Yale University

EliScholar – A Digital Platform for Scholarly Publishing at Yale

Yale Medicine Thesis Digital Library

School of Medicine

9-30-2010

Impact of Seasonality and Food Security on Growth and Morbidity in Children under 2 Years in Rural Honduras

Jacqueline Wilson

Follow this and additional works at: http://elischolar.library.yale.edu/ymtdl

Recommended Citation

Wilson, Jacqueline, "Impact of Seasonality and Food Security on Growth and Morbidity in Children under 2 Years in Rural Honduras" (2010). *Yale Medicine Thesis Digital Library*. 176.
http://elischolar.library.yale.edu/ymtdl/176

Impact of Seasonality and Food Security on Growth and Morbidity in Children Under 2 Years in Rural Honduras

A Thesis Submitted to the Yale University School of Medicine in Partial Fulfillment of the Requirements for the Degree of Doctor of Medicine

by
Jacqueline Deanna Wilson
2010

Impact of Seasonality and Food Security on Growth and Morbidity in Children under 2 Years in Rural Honduras

Deanna Wilson (Sponsored by Andrea Asnes, Department of Pediatrics, Yale University School of Medicine and Urania Magriples, Division of Maternal Fetal Medicine, Department of Obstetrics and Gynecology, Yale University School of Medicine.)

Child malnutrition remains a significant problem worldwide with children under two years of age at particular risk. Even mild to moderate child undernutrition in food insecure households has been associated with poor growth, increased rates of infection and poor development. Rural Honduras undergoes a rainy and a dry season each year. Households rely on subsistence agriculture and as the dry season progresses, they have fewer food reserves and limited cash resources. It is anticipated that this will lead not only to decreased measures of food security, but also that children in food secure households will have higher rates of growth and lower rates of disease than children from food insecure households.

This study aims to determine predictors of household food security, the impact of seasonality on food security and the utility of food security at predicting rates of growth and disease in children under two in rural Honduras. One hundred and forty-one mother-infant pairs participated in this longitudinal, observational study. Food security was assessed at baseline and at the close of the study period utilizing a 14 question Food Insecurity Questionnaire. Additional measures included: a baseline demographic assessment and monthly child health questionnaire. Analyses of food security were completed using both a paired sample t-test and a repeated measures ANOVA to determine the impact of season (dry versus rainy) on food security. A multivariate regression model using backwards selection determined the best fit model for predicting total food security in both dry and rainy seasons. Multivariate regression modeling identified the food security questions that were the best predictors of growth and illness during dry season controlling for age cohort and gender.

Food security was significantly lower during the dry season (mean 32.98 ± 4.35) compared to the rainy season (mean=36.44 ± 5.23) ($p<0.001$). Bivariate analyses showed decreased rates of food security in households with female children (N=65; mean 32.5 ± 4.98) compared to households with male children (N=74; mean 34.0 ± 5.3; p=0.099) during the dry season. In addition, rates of food security in households with younger children (ages 6-12 months of age) were lower than households with older children (ages 12-19 months of age) in both dry and rainy season (p=0.110; p=0.038). Multivariate regression modeling identified the food security measures and maternal and child characteristics that predicted total food security during rainy (p=0.002) and dry season (p<0.001). Multivariate regression models used questions from the food security questionnaire to predict parent-reported days of illness controlling for age and gender. Different groupings of food security questions were significant predictors for parent-reported days of diarrhea, fever, shortness of breath, and vomiting, but not days of cough.

Our findings confirm higher rates of food insecurity during the dry season than during the rainy season in rural Honduras. They identify maternal and child characteristics that increase the risk and severity of food insecurity in children and also illustrate the link between different indicators of household food security and rates of child growth and morbidity.

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

INTRODUCTION

Though the worldwide prevalence of underweight children has decreased since 1990, a staggering 143 million children younger than five years of age still suffer from undernutrition [1]. During the United Nations Millennium Summit, the UN set a goal to reduce the prevalence of underweight children in half by 2015. From 1990, there has been gradual progress and small gains made in the proportion of people who are undernourished. The current global economic crisis has, for the first time, led to an increase in the rate of undernutrition in 2008. Increases in food prices triggered by supply problems and increasing demand continue to erode the gains made in hunger reduction [2]. Today, undernutrition impacts one in three people globally [2, 3].

Poor childhood nutrition remains a significant cause of morbidity and mortality worldwide. Malnutrition suppresses the immune system impairing both humoral and cell-mediated immunity thereby increasing a child's vulnerability to infection. Studies have estimated that in developing countries, malnutrition contributes to about half of all deaths among children and the risk of death is increased with even mild or moderate undernutrition [4]. Malnutrition also decreases the ability of a child to recover from disease [5, 6]. Poor nutrition prior to a given illness has been associated with increased recovery times for catch-up growth following the resolution of a major illness [5, 7]. Diarrhea tends to be more severe and to last longer in poorly nourished children [8, 9]. The loss of nutrients with diarrheal illnesses compounds preexisting nutrient deficiencies thereby diminishing growth and development and increasing the risk of acquiring another illness[10]. Bhutta et al. (2008) estimate that 10% of total deaths and disability adjusted life years in children younger than 5 years are attributable to micronutrient deficiencies, many secondary to vitamin A and zinc deficiency [11, 12].

Fifty-five million children globally have wasting, defined as a weight-for-height Z score of less than -2, which is an indicator of not only long-term undernutrition, but also a manifestation of acute food shortage and/or disease [13]. Wasting is a strong predictor of mortality among children under five, while stunting (height-for-age Z score of less than -2) reflects long-term insufficient intake. One-third of children under five in the developing world experience stunting, which has been linked to poor school performance[14, 15], impaired cognitive development [16-18], and behavioral and emotional problems impeding success in school and productivity in the workforce[1, 18]. In addition, children who experience stunting are at risk of not only poor immune function[19] and increased risk of mortality [20], but also, according to a growing body of literature, are at risk for long-term chronic conditions like hypertension, diabetes and obesity in adulthood[18, 21].

Anthropometric measurements quantify the severity of undernutrition only in children who already exhibit physical sequelae of scarcity; food security is a way to assess children who experience mild to moderate undernutrition. The term food security has been defined by the Food and Agriculture Organization of the United Nations (FAO) as "access by all people at all times to enough food for an active, healthy life [22]." Food insecurity occurs when members of a household are unable to obtain or are worried about being able to obtain sufficient healthy foods for all members of a given household [23]. A crucial component of food security is the acquisition of food, which is both nutritionally adequate and safe, in socially acceptable ways. For example, families that resort to extreme measures to maintain adequate quantities of food via food pantries, food banks, or through donation may have sufficient foods to meet caloric needs, but they are not

food secure. Research looking at the impact of food security has shown a relationship between food insecurity (even in the setting of normal anthropometrics) and numerous negative health outcomes [15, 18, 21, 24-26]. Children in food insecure families are at greater risk of recurrent infections, are at risk of poor growth and are at higher risk of developing psychosocial problems and learning delay even in the absence of anthropometric abnormalities [15, 21, 25, 27, 28].

