaje, Onufade, and Desmennu are not the only factors that should be considered when looking at child under-nutrition. It is important to also consider the inputs in the household such as: refrigerators, stoves, and storage compartments for fresh food (Schiff & Valdes, 1990). These items can be related back to the overall income and food security of the household in the ability to obtain the necessary household inputs for preparing and storing food in a safe and sanitary manner.

**Poverty.** In the past 30 years the World Bank has observed a decline in the number of people living in extreme poverty. Goal 1 of the MDGs has been met, however the majority of the decline has occurred in high and middle-income countries (i.e., China and India), leaving extreme poverty in the rest of the developing world. Since 1981, only a one-third decrease in extreme poverty has been seen in low-income countries. It is important to note however, that an increase in populations among these countries results in an increase in the total number of people living in poverty. The highest rates of poverty in the developing world are found among children between the ages of 0-12 years and in low-income countries half of all children in this age group are living in poverty. (Olinto, Beegle, Sobrado, & Uematsu, 2013).
Poverty is determined by many factors and varies from nation to nation which makes measurement difficult. The World Bank measures well-being based upon the quality of life within a population by: how much money is earned, living environment, what and how much is eaten, tangible items owned, whether a person goes to school, and whether a person sees a doctor when they are sick. Consumption and income are important indicators in the determination of poverty and are used when a country collects census data to identify the levels of wealth among the population. Poverty is identified when the level of income and consumption become too low to support a good quality of life. The poverty line is set when an individual’s income and consumption is not adequate to cover necessary goods and services. An extreme poverty line is set at the point where minimum food consumption can sustain life (World Bank, 2013).

In the past, poverty has been more concentrated among rural areas. Poor individuals are more likely to generate income through agricultural means (Olinto, Beegle, Sobrado, & Uematsu, 2013). This ability to farm and produce food for themselves creates the difference between rural poor and urban poor to be self-sustainable and produce food which in turn contributes to the level of food security of the poor. The WHO defines food security as “existing when all people, at all times, have access to sufficient, safe, nutritious food to maintain a healthy and active life”. This idea is built upon 1) food availability and access: whether enough food is at hand for the entire household and 2) food use: the distribution and if the food satisfies the nutritional needs of the household members (WHO, 2013).
**Food Security.** The urban poor population is generally a population of people who spend more on food than the food they grow themselves. These people rely on income for food security, spend large proportions of their total budget on food, and have little access to agriculture or land to fall back on for increasing food access. Children are most vulnerable in these situations based on the household’s capacity and willingness to reallocate food to support their nutritional needs. Ruel et al. (2010) identified characteristics that increase the risk of losing food security in the urban poor as:

- Greater dependence on cash income since the urban population uses cash to pay for obtaining food and basic necessities (i.e., water, transportation, housing, health care);
- Limited access to agriculture or to land in the rural areas as many urban dwellers do not have access nor do they rely on hunting and/or food production for their nutritional needs; and
- Greater availability to urban utilities but limited access to such services with socioeconomic diversity the poor urban populations experience greater health risks, such as stunting and micro-nutrient deficiencies, regardless of the access to both preventive and curative health care.

Some coping strategies to minimize the effects of food security households use are: 1) switch to lower quality, cheaper staples; 2) buy less food or reduce overall food intake; 3) decrease intake of non-staple foods (i.e., meat, dairy, eggs); and/or 4) use different ingredients and cooking methods (Ruel et al., 2010). The overall consequence of these coping strategies is increased risk of under-nutrition and micronutrient deficiencies.
explaining why the poverty-stricken are more likely to experience deficient nutrition status due to limited or poor diet quality (Darnton-Hill et al., 2005).

While food security is an indicator of adequate nutrition, a phenomenon known as “hidden hunger” can still plague well fed individuals with micronutrient deficiencies (UNICEF, 2012). This term is an indicator that the signs of under-nutrition and hunger are not visible to the casual onlooker regardless of the outward appearance of an individual (Muthayya et al., 2013).

**Diarrhea.** According to the WHO (2013), the leading cause of malnutrition and the second leading cause of death in children under five years old is diarrhea. Diarrhea is especially a concern in developing countries where children under five years old are at an increased risk (Ferdous et al., 2013). It is “defined as the passage of three or more loose or liquid stools per day (WHO, 2013)” and can be caused by a variety of reasons related to poor hygiene or contaminated food and water sources.

The developing world remains at risk for many public health concerns and yet malnutrition, including micronutrient malnutrition, is still one of the major concerns among the public health community (Bhutta, Salam, & Das, 2013). Malnutrition is directly related to diarrhea due to aspects of the disease such as: anorexia, reduced nutrient absorption, water and electrolyte loss, mucosal damage, and exhaustion of the body’s nutrient supply (Unger et al., 2014) (Ferdous et al., 2013). Reduced absorption and exhaustion of the body’s nutrient supply due to diarrhea leads to disruption in adequate growth, specifically in height and weight, and therefore each episode compounds the already present malnutrition (Ferdous et al., 2013). Dehydration is the
result of extreme water and electrolyte excretion. As the body loses electrolytes normal biological functions are adversely affected.

In a study conducted on the severity of diarrhea and malnutrition of children under five-years old in Bangladesh by Ferous et al. (2013) found that malnutrition related to growth—stunting, under-weight, and wasting—was significantly associated with the severity of the diarrheal disease. The researchers discussed that within the study, those children presenting as malnourished were more likely to have an increased severity of diarrhea when compared to well-nourished children. The level of malnutrition, whether acute or chronic, did not change this observation (Ferous et al., 2013).

Diarrhea can be prevented when at risk behaviors and resources are identified and ameliorated. For instance, exclusive breastfeeding for the first six months of life can be a preventative measure of diarrhea while breast milk can also be a treatment due to it’s high nutrient content. Ultimately, diarrhea treatment involves adequate nutrition to children when they are well creating a well-nourished body ready to fight disease and infection (WHO, 2013).

**Summary**

While malnutrition is a constant concern for developing countries, under-nutrition is not always visible to the human eye. Poverty and food security can affect a child’s ability to grow at a normal rate by limiting the amount and type of foods available. When a child cannot get enough of the right types of food he/she can experience micronutrient deficiencies. The nutritional status of children is used as an indicator of overall health status. Currently, 38% of preschool aged children and pregnant women in Ecuador are
anemic (World Bank, 2011). In Ecuador, the socioeconomic status and geographical location of a child’s family influence nutritional status.

The nutrients critical to health can work against each other leading to malabsorption and eventually deficiency. For some countries, the types of food available contain substances that prevent these essential micronutrients to be absorbed by the body and to help children grow. While there are generalized methods for measuring weight status of individuals, few studies have addressed nutritional disparities in Ecuador (Katuli, Natto, Beeson, & Cordero-MacIntyre, 2013).
Chapter 3

Methodology

This research was a quantitative study. The study is quantitative in that the data acquired through both lab values and 24-hour food recalls were numerically interpreted and analyzed.

