Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.
Signature:

_____ _____

Danielle Tuft 04/21/2011

The Determinants of Obesity among the Adult Population in San Joaquin, Ecuador

By

Danielle Tuft
Master of Public Health

Global Health

_____
Deborah McFarland, PhD, MPH
Committee Chair

_____
Aimee Webb Girard, PhD
Committee Member

The Determinants of Obesity among the Adult Population in San Joaquin, Ecuador

By

Danielle Tuft
B.A., Boston University, 2009

Thesis Committee Chair: Deborah McFarland, PhD, MPH

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health in Global Health
2011

Abstract

The Determinants of Obesity among the Adult Population in San Joaquin, Ecuador

By

Danielle Tuft

Background: Malnutrition is a complex and serious issue in Ecuador. While undernutrition exists, severe problems with obesity are gaining recognition. In 2005, approximately 40% of men and 50% of women in Ecuador were overweight (BMI > 25) and 6% of men and 16% women were obese (BMI >30). It has been argued that Ecuador is in a period of nutrition transition due to availability of new and diverse food products as well as the shifts in age structure and urbanization. These changes increase Ecuador's risk of an overweight and obesity epidemic

Objective: To explore the dietary and food consumption patterns of adults in the peri-urban community of San Joaquin, Ecuador, to determine the risk factors of a high body mass index (BMI) and determinants of low diet diversity and to explore whether diet diversity is associated with overweight and obesity.

Methods: One hundred and thirty nine household surveys were conducted door to door among adults residing in 6 sectors in San Joaquin. These surveys primarily sought to determine the food consumption patterns of the adults residing in the community. A market survey determined food availability and costs.

Results: Approximately 31.5% of the participants were overweight and 20.8% were obese. While education was negatively associated with a high BMI and grain consumption was positively associated with a high BMI, diet diversity was not found to have any significant association with BMI. Income was positively associated with low diet diversity and residing in Cañaro or Pinchisana was negatively associated with diet diversity.

Discussion: The determinants of low diet diversity found in this study indicate a need for special attention to families that reside in the outskirts of San Joaquin and those who have low household incomes. An association between grain consumption and a high BMI suggests that more research is needed to establish why that relationship exists within San Joaquin. The average family in the community has significantly less money to spend than is necessary to meet current food intake recommendations. Increased partnership with the cooperative in San Joaquin and further research into possible subsidization options are needed to bridge this gap.

The Determinants of Obesity among the Adult Population in San Joaquin, Ecuador

By

Danielle Tuft
B.A., Boston University, 2009

Thesis Committee Chair: Deborah McFarland, PhD, MPH

A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health in Global Health
2011

Acknowledgements

Much time has been spent on this thesis and its corresponding project and none of this would have been possible without the support and guidance of many individuals.

I am most grateful to Dr. Deborah McFarland and Dr. Aimee Webb Girard for their constant support and guidance towards the completion of this thesis.

I must also thank Mike Weber of the Centers for Interamerican Studies (CEDEI) for his assistance in the development of this project and his field support.

The success of my fieldwork would not have been possible without the assistance and support of Consejo Cantonal de Salud, the Ministry of Health in Cuenca, and the San Joaquin Municipal.

I am sincerely grateful to the tireless efforts of the Sub Central de Salud staff particularly: Dr. Elizabeth Alvarracin, Dr. Franklin Iniguez, Elizabeth Gomez, and Carolina Alvarado. They not only provided cultural assistance and in depth knowledge of the community, but also provided much needed company and support during the days spent in San Joaquin. I am eternally grateful that they offered their valuable time to accompany me in my fieldwork; their help was invaluable.

I especially wish to express thanks to my research assistant, Julia Schiff, who not only provided assistance in conducting the surveys and acting as a sounding board, but was also a good friend to me throughout the whole process and beyond.

Table of Contents

List of Tables

List of Figures

CHAPTER 1: INTRODUCTION

Background

It has been argued that Ecuador, like other Latin American countries, is in a period of nutrition transition in part due to expanding foreign trade allowing for easier access to new and diverse food products as well as shifts in population growth, age structure, and urbanization. It is believed that urbanization creates a large centralized consumer base and leads to decreased physical activity. These changes ultimately increase Ecuador's risk of an overweight and obesity epidemic [1].

Ecuador is combating problems with malnutrition of all kinds. Approximately 6% of individuals in Ecuador are undernourished, 41% of whom are classified as poor [2, 3]. Though only a small percentage of the population is undernourished, children are most affected. Approximately 12% of children under 5 are under weight for their age and 26% of children under 5 have stunted growth, a prevalence which increases to 47% among indigenous populations. Malnutrition as a whole is a complex issue and a serious one for Ecuador, and while undernutrition clearly still exists, severe problems with obesity are beginning to gain recognition. As of 2005, approximately 40% of men and 50% of women in Ecuador were overweight (BMI > 25) and 6% of men and 16% women were obese (BMI >30) [1]. These high rates of obesity are very similar to other countries within the region; for example obesity ranges from 19.7% in Chile to 29.3% in Paraguay. In many of these countries, like Ecuador, the prevalence of overweight individuals is also a serious concern and makes up a much larger percentage of the population than obesity [4]. These new patterns of obesity also are believed to be affecting the prevalence of chronic disease associated with obesity. Among Ecuadorian men, heart disease increased

from 32% to 36% between 1970 and 2000. Diabetes deaths also greatly increased between 1990 and 2000 among the population with an increase from 8% to 18% among men and 11% to 22% among women [1].

The diets of individuals are an important risk factor for obesity and other chronic diseases. In 2003, the World Health Organization (WHO) collected data estimating the amount of fruit and vegetable intake among Ecuadorian populations, recognizing that a diet with insufficient fruits and vegetables increases risk for cardiovascular diseases and certain cancers [1]. In Ecuador, approximately 58% of the population consumed less than 3 servings a day of vegetables and fruit while 88% of the population consumed less than 5 servings a day. In addition, 2.3 % of the population ate no fruits or vegetables per day [5].

As of 2010, approximately 15 million people reside in Ecuador with an age structure much like other low- and middle- income countries [6]. Population growth has slowed down immensely in the past 40 years and is currently at a growth rate of 1%. Ecuador went through a period of significant economic growth in the 1950s and 1970s, primarily due to banana and oil exports respectively. However, due to political instability and an economic crisis from 1998 onwards, the country has been affected by a long-lasting stagnation. As of 2005, current per capita income is still slightly below the figure from 1980. Ecuador is one of the less developed countries in Latin America [7]. Ecuador has also seen increased interaction with the rest of the world, especially the United States, with a shift from more traditional exports, to more non-traditional items, such as cut flowers. Also, Ecuadorian workers produce for a global market, particularly as transnational migrants [8].

The country has seen other dramatic demographic and epidemiological shifts over the past 20 years. The life expectancy in Ecuador as of 2008 is 75.1 years, a significant increase from 1990 when the life expectancy was 68.9 years. The fertility rate has decreased from 3.7 children per woman in 1990 to 2.6 in 2008. As life expectancy has increased and the fertility rates have decreased there has been a transition in the population age structure with adults and elderly making up a larger percentage of the population [9].

Epidemiologically, the country has seen a decrease in communicable diseases, such as tuberculosis (TB), and increases in non-communicable diseases. For example, TB incidence has gone from 170 cases for every 100,000 individuals in 1990 to 71.9 cases in 2008 [9]. Concurrently, non communicable diseases have become the primary causes of death in the country, with heart disease, pneumonia, cerebrovascular disease, and diabetes as the top 4 causes of death [8]. With the epidemiological and demographic shifts, obesity has become an increasingly understudied but growing concern.

Purpose Statement

The purpose of this study is to explore the dietary and food consumption patterns of adults in the peri-urban community of San Joaquin, Ecuador, a village in the Andes region of Ecuador, to determine the risk factors of a high body mass index and the social determinants of low diet diversity, and to explore to what extent diet diversity is associated with overweight and obesity.

Research Questions

Research Question 1: What are the food consumption patterns of the adult population in San Joaquin, Ecuador?

Research Question 2: Is diet diversity associated with overweight and obesity among the adult population?

Research Question 3: Does the prevalence of overweight and obesity differ by the following socio-demographic characteristics: family income, education, residence, number of individuals in household, sex?

Significance

Most quantitative nutrition research focuses on measuring the nutritional status of communities, focusing largely on children under 5. With the growing rates of obesity in Ecuador, there is a need to assess the prevalence of obesity starting with adults in the community. In addition, it is necessary to determine how obesity differs among Ecuadorians by place of residence, number of individuals in the household, and income, so that proper interventions can be developed that target specific characteristics which may increase risk of obesity. This study will also provide information about the current eating habits of the community, allowing for culturally appropriate nutrition interventions, and provide new information for further research.

CHAPTER 2: LITERATURE REVIEW

Nutrition Transition

Over the past several decades there has been a significant transition in dietary intakes within Latin American populations. According to BM Popkin, "nutrition transition" coincides with both an epidemiological transition as well as a demographic one. As countries move from a profile of high fertility and high mortality to low fertility and mortality, there is also a shift from a high prevalence of infectious disease to a pattern of high prevalence of chronic diseases [10]. Popkin argues that the nutritional transition happens in three main stages: receding famine, degenerative disease, and behavioral change. In the first stage, as famine recedes, income rises and leads to stage 2 where there are changes in the diet and activity level of the population. This stage ultimately leads to new disease problems and increased disability. From here the population inevitably moves to the last stage, behavioral change, where a reversal of negative tendencies are seen which allow for what Popkin labels "successful aging" [10]. These changes are initiated by multiple different factors and are largely associated with an increase in obesity in low income countries.