Research has identified several risk factors that increase the likelihood that a child will be malnourished. Several risk factors such as large family size [28, 29] and birth intervals of less than 35 months [30] likely act by increased strain on limited financial resources. Decreased birth spacing and large family size may cause mothers with multiple children to wean from breastfeeding earlier [31]. Some other factors associated with malnutrition are low levels of maternal education [28, 29, 32-34] and poverty[34, 35]. Weaning children (between 6 months and 2 years of age) are often at increased risk for malnutrition even in food secure households[29, 30]. Breast feeding is protective of stunting (a marker of long-term food shortage) [14], but as children begin to reduce the quantity of breast milk consumed and mothers substitute breast milk with other foods, children can often become under- or malnourished. The possible mechanisms for this include: the physical inability of many young children to digest certain solid foods at early ages, the foods replacing or supplementing breastmilk may be nutrient or calorie deficient, and improperly prepared and stored foods increase the risk of acquiring food-borne bacteria and illnesses in young children [31].

Like malnutrition, food security can be chronic, but most often there are acute or seasonal stressors that impact food access and nutritional status [19, 36-43]. These cycles

may be related to planting and harvesting in societies reliant on agriculture. Rural communities have a greater reliance on subsistence farmers for food production and are subject to a greater impact of seasonality on food availability [14, 34, 44, 45]. Children in rural communities are nearly twice as likely to be underweight as those in urban areas [1]. The seasonal shortages of food have been associated with poor child health outcomes. In the time period immediately prior to the harvest, many families are forced to purchase staples, such as, rice and beans, and have decreased money for nutrient-rich foods, like milk or meat [42]. A recent study in Zimbabwe found a small but significant increase in numbers of underweight children that coincided with the period of food scarcity before a harvest. These periods of scarcity also coincided with increased rates of diarrhea and malaria that posed an additional biological stress [42]. Frequently, heavy rains cause increased contamination of water sources with fecal matter and lead to increased incidence of diarrheal illnesses that drive increased levels of child malnutrition. But seasonal patterns of growth are not limited to agricultural societies and are present in both the developing and developed world. Weight gain tends to peak in autumn and winter and height gain peaks in spring and summer [37, 38, 40, 43, 46]. This has been attributed to diverse factors ranging from variability in the availability of food and changing prevalence of disease to climatic and environmental factors that trigger differences in hormone production [47-49].

A number of studies suggest seasonality has a more marked difference in the number of children with wasting versus the number of children with stunting [50]. This may be secondary to wasting being a more accurate reflection of acute food shortage and stunting being more reflective of chronic (and therefore not seasonal) food shortages.

Conversely, it appears that gains in height in young children also lag behind gains of weight by three to four months [39]. The recovery of growth following acute stressors often begins with weight gain and gradually will lead to recoveries in linear growth velocity[49].

Even though children younger than five are at increased risk for developmental and neurological consequences of malnutrition, little research has been done on the effectiveness of nutritional interventions targeting children under five. Many international organizations and researchers have developed school-based nutritional interventions because of the ease with which needy children can be identified and the intervention delivered. These interventions often target children who may already have stunting and impaired cognitive development thereby potentially decreasing the clinical effectiveness of the intervention. There has been some research on the impact of supplementary feeding programs in school age children that shows improvement in wasting in already malnourished children with increased dietary intake [51]. A recent review by Bhutta et al (2008) found evidence to suggest that some interventions, such as nutrition education with complementary feeding support (via food supplements or conditional cash transfers), led to improved child health outcomes and increased linear growth [11]. Studies to evaluate the efficacy of community-based feeding programs targeting those at increased risk for the negative health consequences of poor nutrition-- children under age 5--are limited. Interventions that provide food supplementation are often expensive and difficult to sustain. If it were possible to use limited resources to target the time period or season where children were most at risk for becoming food

insecure, resources could be better utilized to achieve the maximum impact on growth and development.

STATEMENT OF PURPOSE

This analysis will explore the impact of seasonality on anthropometrics for young children in rural Honduras. Honduras is the second poorest country in Central America [52]. Sixty-eight percent of Honduran families live on less than $2 per person per day with a disproportionate number of those residing in rural areas. Though the prevalence of stunting has decreased significantly in some parts of the world, it has changed minimally (26.1 to 24.0% of children under five) in Central America from 1980 to 2000 and continues to impact about 3.9 million preschool children [53]. Poor child nutrition remains a significant public health problem in Honduras: About 25% of children under-five suffer from moderate to severe stunting, 11% are moderately to severely underweight and 1% have moderate to severe wasting (weight for height z score less than -2). In some rural areas, like the state of Intibucá, the stunting prevalence is as high as 60% and the prevalence of wasting is 20% in children under five.[1] The data used in this analysis are part of a larger study looking at the impact of a community-feeding intervention on growth, development, and health in children from six months to two years of age. This analysis aims to study factors that mediate food security, the impact of seasonality on food security and the utility of food security at predicting growth and child morbidity in this sample.

Honduras has a both a dry and a rainy season. The dry season leads to periods of food scarcity. The dry season begins in mid-November. Temperatures reach their peak in

---

[1] Unpublished data: Shoulder to Shoulder.

April and mid-May and the onset of the first rain and rainy season begins towards the end of May and beginning of June. Subsistence farmers plant the first crops of basic grains (maize and beans) during the start of the rainy season and these crops are then harvested during July and August. The rains continue until the beginning of November. The second round of crops is harvested in Mid-November, as the dry season begins, through the end of January. There is a decrease of food availability as the dry season progresses and families experience a decline in stored crops. There is a corresponding increase in price of basic foods beginning in April to the harvest. This is traditionally viewed as the "hunger season" and a time of increased food insecurity [54].

It is hypothesized that rates of household food security will be lower during the dry season than during the rainy season. Families often rely on subsistence agriculture and as the dry season progresses, families have fewer food reserves and limited cash resources. It is anticipated that this will lead not only to decreased measures of food security, but also that children in food secure households will have higher rates of growth (both weight and height) and lower rates of disease than children from food insecure households. Previous studies suggest a link between food security and child health. It is unclear, however, whether seasonal changes in food security will lead to seasonal patterns of growth and child morbidity.

MATERIALS AND METHODS

1) Setting

Shoulder to Shoulder is a 501 C3 non-governmental organization that consists of a network of partnerships between academic health centers and rural communities in

Honduras and other resource-poor countries. The organization serves as a paradigm for channeling short-term medical volunteerism into sustainable health partnerships. Local community health boards in the host countries help craft the health, research and advocacy agenda in their community [55]. In Honduras, Shoulder to Shoulder in conjunction with a Honduran non-profit, Hombro a Hombro, provide primary care to several of the poorest municipalities in the state of Intibucá. The organization covers a geographic area of several hundred square miles and provides care for about 75,000 people. It has a contractual arrangement with the Honduran Ministry of Health to provide all of the primary care and public health for the three municipalities selected in this study. The children used in the analysis are participating in a Shoulder to Shoulder community-based feeding intervention (Mejorando la Alimentación de los Niños de Intibucá/ MANI), which is assessing the impact of a feeding and education intervention on the growth, development, nutritional biomarkers, and morbidity of children under age two.

Intibucá is a mountainous region of Honduras that borders El Salvador. The site was chosen because of the long-standing relationship between the various communities within the Intibucá region and Shoulder to Shoulder. The state of Intibuca has high rates of child malnutrition: stunting prevalence is around 60% and the prevalence of wasting about 20% in children under five.[2]

2) Study Participants

Children were eligible to participate in the study if they were between 5 months and 19 months of age at the time of recruitment and resided in the communities of Santa

---

[2] Unpublished data: Shoulder to Shoulder.