Research Design

This study utilized ex-post facto research and descriptive survey non-experimental research design. The multidisciplinary medical brigade of the University of Kentucky observed many cases of anemia and stunting in school-aged children during brigades to Centro Medico in Santo Domingo. The study used laboratory data to help determine a cause and effect relationship of types and quantities of food to the anemia and stunting observed. This descriptive survey provided information to help determine the quantity of anemia and stunting and to compare the results to a parental reported dietary recall with the child present for verification.
Population and Sample Selection

Santo Domingo, also known as Santo Domingo de los Colorados, located in the tropical region between the coast and the mountains is the third largest city in Ecuador (This is Ecuador, 2014). Santo Domingo has a population of about 368,013 according to the 2010 census living within the 3,805 km$^2$ area (www.citypopulation.de, 2013). The sample population consisted of 67 preschool aged children between the ages of 1 and 5 years of age and their families living in the urban area of Santo Domingo, Ecuador whose families utilize the University of Kentucky’s Shoulder to Shoulder Global clinic.

The population of the study was located in the three communities served by Centro Medico Hombro a Hombro. The communities are located in the poor suburbs surrounding Santo Domingo, Ecuador. The sample was chosen from mothers and their children who use the clinic during one of the health brigades to Santo Domingo between May and August 2011. Sample size was dependent on the number of children and their
families utilizing the medical clinic during the specified brigade visits and the number of mothers willing to participate in the study.

**Methodology**

This study employed food recalls-a FFQ and 24 hour recall to gather data on the types and amount of foods consumed over a one week as reported by the caregiver. Food frequency questionnaires are routinely used as a dietary assessment tool designed to represent an individual’s usual intake. The two food recall measures offer great validity in reporting the intake. These tools were used to help measure the macro- and micro-nutrient content of the recalled foods. It has been observed that when FFQs are given to parents rather than the child, there is a modest correlation to the validity of the responses (Kolodziejczyk, Merchant, & Norman, 2012). The reliability of self-reported food recall remains unclear; therefore this study employed a second method to determine if the participants’ food intake were aligned. The most reliable test for this is a blood test because blood reports only what has been consumed and absorbed into the system. These two types of measures were used to compare what was reported and what was biochemically present in the body.

**Procedures**

The clinic staff (i.e. nurse, Peace Corps member, and physician) were trained in all aspects of the study including recruitment, obtaining informed consent, and proctoring the FFQ. Teleconference meetings with UK and Santo Domingo personnel clarified the process. Prior to the arrival of the health brigade, the Peace Corps member working in the
community recruited families of preschool aged children, between one and five years of age, at Centro Medico for participation. Informed consent was obtained by the caretaker for each child and a data entry form completed for each participant. A trained nurse took and recorded anthropomorphic measurements of height and weight, head circumference, and medical history since the last visit to the clinic for every child. Both the mother and father’s height were taken. If either caregiver was absent on the day information was obtained, the family member who was present supplied an estimate. All measurements were taken using a height marker attached to the wall that showed standard heights.

The trained nurse drew a blood sample for each child. The sample was brought back to a Kentucky lab and was analyzed for hemoglobin, serum iron, C-reactive protein, serum zinc, and serum retinol levels. The blood was drawn during the clinic visit when the families were recruited as participants and were taken only after the parent had signed the consent form.

All communication in Santo Domingo was done in the local Spanish dialect. Each family completed a food recall, using the FFQ, of the usual foods eaten weekly and a 24-hour multi-pass recall of what the child had eaten the previous day. The FFQ included detailed information on the quantity and type of consumption of beverage, fruit, vegetable (leafy green and starchy), grain, meat, seafood, dairy, and sweets. A Spanish speaker of the healthcare team conducted the food recall by verbally reading the FFQ to the caregiver. The child was present during the food recall and if they were old enough verified some of the foods eaten both at and away from home. Following the food recall, the questionnaire included demographic information on type of equipment used for preparing meals at home, refrigerator access, mothers’ education, family’s ability to buy
food, family employment, Chiz Paz supplementation (A micro nutrient vitamin and
tablet mineral supplementation given in some communities by the Ecuadorian health ministry),
and if the child had been treated for anemia in the past year. The staff member recorded
the responses as reported by the caregiver. See the appendix I for attached questionnaires.

**Data Analysis**

The data from the food recalls for each participant were entered into the Nutrition
Data System for Research (NDSR) to identify nutrient intakes for comparison to growth
parameters. After the nutrient analysis in the NDSR, macro- and micro- nutrient levels
were retrieved to compare blood lab values to the micro- nutrients of concern. Data
analysis included a comparison of nutritional and health status compared to food security
and Z-scores of height-for-age. This investigation used the Statistical Analysis System
(SAS) for a statistical comparison using Fisher’s exact test, ANOVA, and Odds
Likelihood Ratio tests of:

1. Dietary intake of zinc to serum levels
2. Dietary intake of iron to hematocrit (HCT) levels
3. Dietary intake of iron to serum zinc levels
4. Dietary zinc to presence of diarrhea
5. Dietary iron to presence of diarrhea
6. Serum levels of zinc to presence of diarrhea
7. HCT levels to presence of diarrhea
8. Dietary zinc to presence of food insecurity
9. Dietary iron to presence of food insecurity
10. Serum levels of zinc to presence of food insecurity

11. HCT levels to presence of food insecurity

12. Serum levels of zinc to weight-for-age (WAZ) and height-for-age (HAZ) z-scores

13. HCT levels to WAZ and HAZ

The use of Z-scores to assess and monitor a population can show high deficits indicating health and nutritional problems within the sample as well as the population as a whole. When assessing growth disturbances there is an implied comparison of the participants to a reference of the same age and gender. The WHO developed the reference point using growth curve data from the National Center for Health and Statistics (NCHS) on healthy and well-fed pre-school children with diverse ethnicities. While some differences were noted during the establishment, overall, this is a useful reference across the globe. When working with children, the Z-scores used are height-for-age, weight-for-age, and weight-for-height. Z-scores are a mathematical calculation of the participant’s anthropometrics as a number of standard deviation from the relative reference, or median value, allowing statistical analysis for the classification of a population’s growth status. (WHO, 2014).
Chapter 4

Results

Demographics

**Family Size.** The size of a family relates to the available resources for each individual. The number of children in each family (n=67) ranged from one child to ten children ranging in age from 17 days old to 26 years of age.

![Bar chart showing the number of children per family](image)

Figure 4.1. Number of Children Per Family.

Families had two or three children. Approximately 27% (26.87%) had two children and 27% (26.87%) had three children, followed by 18% (17.91%) having one child. About 12% (11.94%) of the families have four children, 8% (7.46%) have five children, 6% (5.97%) have seven children, and 3% (2.99%) have ten children.
**Maternal Education Level.** The level of education of mothers of the participants (n=67) showed the 73% of mothers had between 4-6 years of education with 47 mothers reporting 6 years of education.

![Mothers’ Level of Education](image)

Figure 4.2. Mothers’ Level of Education.

18% of mothers had between 0-3 years of education, 6% between 7-9 years, and 3% had between 10-12 years.

**Breastfeeding Duration.** Of the participants (n=67), 24 mothers reported breastfeeding for between 1 to 6 months (36%) and 22 mothers (33%) reported breastfeeding between 7 months to a year.

![Breastfeeding Duration](image)

Figure 4.3. Breastfeeding Duration.

There were 7 mothers (11%) who reported breastfeeding between 13 and 19 months and 5 mothers (8%) reported breastfeeding between 20 to 24 months. Breastfeeding for less
than 1 month, this ranged from not breastfeeding to breastfeeding for 15 days, was reported by 8 mothers (12%).

**Family Income.**

Figure 4.4. Monthly Family Income.