There is evidence that overnutrition is the most common form of malnutrition in the higher income countries of South and Central America. In the same countries, similar patterns exist in both the higher and lower income populations [11]. According to Popkin (2003), the rate of change in obesity in lower and middle- income countries is much higher than in higher-income countries [12]. These dramatic increases in obesity are largely due to dietary shifts in the population in which fat, caloric sweeteners, and animal

source foods have become more prevalent in the peoples' diets. In this case, increased diet diversity leads to negative health outcomes.

Much of the research driven by Popkin's theory has taken place in Brazil and Chile. Albala et al. (2001) reviewed the nutrition transition in Latin America using Chile as a case study. With improvements in SES and human development indicators Chile has seen a remarkable epidemiologic transition in the past 50 years. In the 1960s the country's epidemiologic profile largely matched that of other Latin American countries, but in the last 20 years Chile has seen a decrease in infant mortality rate and an increase in noncommunicable diseases unlike other countries in the region [13]. The rise of obesity in the country is thought to be partly due to the increase in fat consumption among the Chilean population, a decrease in fiber rich foods, and an increasing sedentary lifestyle [13].

While many Latin American countries still face issues of undernutrition, dietary changes, like those documented in Chile, are leading to increased obesity and the need for further research to understand the patterns of transition. While nutrition transition has been investigated in certain Latin American countries, particularly in Chile and Brazil, the nutritional transition of other Latin American countries has been overlooked. Latin American culture, geography, and demographics differ from country to country and it would be wrong to assume that all Latin American countries move through the stages of nutritional transition at the same time or at the same pace. It is important that country specific research is conducted to determine how and to what extent diets have changed over the past couple decades. For example, the situation in Chile may not be parallel in Ecuador; however, as Ecuador has had increasing access to new food items and its

epidemiologic and demographic profile has shifted, it is not unlikely that a dramatic transition will occur if it has not already.

Obesity in Latin America

There are very limited data available that address adult overweight and obesity in Latin America and the data that are available have several limitations that make comparisons across studies problematic. In particular, many studies have differing definitions of obesity, use different methods with which to determine obesity, and use different age ranges for study participants [4]. A review in 2001, which attempted to address these inconsistencies, looked at the obesity prevalence and trends in Latin America. The review included only previous studies that used the World Health Organization recommended BMI classification for obesity (BMI>30), that conducted measurements of height and weight internal to the study, and that were conducted in the last decade [4]. There were still limitations in that many of the studies did not contain nationally representative samples, a reoccurring issue in many of the studies conducted on obesity.

The prevalence of obesity in many Latin American countries was slightly higher than the current rates of obesity in Ecuador; however, prevalence of overweight individuals in the study countries was very similar to that in Ecuador. The 2001 review reported that there was a prevalence of obesity (BMI >30) of 26.9% in Argentina, 19.7% in Chile, 20% in Mexico, and 29.3% in Paraguay. In addition, the overweight prevalence (BMI of 25–29.9) ranged from 28.6% in Brazil to 41.3% in Peru [4].

Obesity in Ecuador

Few studies or reviews have addressed obesity, especially that of adults, in Ecuador. In addition, few multi country studies focused on Latin America have included Ecuador in the review. The diet of those residing in Ecuador has changed over the past 10 years. The WHO estimates that as of 2003, approximately 60% of the Ecuadorian population ate fewer than 3 servings of fruit and vegetables per day and that almost 90% of the population ate fewer than 5 servings [1]. In addition, the Food and Agriculture Organization (FAO) estimated that about 65% of the population's calories came from grains, fats, oils, sugars, and sweets [1]. These patterns in conjunction with a caloric intake increase from 2490 (1989) to 2710 (2003) per day, further shows the growing risk for obesity and chronic health problems within Ecuador [1]. In 2005, the WHO estimated that 40% of men and 50% of women were overweight based on a body mass index (BMI) greater than 25. In addition, they reported that 6% of men and 16% of women were obese based on a BMI greater than 30 [1].

Consumption patterns in Ecuador

A study conducted by Berti and Leonard (1998) explored the socioeconomic and demographic factors which influenced diet variation among an Andean community. The study collected dietary data on 221 residents of a rural community near Quito through the use of 24 hour recalls. Diets were made up primarily of tubers, with residents consuming potatoes approximately 2.7 times per day; however, it was determined that grains, such as white rice, white bread, barley flour, and pasta, provided more of the total energy in the diet [14]. This basic diet is still very prevalent in Ecuador, although there is increasing

access to more fat and sugar based foods. In the Andean community studied in Berti and Leonard (1998), 80% of the dietary energy was carbohydrates and less than 15% was contributed by either protein or fat [14]. Adults consumed more tubers and oil as well as fewer sweets than children in the community. In addition there was no effect of sex on dietary intake, which the authors argue is due to the fact that many Andean households avoid sex-based biases in food distribution [14].

This study is one of the few that explores research on food consumption among adults in Ecuador. The context of the Andean community is very similar to that of the current study community outlined in this thesis. However, while the Berti and Leonard study provides insight into the diet of the Andean population, there were several limitations. First, the diet of many in Ecuador is largely influenced by the agriculture in the area, which varies depending on geographic conditions between the coastal and mountainous areas of Ecuador. The diet observed in the Andean community could potentially vary dramatically from other communities in the country. In addition, the study was conducted in 1994 and if Ecuador has in fact been transitioning nutritionally, the diet and the role of fats and sugars may have changed since then. Lastly, the study did not use a random sample and instead used convenience sampling, thus decreasing the studies generalizability to other communities.

Diet diversity and obesity

Dietary diversity scores (DDS) have been determined to be an effective indicator for assessing overall diet. Among adults and adolescents, eating a varied diet has been associated with an increased intake of macro- and micronutrients as well as higher

nutritional adequacy [15]. Given this, it seems reasonable that there would be some association between diet diversity and obesity; however, there have been differing conclusions regarding this association. A review conducted in 2004 looked to determine this association, but found that recent studies did not come to the same conclusions [16]. One review published in 2001 reviewed 39 animal and human studies and ultimately concluded that when there is more variety in a diet, food consumption increases and that greater variety is associated with increased body weight and fat [17]. That being said, another 2001 study that looked at different diets and their associations with BMI concluded that the average BMIs for men and women were significantly lower among those who consumed the high carbohydrate diet with more variety. In addition, those in this diet group were significantly less likely to have BMIs greater than 25. In this study, diet variety was associated with a BMI more likely to be in the normal range [18].

A cross-sectional study published in 2010 attempted to determine the association between DDS, obesity, overweight, and central adiposity among Iranian female youth ages 18-28. The study concluded that there was an inverse association between DDS and obesity, thus the prevalence of obesity was lower among students with a higher DDS than those with lower dietary diversity [15]. The study also analyzed the relationship between the consumption of each main food group and obesity. It was determined that those with a higher vegetable diversity score were at lower risk of obesity. This same relationship was there for fruit consumption; however there was no significant association between the grain, meat, or dairy groups and the prevalence of obesity [15].

The Iranian study was very useful in providing new information into the relationship between DDS and obesity and even went a step further in analysis by looking

at individual food groups as well. The study had weaknesses that limit its generalizability. For example, in analyzing associations with obesity, due to low numbers of obese students, the prevalence of obesity included both overweight and obese students. As diets vary between cultures and countries, the data collected and results found specifically in regard to actual food consumed will most likely vary significantly among the Ecuadorian population.

Negative health effects of obesity

Obesity is a problem that has long lasting effects on individuals and populations. It has already been determined that excess weight is associated with increases in incidence of a range of health problems, such as cardiovascular disease, type 2 diabetes mellitus, hypertension, stroke, and some cancers [19]. A higher BMI has been determined to account for up to 16% of the global burden of disease, expressed as a percentage of disability-adjusted life years (DALYs). In addition, "in the developed world, 2 to 7% of total health care costs are attributable to obesity". In the United States, the cost of obesity, direct and indirect combined, was estimated to be $123 billion dollars [20].

A representative cross sectional study conducted in 1999 in the United States used national data to look at the association between health conditions in which excess weight was an established risk factor for obesity. Strong associations were observed between type 2 diabetes and hypertension [19]. There has been a reported increase of the prevalence of diabetes in the developing world, with approximately 90% of type 2 diabetes in the world attributable to excess weight [20]. More recently, a meta analysis

study, published in 2009, sought to determine the relationship between obesity and the incidence of co-morbidities. The study reviewed 89 studies and found that there were statistically significant associations for overweight with the incidence of type II diabetes, all cancers excluding esophageal among females, pancreatic, and prostate cancer, all cardiovascular diseases with the exception of congestive heart failure, asthma, gallbladder disease, chronic back pain, and osteoarthritis. Obesity was found to be significantly associated with the incidence of all those listed above in addition to pancreatic cancer and congestive heart failure [21].

There have been a few studies and surveillance programs that have collected information on obesity related chronic diseases in Ecuador. Based on death certification numbers, from 1970 to 2000, Ecuador has seen an upward trend in CHD mortality [22]. In addition, death due to diabetes has increased between 1990 and 2000 for both men and women in Ecuador, from 8% of all deaths in men to 18% and from 11% of all deaths in women to 22% [1]. Similarly, a study conducted in Guayaquil, Ecuador among postmenopausal women in 2006 determined that 41% of participants had metabolic syndrome [23]

CHAPTER 3: METHODOLOGY

The purpose of this study is to explore the dietary and food consumption patterns of adults in the peri-urban community of San Joaquin, Ecuador, a village in the Andes region of Ecuador, to determine the risk factors of a high body mass index and the social determinants of low diet diversity, and to explore to what extent diet diversity is associated with overweight and obesity. Cross sectional household surveys were conducted door to door among adults, defined as any individual over the age of 18, residing in one of the 6 sectors selected for the study. For the purposes of this study, a household was defined as any group of individuals who eat meals together in the same location. In addition, a market survey was conducted to determine food availability and prices.