Lucia, Magdalena, and San Antonio, Intibucá Honduras.   Children were required to have

a maternal primary caregiver over the age of sixteen with plans to reside in the study area

for the length of the study period. Children were excluded if they any had any chronic

comorbidities or congenital conditions that contributed to poor feeding or undernutrition,

such as heart disease or kidney failure. Because the intervention group required children

to consume a peanut-butter based supplement, all children with known peanut or egg

allergies were also excluded. Children who had weight for age z-scores below -2 were

also excluded and referred for follow-up to the central Shoulder to Shoulder Clinic in

Santa Lucia.

Potential participants were identified from a census conducted by Shoulder to

Shoulder in August and September of 2008. Participants were recruited from local

communities through door-to-door visits by local health promoters, radio announcements

and recruitment sessions at local churches and schools. Eligible households within the

three municipalities studied were visited by Shoulder to Shoulder staff. The goal for

patient recruitment was 300 children with a goal of 150 children in the control with 75 in

the age range of 5 to 12 months and 75 in the age range of 12 to 19 months.

3) Experiment Design

The analysis groups used in this study were part of a larger study of 18 village

clusters. The clusters consisted of several villages matched by characteristics elicited

during a 2008 census and were randomized to intervention and control groups. Nine

cluster pairs were matched by poverty indicators derived from the census: percentage of

households with a dirt floor, percentage with a household density of greater than 4 people

and percentage without a latrine. For this particular analysis, only children from the nine

control clusters were included. Children were assigned to a given village cluster based on maternal residence in the 2008 census. A centrally-located site (often a clinic or school) in each cluster was chosen and participants were encouraged to participate in each session at their assigned cluster. The intervention consisted of monthly educational sessions about various aspects of child feeding and health and provided food vouchers for all participants with the addition of a peanut-butter-based nutritional supplement for members of the control group. Study design was conceptualized by the principal investigator and Shoulder to Shoulder project staff with assistance from this author on multiple pieces, including randomization procedure, creation of village clusters, food voucher system design, and logistical details of intervention.

4) Data Collection

Children and mothers enrolled in the study attended monthly meetings at their assigned sites. During each meeting, mothers attended an educational session guided by adult-learner techniques that provided in-depth information about topics like complementary feeding, breast-feeding, food hygiene, and feeding children who are ill. During each monthly session, children were weighed and recumbent length was measured. Caregivers answered questions about various aspects of their child's health and participated in the educational session. At the conclusion of each session, women received two food vouchers that could be redeemed at a local store for rice, beans, corn, fruit and vegetables. Food vouchers provided a nominal amount for families as an incentive for participation that was not expected to impact overall household food security. The quantity of the food voucher was based on family size: families with <4 people in the household received about $11 per month, 5-8 people in the household

received about $16 dollars per month, and greater than 8 people in the household

received about $20 per month.

5) Study Measures

Although additional data were gathered for study participants including a monthly

24-hour dietary recall, an assessment of child and parent's acceptability to intervention, a

developmental and cognitive assessment and nutritional biomarkers, only the following

measures were used in this study: demographics, anthropometrics, health outcomes, and

food security. The measurements were conducted by a team of eight health promoters

trained by study staff and the author. A chart review was conducted at clinic sites that

service the villages utilized in the study to collect additional health data. All measures

were translated and tested for cultural appropriateness and appropriate vocabulary prior

to use in the field. A community health promoter, trained by the author, entered data

gathered from the field into an Access database designed by the author.

Demographics:

Maternal and child demographic information was collected from a fifteen item

questionnaire and census information collected by Shoulder to Shoulder (See Appendix

1).

Anthropometrics:

Anthropometrics were conducted monthly. Children were weighed without

clothing on a Weigh South Medical Model WM2300 Baby Scale to the nearest 0.01 kg

and recumbent length was measured a measuring board to the nearest 0.01 cm. Growth

parameters were calculated using World Health Organization (WHO) Anth software and

children who had weight-for-age z-scores (WAZ) below -2 were flagged for additional follow-up with Shoulder to Shoulder physicians and were not eligible to continue with the study. Children who had a WAZ <-2 during the study period were referred to the study coordinator for an additional assessment. Children who had a recent diarrheal illness or other cause of acute weight loss were maintained in the study but were monitored to insure appropriate weight gain. Children who maintained a WAZ of <-2 for several months, were referred to the clinic for a medical assessment. One health promoter, trained using a protocol written by the author, conducted all of the measurements during the study period. Measurements were recorded by hand in the field and were later entered into the electronic medical database for each child.

Parent-reported child health outcomes:

Child health outcomes were measured monthly in a 15 item questionnaire (See Appendix 2). Parents were asked to report the overall health of their child over the previous month including the number of days of diarrhea, respiratory illness, cough and fever, as well as, change in appetite, medication use and number of visits to local health clinics or alternative health providers. The questionnaire was written by the author and was administered by a trained health promoter (See Appendix 2).

Chart Review:

Parent-report of child health status was corroborated with a medical record review. There are five clinics that provide all primary care to the participants residing in the 18 village clusters used in the study: Santa Lucia Central Clinic, Santa Lucia Health Center, San Antonio Health Center, Magdalena Health Center, and San Jose Health

Center. At the inception of the study period, the only clinic with any electronic information was Santa Lucia Central Clinic. At the close of the visit day, each chart in Santa Lucia was pulled and information about each visit was entered into an electronic database. The information recorded included: date of visit, demographic information, vital signs, anthropometrics, and medical codes. The coding system is based on the International Classification of Diseases 9 (ICD 9) which lists specific codes for signs, symptoms, and diagnoses. Practitioners were instructed to code for all three when evaluating a patient. In all other clinics, the study author coded charts by hand using a coding protocol based on the ICD 9.

Study visits were recorded in an electronic database at the main Shoulder to Shoulder clinic in Santa Lucia for all patients who utilize that clinic and in paper files in clinics who have not yet converted to the electronic record. Although each clinic visited in the study period was affiliated with Shoulder to Shoulder, each clinic site is required to fulfill documentation required by the Honduran government. Each clinic is required to have a monthly patient log that records all patients seen and their diagnoses. The Honduran government requires that every healthcare provider record visit information for a child over 4 months of age and <5 years of age in particular form designed to facilitate history taking and to help standardize charting.

During the chart review, completed by the author, monthly logs recording all patient visits for a given month were studied. All visits for children under 3 years of age were flagged and each child identified was crosschecked against a master list to determine if he or she was a study participant. The following information was recorded for all study participants: the visit date, healthcare provider, diagnoses, and the child chart

number.   The chart for each child was then screened to confirm diagnosis and visit information. Clinic notes were reviewed for each child and information was coded (including, symptoms and signs) using the ICD 9 system consistent with training given to health practitioners. The information was then entered into the electronic record database.

Food Security:

Food security was assessed at baseline and at the close of the study period utilizing a 14 question Food Insecurity Questionnaire (FIQ) created by Costillo, *et al* [23]. The verbally administered questionnaire was developed to assess food security in Costa Rica (Cronhbach's α=0.89). In this study, the questionnaire is analyzed in two ways: as an expression of total of food security and by individual responses to each question. Each question in the questionnaire had three possible responses: 1=always; 2=sometimes; 3=never. Higher scores on a given question are associated with decreased likelihood of experiencing a given event or exhibiting a given behavior. Higher values are associated with higher levels of food security (See Figure 1).