Of the participants (n=67), 7 did not report their average monthly income. Of the reporting families, 30 (50%) reported a monthly income between $100 and $299, 10 (17%) reported a monthly income between $300 and $399, 9 (15%) reported a monthly income between $400 and $499, 6 (10%) reported a monthly income of greater than or equal to $500. There were 5 families (8%) who reported less than a $100 monthly income. The monthly income is related to the number of earners in the family. The number of earners in the family ranged between 0 and 5 earners.
Households (n=67) with ≤1 earner (74%) had single income households being reported by approximately 73% of the participants. Dual-income households were reported by 18% while 4% of participants reported ≥3 earners in the family.

**Factors Influencing Food Security.** The factors influencing food security are work frequency and amenities in the home such as: type of stove and access to a refrigerator.

*Work Frequency.* Among participants (n=67) who reported single or dual income households, 47 participants (72%) reported having seasonal work and 24 participants (36%) reported having work all year.
Around 29% of the participants reported not having seasonal work and 64% reported not having work year-round.

*Type of Stove Used in the Home.* There are a variety of options for stoves within the community: gas, electric, coal, and kerosene.

![Type of Stove Used in the Home](image)

Figure 4.7. Type of Stove Used in the Home.

Sixty-five participants (98.48%) use a gas stove compared to the 4 participants (6.06%) who used an electric stove, 3 participants (4.55%) using a coal stove, and 0 participants using a kerosene stove (n=67).
Refrigerator Access. Amenities in the home for food storage and preservation were refrigerators and kitchen shelving. These amenities were not found in every home. Of the participants (n=67), 39 own a refrigerator (59.09%) and 27 do not own a refrigerator (50.91%).

![Refrigerator Access Chart](image)

Figure 4.8. Refrigerator Access.

Of the participants without a refrigerator, 25 (37.88%) have access and 3 participants (4.55%) do not have access to a refrigerator.

**Hypothesis Testing**

Each hypothesis was tested using the Fisher Exact Test in regards to serum zinc levels, HCT, dietary iron and zinc, diarrhea and food security. To determine the correlation between growth delays, serum zinc and HCT an ANOVA test was conducted.

**Hypothesis 1.** The assessment of dietary intake of micronutrients will show deficiencies in both zinc and iron in school aged children in an Ecuadorian community.
**Dietary intake of zinc to serum zinc levels.** Dietary zinc intake was defined as higher than 3mg/day, which is the Recommended Daily Allowances (RDA). 80.6% of the participants had serum zinc levels below the normal levels (NL) of 66-194. When dietary zinc intake was within the RDA 7.46% of the participants had low serum zinc and when dietary zinc intake was below the RDA 5.97% of the participants had low serum zinc. 4.48% of participants with high dietary zinc intake had NL of serum zinc and 1.49% of participants with dietary intake within the RDA had high levels of serum zinc.

Table 4.1. Dietary Intake of Zinc to Serum Zinc Levels.

<table>
<thead>
<tr>
<th>Dietary Zinc</th>
<th>Serum Zinc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Low</td>
<td>5.97%</td>
</tr>
<tr>
<td>Normal</td>
<td>7.46%</td>
</tr>
<tr>
<td>High</td>
<td>80.60%</td>
</tr>
</tbody>
</table>

**Fisher’s Exact test (df): 4**
**p-value: 0.20**

No significant differences in percentages of reported intake of dietary zinc levels when compared to serum levels of zinc were identified (p=0.20).

**Dietary intake of iron to HCT levels.** About 10% (10.45%) of participants with dietary iron intake below the RDA of 7-10mg/d were found to have low HCT levels and 10.45% were found to have HCT within the NL. About 12% (11.94%) of participants with dietary iron intake within the RDA were found to have HCT within NL and 1.49% were found to have HCT above the NL. Around 23% (22.39%) of participants with dietary iron intake above the RDA were found to have HCT below NL, 41.79% were
found to have HCT within NL, and 1.49% were found to have HCT above the NL.

Table 4.2. Dietary Intake of Iron to HCT Levels.

<table>
<thead>
<tr>
<th>Dietary Iron</th>
<th>HCT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Low</td>
<td>10.45%</td>
</tr>
<tr>
<td>Normal</td>
<td>0%</td>
</tr>
<tr>
<td>High</td>
<td>22.39%</td>
</tr>
</tbody>
</table>

Fisher’s Exact test (df): 4
p-value: 0.05

Significant differences were found in the percentages of reported intake of dietary iron when compared to HCT (p=0.05).
**Dietary intake of iron to serum zinc levels.** When compared to the RDA, about 20% (19.40%) of participants with low dietary iron intake were found to have serum zinc levels below NL and 1.49% were found to have serum zinc within NL. Around 14% (13.43%) of participants with dietary iron intake within the RDA were found to have serum zinc below NL. Around 61% (61.19%) of participants with dietary iron intake above the RDA were found to have serum zinc below NL, 2.99% were found to have NL of serum zinc, and 1.49% were found to have serum zinc levels above NL.

Table 4.3. Dietary Intake of Iron to Serum Zinc Levels.

<table>
<thead>
<tr>
<th>Dietary Iron</th>
<th>Serum Zinc</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>19.40%</td>
<td>1.49%</td>
<td>0%</td>
</tr>
<tr>
<td>Low</td>
<td>Normal</td>
<td>13.43%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Normal</td>
<td>High</td>
<td>61.19%</td>
<td>2.99%</td>
<td>1.49%</td>
</tr>
</tbody>
</table>

**Fisher’s Exact test (df): 4**  
P-value: 1.00

The percentage of high intake of dietary iron was not significant in relation to levels of serum zinc (p=1.00).
**Hypothesis 2.** School aged children of urban Ecuador with diarrhea are more likely to be zinc deficient and anemic than those children without diarrhea.

Episodes of diarrhea cause fluid and electrolyte loss, reduce nutrient absorption, and deplete the body’s nutrient stores. During the physical exam taken of each participant (n=67), the parent was asked about the presence of diarrhea within the last month.

![Occurrence of Diarrhea](image.png)

**Figure 4.9.** Occurrence of Diarrhea.

Of the 67 participants, 35 (52%) reported diarrhea within the month prior to the examination compared to the 31 participants (48%) who did not report any diarrhea within the last month.
**Dietary zinc to presence of diarrhea.** About 9% (8.57%) of participants with dietary zinc intake below the RDA were found to have diarrhea, 2.86% of participants with dietary zinc intake within the RDA were found to have diarrhea, and 88.57% of participants with dietary zinc intake above the RDA were found to have diarrhea. Around 3% (3.13%) of participants with dietary zinc intake below the RDA did not have diarrhea, 15.63% of participants with dietary zinc intake within the RDA did not have diarrhea, and 81.25% of participants with dietary zinc intake above the RDA did not have diarrhea.

Table 4.4. Dietary Zinc to Presence of Diarrhea.

<table>
<thead>
<tr>
<th>Dietary Zinc</th>
<th>Diarrhea</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>8.57%</td>
<td>3.13%</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>2.86%</td>
<td>15.63%</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>88.57%</td>
<td>81.25%</td>
<td></td>
</tr>
</tbody>
</table>

Fisher’s Exact test (df): 2
p-value: 0.15

No significant findings in percentages of participants reporting diarrhea in the past month to dietary zinc deficiency (p=0.15) was observed.
**Dietary iron to presence of diarrhea.** About 23% (22.86%) of participants with dietary iron intake below the RDA were found to have diarrhea, 20% of participants with dietary iron intake within the RDA were found to have diarrhea, and 57.14% of participants with dietary iron intake above the RDA were found to have diarrhea. Around 19% (18.75%) of participants with dietary iron intake below the RDA did not have diarrhea, 6.25% of participants with dietary iron intake within the RDA did not have diarrhea, and 75% of participants with dietary iron intake above the RDA did not have diarrhea.