Study Site and Population

Figure 1 shows the map of Ecuador divided by each province. The city of San Joaquin, located within Azuay province, has a population of approximately 10,000 individuals and is a 15 minute bus ride from Ecuador's third largest city, Cuenca. The center of town includes a church, a school, a free clinic, and a municipal building. There are several small stores with basic amenities such as a small selection of fruits and vegetables, snacks, alcohol, toiletries, candy, beverages, and bread. There is also a cooperative, Coopera, that works in agricultural research and food distribution. Coopera works to find ways in which to diversify agriculture in the southern Ecuador climate and soil conditions. The organization also has a food processing plant from which it distributes a variety of fruits, vegetables, nuts, and meats to the local markets in Cuenca.

The cooperative has a small store in San Joaquin open to the local community; however, it is a bit inaccessible, as there is a large gate at the entrance to the cooperative and the store is difficult to locate within the compound. The store also sells its food using a different weight system than the local residents are used to. Most residents buy their food by the pound in the local market, but Coopera sells its food by the kilogram which could be confusing to residents. Thus they may not realize that the food at Coopera is in fact cheaper than that at local markets.

San Joaquin is serviced by 2 different bus routes that can bring residents into Cuenca. There are no paved roads in San Joaquin and through personal observation, most residents seem to get around San Joaquin by walking. There is no major market in San Joaquin or any grocery stores, so residents must walk to the bus stops and then take the bus into Cuenca to access a larger variety of food. While some residents live close to the center of San Joaquin, many live further out in more mountainous areas, anywhere from 30 minutes to an hour walk from the center of town. Due to the nature of available transportation, most residents can only buy the food that they can carry back on a bus and then on a long walk through uneven terrain. According to those with knowledge of the local community, the food intake of those living in areas farther from the center of town can differ significantly from those closer to town. For example, those in more remote areas apparently eat less rice than those in the center because they can't carry as much rice back to their homes as those residing closer to the center of town.

Those eligible for the survey were adult men and women over the age of 18, the legal age of adulthood in Ecuador, who resided in the 6 sectors visited. Seven pilot surveys were conducted and the surveys were edited to account for any confusion or poor

wording determined through the pilot testing. A total of 149 surveys were conducted following the pilot surveys and these constitute the study data base.

Figure 1: Map of Ecuador Divided by Province

galapagos2009.wordpress.com

Procedures

The study began with months of preparation prior to fieldwork in which there were continuous meetings and email communication with the stakeholders of the project. The project was initiated by the Centers for Interamerican Studies (CEDEI) which then partnered with *Consejo Cantonal de Salud,* the Azuay province health department. Development of the project and implementation of the fieldwork was conducted in partnership units, the municipality of San Joaquin, the Ministry of Health, and the Sub Central de Salud. The Ministry of Health and Consejo Cantonal de Salud provided oversight and professional knowledge of nutrition. CEDEI served as the connection between organizations and provided much of the resources needed to conduct the surveys and analyze the results. In addition, the San Joaquin municipal staff provided the research team with knowledge of the local community and assisted in arranging introductory meetings with the local health clinic which in turn provided staff to assist in actual data collection.

The survey was developed by the lead investigator and reviewed and edited on multiple occasions by the local clinic staff, CEDEI staff, and the director of Consejo Cantonal de Salud. The fieldwork was conducted by the lead investigator and an American research assistant who was fluent in Spanish was recruited by CEDEI. The research assistant had gained CITI certification prior to research and was briefly trained in the goals and objectives of the project and how to fill out the survey in the same manner as the lead investigator.

Convenience sampling was used to find participants. The six sectors that were chosen as samples of the San Joaquin community were chosen by local physicians with

good knowledge of the community. Houses were not randomized. The team visited as many houses as possible.

In addition to household surveys, a market survey was conducted. The research team went to the main market in Cuenca, *Ferria Libre*, and recorded all available foods and their respective prices. This was done in a single morning. The data were used to determine food availability as well as what foods were most expensive and which were least expensive. Data were used in the development of a low cost food plan for the community.

Instruments

In order to collect data for this project a household survey was developed and translated into Spanish. Both the English and Spanish surveys are included in Appendix A. The majority of the survey included close ended questions regarding food consumption, such as how often meat, vegetables, and fruit were consumed by the individual each week as well as exactly what types of food the person consumed. In addition to these questions, a few more open ended questions were about their daily breakfast, lunch, and dinner.

The surveys were conducted door-to-door in 6 sectors of the community over a period of 4 weeks from June – July 2011. The 6 sectors that were visited were Barabon Chico, Canaro, Pinchisana, Cruz Verde, Florida, and Autopista. Florida was the only sector in which surveys were not conducted door-to-door. The Florida surveys were instead conducted at a temporary family clinic that served the sector while mothers waited to see the health care providers. Cañaro and Pinchisana were the 2 communities

farthest from the center of town and described by local clinic staff as poor communities. The other communities were closer to the center of town and described as not being very poor. With the door-to-door surveys, the research team visited as many houses in each sector as time permitted and surveyed one adult per household. We assumed that most individuals in a household consumed similar if not the same food on a daily basis due to the family structure and cultural norms around meals.

In addition to the lead investigator and research assistant, the team included local medical staff with knowledge of the community and who had a positive reputation among the residents. The physicians and nurses that accompanied the research team distributed albendazole and calcium tablets as well as updated their records of each family as the team moved door-to-door, as is standard practice for clinic outreach practices. Although the lead investigator and research assistant conducted the interviews, the medical staff greatly assisted when participants had questions and/or needed clarification.

Data Analysis

SAS 9.2 was used for the data analysis. The data were cleaned and the outcomes of interest, BMI and total diet diversity score, were checked for normal distribution. Multiple new variables were then created. Total diet diversity score was created based on the frequency of consumption for each food group. Individual diet diversity scores for each consumption frequency were calculated. For this purpose, consumption of a food group 0-1 days per week was assigned a score of 0.0, consumption 2-6 days per week was assigned a score of 0.5, and consumption of a food group 7 days per week was assigned a score of 1.0. The only exception to this is in the calculation of the individual

diet diversity scores for nuts/beans and the scores for dairy. For the nuts/beans score the same rule applied, except that 0.5 points was assigned both if an individual consumed nuts 1-6 days per week or they consumed beans as part of their normal diet. For the dairy score, consumption of cheese and milk were combined in that an individual only had to consume one or the other to receive the respective score. Once these individual scores were calculated, they were added up to create the main variable of interest, total diet diversity score. Next, a categorical variable was created using the following BMI cutoffs: Normal ($18.5 \leq BMI < 25$); Overweight ($25 \leq BMI < 30$); Obese ($BMI > 30$). Lastly, a new income variable was created, removing "Don't Know" as a category by marking it missing.

Frequencies, mean values, and standard deviations were calculated for each variable. Next, to determine the associations between BMI and potential risk factors, analysis of variance (ANOVA) tests, chi square tests, and linear regression were conducted.

Lastly, 2 associative models were developed to determine the effect each risk factor has on each outcome of interest, BMI and total diet diversity score. In order to create the models, unadjusted associations were calculated for each risk factor and outcome of interest. The r squared values were reported for each model in addition to the p-values which were used to determine significant association between the variable and the outcome of interest. Those risk factors with a p-value of 0.2 or less were placed in a model together. The value of 0.2 was used because in smaller studies it can be useful to relax the standard 0.05 alpha level as there is the possibility that confounders may not be statistically significant even though they may affect the parameter estimates of the

primary variables of interest. At this point, multicollinearity was tested by determining the variance inflation factors for each risk factor and comparing them to see if any were above 10.0, the point at which we assumed multicollinearity between factors. Next, confounding was tested by looking at the amount of change in the beta value of the primary variables for each model when adjusted for an individual variable in the model. Confounding was determined using the 10% rule, which states that if the beta value changes by 10% in either direction, then confounding is present. Lastly, risk factors with a significant p-value of 0.05 or less and confounding variables were left in the model. All other variables were removed.

Logistic regression was also conducted to see if there were associations between diet diversity and BMI. Three new variables were created to look at the unadjusted association between diet diversity and overweight (BMI≥25) versus obese (BMI≥30), overweight or obese versus normal (18.5≤BMI<25), overweight versus normal, and obese versus normal.

Development of Low Cost Food Plan Market Basket

Using the data collected as part of the market survey, a low cost market basket was developed. The food plan was adapted from the United States Department of Agriculture (USDA) low cost food basket which is used in the United States as a standard for a nutritious diet that can be purchased at minimal cost. The USDA food basket uses multiple nutrition standards and recommendations and meets all recommended intakes [24]. The USDA food baskets were created using mathematical optimization models each of which consisted of four data inputs (average consumption, average cost per 100

grams, average nutrient profile per 100 grams, and average My Pyramid ounce or cup equivalents profile per 100 grams) and three constraints (dietary standards for each age group, My Pyramid recommendations for each age group, and food plan maximum cost allotment for each age group). This data was determined through the results of the NHANES 2001-2002 which, among other things, collected data on participants' consumption of food and nutrients as well as a 2001-2002 Food Price Database. The Food Price Database was developed by merging the data collected from NHANES with national data on food prices from the 2001 and 2002 Nielsen Homescan Panels. For each age group, the optimization model chose the optimal food plan that met dietary standards, accounted for cost constraints, and accounted for as little change as possible from reported consumption patterns of the population [24]. The USDA plans are created for both genders and multiple age groups. For the low cost market basket developed as part of this thesis, a household plan based on the following, was developed: a male (age 19-50), a female (age 19-50), and 3 children (age 2-3, 4-5, and 6-8). The choice to include 5 members in a family was decided because the average surveyed family in San Joaquin consisted of 5 members.