FIGURE 1. FOOD INSECURITY QUESTIONNAIRE (FIQ) (TRANSLATED FROM SPANISH)	
	IN THE PAST MONTH…
FIQ 1	… have you worried that in your home there was not enough food and you could not obtain more?
FIQ 2	…did you or any adult in your home have to limit the variety of food because of lack of resources?
FIQ 3	…did you or any adult in your home have to eat the same for several days in a row because you didn't have food to prepare a different meal?
FIQ 4	…did you have to serve less food because there weren't resources to obtain enough food?
FIQ 5	…because there was not enough food at home, were you unable to prepare 1 of the meals of the day?
FIQ 6	…did you or any adult in your home have to skip 1 of the meals of the day because there was not enough food?
FIQ 7	…did you or any adult in your home have to go to sleep without eating because there was not enough food at home?
FIQ 8	…did you or any adult in your home have to go a whole day without eating because there was not enough food?
FIQ 9	…did you have to stop giving the children the food they should have because you couldn't obtain it?
FIQ 10	…because there was not enough food at home, did you have to serve less food to the children?
FIQ 11	…did any of the children have to skip 1 of the meals of the day because there was not enough food at home?
FIQ 12	…did any of the children have to go to sleep without eating because there was not enough food at home?
FIQ 13	…did any of the children have to go to a whole day without eating because there was not enough food?
FIQ 14	…in order to have food in your home, did you have to do things that make you feel ashamed?

The questionnaire can identify three levels of severity of food insecurity. The initial level refers to affirmative answers to questions 1, 2, 3 or 4 of the questionnaire. This is defined as mild food insecurity and includes parents who are worried about their ability to meet their family's food needs and may include adults that reduce the variety of items they eat because of financial constraints. The moderate level of food insecurity includes affirmative responses to questions 5, 6, 7, 9, or 10. This level encompasses parents whose eating patterns are altered because of limited financial resources resulting

in a decrease in the quantity of adult intake and a reduction in quality of the children's

diets. Importantly, these families maintain the same number of meals and the general

eating patterns for children remain similar to food secure families. The third level of

food insecurity is the most severe and is marked by a disruption in the eating pattern of

children in the family with a reduction in the quantity or frequency of their intake. Some

family members may engage in practices they believe to be shameful to secure food for

the family. This level is defined by affirmative answers to questions 8, 11, 12, 13, or 14

[23]. The questionnaire was piloted by health promoters with volunteers from the local

clinic (See Appendix 3).

6) Patient Safety

      This study was approved by the University of North Carolina-Chapel Hill

Institutional Review Board (Study #09-0018) and by Dr. Luis Isabel Giron; Director

Region Sanbitaria No 10 Intibuca, Honduras on February 24, 2009 for the period of one

year. A Data Safety Monitoring Board met at the mid-point and conclusion of the study

period to determine the presence of any adverse reactions or events and the need for any

study modifications. Five children in the intervention group had suspected food allergy

and two children were confirmed to have a food allergy to the complementary

supplement. No children in the control group suffered from adverse events and no

recommendations were made to the investigators.

7) Statistical Analyses

      Data from questionnaires were entered into an Access database created by the

author for study. Data was then extracted from this database along with the clinic system

(containing both census information and the electronic medical record) into a separate access file used for analysis in SPSS.

Demographic information from mothers and census information were analyzed to determine maternal and family characteristics of study participants. Frequencies and descriptive statistics were completed for each component of the analyses.

Data analysis is divided into three parts: Part One evaluated the affect of seasonality on food security; Part Two describes the variables that impact food security in both the dry and rainy season and Part Three assesses the ability of various measures of food security to predict rates of growth and of disease.

Initial analyses of food security were completed using a paired sample t-test to compare the mean scores summed from the food security questionnaire. This served as a marker of overall food security. A Repeated Measures Anova evaluated the impact of season (dry versus rainy) for each question of the food security questionnaire, using the mean for each question during each season (dry versus rainy) in the analysis.

Separate univariate analyses looking at gender and age cohort were conducted to determine what effect if any these variables would have on total food security in the dry and rainy season. A multivariate regression model was created using backwards selection to determine variables that were the best fit to predict total food security in both dry and rainy seasons. Seasons were separated for analysis to further elucidate the potential variables that might drive food security during a given season. A backward stepwise approach was utilized to determine the factors that would remain in the model. Values were deleted in a stepwise fashion determined by the least significant p value in parameter effects until all p values<0.10. Factors included in the model include

demographics questions (DAQ) 3, 6, 8, 7, 9, 10, 13, 14, 15, gender, and age cohort (See Appendix 1). Age cohort was defined by dividing study participants into two groups based on age at March 1, 2009. Study participants were divided into a younger age cohort: 5-12 months and older age cohort: 12-19 months.

A multivariate regression model was created using backwards selection to determine the food security questions that were best able to predict growth (weight and height) during dry season. Growth and height velocities were calculated by dividing the difference in height (cm) or weight (kg) between measurements at the mid-point and baseline (dry season) and at the study close and midpoint (rainy season) by the difference in days between measurements.   Measurements were then multiplied by 365 because of the small change in growth to provide growth in kg or cm per year. During the analysis, variables were removed in a stepwise fashion with a parameter exclusion criteria of p value <0.10. The food security variables that were found to be a best fit for predicting weight velocity during the dry season were added to a larger multivariate regression model combining demographic variables utilized in earlier analyses to determine the overall best fit model to predict growth during the dry season. The same process was employed to determine the questions from the FIQ that would be the best fit for predicting height velocity during the dry season with a p value <0.10. These variables were then added to the full list of demographic variables described above to determine the best model to predict height velocity during dry season.

Multivariate regression models were then created using components of the food security questionnaire, gender, and age cohort to create a model capable of predicting parent-reported days of diarrhea, vomiting, cough, difficulty breathing and fever using

the process described above. The default p value utilized during stepwise backward selection was p<.15 unless described otherwise.

RESULTS

DESCRIPTIVE STATISTICS

Three hundred and one mother-infant pairs were recruited. Among these pairs, one -hundred-and-forty mother-infant pairs were assigned to the control group, the group utilized in this study, based on their address (and position within a geographical cluster). Twenty children were unable to participate in the study. Fifteen children had a weight-for-age z-score of <-2, were planning on moving within 2 months of study onset (n=1), had a pre-existing medical problem (n=1), study staff were unable to weigh the child due to child behavior (n=1), a refusal of consent (n=1), or failed to appear at the meeting for baseline measures (n=1). Of the 140 participants, four had maternal caregivers who were not their biological mothers: one caregiver was a grandmother, two were aunts and one was identified as "other." There were 77 children in the 6 month to 12 month age cohort and 63 children in the 12 to 18 month age cohort. There were 65 females and 75 males.