Table 4.5. Dietary Iron to Presence of Diarrhea.

<table>
<thead>
<tr>
<th>Dietary Iron</th>
<th>Diarrhea</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Low</td>
<td>22.86%</td>
<td>18.75%</td>
</tr>
<tr>
<td>Normal</td>
<td>20.00%</td>
<td>6.25%</td>
</tr>
<tr>
<td>High</td>
<td>57.14%</td>
<td>75.00%</td>
</tr>
</tbody>
</table>

Fisher’s Exact test (df): 2
p-value: 0.21

No significant findings in percentages of participants reporting diarrhea in the past month to dietary iron intake (p=0.15) was observed.
Serum levels of zinc to presence of diarrhea. About 97% (97.13%) of participants with serum zinc below NL were found to have diarrhea and 2.86% of participants with serum zinc within NL were found to have diarrhea. No participants with serum zinc above NL were found to have diarrhea. Around 91% (90.63%) of participants with serum zinc below NL did not have diarrhea, 6.25% of participants with serum zinc within NL did not have diarrhea, and 3.13% of participants with serum zinc above NL did not have diarrhea.

Table 4.6. Serum Levels of Zinc to Presence of Diarrhea.

<table>
<thead>
<tr>
<th>Serum Zinc</th>
<th>Diarrhea</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Low</td>
<td>97.13%</td>
<td>90.63%</td>
</tr>
<tr>
<td>Normal</td>
<td>2.86%</td>
<td>6.25%</td>
</tr>
<tr>
<td>High</td>
<td>0%</td>
<td>3.13%</td>
</tr>
</tbody>
</table>

Fisher’s Exact test (df): 2
p-value: 0.41

No significant findings in percentages of participants reporting diarrhea in the past month to participants presenting with zinc deficiency (p=0.41) was observed.
**HCT levels to presence of diarrhea.** About 32% (31.43%) of participants with HCT below NL were found to have diarrhea, 65.71% of participants with HCT within NL were found to have diarrhea, and 2.86% of participants with HCT above NL were found to have diarrhea. Around 35% (34.38%) of participants with HCT below NL did not have diarrhea, 62.5% of participants with HCT within NL did not have diarrhea, and 3.13% of participants with HCT above NL did not have diarrhea.

Table 4.7. HCT Levels to Presence of Diarrhea.

<table>
<thead>
<tr>
<th>HCT</th>
<th>Diarrhea</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Low</td>
<td>31.43%</td>
<td>34.38%</td>
</tr>
<tr>
<td>Normal</td>
<td>65.71%</td>
<td>62.50%</td>
</tr>
<tr>
<td>High</td>
<td>2.86%</td>
<td>3.13%</td>
</tr>
<tr>
<td>Fisher’s Exact test (df): 2</td>
<td>p-value: 0.90</td>
<td></td>
</tr>
</tbody>
</table>

No significant findings in percentages of participants reporting diarrhea in the past month to participants presenting with anemia (p=0.90) were observed.

**Hypothesis 3.** There will be observable differences in the zinc and iron status of school aged children of urban Ecuador who are food secure when compared to those who are food insecure.

Food security was reported by almost half of the participants. About, 54% of the participants were found to be food insecure based on criteria from the USDA Food Security Survey (2012).
Of the 67 participants, 54% reported difficulty obtaining food almost every month or every month. In comparison 46% of participants reported no trouble getting food. Of the 46% participants reporting, they did not have trouble or had trouble for 1 to 2 months.

**Dietary zinc to presence of food insecurity.** About 3% (2.78%) of participants with dietary zinc intake below the RDA, 11.11% of participants with dietary zinc intake within the RDA, and 86.11% of participants with dietary zinc intake above the RDA were also food insecure. Around 10% (9.68%) of participants with dietary zinc intake below the RDA, 6.45% of participants with dietary zinc intake within the RDA, and 83.87% of dietary zinc intake above the RDA were also food secure.

Table 4.8. Dietary Zinc to Presence of Food Insecurity.

<table>
<thead>
<tr>
<th>Dietary Zinc</th>
<th>Food Insecurity</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>2.78%</td>
<td>9.68%</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>11.11%</td>
<td>6.45%</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>86.11%</td>
<td>83.87%</td>
<td></td>
</tr>
</tbody>
</table>

Fisher’s Exact test (df): 2
p-value: 0.46
No significant differences found in percentages of dietary intake of zinc to presence of food insecurity (p=0.46).

Statistical testing using binary logistics testing a global null hypothesis (β=0) showed a significant likelihood ratio (p=0.025). With further analysis of the binary logistic regression the dietary zinc intake is associated with food insecurity using the statistically significant Wald Chi-Square statistic of maximum likelihood estimates for high dietary zinc intake (p=0.037).

**Dietary iron to presence of food insecurity.** About 11% (11.11%) of participants with dietary iron intake below the RDA, 11.11% of participants with dietary iron intake within the RDA, and 77.78% of participants with dietary iron intake above the RDA were also food insecure. Around 32% (32.26%) of participants with dietary iron intake below the RDA, 16.13% of participants with dietary iron intake within the RDA, and 51.61% of dietary iron intake above the RDA were also food secure.

Table 4.9. Dietary Iron to Presence of Food Insecurity.

<table>
<thead>
<tr>
<th>Dietary Iron</th>
<th>Food Insecurity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Low</td>
<td>11.11%</td>
</tr>
<tr>
<td>Normal</td>
<td>11.11%</td>
</tr>
<tr>
<td>High</td>
<td>77.78%</td>
</tr>
</tbody>
</table>

Fisher’s Exact test (df): 2  
*p-value*: 0.06

No significant differences found in percentages of dietary iron intake to presence of food insecurity (p=0.06).
Statistical testing using binary logistics testing a global null hypothesis ($\beta=0$) showed a significant likelihood ratio ($p=0.025$). With further analysis of the binary logistic model the dietary iron intake is associated with food insecurity using the statistically significant Wald Chi-Square statistic ($p=0.038$) and the maximum likelihood estimate for low dietary iron intake ($p=0.0138$).

**Serum levels of zinc to presence of food insecurity.** About 94% (94.4%) of participants with serum zinc below NL and 5.56% of participants with serum zinc within NL were also food insecure. No participants with serum zinc above NL were also food insecure. Around 94% (93.55%) of participants with serum zinc below NL, 3.23% of participants with serum zinc within NL, and 3.23% of serum zinc above NL were also food secure.

Table 4.10. Serum Levels of Zinc to Presence of Food Insecurity.

<table>
<thead>
<tr>
<th>Serum Zinc</th>
<th>Food Insecurity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Low</td>
<td>94.44%</td>
</tr>
<tr>
<td>Normal</td>
<td>5.56%</td>
</tr>
<tr>
<td>High</td>
<td>0%</td>
</tr>
</tbody>
</table>

Fisher’s Exact test (df): 2  
*p-value: 0.78*

No significant differences found in percentages of serum zinc levels to presence of food insecurity ($p=0.78$).
*HCT levels to presence of food insecurity.* About 42% (41.67%) of participants with HCT below NL, 55.56% of participants with HCT within NL, and 2.78% of participants with HCT above NL who were also food insecure. Around 94% (93.55%) of participants with HCT below NL, 74.16% of participants with HCT within NL, and 3.23% of HCT above NL were also food secure.