Food types and quantities were adapted from the USDA plan based on food availability in San Joaquin and cultural appropriateness. Whole grain foods and low fat milk are very difficult to access, so they were removed and their quantities were added to non- whole grain foods and whole milk, respectively. Milk desserts and fruit juices are not likely to be accessible so they were added to whole milk and whole fruit, respectively. The quantity of beef and pork was decreased and that which was subtracted was split evenly and added to chicken and fish as they are cheaper and more

popular options among resident of San Joaquin. Nutritionally, they still provide a good source of protein and are ultimately very nutritionally similar to beef and pork products [25]. Nuts were also removed and their quantities were added evenly to fish and chicken, as nuts are almost never consumed. Soda was included in the basket as, while it is not consumed regularly, it is consumed. The soda quantity was reduced from that of the original USDA basket and the extra pounds were added evenly to potatoes and rice. This was done because potatoes and rice are similar to soda in their carbohydrate content and rice and potatoes are a staple and thus consumed more often than soda [25].

Cost for each food item was determined using the prices reported in the market survey. For items, such as fruit, vegetables, and eggs, which are not sold by the pound in Ecuador, the USDA nutrition database was used to determine individual weights of each food item [25]. For fruits and vegetables, the most popular and cheapest choices were used to develop sample costs. For whole fruit, the recommended quantity was divided among apples, oranges, and bananas and the cost was then calculated. For vegetables, broccoli was used for dark green vegetables, carrots were used for orange vegetables, lentils were used for dry beans, and tomatoes and cabbage were used for the other vegetables category. Once the total quantities and costs for each person was calculated, totals were added up to provide the recommended total pounds for each food group and total cost for a family of five.

CHAPTER 4: RESULTS

Tables 1 and 2 show the descriptive statistics for all variables overall as well as stratified by three categories of BMI. Of the surveyed population, 89.2% were female and 10.8% were male. The mean age of respondents was 42.4 with a minimum age of 18 and a maximum age of 99. The adult population of San Joaquin is fairly short with an average height of 151.9 centimeters or 4 feet and 11 inches. The average weight of the population is 62.1 kg or approximately 140 pounds. In addition, the average BMI is 27.0 which falls into the overweight range according to CDC BMI cutoff guidelines. With respect to education, most respondents did not attend school past primary school with 39.1% (54) of the residents finishing primary school only and 29.0% (40) or residents attending primary school but not having completed it. Over half of households (51.8%) included 4 to 6 family members and 25.9% had 7 or more family members. Over three quarters of the population had incomes less than $500 per month, 32.6% had incomes less than $200 per month and 47.10% had incomes of $200-$500 per month.

Food consumption varied considerably among food groups. Grain is a staple of the diet with a mean grain consumption of 6.5 days per week. Nuts are consumed rarely with a mean consumption of 0.4 days per week. The mean total diet diversity score was 4.1 out of a possible range of 0 to 7. This data analysis found that only weight, BMI, and the mean grain consumption differed significantly across BMI groups. Among those who were in the normal, overweight, and obese ranges the mean grain consumption was 6.1, 6.5, and 7.0 days per week respectively ($p= 0.0334$).

Table 1: Continuous Variable Means and Medians Stratified by Body Mass Index among the Adult Population of San Joaquin, Ecuador (N=139)					
		Body Mass Index Mean ± Std Dev/Med (IQR)			
Variable	**Mean ± Std Dev/Med (IQR)**	**Normal (n=40)**	**Overweight (n=61)**	**Obese (n=26)**	**p-value**
Age	42.4 ± 16.5	41.2 ± 19.0	44.0 ± 15.9	46.4 ± 14.0	0.4459
Height (cm)	151.9 ± 6.9	152.6 ± 7.3	152.3 ± 6.4	149.5 ± 6.9	0.1559
Weight (kg)	62.1 ± 9.5	54.2 ± 4.9	63.2 ± 6.7	73.0 ± 8.8	<0.0001*
Body Mass Index	27.0 ± 3.7	23.3 ± 1.3	27.2 ± 1.4	32.6 ± 2.0	<0.0001*
Food Consumption (days per week)					
- Fruit	3.0 (2,7)	4.0 (1,7)	3.0 (1,7)	3.0 (2,7)	0.9128
- Vegetable	7.0 (2,7)	4.0 (2.5,7)	7.0 (2,7)	3.0 (2,7)	0.3833
- Meat	3.0 (2,7)	3.0 (2,7)	3.0 (2,7)	3.5 (3,7)	0.4964
- Grains	7.0 (7,7)	7.0 (7,7)	7.0 (7,7)	7.0 (7,7)	0.0334*
- Eggs	3.0 (2,7)	3.0 (1.5,7)	2.0 (2,7)	2.0 (1,5)	0.6651
- Cheese	2.0 (0,7)	2.0 (0,4)	1.0 (0,3)	2.0 (0,7)	0.5196
- Milk	7.0 (2,7)	7.0 (0.5,7)	7.0 (3,7)	3.0 (0,7)	0.0821
- Nuts	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.0 (0,0)	0.1922
Total Diet Diversity Score	4.1 (4.0, 5.5)	4.75 (3.5,5.5)	4.5 (3.5, 5)	5.0 (4, 5.5)	0.6004

* p-value is significant at α=0.05

Table 2: Frequencies of Socio-demographic Variables Stratified by Body Mass Index among the Adult Population of San Joaquin Ecuador (N=139)							
				Body Mass Index N (Percent)			
Variable	**Category**	**Percent (%)**	**Number**	**Normal (n=40)**	**Overweight (n=61)**	**Obese (n=26)**	**P-value**
Education	No school	6.52	9	3 (7.5%)	3 (5.0%)	2 (7.7%)	0.3113
	Primary Incomplete	28.99	40	6 (15.0%)	20 (33.3%)	11(42.3%)	
	Primary Complete	39.13	54	17 (42.5%)	25 (41.7%)	10 (38.5)	
	Secondary Incomplete	7.97	11	4 (10.0%)	5 (8.3%)	1 (3.9%)	
	Secondary Complete	11.59	16	6 (15.0%)	6 (10.0%)	1 (3.9%)	
	More than Secondary	5.80	8	4 (10.0%)	1 (1.7%)	1 (3.9%)	
Number of Individuals in Household	0-3	22.30	31	7 (17.5%)	16 (26.2%)	4 (15.4%)	0.6763
	4-6	51.80	72	23 (57.5%)	29 (47.5%)	13(50.0%)	
	7 or more	25.90	36	10 (25.05)	16 (26.2%)	9 (34.6%)	
Household Income (per month)	Less than $200	32.61	45	11 (27.5%)	23 (38.3%)	9 (34.6%)	0.7267
	$200 - $500	47.10	65	21 (52.5%)	26 (43.3%)	12(46.2%)	
	$500 - $1000	7.97	11	5 (12.5%)	4 (6.7%)	1 (3.95)	
	More than $1000	2.90	4	1(2.5%)	1 (1.7%)	0 (0.0%)	
	Don't Know	9.42	13	2 (5.0%)	6 (10.0%)	4 (15.4%)	
Residence	Barabon Chico	20.14	28	4 (10.0%)	14 (23.0%)	7 (26.9%)	0.3348
	Cañaro	19.42	27	7 (17.5%)	12 (20.0%)	7 (26.9%)	
	Pinchisana	15.83	22	8 (20.0%)	6 (9.8%)	4 (15.4%)	
	Florida	15.83	22	10 (25.0%)	9 (14.8%)	2 (7.7%)	
	Cruz Verde	14.39	20	4 (10.0%)	12 (19.7%)	2 (7.7%)	
	Autopista	14.39	20	7 (17.5%)	8 (13.1%)	4 (15.4%)	

* p-value is significant at α=0.05

To determine the effect of each independent variable of interest on the two outcomes of interest, diet diversity and BMI, two associative models were developed. In order to determine which variables should be placed in the model, unadjusted associations between each independent variable and outcome using a p-value of less than or equal to 0.2 were used to determine significance. Table 3 shows these associations. With BMI as the outcome of interest, 8 variables were found to be significantly associated: number in household (r^2 =0.02, p=0.1188); education (r^2 =0.06, p=0.0050); household income (r^2 =0.05, p=0.0147); residing in Barabon Chico (r^2 =0.01, p=0.1840), residing in Florida (r^2 =0.02, p=0.1517), residing in Cruz Verde (r^2 =0.01, p=0.1957); grain consumption (r^2 =0.06, p=0.0071); milk consumption (r^2 =0.001, p=0.1855). The corresponding r squared values indicate that each variable alone does not account for much of the variability of BMI. Based on the data analyzed as part of this thesis, total diet diversity score was not associated with BMI. Similarly, the logistic regression analysis also determined that diet diversity was not significantly associated with BMI when categorized in the following ways: overweight/obese; overweight or obese/normal; overweight/normal; obese/normal.

Once these variables were placed in a model together, number in household, residence in either Barabon Chico, Florida, or Cruz Verde, and milk consumption were no longer significant and were not confounders, and thus were removed. Income was also determined not to be associated with BMI; however, it was found to be a confounding factor and thus was left in the model. The final model developed, shown in table 4, was BMI = -0.65(education) + -0.65(household income) + 0.56(grain consumption). Thus, there is a negative association between education and BMI, that is,

every 1 percentage-point increase in education is associated with a 0.65 decrease in BMI. In addition, there is a positive association between grain consumption and BMI in that for every 1 percentage-point increase in grain consumption is associated with a 0.56 increase in BMI.

For the second model with total diet diversity score as the outcome of interest, 7 variables were found to have an unadjusted association with diet diversity score, at $p \leq 0.2$. These associations are shown in table 5.Those variables were as follows: age ($r^2 = 0.02$, $p=0.1306$); income ($r^2 = 0.20$, $p = <0.0001$); education ($r^2 = 0.12$, $p=<0.0001$); and residing in Cañaro ($r^2 = 0.04$, $p=0.0173$), Pinchisana ($r^2 = 0.05$, $p=0.0060$), Florida ($r^2 = 0.02$, $p=0.0812$), or Cruz Verde ($r^2 = 0.07$, $p=0.0015$). According to the corresponding r square values, income and education are the terms which best account for the variability of diet diversity score by themselves. When placed in a model together, only income, residing in Cañaro, and residing in Pinchisana were found to be significant with a p-value ≤ 0.05. Education was found to be a confounder and as such was kept in the model with the other significant variables. The final model developed, shown in table 6, was diet diversity score = 0.03(education) + 0.58(household income) + -0.55(residing in Cañaro + -0.61(residing in Pinchisana). There is a positive association between household income and diet diversity with every 1 percentage-point increase in income associated with a 0.58 increase in diet diversity score. Residence in either Cañaro or Pinchisana is negatively associated with diet diversity as living in either community is associated with a 0.55 and 0.61 decrease in diet diversity score respectively.