Maternal demographics are presented in Table 1. The majority of the women in the study were either unmarried and living with the father of the participating child (50%) or married (31.4%). The mother-infant pairs included in the study had limited financial resources with few mothers able to contribute to family income. Living situations were crowded with an average of 7.54±3.69 people per household in an average of 1.60±0.932 rooms. Homes were primitive with 69.3% (N=97) living in households with dirt floors and only 30.7% (N=43) of households had toilets; the majority urinated and defecated outside (N=75; 53.6%).

Table 1. Maternal and Household Characteristics for Mother-Infant Pairs(N=140).

	Mean ± Std. Deviation	Median	Range
Age of mother (N=140)	**26.54 ±7.016**	**25.00**	16-44
Years of schooling (N=134)	**5.84 ±** 2.978	**6.00**	**1-15**
Age of first child (N=139)	**19.65 ± 3.736**	**19.00**	**14-33**
Number of pregnancies (N=140)	**3.11 ± 2.525**	**2.00**	**1-13**
Number of living children (N=138)	**2.83 ±2.240**	**2.00**	**1-10**
% Married mothers	**31.4 (N=44)**		
% Mothers unmarried, living with child's father	**50 (N=70)**		
% Mothers contributing to household food budget	**5 (N=7)**		
% Mothers who work outside home	**10 (N=14)**		
Sanitation Services: % Households:			
toilets	**30.7 (N=43)**		
simple holes	**2.9 (N=4)**		
covered holes	**9.3 (N=13)**		
outside	**53.6 (N=75)**		
% Households with dirt floors	**69.3 (N=97)**		

SEASONALITY AND FOOD SECURITY:

Food security was significantly lower (t=-7.916; 95% CI (-4.321, -2.593); p<0.001) during the dry season (mean 32.98±4.35) compared to the rainy season (mean=36.44±5.23). A Repeated Measures Anova demonstrated higher levels of food insecurity during the dry season versus the rainy season for all questions on the food security questionnaire with the exception of 13 and 14, which are both markers of severe food insecurity. In the dry season, mothers reported worrying more about food (dry mean: 1.85 ±0.748; rainy mean: 2.12 ±0.718; p=0.002), limiting the variety of food (dry mean=1.89 ±0.060; rainy mean; 2.18 ±0.058; p=0.001), more frequently eating the same

thing daily (dry mean=1.74 ±0.695; rainy mean=2.18 ±0.605; p<0.001), and reducing the quantity of food (dry mean=1.81 ±0.059; rainy mean=2.25 ±0.056; p<0.001); all markers of mild food insecurity.

There was significantly more moderate food insecurity during the dry season as well: Maternal caregivers were more likely to have been unable to prepare one or more meals (dry mean= 2.26±0.783; rainy mean=2.56±0.636; p=0.001), live in households where adults had to skip 1 or more meals(dry mean=2.41±0.739; rainy mean=2.65±0.582; p=0.004), where adults would have to go to sleep without eating (dry mean=2.80±0.483; rainy mean=2.91±0.280; p=0.019) and where households would have to limit the amount of food they were able to serve children (dry mean=2.13±0.738; rainy mean=2.52±0.626; p<0.001). In addition, caregivers were more likely to be unable to give children the foods that they themselves identified as optimal for children to eat (dry mean=2.29±0.761; rainy mean=2.52±0.626; p=0.007). These are all markers of moderate food insecurity.

There was less of an effect on all markers of severe food insecurity, with only two of five markers significant. During the dry season, significantly more women lived in households where adults would go one day without eating (dry mean=2.92±0.295; rainy mean=2.98±0.124; p=0.025), where children would avoid meal times (dry mean=2.54±0.672; rainy mean=2.74±0.489; p=0.004), and where children would go to bed hungry (dry mean=2.85±0.414; rainy mean=2.96±0.231; p=0.008). There was, however, no significant difference identified between rainy and dry seasons of a major marker of severe food insecurity: there was no difference in the number of women between the dry or rainy season who reported children spending the whole day without

eating (dry mean=2.97±0.167; rainy mean=2.97±0.174; p=0.907) and eating things that

they considered shameful (dry mean=2.88±0.388; rainy mean=2.87±0.403; p=0.830) (See

Table 2).

Table 2. A Repeated Measures Anova demonstrated significantly higher levels of food security during the rainy season compared to the dry season for all questions on the food security questionnaire with the exception of 13 and 14, which demonstrated no significant difference between the two seasons.

Question	Dry mean	Rainy Mean	Significance
Worrying more about food (FIQ1)	1.85 ±.748	2.12 ±.718	p=0.002
Limiting the variety of food (FIQ2)	1.89 ±.060	2.18 ±.058	p=0.001
More frequently eating the same thing daily (FIQ3)	1.74 ±.695	2.18 ±.605	p<0.001
Reducing the quantity of food (FIQ4)	1.81 ±.059	2.25 ±.056	p<0.001
Unable to prepare one or more meals (FIQ5)	2.26±0.783	2.56±0.636	p=0.001
Adults had to skip one or more meals (FIQ6)	2.41±0.739	2.65±0.582	p=0.004
Adults had to go to sleep without eating (FIQ7)	2.80±0.483	2.91±0.280	p=0.019
Adults would go one day without eating (FIQ8)	2.92±0.295	2.98±0.124	=0.025
Unable to give children foods they should have (FIQ9)	2.29±0.761	2.52±0.626	p=0.007
Limit the amount of food able to serve children (FIQ10)	2.13±0.738	2.52±0.626	p<0.001
Children have to skip meal times (FIQ11)	2.54±0.672	2.74±0.489	p=0.004
Children go to bed hungry (FIQ12)	2.85±0.414	2.96±0.231	p=0.008
Children spent whole day without eating (FIQ13)	2.97±0.167	2.97±0.174	p=0.907
Do shameful things in order to obtain food (FIQ14)	2.88±0.388	2.87±0.403	p=0.830

The scale is scored from 1 to 3 with 1=always; 2=sometimes; 3=never. Lower numbers are associated with a higher degree of agreement and in this analysis, the lower the score, the more food secure the household.

PREDICTORS OF FOOD SECURITY:

Univariate analyses showed decreased rates of food security during dry season in households with female children (N=65; mean 32.5±4.98) compared to households with males (N=74; mean 34.0 ±5.3), although this did not reach statistical significance (B=-1.463; p=0.099). The impact of gender on food security during the rainy season decreased: mean total food security score for female children (N=62; mean 36.1±4.41) was less than households with males (N=67; mean 36.8 ±67), but this was not significant (B=-0.727 +/-0.767; p= 0.345). Younger children (ages 5-12 months of age) had lower total food security scores (N=76; mean 32.7±5.25) than households with older children (ages 12-19 months of age) (N=63; mean 34.1 ±5.10), but this was not significant, p=0.110). Univariate analysis showed decreased rates of food security during rainy season in households with younger children (ages 6-12 months of age) (N=72; mean 35.7±4.40) compared to households with older children (ages 12-19 months of age) (N=57; mean 37.3 ±4.18, B=1.421, p=0.038). (See table 3).

Table 3. Bivariate analyses of the impact of gender and age cohort on total food security during rainy and dry season.