Table 4.11. HCT Levels to Presence of Food Insecurity.

<table>
<thead>
<tr>
<th>HCT</th>
<th>Food Insecurity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Low</td>
<td>41.67%</td>
<td>22.58%</td>
</tr>
<tr>
<td>Normal</td>
<td>55.56%</td>
<td>74.16%</td>
</tr>
<tr>
<td>High</td>
<td>2.78%</td>
<td>3.23%</td>
</tr>
</tbody>
</table>

Fisher’s Exact test (df): 2  
p-value: 0.21

No significant differences in percentages of HCT levels to presence of food insecurity (p=0.21).
Hypothesis 4. Zinc deficiency and anemia will be related to growth and development delays in school-aged children in an urban community in Ecuador.

Z-scores are equal to the observed value subtracted by the median value of the reference population and then divided by the standard deviation of the reference population. Each participant’s calculated Z-score corresponds to the correct age and gender reference as designated by the World Health Organization (WHO).

The calculated weight-for-age Z-scores (WAZ) showed that 9 participants (13%) exhibit moderate to severe wasting defined by the WHO (2013) as z-scores less than -2 standard deviations (SD) from a set mean, 45 participants (67%) were at risk for wasting with z-scores between 0 and -1.99 SD from the mean. The remaining 13 participants (19%) had z-scores greater than or equal to 0 from the mean placing them in the normal range of weight for their age groups.

Figure 4.11. Weight-For-Age Z-Scores.

The highest category within the WAZ shows that this sample is at risk for wasting.
The calculated Height-for-age Z-scores (HAZ) is a measure to determine the growth disturbance known as stunting.

![Height-for-Age Z-Scores](image)

Figure 4.12. Height-For-Age Z-Scores.

The calculated HAZ showed that 30 participants (45%) exhibit moderate to severe stunting defined by the WHO (2013) as z-scores less than -2 SD from the mean, 30 participants (45%) were at risk for stunting with z-scores between 0 and -1.99 SD from the mean, and 7 participants (10%) had z-scores greater than or equal to 0 SD from the mean placing them in the normal range of height for their age group. The highest categories within HAZ show that this sample exhibits and is at risk for stunting.
Serum levels of zinc to WAZ and HAZ. The normal serum zinc levels are in a range of 66-194mg/dL. The average serum zinc levels of the participants fall below normal limits while the WAZ and HAZ show that on average the participants 1-2 years, 3-4 years, and 4-5 years of age are at risk for stunting and wasting. Participants from 2-3 years are on average stunted.

Table 4.12. Serum Levels of Zinc to WAZ and HAZ.

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Avg Serum Zinc (mg/dL)</th>
<th>WAZ</th>
<th>HAZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 years</td>
<td>36.5</td>
<td>-1.02</td>
<td>-1.84</td>
</tr>
<tr>
<td>2-3 years</td>
<td>41.5</td>
<td>-1.16</td>
<td>-2.04</td>
</tr>
<tr>
<td>3-4 years</td>
<td>39.6</td>
<td>-1.28</td>
<td>-1.88</td>
</tr>
<tr>
<td>4-5 years</td>
<td>48.1</td>
<td>-0.76</td>
<td>-1.14</td>
</tr>
</tbody>
</table>

No significant differences between the serum levels of zinc and WAZ (p=0.81) and HAZ (p=0.52) were observed.
**HCT to WAZ and HAZ.** The normal hematocrit (HCT) levels are in a range of 33% to 40%. The average HCT for participants between 1-2 years and 2-3 years of age are below the normal range showing anemia within the age ranges. The average HCT for participants between 3-4 years and 4-5 years of age fall within the normal HCT range. The WAZ and HAZ show that on average the participants 1-2 years, 3-4 years, and 4-5 years of age are at risk for stunting and wasting. Participants from 2-3 years are on average stunted.

Table 4.13. HCT to WAZ and HAZ.

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Avg HCT (%)</th>
<th>WAZ</th>
<th>HAZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 years</td>
<td>32.7</td>
<td>-1.02</td>
<td>-1.84</td>
</tr>
<tr>
<td>2-3 years</td>
<td>32.8</td>
<td>-1.16</td>
<td>-2.04</td>
</tr>
<tr>
<td>3-4 years</td>
<td>35.5</td>
<td>-1.28</td>
<td>-1.88</td>
</tr>
<tr>
<td>4-5 years</td>
<td>35.6</td>
<td>-0.76</td>
<td>-1.14</td>
</tr>
</tbody>
</table>

No significant differences between the HCT and WAZ (p=0.58) and HAZ (p=0.61) were observed.
**Average Dietary Intake.** The dietary intake reported shows the average caloric intake for participants between 1-2 years is 1406kcal per day, 2-3 years 1980kcal per day, 3-4 years 1721kcal per day, and 4-5 years 1764kcal per day. This average diet consists of 66% carbohydrates, 16% protein, and 18% fat. The RDA for iron intake is 7-10mg per day and the average dietary iron intake for participants was higher than the RDA. The RDA for zinc is ≥3mg per day and the average dietary zinc intake for participants met the RDA.

Table 4.14. Average Dietary Intake by Age Range.

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Avg Total Fat (g)</th>
<th>Avg Total Carbs (g)</th>
<th>Avg Total Protein (g)</th>
<th>Avg Total Calories (kcal)</th>
<th>Avg Dietary Zinc (mg)</th>
<th>Avg Dietary Iron (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 years</td>
<td>32.2</td>
<td>223.8</td>
<td>56.7</td>
<td>1406</td>
<td>8.2</td>
<td>8.6</td>
</tr>
<tr>
<td>2-3 years</td>
<td>39.3</td>
<td>332.9</td>
<td>77.6</td>
<td>1980</td>
<td>9.9</td>
<td>13.1</td>
</tr>
<tr>
<td>3-4 years</td>
<td>34.6</td>
<td>285.4</td>
<td>76.0</td>
<td>1721</td>
<td>9.7</td>
<td>12.8</td>
</tr>
<tr>
<td>4-5 years</td>
<td>36.4</td>
<td>288.5</td>
<td>71.8</td>
<td>1764</td>
<td>9.8</td>
<td>13.9</td>
</tr>
</tbody>
</table>

Dietary recommendations for children between 1-5 years of age vary. The American Heart Association (2014) says that energy intake should be adequate to support growth and development. For active children between 1-3 years of age, 1200-1300kcal per day should be consumed, yet the participants in this age range on average reported consuming more. For active children between 4-5 years, 1500-1700kcal per day should be consumed, and on average this age range is slightly above recommendations. The macronutrient recommendation ranges based on data from the Institute of Medicine DRIs for macronutrients (2005) vary depending on age group. Daily, the macronutrient
breakdown for children by age range is: 1-3 years should have 30-40% fat and 4-5 years should have 25-35% fat; 1-5 years should have 45-65% carbohydrates; and 1-3 years should have 5-20% protein and 4-5 years should have 10-30% protein. The following chart shows the research sample’s macronutrient breakdown by age range.

Table 4.15. Average Total Macronutrient and Calorie Reported Intake.