Table 3: Unadjusted Associations Between Body Mass Index and Potential Risk Factors among Adult Population of San Joaquin (N=139)			
Predictor	**R^2**	**β_1**	**p- value**
Gender	0.0062	0.96	0.3503
Age	0.0041	0.01	0.4744
Number in Household	0.0192	0.73	0.1188*
Education	0.0614	-0.75	0.0050*
Household Income (per month)	0.0515	-1.17	0.0147*
Residence			
- Barabon Chico	0.0140	1.10	0.1840*
- Cañaro	0.0126	1.03	0.2075
- Pinchisana	0.0037	-0.64	0.4981
- Florida	0.0162	-1.27	0.1517*
- Cruz Verde	0.0133	-1.20	0.1957*
- Autopista	0.0023	0.50	0.5886
Food Consumption (days per week)			
- Fruit	0.0096	-0.13	0.2743
- Vegetable	0.0003	0.02	0.8551
- Meat	0.0061	0.13	0.3819
- Grains	0.0562	0.53	0.0071*
- Eggs	0.0058	-0.11	0.3921
- Cheese	0.0002	0.02	0.8901
- Milk	0.0139	-0.15	0.1855*
- Nuts	0.0013	-0.10	0.6889
Total Diet Diversity Score	0.0001	0.03	0.9168

* p-value is significant at α=0.2

Table 4: Variables associated with increased BMI in adult population of San Joaquin (N=139) identified by linear regression model			
Predictor	**β_1**	**p- value**	**Confounding**
Education	-0.65	0.0370	yes
Income	-0.65	0.2339	yes
Grain Consumption	0.56	0.0256	no

* p-value is significant at α=0.05

Table 5: Unadjusted Associations Between Diet Diversity Score and Potential Risk Factors among Adult Population of San Joaquin (N=139)			
Predictor	**R^2**	**β_1**	**p- value**
Gender	0.0007	-0.09	0.7622
Age	0.0166	-0.01	0.1306*
Number in Household	0.0024	-0.08	0.5676
Education	0.1226	0.31	<0.0001*
Household Income (per month)	0.2020	0.68	<0.0001*
Residence			
- Barabon Chico	0.0001	0.03	0.9117
- Cañaro	0.0407	-0.57	0.0173*
- Pinchisana	0.0537	-0.71	0.0060*
- Florida	0.0220	0.45	0.0812*
- Cruz Verde	0.0711	0.85	0.0015*
- Autopista	0.0013	0.12	0.6684

* p-value is significant at α=0.2

Table 6: Socio-demographic variables associated with more diet diversity in the adult population of San Joaquin (N=139) identified by linear regression model			
Predictor	**β_1**	**p- value**	**Confounding**
Education	0.03	0.7433	yes
Income	0.58	<0.0001	yes
Residing in Cañaro	-0.55	0.0229	yes
Residing in Pinchisana	-0.61	0.0257	yes

* p-value is significant at α=0.05

Table 7 depicts the low cost food plan market basket for a family of five residing in San Joaquin. The total cost for the basket was found to be $76.36 per week. The most pounds purchased each week are for milk, fruits, and vegetables. The most expensive components of the basket are whole milk and whole grain, in this case quinoa. The least expensive components of the basket are eggs, cheese, and soda. The cost for the basket for an individual man is similar to that of a woman at $19.93 and $19.33 respectively. For children ages 2-3, 4-5, and 6-8, the prices for a week are $10.42, $12.10, and $14.58 respectively.

Table 7: Low Cost Food Plan Market Basket: quantities and cost of food purchased per week for family of five residing in San Joaquin, Ecuador						
Category	Male (19-50)	Female (19-50)	Child (2-3)	Child (4-5)	Child (6-8)	Total Pounds ($)
	Lbs (Cost)					
GRAINS						
- Whole Grain – Quinoa	1.96 ($2.94)	1.96 ($2.94)	1.21 ($1.82)	1.69 ($2.54)	1.09 ($1.64)	7.91 ($11.88)
- Non Whole Grain (Rice, Pasta)	3.12($1.25)	2.46 ($0.98)	0.63 ($0.25)	0.79 ($0.32)	1.42 ($0.57)	8.42 ($3.37)
TUBERS						
- Potatoes	4.07 ($0.61)	2.65 ($0.40)	0.33 ($0.05)	0.56 ($0.08)	0.42 ($0.06)	8.03 ($1.20)
VEGETABLES						
- Dark Green (broccoli)	1.01 ($0.38)	1.18 ($0.44)	0.83 ($0.31)	0.75 ($0.28)	1.01 ($0.37)	4.78 ($1.78)
- Orange (carrots)	0.91 ($0.35)	0.68 ($0.26)	0.41 ($0.16)	1.02 ($0.39)	0.62 ($0.24)	3.64 ($1.40)
- Dry beans, peas, lentils	1.83 ($1.37)	1.56 ($1.17)	0.48 ($0.36)	0.66 ($0.50)	1.69 ($1.27)	6.22 ($4.67)
- Other (tomato, cabbage)	3.39 ($1.60)	2.63 ($1.24)	1.20 ($0.56)	1.58 ($0.75)	2.61 ($1.23)	11.41 ($5.38)
FRUITS						
- Whole Fruit (apples, bananas, oranges)	7.71 ($1.69)	8.02 ($1.76)	3.56 ($0.78)	5.42 ($1.19)	4.55 ($0.99)	28.76 ($6.41)
Milk						
- Whole milk products	10.68 ($4.81)	11.68 ($5.26)	8.14 ($3.66)	8.02 ($3.61)	8.20 ($3.69)	46.72 ($21.03)
- Cheese	0.27 ($0.41)	0.18 ($0.27)	0.03 ($0.05)	0.02 ($0.03)	0.00 ($0.00)	0.50 ($0.76)
MEAT						
- Beef, Pork	0.25 ($0.50)	0.25 ($0.50)	0.20 ($0.40)	0.20 ($0.40)	0.50 ($1.00)	1.40 ($2.80)
- Chicken	1.90($2.28)	1.76 ($2.11)	0.62 ($0.74)	0.78 ($0.94)	1.42 ($1.70)	6.76 ($7.77)
- Fish	1.02 ($1.28)	1.17 ($1.46)	0.96 ($1.20)	0.82 ($1.03)	1.32 ($1.65)	5.29 ($6.62)
- Eggs	0.18($0.23)	0.24 ($0.31)	0.02 ($0.03)	0.02 ($0.03)	0.02 ($0.03)	0.48 ($0.63)
OTHER						
- Soda	1.00 ($0.23)	1.00 ($0.23)	0.20 ($0.05)	0.02 ($0.01)	0.62 ($0.14)	2.84 ($0.66)
Total Cost	$19.93	$19.33	$10.42	$12.10	$14.58	143.16 ($76.36)

CHAPTER 5: DISCUSSION AND RECOMMENDATIONS

Discussion

The results of this data analysis provide a fresh, though somewhat limited, idea of the food consumption patterns of the adult population of San Joaquin. Grains are consumed most regularly with most residents (86.3%) consuming grain products every day while products like cheese and nuts are consumed much less often, if ever. Meat is consumed on average around 4 times per week, chicken and fish being the most common meat items consumed by the population, though specific types of consumption is unknown from the survey questions. Average consumption frequencies of fruits and vegetables are around 3 or 4 times per week. The current recommended fruit and vegetable consumption for adults being daily consumption, it is clear that, since on average, the population does not consume fruits and vegetables every day, much of the population is not meeting the recommended number of servings and thus are most likely not meeting the recommended nutrient intakes [26]. In addition to fruits and vegetables, it is likely that the adult population is not meeting the recommended intake of dairy as well as current recommendations call for 3 cups of dairy products per day and the average milk consumption is 4.6 times per week [26]. Only 57.6% of the populations reported consuming milk everyday of the week and 18.7% reported that they never consume milk.

It is important to note one serious limitation to these data, is that, while much of the population consumes these food groups every day and thus may in fact meet recommended values, the data does not provide information about daily consumption. Since it is recommended that each individual have multiple servings of each food group

every day and the data collected only accounts for weekly consumption, it is impossible to say for sure whether those individuals consuming daily fruit, vegetables, and milk are in fact consuming the correct daily recommended amounts as there is no way from the data to determine how often they consume each food group per day.

Beyond inadequate food intake, the San Joaquin adult population is also clearly having troubles with obesity, as we might anticipate, due to the current rates of obesity in the country as a whole. More individuals are overweight than normal, with 48% (61) of the residents being overweight and 31.5% (40) being of a normal weight range. In addition, approximately 20.8% of the population is obese. These rates of obesity are very similar to those found in other Latin American countries where rates range anywhere from a low of 20% in Mexico to a high of 29.3% in Paraguay [4]. These statistics signify that San Joaquin has not escaped the growing obesity epidemic and that changes in diet and potentially policy and food accessibility are incredibly important if the community is to address the problem and reduce current rates. With the majority of the population being either overweight or obese, it can be expected that the community will also progressively begin to see increased complications and rates of chronic disease, if they have not seen so already.