	Mean ± std dev	B (95% CI)	Significance
Dry season[a]			
Female	32.5±4.98	-1.463 (-3.204, 0.277)	.099
Male	34.0 ±5.3		
Rainy season[b]			
Female	36.1±4.41	-0.727 (-2.243, 0.790)	.345
Male	36.8 ±67		
Dry season[c]			
Older age cohort (12-19 months)	34.1 ±5.10	1.421 (-.324, 3.167)	.110
Younger age cohort (5-12 months)	32.7±5.25		
Rainy season[d]			
Older age cohort (12-19 months)	37.3 ±4.18	1.597 (0.092, 3.103)	.038
Younger age cohort (5-12 months)	35.7±4.40		

95% CI, 95% confidence interval; a. R Squared = .020 (Adjusted R Squared = .013); b. R Squared = .007 (Adjusted R Squared = -.001); c. R Squared = .019 (Adjusted R Squared = .011); d. R Squared = .034 (Adjusted R Squared = .026)

*Age cohorts created based on age of child at time of enrollment.

In a multivariate regression model evaluating the impact of maternal and child characteristics on levels of household food security during rainy season, the only factors that remained significant with stepwise backward selection were the number of maternal pregnancies, the number of living children, and the age cohort of child. The corrected

model accurately predicted the impact of food security during the rainy season (F 5.302; p=0.002). For each additional pregnancy, the total food security score during rainy season decreased by 1.416 (p=0.011), while for each increase in the number of living children the total food security score increased by 1. 209 (p=0.055). Children in the older age cohort (12-19 months of age) had a greater likelihood of having higher levels of food security during the rainy season compared to younger children (5-12 months of age) (B=1.532 for older children; p=0.042). (See Table 4).

Table 4. Multivariate regression model of maternal and child characteristics that predict levels of total food security during rainy season (N=128; p=0.002)

	B (95% CI)	Significance
Number of maternal pregnancies	-1.416 (-2.499, -0.332)	.011
Number of living children	1.209 (-0.028, 2.446)	.055
Age cohort of child* **(older:younger)**	1.532 (0.054, 3.009)	.042

95% CI, 95% confidence interval; R Squared = .114 (Adjusted R Squared = .092)
*Age is based on time of enrollment in the study. Age cohorts are 6-12 months of age and 12-19 months of age. B value is for older age cohort in reference to younger age cohort.

In contrast, the multivariate regression model predicting food security during the dry season found the following variables to be significant: maternal age; number of maternal pregnancies; and the number of children who are not the mother's but who live or eat in the household (F (3,1) 8.631; p<0.001; R squared=0.161). For each yearly increase in the age of the mother, the total food security score increased by 0.186 (p value=0.065). The number of pregnancies and the number of children who were not the mother's but who lived or ate in the home, had significant, negative relationships to total

food security during the dry season (-1.162, 95 CI (-1.712, -0.611); p<0.001); and -0.679, 95 CI (-1.327, -0.031); p=0.040). For each additional pregnancy or number of children who lived or ate in the home, the total food security score would decrease by -1.162 and -0.679 respectively. (see Table 5).

Table 5. Multivariate regression model based on maternal and child characteristics that predict levels of total food security during dry season (mean 33.3022+/- 5.21; N=139; p<0.001).

	B (95% CI)	**Significance**
Age of mother	0.186 (-0.012, 0.384)	.065
Number of pregnancies	-1.162 (-1.712, -0.611)	.000
Number of children*	-0.679 (-1.327, -0.031)	.040

95% CI, 95% confidence interval; R Squared = .161 (Adjusted R Squared = .142)

*Children who are not the mother's but who live or eat in the home

FOOD SECURITY AS PREDICTOR
PREDICTOR OF GROWTH

In a multivariate regression model utilizing backward stepwise selection (p<.15 as selection parameter), only three questions (FIQ1; FIQ5 and FIQ11) from the food security questionnaire remained as predictors of the velocity of weight during dry season (F 3.578; p=0.016). These were added to a range of other demographic variables and the factors that remained following selection were shown to have a significant effect on weight velocity during dry season (F5.721; p<0.001). Number of living children and FIQ 1 had a significant and negative relationship with weight velocity (B -5.79E-6 ± 1.53 ± -6; p=0.001 and -7.2E-6 ± 2.95 E-6; p=0.016) while FIQ 5 and maternal age had a positive

relationship (B4.81E-6 B 1.63E-6 ±4.74 E-7; p 0.0012.88E-6 p=0.097 and 1.63E-6 ±4.74

E-7; p 0.001). (See Table 6).

Table 6. Multivariate regression model of maternal and child characteristics and food security questionnaire* responses that predict weight velocity during dry season (P<0.001).		
	B (95% CI)	**Significance**
Worry about food sources (FIQ1)	-7.215E-6 (-1.305E-5, -1.382E-6)	.016
Skipped meals (FIQ5)	4.810E-6 (-8.818E-7, 1.050E-5)	.097
Maternal age	1.633E-6 (6.946E-7, 2.572E-6)	.001
Number of living children	-5.794E-6 (-8.826E-6, -2.762E-6)	.000
R Squared = .156 (Adjusted R Squared = .129)		
*The scale is scored from 1 to 3 with 1=always; 2=sometimes; 3=never. Lower numbers are associated with a higher degree of agreement and in this analysis, the lower the score, the more food secure the household.		

Multivariate regression modeling found a number of questions on the food

security questionnaire that were useful for predicting height velocity during dry season.

In the final comprehensive model (utilizing p <0.10 as selection parameter), only FIQ 7,

FIQ 9, FIQ 12, the number of people living in the home and the number of adults in the

home remained significant predictors of height velocity during dry season (F(5,1) 5.848;

p <0.001). (see Table 7).

Table 7. Multivariate regression model of maternal and child characteristics and responses from food security questionnaire* that predict height velocity during the rainy season (p<0.001).

	B (95% CI)	Significance
Adults go to sleep without eating (FIQ7)	3.233E-5 (4.011E-6, 6.065E-5)	.026
Stop giving children food they should have (FIQ9)	3.233E-5 (1.366E-6, 3.064E-5)	.032
Child go to sleep without eating (FIQ12)	-6.527E-5 (-9.877E-5, -3.178E-5)	.000
# of people living in the home	-5.549E-6 (-1.042E-5, -6.768E-7)	.026
# of children (not mother's that live or eat in the home)	1.540E-5 (6.845E-6, 2.395E-5)	.001

R Squared = .191 (Adjusted R Squared = .158)

*The scale is scored from 1 to 3 with 1=always; 2=sometimes; 3=never. Lower numbers are associated with a higher degree of agreement and in this analysis, the lower the score, the more food secure the household.

PREDICTOR OF ILLNESS

Multivariate regression models used questions from the food security questionnaire to predict parent-reported days of illness in concert with gender and age cohort. A corrected model found that FIQ 4 (B -.833±.353; p=0.20) and FIQ 7 (B 1.373; ±0.505; p=0.007) were able to significantly predict parent-reported days of diarrhea in the month prior and (F (2,1) 4.971; p=0.008) (see Table 8).

Table 8. Multivariate model of responses to food security questionnaire* that predict days of diarrhea (mean 1.69 days ± 2.81) in children for the preceding month (p=0.008).

	B (95% CI)	Significance
Lack of resources for food (FIQ4)	-.833 (-1.530, -.135)	.020
Adults go to sleep without eating (FIQ7)	1.373 (.373, 2.372)	.007

R Squared = .069 (Adjusted R Squared = .055)

* The scale is scored from 1 to 3 with 1=always; 2=sometimes; 3=never. Lower numbers are associated with a higher degree of agreement and in this analysis, the lower the score, the more food secure the household.