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Avg Total Fat (% kcal)</th>
<th>Avg Total Carbs (% kcal)</th>
<th>Avg Total Protein (% kcal)</th>
<th>Avg Total Calories (kcal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 years</td>
<td>21**</td>
<td>64</td>
<td>15</td>
<td>1406*</td>
</tr>
<tr>
<td>2-3 years</td>
<td>17**</td>
<td>67**</td>
<td>16</td>
<td>1980*</td>
</tr>
<tr>
<td>3-4 years</td>
<td>17**</td>
<td>66**</td>
<td>17</td>
<td>1721*</td>
</tr>
<tr>
<td>4-5 years</td>
<td>19**</td>
<td>65</td>
<td>16</td>
<td>1764*</td>
</tr>
</tbody>
</table>

* value is higher than DRI
**value falls below DRI

Summary

Multiple statistical analyses were run with no statistical significance; however, an association between food security and dietary intake of iron, and the dietary intake of zinc was identified, and a statistical significance observed in the percentages of participants when comparing dietary intake of iron to HCT levels. High percentages of participants were identified as stunted or at risk for stunting and also as at risk for wasting. On average, the reported dietary intake showed high caloric value with imbalanced macronutrient ranges.
Chapter 5
Discussion

When using the DRIs set by an affluent country like the United States compared to Ecuador it is important to remember that nutrition needs vary by environment and culture. Overall, children in the study reported an unbalanced diet. The reported diet does not meet recommendations of the American Heart Association (2014) guidelines for fats or carbohydrates and exceeds recommendations for age specific caloric intake. During an observational visit to Santo Domingo, it was observed that the children predominately walk throughout the community and appear highly active. Many children assist their parents around the home and therefore spend little time being sedentary so energy storage is minimal. In a study by Prentice and Paul (2000), the energy expenditure of children in developing nations was compared to children in an affluent country. Higher energy was expended in the developing nations related to a traditionally more active lifestyle. Children maximized energy use without further nutritional deficiencies; therefore, this indicates that energy needs in developing countries may be increased as a result of the increased physical activity (Prentice and Paul, 2000). The dietary analysis in Table 5.1 suggests the need for a nutrition intervention among this population of school-aged children in Santo Domingo, Ecuador related to an insufficient distribution of macronutrient intake.

Hypothesis 1 predicted that the dietary assessment of micronutrient intake would show deficiencies in both zinc and iron in school aged children in an Ecuadorian community. This compares to data from Freire, Siva-Jaramillo et. al. (2014) who examined the double burden of undernutrition and overweight in Ecuador. After
reviewing the dietary analysis of parent-reported intake all participants are consuming adequate amounts of both iron and zinc; yet, the participant’s lab results contradict the reported intake. On average, participants in all age ranges were zinc deficient and participants between 1-3 years of age were identified as anemic. Potential explanations for this inaccuracy between intake and serum levels include: 1) Over-estimation of intake during the parent-reported survey: Rangan et al. (2014) identified that over-reporting was more prevalent in children with low a BMI. Those identified as over-reporters, claimed to eat higher quantities of meat, milk, and pastries than what was actually consumed. In the present study, over-estimation was observed and evidenced by the high rate of stunted participants. 2) Biological interference during nutrient absorption: The Ecuadorian diet consists of lentils/beans and rice. These food items are high phytate foods increasing the potential for inhibited absorption of dietary zinc and iron as the minerals create a phytate-complex. This complex prevents bioavailability for adequate absorption. As absorption decreases, micronutrient deficiencies increase. 3) Inaccurate nutrient profiles in the dietary analysis software. The Nutrition Data Systems for Research (NDSR) is a validated dietary analysis program that includes 18,000 food items with preparation including over 300 Hispanic foods and the capabilities for a multi-pass methods or recall (University of Minnesota, 2014). Using the NDSR, the study had the reliability for analyzing the reported intake. However, the Hispanic foods within the software are not country specific creating a possible discrepancy in nutrient breakdown.

Iyengar et al. (2009) describes the similar properties of iron and zinc explaining how both have the affinity for the same transporters. Although not statistically significant, when participants in the present consumed high levels of dietary iron the
hematocrit (HCT) levels generally fell within the normal limits. While HCT levels are more normal with high intake of dietary iron, an increased serum zinc deficiency was observed. This observation supports the literature indicating a competitive inhibition between zinc and iron for absorption. Our findings of micronutrient deficiencies in Ecuadorian children when compared to their dietary intake of iron and zinc support the stated hypothesis.

Hypothesis 2 predicted that school aged children of urban Ecuador with diarrhea were more likely to be zinc deficient and anemic than those children without diarrhea. Just over half of participants reported diarrhea within the month prior to the brigade’s visit to Santo Domingo. There was not an association observed between the presence of diarrhea with low levels of both dietary zinc and iron on zinc deficiency and anemia. Each episode of diarrhea in an individual causes mucosal damage and nutrient exhaustion; therefore, chronic diarrhea leads to reduced absorption and malnutrition (Ferdous et al 2013). However, the duration of diarrhea was not assessed in this study.

The WHO defines diarrhea as three or more loose stools per day (WHO 2013). In the physical exam the caretaker was asked if their child had diarrhea present within the past month. The child may have had one day of diarrhea, which would not cause these micronutrient deficiencies. More specific information about the duration and frequency of the cases of diarrhea would provide better information for identifying an association between micronutrient deficiencies and cases of diarrhea.

Hypothesis 3 posed there would be observable differences in the zinc and iron status of school aged children of urban Ecuador who are food secure when compared to those who are food insecure. The majority of the participants reported having difficulty
buying food every month or almost every month. Based on the binary logistic model for food security, there is a statistically significant association between food insecurity and low dietary iron and high dietary zinc intake. There is not an association between the serum lab values for HCT and zinc and food insecurity.

Based on the reported intake, the types of food consumed by the families who are considered food insecure were zinc-rich foods like legumes. The reported intake of food insecure participants revealed less iron-rich food consumption like meat and leafy greens. The typical Ecuadorian diet consists of a stew like food called menestra, meat, rice, and a starchy vegetable like plantains. Menestra is commonly made with lentils or kidney beans. Both are legumes. This may account for the high consumption of dietary zinc. Many food insecure participants consumed less meat and leafy greens; therefore, this could be the reason for a lower dietary iron intake.

As previously discussed, iron and zinc have similar physicochemical properties (Iyengar, Pullakhandam, & Nair 2009) which may account for the similarities in foods with inhibitory effects on the absorption of both iron and zinc. Foods containing these nutrients were included in the dietary intake of the Ecuadorian families studied. Some of these food sources were beans, seafood (i.e. fish and shrimp), red meat, poultry, yogurt, and cheese.

Low cost food items (i.e. lentils, beans, and rice) contain phytate which complexes with both iron and zinc causing the nutrients to be excreted rather than absorbed (Lonnerdal 2000). Low cost food items, such as lentils and beans, are easily obtained and storable non-perishable food items for families with difficulty buying food and limited accessibility to refrigeration. While no significance was observed on the serum levels of
zinc and HCT to food insecurity, the participants exhibited zinc deficiency and anemia. This indicates a need for interventions targeting improving zinc and iron intake.