The models developed in the data analysis portion of this thesis provide insight into the relationship and effect of the relationship between risk factors and BMI and diet diversity. It is important to note that the results found in this study regarding the relationship between diet diversity and obesity are not consistent with those in other studies. While there have been some inconstancies regarding the direction of the association between BMI and diet diversity, most research has determined that,

regardless of direction, there is an association [15, 16, 17, 18]. The reason that this study may have found different results is twofold. One, it is likely that the small sample size did not provide enough precision to determine associations. Second, the methods used in this study were significantly different than those most commonly used for diet diversity studies, such as 24 hour recalls. Thus, the methods used in this study may not be useful in determining the association between diet diversity and BMI.

Education and grain consumption are independently associated with BMI and, when adjusted for other covariates, are respectively negatively and positively associated with BMI. This means that the less educated an individual is the more likely he/she is to have a high BMI and thus be categorized as overweight or obese. This is of particular importance because the majority of the population surveyed had very low educational attainment and is thus at a higher risk of being overweight or obese. Literature exploring the independent effect of education on obesity in developing countries is limited; however, based on the literature available, the association found in this study between education and obesity is consistent with similar literature [27, 28]. One study conducted in 2001 among the adult Brazilian population living in two distinct areas of the country concluded that education had a strong inverse relationship with obesity (BMI >30) among women, regardless of region of residence and a small but significant association among men in the more developed region [27].

The association found in this thesis could be explained by the expected increase of knowledge of nutrition and obesity prevention among the more educated. There may also be a role in the relationship between income and education, in that, a more educated individual may have the opportunity for a better job and a higher income. As this study

found, a higher income warrants a more diverse diet which ultimately has significant effects on one's health.

The positive association between grain consumption and BMI means that, in this study, the more days per week an individual consumes grain, the more they are at risk for being overweight or obese. This too is especially important as approximately 86.3% of the population reported consuming grains every day of the week. While daily consumption of grain is currently recommended and not seen as a harmful behavior, the fact that increased consumption is a problem for residents in this community could signify 2 different issues. The first issue is that those who eat grains more often per week are also more likely to consume grains more often during the day, potentially exceeding diet recommendations. Secondly, most of the population reported never consuming whole grain rice or bread options, thus their entire diet of grains is made up of white rice and white bread. Both of these food choices are poor when lacking supplemental whole grain options as non whole grain items often lack nutrients and vitamins when compared to their whole grain counterparts.

This study concluded that income is positively associated with diet diversity. As the more income a household makes, the more likely it is to have a higher diet diversity score and thus a more diverse diet. Much of the current literature addresses income as a component of SES, but does not necessarily look at the independent effect income has on diet diversity. In addition, many studies focus on the relationship between income and obesity, rather than income and diet diversity. One study, published in 2006, found that among Korean adults, those with higher household incomes consume a greater variety of food than those with lower incomes [29].

This idea is very straightforward in that the market basket developed in this thesis indicates the least amount of money needed for a diverse diet and those who do not have that available income simply cannot purchase the necessary foods. Based on recent data on household food consumption expenditure, families in Ecuador spend approximately 50% of their total expenditure on food [30]. Understanding this, assuming a family in San Joaquin makes the average household income of $200, then they only have approximately $25 per week to spend on food; however, the food basket costs $76.36. That means that on average, families are approximately $51.36 short each week. There is a huge gap between the money earned by each resident and that which is necessary to consume a healthy and diverse diet eat week. In addition, the food basket at a cost of $76.36 is for a family of 5; however, approximately 25% of the population has a family of 7 or more members. Thus, at least a quarter of the population has an even larger gap. It is clear why those with low incomes have low diet diversity, as they simply can't afford a more diverse diet.

It also goes without saying that the more money an individual has, the more they have to spend on food, although there is no guarantee that that extra income is spent on food or that individuals will use it to purchase a more diverse diet.

Place of residence, specifically residing in either Cañaro or Pinchisana, was determined to be negatively associated with diet diversity scores in that an individual who resides in either community, is more likely to have a lower diet diversity score, and thus a less diverse diet. These results are consistent with previous studies which have determined that individuals living in less isolated communities or urban areas have more diverse diets compared to those in rural or isolated communities [29, 31].

Based on personal observations during fieldwork, this association could largely be due to an economic inequality as well as difference in access to food among residents in the community. Cañaro and Pinchisana are located about an hour and hour and a half away, respectively, from the center of San Joaquin. In these areas of San Joaquin that are located far from the city center, many people may only buy food once a week. The urban center of Cuenca provides access to supermarkets and local outdoor markets; however, those residing in San Joaquin only have consistent access to small convenience stores which stock necessities, but offers much less of a selection of fruits, vegetables, and meat products. In addition, those that live far can only buy what they can carry back home. This means that they cannot purchase a wide variety, simply because they cannot carry all of it home. Transportation options also become increasingly limited the further the communities are from the center as the roads are fewer in number and in worse condition. This means that they are limited in their options for transporting food from Cuenca to their individual homes. The distance often means that families cannot access or keep enough food to have a nutritional diet each week. Based on all of this, it would make sense that the two farthest communities are the only ones which have an association with diet diversity.

Recommendations

Based on personal observations as well as support from the data collected as part of this thesis, accessibility, both geographic and economic are some of the more significant concerns that must be addressed if the community is to combat their current rates of obesity. Perhaps one way to address the geographic component would be to encourage the start of a weekly local market in San Joaquin. Currently, the only large markets are in Cuenca and many people must not only walk to the center of town to catch a bus, but also take the bus to the market in Cuenca. Since many of the community members are the producers of much of the foods found in the Cuenca markets, they could potentially set up in San Joaquin once a week rather than the city markets. While this would not solve all of the geographic barriers residents face, it would cut down on distance and time. Another potential option is to have mobile food vendors, such as trucks, which would travel throughout the community allowing residents to purchase food close to their homes. This could allow for residents to both purchase more food at once as transporting groceries long distances would no longer be an issue as well potentially allow residents to purchase food more frequently. Many of the more nutritious foods are much more difficult to find if people are not shopping at the supermarket, which 75.5% of the surveyed population does not. Based on observations of the most frequented market, Ferria Libre, unless one specifically looks for food, such as quinoa, it is almost impossible to find. In addition, during our market survey we were unable to find foods such as whole grain bread or brown rice at the market. Suggestions for improvement include encouraging the sales of these types of food at the market or finding ways to make supermarket quality food available to the people of San Joaquin

outside of the supermarket. This is perhaps an opportunity to strengthen the current partnership between the community of San Joaquin and Coopera, as one of its main goals is to provide quality food for less money. A strengthened partnership could provide a more local source of food products, as there is currently a small store which residents can access in the community, though it is important to note that it is not easy to find. With goals of the Coopera being to diversify current crops and to distribute quality food cheaply, there is a great opportunity to make less available foods, such as wheat bread or wheat rice, more readily available. There is no guarantee that residents will purchase food from Coopera; however, the collected data demonstrated that there are some residents that currently purchase their food from the cooperative. Perhaps increased communication and advertisements promoting purchase could encourage increased community support. In addition, much of the food at Coopera is cheaper than at the market, so it would be in the best interest of the residents to purchase their food from the cooperative. One current complication to this, as was noted in an earlier chapter, is that Coopera currently prices food items by kilogram; however, community members only know the costs of foods based on pounds, the measurement used in Cuenca markets. It is recommended, and there was brief conversation about this when the team was in the field, that Coopera transition from using kilograms to using pounds.

Another potential option to increase the diet diversity of the community would be an agricultural intervention which encouraged households to grow more diverse crops for personal consumption. Again, the potential for increased partnership with Coopera exists within this idea, as stated above, a major goal of the cooperative is to find new ways to diversify current crops in the local environment. They could assist in teaching

community members which food will grow well and how to grow food that the community members may not have experience cultivating. In addition, perhaps through partnering with the Ministry of Health or the Ministry of Agriculture, counseling and education could be provided to teach the community the importance of consuming these new foods. Ideally, this would not only lead to better nutrition within the community, but could also develop the local economy if households were able to diversify their products for sale in the markets or if Coopera was willing to employ community members as vendors and purchase their excess crops.

Current consumption patterns result from both economic as well as cultural factors. While potatoes, rice, pasta, and mote are some of the cheapest options for food, these foods are also very much imbedded in the culture in Ecuador. Eating other nutritious foods must combat current cultural understandings as well. For example, when asked if they ate whole grain bread, many people responded that whole grain bread is for people who want to go on a diet or who are sick. It is important that new communication strategies are developed that portray those foods with negative cultural views as every day food for everyday people.

Lastly, as income plays such an important role in diet diversity, increased research is necessary to determine possible subsidization options that will allow residents of San Joaquin to purchase the necessary quantities of food for a healthy diet, something it is clear they cannot currently do based on the monetary gap between average weekly food expenditures and the cost of a healthy weekly diet, as evidenced from the developed low cost basket. However, recognizing that this is something that will take quite a bit of time to address, it is important to focus more on encouraging the community to change their

diet consumption rather than the frequency of consumption. While each issue is important in combating obesity, until ways in which an individual can carry and keep enough food to meet the daily recommended intakes are developed, perhaps the more useful approach would be to focus on changing diet consumption to include more nutritious foods while also keeping the total price down. For example, there should be a push towards supplementing current grain intake with whole wheat products and encouraging increased fish consumption over poultry or meat consumption. This recommendation was briefly explored, though more discussion between stakeholders in country is needed, as part of the larger project. The primary researcher and research assistant developed a communication tool to be distributed to the community during community events and physicians community visits. The tool consisted of a calendar that contained a pictorial nutrition message encouraging a more balanced diet. While there were plans to produce and distribute these calendars, currently no action has been taken by *Consejo Cantonal de Salud*.

Limitations

It is important to recognize that there were some limitations that may have affected the results of this study. First, while the study aimed to survey both males and females, few adult men were actually surveyed. Many of the men in the community worked away from their homes, either in nearby fields or in the surrounding city area and since surveys were conducted door-to-door during the morning and early afternoon when most men were at work, many were unavailable to participate in the survey. This may have affected the results by limiting the study's ability to determine if and what kind of

the food consumption differences exist between men and women in the community and whether those differences increase their risk of obesity differently.