This contrasted with FIQ 1, FIQ 8 and 14, which significantly predict days of vomiting (B -.438±0.020, p=0.20; B 1.394; ±.479, p=0.004; and B -1.427; ±0.362; p<0.001) (corrected model F (2,1) 4.971; p=0.008) (See Table 9).

Table 9. Multivariate model of responses to food security questionnaire that predict days of vomiting (mean 0.80 days ± 1.65) for the preceding month (N=137; p<0.001).

	B (95% CI)	Significance
Worry about food sources (FIQ1)	-.438 (-.805, -.071)	.020
Adult go day without eating (FIQ8)	1.394 (.447, 2.342)	.004
Feel ashamed (FIQ14)	-1.427 (-2.144, -.711)	.000

R Squared = .159 (Adjusted R Squared = .140)

* The scale is scored from 1 to 3 with 1=always; 2=sometimes; 3=never. Lower numbers are associated with a higher degree of agreement and in this analysis, the lower the score, the more food secure the household.

An additional model found only FIQ 7 (p=0.054); FIQ 11 (p=0.096); and FIQ 14 (p=0.037) were significant predictors of parent-reported days of difficulty breathing (F (3,1) 2.874; p=0.039) (See Table 10).

Table 10. Multivariate model of responses to food security questionnaire* that predict days of difficulty breathing (mean 0.93 days ± 2.21) for the preceding month (N=137; p=0.039).		
	B (95% CI)	**Significance**
Adults go to sleep without eating (FIQ7)	.824 (-.014, 1.663)	.054
Child skips one meal (FIQ11)	-.502 (-1.095, .091)	.096
Feel ashamed (FIQ14)	-1.036 (-2.006, -.066)	.037
R Squared = .061 (Adjusted R Squared = .040)		
* The scale is scored from 1 to 3 with 1=always; 2=sometimes; 3=never. Lower numbers are associated with a higher degree of agreement and in this analysis, the lower the score, the more food secure the household.		

In multivariate regression analysis using backward stepwise analysis with p value<.1, only FIQ 1 (p=0.017); FIQ2 (p=0.065); and FIQ 9 (p=0.082) remained significant at predicting days of fever (F (3,1) 3.531; p=0.017) (see Table 11). No questions from the food security questionnaire were able to predict parent-reported days of cough.

Table 11. Multivariate model or responses to food security questionnaire* and parent-reported days of child fever (mean 1.72 days ± 2.05) for the preceding month (N=137; p=0.017).

	B (95% CI)	Significance
Worry about food sources (FIQ1)	-.659 (-1.197, -.121)	.017
Resources limit food variety (FIQ2)	.562 (-.036, 1.160)	.065
Stop feeding children food they should have (FIQ9)	-.469 (-.999, .061)	.082

R Squared = .074 (Adjusted R Squared = .053)

* The scale is scored from 1 to 3 with 1=always; 2=sometimes; 3=never. Lower numbers are associated with a higher degree of agreement and in this analysis, the lower the score, the more food secure the household.

DISCUSSION

Our findings confirm higher rates of food insecurity during the dry season than during the rainy season in rural Honduras. They identify maternal and child characteristics that increase the risk and severity of food insecurity in children and also illustrate the link between different indicators of household food security and rates of child growth and morbidity.

The women and children who participated in this study are members of particularly vulnerable groups. The women were likely to have had multiple children and many had their first child during their teen years. Only a third of the women were married. In our study, maternal age at the time of enrollment was a significant predicator of food security during the dry season. Younger mothers had higher rates of food insecurity than older mothers. The relationship between maternal age, child nutritional status, and food security has been well established [56]. Younger women have more limited experience with childrearing and may encounter increased difficulty with behavioral aspects of feeding children. Teenage mothers are more likely to live in

poverty with decreased financial resources compared to older mothers. Women who are more likely to become teenage mothers are also more likely to come from poor households with limited educational opportunities [57]. Teenage mothers are more at risk for complications during pregnancy, including giving birth to preterm and low birth weight babies [58]. These factors predispose infants to diminished growth and poor health as they age. In our study, maternal age was a significant predictor of weight velocity during the dry season as well as food security during the dry season. Interestingly, age was not a predictor of food security during rainy season. This suggests that the negative consequences of decreased maternal age and the feeding behaviors associated with teenage mothers are diminished during times of relative abundance.

In addition to maternal age, the number of maternal pregnancies was also a significant negative predictor of food security in both rainy and dry season. Research has found that large family size and, in particular, smaller intervals between births are associated with child malnutrition [29, 30]. An increased number of maternal pregnancies may be a significant predictor of food security, not only because it is reflective of a larger household size, but also because it may reflect shorter birth intervals or an earlier age of first pregnancy for women in the study; all factors that have a known association with food security [29, 59, 60]. It is unclear from our study if the number of maternal pregnancies is a reflection of shorter birth intervals and the impact of earlier weaning and cessation of breastfeeding with pregnancy or if it is a reflection of the risk factors that might predispose mothers to frequent pregnancies. Women with more pregnancies may utilize birth control less frequently or who may be less empowered to make decisions about their bodies than women with fewer pregnancies. The negative association of the

number of maternal pregnancies and child health outcomes has been documented in a growing body of scientific literature [28, 29]. Interestingly, although the number of overall maternal pregnancies is negatively associated with food security, the number of maternal living children is positively associated with food security. Although this relationship may initially appear contradictory, a woman with a greater number of living children may be reflective of a woman who has had fewer incidences of infant mortality. Women with a greater number of living children may have greater resources (both financial and social) and a better set of health-related behaviors or knowledge to raise a larger number of children from birth to adulthood. Even though an increased number of living children may not be associated with decreased food security, it is significantly associated with a slower velocity of weight gain during dry season in our study. This may be reflective of the limitation of other, non-food resources in households of mothers with multiple children. Even if food may be readily available in the household, mothers with large numbers of other children may have less time devoted to feeding a young child or may be already breastfeeding a younger sibling.

Despite the significant role of maternal pregnancies in predicting food security, the number of children and adults residing in the household failed to reach significance as a predictor of food security in our model. This is unexpected based on prior research. Piaseu et al (2006) showed that higher numbers of children in households was associated with a greater risk of household food insecurity and in particular, Baer and Madgrial (1993) have found that larger households were more likely to be food insufficient even when controlling for disparity in household income [61]. This unexpected result may reflect the limited sample size of the study population or may indicate a paradoxical

relationship between household size on variables like food security: Increased numbers of adults may require more food and resources, but also may have the potential to generate and contribute more income to the family. In fact, our study found that households with a greater number of individuals had a child with a slower child height velocity (a measurement of growth) than households with fewer adults. Though Shariff and Khor (2008) show that more children often lead to higher child expenditures, children, in a similar manner to adults, may also contribute meaningful resources and labor, particularly in agricultural-based societies [62].