Hypothesis 4 stated that zinc deficiency and anemia would be related to growth and development delays in school-aged children in an urban community in Ecuador. All age ranges of participants were found to be zinc deficient and at risk for both stunting and wasting. However, those participants from 2-3 years of age were found to be stunted based on the height-for-age Z-scores (HAZ). Zinc deficiency has been identified as a cause of growth retardation (Prasad, 1991). Thus, low serum zinc levels help to explain the observation of high percentages of participants at risk for stunting and stunted. The 4-5 year age group was the closest to normal serum zinc levels, but still deficient, and the average risk of stunting was lowest in this age range (z=-1.14). Anemia was identified in children from 1-3 years of age and appears to correct in children from 3-5 years of age as the risk of stunting and wasting displayed a slight decrease in cases. This illustrates that as participant got older, micronutrient absorption increased and a positive effect on growth was observed. This indicates the importance of early nutrition to ensuring proper growth in young children.

Evidence shows that breastfed infants grow more slowly in the second half of infancy. This is faltering growth may be related to weaning from breast milk as the child may not be able to consume the adequate amount of nutrients through solid foods as they received through maternal breast milk (Noble & Emmett, 2006). Nutrition education should begin with the parents, particularly focused on adequate nutrition during weaning. As the children grow and become more able to comprehend information, they should then be included in nutrition education for continued and sustained adequate intake.
As children age and have more self-feeding abilities some of these deficiencies decrease while still placing the child at risk for stunting. Within this sample population, pre-school aged children between 2 to 3 years are the most vulnerable to stunting ($z=-2.04$). It is, therefore, important for health care providers to target the parents of children between 1 and 3 years for early prevention of growth and developmental delays with education on proper nutrition. It is equally important to educate both the children and the parents of children between 3 and 5 years for continued prevention as children’s nutritional needs change through the life cycle.

Poor households spend approximately 60% of their income on food thus limiting the variety of food available to children (Larrea and Kawachi, 2005). Food security is a major concern with over half of the sample population identified as food insecure, based on the USDA food security guidelines. This number poses a risk for preschool aged children who need adequate nutrition for proper growth and development.

Awareness is the first step to making any change. Identification of high levels of zinc deficiency, anemia, stunting, and wasting by health care teams, such as the brigade, can initiate activism to uncover the root cause of the problem. Stunting is considered the most reliable measure of under-nutrition because it indicates prolonged periods of inadequate food intake (UNICEF, 2012). Poor nutrition in preschool children can lead to lifelong maladies and therefore needs to be a priority within this community of Santo Domingo, Ecuador. The World Health Organization’s (WHO) standards confirm that children born anywhere in the world have the same potential to develop within the same weight range and height, but growth disturbances up to age 5 are more influenced by nutrition than by genetics (UNICEF, 2012). A nutrition intervention can be the next step
to ameliorating the micronutrient deficiencies and decrease growth and developmental delays.

Summary

The goal of this project was to conduct formative research for development of a nutrition intervention for the Santo Domingo community. Pre-school aged children in Santo Domingo are stunted and exhibit micronutrient deficiencies as evidenced by anthropometric and biochemical laboratory data. The traditional Ecuadorian diet may be a cause for micronutrient deficiencies leading to stunted growth in preschool aged children. The variety in food intake is lacking and may have unintentionally created an unhealthy food environment for pre-school aged children in Santo Domingo, Ecuador. The most impacted age range is when the children are between the ages of 1 and 3 years old. Within this age group, diet is highly dependent on the parent/caregiver. In food insecure homes, the food variety is much less available than is in families of food secure homes. Deficiencies and food insecurity exist concurrently creating an environment that is not conducive to adequate growth and development in preschool aged children.

Recommendations

The sample population participating in this study has open access to the Hombro a Hombro Centro Medico clinic in their community. The clinic currently offers some health and wellness activities, but could also offer more programs directed toward nutrition and nutrition education. Using the results from this study, the Brigade could employ dietetic students to offer a nutrition intervention program during Brigade visits
and to teach clinic staff to continue with the program. This would allow healthcare professionals to then follow up with new lab and anthropometric data as an evaluative measure of program success.

A possible intervention for this population would include a series of classes offered on site at the Centro Medico. The series would begin working with pregnant women in insuring proper nutrition during pregnancy and on the importance of exclusively breastfeeding for the first 6 months of life for new mothers. The next class in the series would focus on weaning and adequate supplemental nutrition during this critical period of growth. The final series of the classes would focus on pre-school aged child nutrition, the importance of variety and how to prepare food with a limited budget and availability. The series might even include a series on community gardening to grow fruits and vegetables that may otherwise be out of the family budget.
Appendix A

Growth and Nutritional Assessment of Preschool Children in an Urban Community in Ecuador

Food Consumption Questionnaire

Instructions:
Answer the following questions as best as you can about your weekly consumption of various foods. If you are unsure of an answer give the best answer you can rather than leaving the question blank. How often means daily or weekly.

The following section asks questions about beverage consumption. Please read the question and wait for a response. Please do not coerce the client about answers to the question. Only record what the client recalls.

- In the past week, what did your child drink and how much?
- How often does your child drink milk? When you do how much does he or she drink?
- How often does your child drink caffeinated drinks, if so which drinks? How much?

The following section asks questions about fruit consumption. Please read the question and wait for a response. Please do not coerce the client about answers to the question. Only record what the client recalls.

- In the past week, what fruits has your child eaten? How much?

The following section asks questions about vegetable consumption. Please read the question and wait for a response. Please do not force an answer by offering suggestions to the client about answers to the question. Only record what the client recalls.

- In the past week, did your child eat any green leafy vegetables like spinach or lettuce? If so, what did the child eat? How much?
- In the past week, did your child eat any starchy vegetables like yuca, potatoes, corn, plantains? If so, which ones did your child eat? How much?

The following section asks questions about grain consumption. Please read the question and wait for a response. Please do not force an answer by offering suggestions to the client about answers to the question. Only record what the client recalls.

- In the past week, how often did your child eat whole grains like, beans, lentils? If so, what did your child eat? How much?
- In the past week, how often did your child eat any bread or bread products including pastries, Pan de yuca and other foods made from corn or yuca or flour etc.? If so, what did your child eat? How much?
- In the past week, how often did your child eat rice and rice products? If so, what did your child eat? How much?
Growth and Nutritional Assessment of Preschool Children in an Urban Community in Ecuador

The following section asks questions about protein consumption. Please read the question and wait for a response. Please do not force an answer by offering suggestions to the client about answers to the question. Only record what the client recalls.

- In the past week, how often did your child eat red meat? If so, what did you eat? How much?
- In the past week, how often did your child eat pork, guinea pig or other meat like those? If so, what did your child eat? How much?
- In the past week, how often did your child eat seafood? If so, what did your child eat? How much?
- In the past week, how often did your child eat birds such as chicken, guinea fowl, turkey, or duck? If so, what did your child eat? How much?

The following section asks questions about dairy consumption. Please read the question and wait for a response. Please do not force an answer by offering suggestions to the client about answers to the question. Only record what the client recalls.

- In the past week, how often did your child eat any dairy products such as milk? If so, what did your child eat? How much?

The following section asks questions about eating sweets. Please read the question and wait for a response. Please do not force an answer by offering suggestions to the client about answers to the question. Only record what the client recalls.

- In the past week, how often did your child eat any sweets? If so, what did you eat? How much?
- In the past week, how often did your child eat cakes, pastries etc.? If so, what did your child eat? How much?

The following section asks about demographic information. Please read the question and wait for a response. Please do not force an answer by offering suggestions to the client about answers to the question. Only record what the client recalls.