A second limitation is that the study used convenience sampling to find participants as there was limited time and resources for the study. This sampling choice may have decreased the ability to generalize the study's results to the larger San Joaquin population and other surrounding communities. There were some attempts to try to stay as representative as possible as the sectors that were visited as part of the study were chosen by local medical providers to give, from their prospective, the most true or representative view of the city. The team visited sectors that were close to the center of town, far from the center, sectors with more wealthy residents and sectors with less wealthy residents.

There were also some possible limitations due to the questions on the surveys. Although the surveys were pilot tested and were reviewed by local medical professionals and the staff at the province health department, some questions remained confusing to respondents. In particular, some foods which were consumed daily by the community, such as potatoes and rice, should have been categorized separately rather than with other foods of the same food group when asked about consumption. Putting potatoes and rice together with other foods in the same food group may have led to an overestimation of the food intake of other grains and vegetables. In addition, potatoes should have been separated from vegetables as potatoes are tubers. Once it became clear that this might be a problem, steps were taken to avoid confusion as much as possible. When asking about vegetable and grain intake and type of food consumption, potato consumption was asked last so that people were less confused as to what "vegetables" were defined as and

questions about quantity were asked before defining the category by asking which types of food were consumed. In addition, the survey only addressed weekly food consumption and not daily consumption like most other nutrition surveys. This means that while we have some idea as to the consumption patterns of the community, we have no way of determining what those patterns are like on a daily level. This also is complicated by the fact that most dietary recommendations are based on daily intake and not weekly, thus there is no way of determining with certainty that individuals are meeting the recommended intakes.

REFERENCES

1. Bernstein, A. (2008). "Emerging patterns in overweight and obesity in Ecuador." Rev Panam Salud Publica **24**(1): 71-74.

2. United Nations World Food Programme. WFP Countries: Ecuador. http://www.wfp.org/countries/ecuador. Accessed: March 4, 2010.

3. Pan American Health Organization. http://new.paho.org/. Accessed: March 4, 2010.

4. Filozof, C., C. Gonzalez, et al. (2001). "Obesity prevalence and trends in Latin-American countries." Obes Rev **2**(2): 99-106.

5. World Health Organization. WHO Global InfoBase: Ecuador: All Data. https://apps.who.int/infobase/reportviewer.aspx?rptcode=ALL&uncode=218&dm=16&surveycode=101704a1. Accessed: March 4, 2010.

6. CIA The World Factbook: Ecuador. https://www.cia.gov/library/publications/the-world-factbook/geos/ec.html. Accessed 1-17-2011

7.Larrea, Carlos and Ichiro Kawachi. (2005). "Does Economic Inequality Affect Child Malnutrition? The Case of Ecuador." Social Science & Medicine **60**: 165-178.

8. Waters, William F. (2006). "Globalization and local response to epidemiological overlap in 21st century Ecuador." Globalization and Health 2(8).

9. World Bank. Ecuador Data: Indicators. http://data.worldbank.org/indicator/SP.DYN.LE00.IN/countries/EC?display=graph. Accessed: March 21, 2011.

10. Popkin, B. M. and P. Gordon-Larsen (2004). "The nutrition transition: worldwide obesity dynamics and their determinants." Int J Obes Relat Metab Disord **28 Suppl 3**: S2-9.

11. Popkin, B. M. (1994). "The nutrition transition in low-income countries: an emerging crisis." Nutr Rev **52**(9): 285-298.

12. Popkin, B. M. (2003). "The nutrition transition in the Developing World." Development Policy Review **21**(5-6): 581-597.

13. Albala, C., F. Vio, et al. (2001). "Nutrition transition in Latin America: the case of Chile." Nutr Rev **59**(6): 170-176.

14. Berti, P. R. and W. R. Leonard (1998). "Demographic and socioeconomic determinants of variation in food and nutrient intake in an Andean community." Am J Phys Anthropol **105**(4): 407-417.

15. Azadbakht, L. and A. Esmaillzadeh (2011). "Dietary diversity score is related to obesity and abdominal adiposity among Iranian female youth." Public Health Nutr **14**(1): 62-69.

16. Kennedy, E. (2004). "Dietary diversity, diet quality, and body weight regulation." Nutr Rev **62**(7 Pt 2): S78-81.

17. Raynor Ha, Epstein LH. (2001). "Dietary variety, energy regulation and obesity". Psychol Bull. 3:127.

18. Eileen, Kennedy T. et al. (2001). "Popular diets: correlation to health, nutrition and obesity". J Am Diet Assoc.101:411–420.

19. Must, A., J. Spadano, et al. (1999). "The disease burden associated with overweight and obesity." JAMA **282**(16): 1523-1529.

20. Hossain, Parvez et al. (2007). "Obesity and Diabetes in the Developing World – A Growing Challenge." N Engl J Med **356**(3):213-215.

21. Guh et al. (2009). "The incidence of co-morbidities related to obesity and overweight:A systematic review and meta-analysis." BMC Public Health **9**(88).

22. Rodriguez, T., M. Malvezzi, et al. (2006). "Trends in mortality from coronary heart and cerebrovascular diseases in the Americas: 1970-2000." Heart **92**(4): 453-460.

23. Hidalgo, L. A., P. A. Chedraui, et al. (2006). "The metabolic syndrome among postmenopausal women in Ecuador." Gynecol Endocrinol **22**(8): 447-454.

24. Carlson, A., Lino, M., & Fungwe, T. (2007). *The Low-Cost, Moderate-Cost, and Liberal Food Plans, 2007* (CNPP-20). U.S. Department of Agriculture, Center for Nutrition Policy and Promotion.

25. United States Department of Agriculture. National Nutrient Database. http://www.nal.usda.gov/fnic/foodcomp/search/. Accessed: April 15, 2011.

26. United States Department of Agriculture. My Pyramid. http://www.mypyramid.gov/. Accessed: April 15, 2011

27. Monteiro, C. A., W. L. Conde, et al. (2001). "Independent effects of income and education on the risk of obesity in the Brazilian adult population." J Nutr **131**(3): 881S-886S.

28. Martorell, R., L. K. Khan, et al. (1998). "Obesity in Latin American women and children." J Nutr **128**(9): 1464-1473.

29. Ahn, Byung Chul, Engelhardt, Katrin and Joung, Hyojee. (2006). “Diet Variety is Associated with Socio-economic Factors”. Ecology of Food and Nutrition **45**(6): 417-430.

30. World Bank (2007). *Nutritional Failure in Ecuador: Causes, Consequences, and Solutions*. Washington D.C.

31. Torheim, L. E., F. Ouattara, et al. (2004). "Nutrient adequacy and dietary diversity in rural Mali: association and determinants." Eur J Clin Nutr **58**(4): 594-604.

APPENDIX A: Survey Instruments (English and Spanish)

Nutrition Survey for the Parrochial San Joaquin 2010 - ENGLISH

Interviewer:_____
Date: _____ Time: _____

DEMOGRAPHIC DATA

1. Age |__|__|

2. Gender ☐Male ☐Female

3. Occupation _____

4. How much money do you make per month?

☐Less than $200 ☐$200 - $500

☐$500 - $1,000 ☐$1,000 +

☐I don't know

5. How many poeple live in your house?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7+

6. What grade in school have you completed?

☐ No School

☐ Primary Incomplete ☐ Primary Complete

☐ Secondary Incomplete ☐ Secondary Complete

☐ University Incomplete ☐ University Complete

7. Height |__|__|__| centimeters

8. Weight |__|__|__| kilos

Comida Ingerida

9. How many days per week do you eat fruit?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

10. What fruits do you eat?

☐ Banana ☐ Grapes ☐ Mangos ☐ Watermelons

☐ Apples ☐ Tree Tomatoes ☐ Peaches ☐ Pears

☐ Plums ☐ Avocados ☐ Oranges ☐ Pineapple

☐ Granadillas ☐ Papaya ☐ Mandarines ☐ Other_____

11. How many days per week do you eat vegetables?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

12. What vegetables do you eat?

☐ Potatoes ☐ Broccoli ☐ Carrots ☐ Lettuce ☐ Tomatoes

☐ Greenbeans ☐ Raddishes ☐ Cabbage ☐ Beets ☐ Coliflower

☐ Celery ☐ Cucumbers ☐ Nabo ☐ Other

13. What types of meat do you eat?

☐ Pork ☐ Beef ☐ Goat ☐ Lamb ☐ Guinea Pig

☐ Chicken ☐ Fish ☐ Otros _____

14. How many days per week do you eat meat?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

15. How many days per week do you eat grains? (rice, bread, cereal, beans, mote, corn, quinoa)?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

16. What types of grains do you eat?

☐ White Rice ☐ Brown Rice ☐ Wheat Bread ☐ White Bread ☐ Cereal

☐ Beans ☐ Mote ☐ Corn ☐ Quínoa ☐ Other _____

17. How many days per week do you eat nuts?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

18. How many days per week do you eat eggs?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

19. How many days per week do you eat cheese?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

20. How many days per week do you drink milk?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

21. What types of drink s do you consume?

☐ Agua de Frescos ☐ Juice ☐ Colada

☐ Sodas ☐ Milk ☐ Tap water

Proceso de Alimentación

22. What do you generally eat and drink for breakfast?

23. What do you generally eat and drinkfor lunch?

24. What do you generally eat and drink for dinner?

25. Where do you buy your food?

☐ Market ☐ Supermarket ☐ Farm ☐ Neighbor ☐ Gifts ☐ Other _____

Food Preparation

26. Do you wash your hands before you eat?

☐ Yes ☐ No

27. Do you wash your hands before you cook?

☐ Yes ☐ No

Suggestions

1. Wash your hands before you eat and cook
2. If possible, include fruits, vegetables, and protein in your diet

ENCUESTA DE NUTRICION DE LA PARROQUIA SAN JOAQUIN 2010 -ESPANOL

Entrevistador:_____
Dato: _____ Tiempo: _____

DATOS DEMOGRAFICOS

1. Edad |__|__|

2. Género ☐Hombre ☐Mujer

3. Ocupación _____

4. ¿Cuánta plata gana usted por mes?

☐Menos de $200 ☐$200 - $500

☐$500 - $1,000 ☐$1,000 +

☐No se

5. ¿Cuantas personas viven en su casa?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7+

6. ¿Qué grado cumplió de escuela?

☐ Analfabeto

☐ Primaria Incompleta ☐ Primaria Completa

☐ Secundaria Incompleta ☐ Secundaria Completa

☐ Superior Incompleta ☐ Superior Completa

7. Altura |__|__|__| centimeters

8. Peso |__|__|__| kilos

Comida Ingerida

9. ¿Cuántos días por semana come fruta?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

10. ¿Qué frutas come?

☐ Guineo ☐ Uvas ☐ Mangos ☐ Sandias

☐ Manzanas ☐ Tomates de árbol ☐ Duraznos ☐ Peras

☐ Reina Claudia ☐ Aguacates ☐ Naranjas ☐ Pinas

☐ Granadillas ☐ Papaya ☐ Mandarina ☐ Otras_____

11. ¿Cuántos días por semana come legumbres?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

12. ¿Qué legumbres come?

☐ Papas ☐ Brócoli ☐ Zanahorias ☐ Lechugas ☐ Tomates

☐ Vainitas ☐ Rábanos ☐ Coles ☐ Remolachas ☐ Coliflores

☐ Apio ☐ Pepinos ☐ Nabo ☐ Otros

13. ¿Qué tipos de carnes come?

☐ Chancho ☐ Res ☐ Borrego ☐ Chivo ☐ Cuy

☐ Pollo ☐ Pescado ☐ Otros _____

14. ¿Cuántos días por semana come carne?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

15. ¿Cuántos días por semana come granos (arroz, pan, cereal, porotos, mote, maíz quinoa)?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

16. ¿Qué tipos de granos come?

☐ Arroz Blanco ☐ Arroz Integral ☐ Pan Integral ☐ Pan Blanco ☐ Cereal

☐ Porotos ☐ Mote ☐ Maíz ☐ Quínoa ☐ Otros
_____

17. ¿Cuántos días por semana come toctes/nueces?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

18. ¿Cuántos días por semana come huevos?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

19. ¿Cuántos días por semana come queso?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

20. ¿Cuántos días por semana toma leche?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

21. ¿Qué tipo de bebida toma?

☐ Agua de Frescos ☐ Jugos ☐ Colada

☐ Gaseosa ☐ Leche ☐ Agua puro

Proceso de Alimentación

22. ¿Qué come y bebe en los desayunos generalmente?

23. ¿Qué come y bebe en los almuerzos generalmente?

24. ¿Qué come y bebe en las meriendas generalmente?

25. ¿Dónde compra ud. la comida?

☐ Mercado ☐ Supermercado ☐ Granja ☐ Vecino ☐ Regalos ☐ Otros _____

Preparación de la Comida

26. ¿Se lava las manos antes de comer?

☐ Si ☐ No

27. ¿Se lava las manos antes de cocinar?

☐ Si ☐ No

Sugerencias

1. Lavarse las manos antes de comer y cocinar
2. Si es posible, incluya frutas, legumbres y proteína en la dieta

APPENDIX B: Market Prices based on July 2010 visit to Ferria Libre

Fruits			Vegetables		
	Price	**Quantity**		**Price**	**Quantity**
Banana	$1.00	18	Broccoli	$0.50	1
Apples	$1.00	8	Lettuce	$0.30	1
Plums	$1.00	8	Green beans	$0.50	packet
Granadillas	$1.00	6	Cabbage	$0.40	1
Pineapples	$1.50	2	Cauliflower	$0.40	1
Pears	$1.00	5	Pepinos	$1.00	4
Mandarins	$1.00	20	Carrots	$1.00	20
Babaku	$1.50	1	Tomatoes	$0.60	3
Kiwi	$1.00	12	Radishes	$0.20	packet
Naranjilla	$1.00	15	Celery	$0.30	packet
Coconut	$1.00	1	Beets	$2.50	packet (25)
Plata	$1.00	7	Turnips	$0.25	packet
Tree Tomatoes	$1.00	10	Onion	$0.50	1 lb
Avocados	$1.00	3	Peppers	$1.00	15
Papaya	$1.50	2	Peas	$1.00	1 lb
Watermelons	$2.00	1	Arelga	$0.25	packet
Peaches	$1.00	5	Spinach	$0.25	packet
Oranges	$1.00	25	Meyoco	$1.00	gallon
Melon	$2.00	1	Yucca	$1.00	7 lbs
Membrios	$1.00	5	Eggplant	$1.00	4
Raspberries	$1.25	1 lb	Potatoes	$1.50	bucket
Strawberries	$1.00	1 lb	Potatoes - chola	$2.00	bucket
Grapes - black	$1.00	1 lb	Potatoes - choucha	$2.50	bucket
grapes - red/green	$1.50	1 lb	Sambo	$0.50	1
Chirimoya	$0.50	1	Zucchini	$0.25	1
Tamarind	$1.00	packet			
Guava	$1.00	17			

Meat			Grains		
	Price	**Quantity**		**Price**	**Quantity**
Pork	$2.00	1 lb	Pasta	$0.50	1 lb
Chicken	$1.20	1 lb	White rice	$0.40	1 lb
Beef	$2.00	1 lb	Quinoa	$1.50	1 lb
Fish	$1.25	1 lb	Wheat	$1.60	1 lb
Lamb	$2.25	1 lb	Cereal	$0.50	med bag
Goat	$2.25	1 lb	Mote	$1.00	1 lb
Guinea Pig	$2.25	1 lb	Beans	$1.00	1.50 lb
Sausage	$2.00	6 pcs	White bread	$0.90	10
Vinesa	$1.00	1 lb (7 pcs)	Arroz de sebada	$0.75	1 lb
Shrimp	$3.50	1 lb	Oats	$0.60	1 lb
Corvina	$2.50	1 lb	Toctes	$1.00	packet
Catfish	$1.80	1 lb			
Pig fat	$1.50	1 lb			
Congrejo	$10.00	12			
Live guinea pig	$7.00	1			
Live rabbit	$7.00	1			
Live chicken	$7.00	1			
Live chick	$1.00	4			
Live duck	$8.00	1			

Miscellaneous		
	Price	**Quantity**
Eggs	$2.80	30
Sapallo	$2.00	1
Soap	$0.40	1 bar
Lentils	$0.75	1 lb
Leinaza	$0.70	1 lb
Achote	$1.25	1 lb
Ginger	$1.50	1 lb
Coffee	$1.70	1
Cangil	$0.60	1 lb
Dry peas	$0.40	1 lb
Morochillo	$0.50	1 lb
Chocolate	$3.00	1 lb
Peanuts	$1.00	1 lb
Aho	$2.00	1 lb
Cheese	$1.50	1 lb

APPENDIX C: Institutional Review Board (IRB) Approval Letter

EMORY UNIVERSITY

Institutional Review Board

FROM: Donna Dent, MS, MISM, CIP
Lead, Research Protocol Analyst
Emory University IRB

TO: Danielle Lee Tuft
Principal Investigators
Emory University

DATE: April 21, 2010, 2010

RE: Notification of Submission Determination: No IRB Review Required

TITLE: **Assessment of Nutritional Behaviors among the Adult Indigenous Population in San Joaquin, Ecuador**

Thank you for requesting a determination from our office about the above-referenced project. Based on my review of the study protocol emailed on 4/21 2010 I have determined that it does not require IRB review because it does not meet the 45 CFR Section 46.102(f)(2) definition of "Human Subjects Research" or the definition of "Clinical Investigation" under applicable federal regulations. As described, these are educational activities and a baseline assessment for the Consejo Cantonal de Salud health department. It involves collecting anonymous interviews of adults and observations in public markets about eating habits and food handling behaviors. No identifiable private information is collected. Accordingly, IRB review is not required.

45 CFR Section 46.102(f)(2) defines "Research involving Human Subjects" as follows:

> Human Subject means a living individual about whom an investigator (whether professional or student) conducting research obtains:
>
> (1) data through intervention or interaction with the individual, or
> (2) identifiable private information
>
> Intervention includes both physical procedures by which data are gathered (for example, venipuncture) and manipulations of the subject or the subject's environment that are performed for research purposes. Interaction includes communication or interpersonal contact between investigator and subject. Private information includes information about behavior that occurs in a context in which an individual can reasonably expect that no observation or recording is taking place, and information which has been provided for specific purposes by an individual and which the individual can reasonably expect will not be

made public (for example, a medical record). Private information must be individually identifiable (i.e., the identity of the subject is or may be ascertained by the investigator or associated with the information) in order for obtaining the information to constitute research involving human subjects.

In addition, the IRB has determined that the study is not a "Clinical Investigation" under applicable Food & Drug Administration regulations because it does not involve a test article and does not otherwise meet the requirements of the definition of "Clinical Investigation" as set forth in 21 CFR Section 50.3(c).

Please note that any changes to the protocol could conceivably alter the status of this research under the federal regulations cited above. Accordingly, any substantive changes in the protocol should be presented to the IRB for consideration prior to their implementation in the research.

Sincerely,

Donna Dent, MS, MISM, CIP
Lead, Research Protocol Analyst
Emory University Institutional Review Board
This letter has been digitally signed

Emory University
1599 Clifton Road, 5th Floor - Atlanta, Georgia 30322
Tel: 404.712.0720 - Fax: 404.727.1358 - Email: irb@emory.edu - Web: http://www.emory.edu/irb