- What equipment do you use for preparing meals at home such as a stove with electric, gas or kerosene fuel, wood or coal burning coal pot as a means of cooking?
- Do you have a refrigerator? If not, where or how do you store food that should be kept cold?
- How many years did the mother in the family spend in school?
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- Is there a time during the year when the family skipped meals or cut the size of meals because there was not enough money to buy food? __________________________
  How often did this happen? Was it every month, some months or only one or two months? __________
- How many persons in the family are employed? __________________________
  If employed, is the job only at some times during the year (seasonal) or all year long? __________________________

1) Where do you typically go to receive healthcare?

2) What do you do when you or your child is sick?

3) What problems do you experience in getting healthcare?

Thank you for your help answering these questions.
Appendix B

Evaluación del estado nutricional y del crecimiento a pre-escolares en una comunidad urbana en Ecuador

Cuestionario del consumo de comida semanal

Instrucciones:

Conteste las siguientes preguntas como mejor pueda acerca de su consumo semanal de varios alimentos. Si no está seguro de la respuesta, conteste lo mejor que pueda en vez de dejar la respuesta en blanco. Que tan frecuentemente significa diario, semanal, mensual, anual.

La siguiente sección pregunta acerca del consumo de bebidas. Por favor lea la pregunta y espere por la respuesta. Por favor no presione al participante a contestar sugiriendo respuestas a la pregunta. Solamente escriba lo que el participante recuerda.

- En la semana anterior, que bebidas tomo su niño/a y que tanto?

- Que tan frecuentemente toma su niño/a leche? Cuando el/ella toma leche, que tanto toma?

- Que tan frecuentemente toma su niño/a bebidas cafeinadas?, Si lo hace, que toma? Que tanto?

La siguiente sección pregunta acerca del consumo de frutas. Por favor lea la pregunta y espere por la respuesta. Por favor no presione al participante a contestar sugiriendo respuestas a la pregunta. Solamente escriba lo que el participante recuerda.

- En la semana anterior, que frutas ha comido su niño/a? que tanto?

La siguiente sección pregunta acerca del consumo de verduras. Por favor lea la pregunta y espere por la respuesta. Por favor no presione al participante a contestar sugiriendo respuestas a la pregunta. Solamente escriba lo que el participante recuerda.

- En la semana anterior, su niño/a comió alguna verdura de hojas verdes como espinaca o lechuga? Si lo hizo, que comió? Que tanto?
Evaluación del estado nutricional y del crecimiento a pre-escolares en una comunidad urbana en Ecuador

- En la semana anterior, su niño/a comió algún vegetal almidonado como yuca, papa, maíz, plátanos? Si lo hizo, que comió? Que tanto?

La siguiente sección pregunta acerca del consumo de granos. Por favor lea la pregunta y espere por la respuesta. Por favor no presione al participante a contestar sugiriendo respuestas a la pregunta. Solamente escriba lo que el participante recuerda.

- En la semana anterior, que tan frecuentemente su niño/a comió algún grano entero como frijoles, lentejas? Si lo hizo, que comió? Que tanto?

- En la semana anterior, que tan frecuentemente su niño/a comió pan o algún producto parecido al pan como pastelitos, pan de yuca, pandebono o otros alimentos hechos de maíz, yuca o harina? Si lo hizo, que comió? Que tanto?

- En la semana anterior, que tan frecuentemente su niño/a comió arroz o productos derivados del arroz? Si lo hizo, que comió? Que tanto?

La siguiente sección pregunta acerca del consumo de proteína. Por favor lea la pregunta y espere por la respuesta. Por favor no presione al participante a contestar sugiriendo respuestas a la pregunta. Solamente escriba lo que el participante recuerda.

- En la semana anterior, que tan frecuentemente su niño/a comió carne roja? Si lo hizo, que comió? Que tanto?

- En la semana anterior, que tan frecuentemente su niño/a comió cerdo, cuí o otra carne parecida? Si lo hizo, que comió? Que tanto?

- En la semana anterior, que tan frecuentemente su niño/a comió comida de mar? Si lo hizo, que comió? Que tanto?
Evaluación del estado nutricional y del crecimiento a pre-escolares en una comunidad urbana en Ecuador

• En la semana anterior, que tan frecuentemente su niño/a comió aves como pollo, gallina, pavo o pato? Si lo hizo, que comió? Que tanto?

La siguiente sección pregunta acerca del consumo de productos lácteos. Por favor lea la pregunta y espere por la respuesta. Por favor no presione al participante a contestar sugiriendo respuestas a la pregunta. Solamente escriba lo que el participante recuerda.

• En la semana anterior, que tan frecuentemente su niño/a comió productos lácteos? Si lo hizo, que comió? Que tanto?

La siguiente sección pregunta acerca del consumo de dulces. Por favor lea la pregunta y espere por la respuesta. Por favor no presione al participante a contestar sugiriendo respuestas a la pregunta. Solamente escriba lo que el participante recuerda.

• En la semana anterior, que tan frecuentemente su niño/a comió dulces? Si lo hizo, que comió? Que tanto?

• En la semana anterior, que tan frecuentemente su niño/a comió pasteles, tortas, etc? Si lo hizo, que comió? Que tanto?

La siguiente sección pregunta acerca información demográfica. Por favor lea la pregunta y espere por la respuesta. Por favor no presione al participante a contestar sugiriendo respuestas a la pregunta. Solamente escriba lo que el participante recuerda.

• Que clase de implementos utiliza para preparar las comidas en casa, por ejemplo estufa eléctrica, de gas, de kerosene, de leña o de carbón?

• Usted tiene nevera? Si no tiene, donde y como guarda la comida para que se mantenga fría?

• Cuando años fue a la escuela (madre)?
Evaluación del estado nutricional y del crecimiento a pre-escolares en una comunidad urbana en Ecuador

- Ha habido algún tiempo durante el año en que su familia ha tenido que saltarse comidas o reducir el tamaño de las comidas por que no ha habido suficiente dinero para comprar alimentos? ________________________
  Que tan frecuentemente esto ha pasado? Cada mes, algunos meses o solo uno o dos meses?
  ____________________________

- Cuantas personas tienen trabajo en la familia? ____________________________
  Si tienen trabajo, el trabajo es solo durante algunas veces al año (por temporadas) o todo el año?
  ____________________________

1) ¿Dónde va típicamente para recibir cuidado de la salud?

2) ¿Qué hace usted cuándo usted o su niño está enfermo?

3) ¿Qué problemas tiene para ir al médico?

Gracias por su ayuda a responder estas preguntas.
References


VITA

Elizabeth Anne Bronner

• Place of Birth
  o Mount Pleasant, South Carolina

• Education

• Professional Positions
  o Graduate Teaching Assistant. University of Kentucky, Lexington, KY. 2012-2014.
  o Americorp Member. Montana Campus Corps, Missoula, MT. 2008-2009.
  o Tour Actor Director. Missoula Children’s Theatre, Missoula, MT. 2006-2010.

• Scholastic Honors
  o Outstanding Dietetic Student of the Year Nominee. Kentucky Academy of Nutrition and Dietetics. Lexington, KY. 2015.

• Professional Honors
  o Caribbean and Americas Conference on Fostering Intergenerational Solidarity through Home Economics, Guyana, South America, Poster Presenter, 03/2015
  o International Federation of Home Economics Symposium, London, Ontario, Canada, Presenter, 07/2014
  o Master of Science Thesis Data Collection, Ecuador, South America, 07/2013
  o Third Annual Global Health Conference, Lexington, Kentucky, Poster Presenter, 10/2012