Even though the number of children or adults in the household was not found to be a significant predictor, the number of non-biological children residing in or eating in the maternal household was significantly related to food security during the dry season. More children were associated with higher rates of food insecurity. This supports the notion that somehow children are both taxing to family budgets, but also may be sources of potential income or labor during planting and harvest season. When children are temporarily residing in or eating in households that are not their own, they will utilize resources without contributing to income. Non-biological children will use food resources during the dry season without having necessarily provided additional resources or income during the planting or harvest season and thus tax the food and family budget. Families may also be better able anticipate the needs of the permanent household during the rainy season and so may be better able to protect the family from food insecurity during the scarcity of the dry season. During the dry season, families already have strained food and financial resources and the demand experienced by an unexpected and unplanned additional child may lead to lower rates of food security. This relationship

disappears during the rainy season and this may again reflect the relative abundance of food during rainy season that insulates families from the additional strain of another child.

The maternal participants in our study had limited educational opportunities and this is highlighted by the fact that the majority had only an elementary school education. Neither regression model showed maternal schooling as a predictor of food security. This may be due to the small sample size and to the limited number of women in the rural community sampled who had access to and completed secondary education, therefore yielding a narrow range of education. Few mothers contributed to household income and a majority of women required the financial support of partners or other family members to feed themselves and their children. While work status was not a variable model in this study, Shariff and Khor (2008) found that housewives in Malaysian households had higher rates of food insecurity compared to women who earned incomes [62]. Women who provide less financial contributions to the home or who have fewer years of education are likely to have less influence on how the household budget is spent. Research has found that even in households where mothers contribute income, the majority of their resources are spent on food and purchasing household goods [63, 64]. The lack of female input into household expenditures is problematic: Research has found that female heads of households, who control household spending and decision-making, more frequently spend more money on meeting family needs when compared to their male counterparts [63, 64]. This can lead to improved health and studies have shown improved child health in households with women who are more empowered to make financial decisions for their families [32, 65-67]. Laraia, et al (2006) also found that less

income and fewer years of education were associated with decreased household food security in their study of pregnant women [68]. The lack of a discrete methodology for assessing household income is a significant limitation in the study and although females were asked if they contributed to household income, these measurements were not included in the regression model. Additional research is needed to tease out the relative importance of maternal contributions to household income and the importance of those variables in food security. In addition, additional questions about female decision-making, gender-based violence, or beliefs about gender, would be intriguing components to subsequent analyses to further illuminate the role of female empowerment in predicting food security.

Preliminary analyses found several intriguing relationships between the impact of gender and age on food security, although the relationship did not persist in the multivariate model. During the dry season, households with a female child reported less food security than households with a male child. Although this did not reach full significance, it was nearly significant and may have been limited by the small sample size. Research has also found that females are often at increased risk for severe malnutrition compared to males [29, 66]. In the Global South and in particular in agricultural-based societies, female children may be viewed as less desirable than their male peers [69]. In times of scarcity when resources are limited, the male provider or other male children may receive additional food over the female child. During times of abundance, normal food distribution will resume and the impact of gender will be reduced or eliminated. In our study, the predictive value of gender was reduced and was eliminated from the rainy season food security model.

As discussed previously, weaning children under two years of age are at increased risk of malnutrition, even in food secure households [70]. In our study, we found that children greater than twelve months of age lived in more food secure households than children between five to twelve months of child age. This relationship was present on univariate analysis and while it was nearly significant during dry season, it was significant during rainy season and continued to remain a significant predictor of food security during the rainy season in the multivariate regression model. Early weaning is a time for the most potential risk of food insecurity. The youngest children in our study were often just beginning to wean. Many mothers had just begun the introduction of complementary foods and children may have been consuming fewer overall calories compared to older children who had a greater interest in and taste for solid foods, a better ability to eat solids and a greater ability to digest a range of foods. Older children may also be better able to verbalize their desire to eat than younger, non-verbal children. The sample of older children in the study may also be reflective of a different population of children: children in this age group have survived the first year of life and may come from families that have less difficulty procuring food and caring for them compared to children who did not survive past the first year.

During modeling analyses, multiple questions from the food security questionnaire were individual predictors of growth velocity during the dry season. A surprising predictor was the association of endorsing "worrying about not having enough food or obtaining more" with increased weight velocity in children in contrast to the expected decreased in velocity of weight. Women who worried more about food might be more proactive about obtaining additional food sources or they might have a better

understanding of what an adequate diet is and so may be more determined to improve children's diets compared to mothers who may be ignorant of their family's food insufficiency. The mothers who express increased worry might also be more anxious and active about hygiene or other aspect of their child's health. These behaviors may be protect against food insufficiency and thus lead to better weight gain.

Many of the food security questions had clear relationships to growth. For example, the more households endorsed "having an adult who went to sleep without eating" or "having to stop giving children the food they should have because they could not obtain it," the slower the height velocities of children in those households. Some of the questions had unanticipated associations with growth: households that endorsed "having to send a child to sleep without eating" had a significantly higher height velocity than other households. This may be the reflection of the small sample size, particularly the small number of families who endorsed markers of severe food insecurity.

Analysis of growth in the study in particular had several limitations. Differences in growth were measured by looking at growth intervals between baseline (the middle of the dry season and the start of the severe food insufficiency) and the mid-point (the start of the rainy season). The time period encompassed about three months and growth (measured in kg/year) during this period was small. Differences in growth are even smaller. More accurate measures of the effects of food security on children's growth may be either to track the proportion of children who are underweight or undernourished or to increase the amount of study time to encompass the start of the dry season through the conclusion of the dry season. In addition, following the initial set of baseline measures, participants had three educational talks about various aspects of child health

and received three months of worth of food vouchers. Though the food vouchers were a modest contribution to the overall food budget, the vouchers were contributing to the food budget during the time of the most strain and may have masked the differences in growth and food security expected to be seen.

Multiple studies have found associations between increased morbidity and malnutrition or food insecurity [21, 24, 26, 71]. In our study, we found specific questions on the food security questionnaire that were predictive of days of reported childhood illness even when controlling for the range of demographic variables. Though the specific predictors from the food security questionnaire varied depending on whether the outcome was parent-reported days of diarrhea, vomiting, difficulty breathing, or fever, all of the measures involved a range of mild, medium and moderate markers of food insecurity. This further supports a link between access to sufficient food and rates of childhood disease. The measurements utilized in this study were parent-reported child health outcomes and are limited by the nature of such an assessment. Parent recall can be biased and definitions of some clinical conditions, like diarrhea, are often varied. Future analyses should correlate these measures to hospital days or clinic visits.

The intervention design was created for rural communities with limited transportation and access to care. The population studied is representative of rural, poor women and children in Central America. It is difficult to generalize the results of the study to other populations, but the importance of considering seasonality when designing interventions is clear. In addition the study has shown that children, particular children younger than age one, born to young mothers with multiple other children, are increased

risk, not only of increased household food insecurity, but also for higher rates of disease and poorer growth.

Additional research is necessary to further explore variables that may be protective of families in settings where food insecurity is seasonal and expected. In particular, additional research should be conducted to tease out the particular maternal characteristics that lead to increased food security and that protect or predispose food insecure households to poor growth or increased illness. Other research studies have suggested links between food security and rates of gender-based violence, attitudes about gender, and female financial independence.

Interventions to ameliorate food security should be broad in scope and design. This study has found that young maternal age and multiple pregnancies are associated with higher rates of food insecurity. These variables occur in settings of low female agency and poor community acceptance of family planning. Strategies that stress the protective effect of birth spacing and birth control, not only for maternal health and well-being, but also for the health of other children, may lead to increased acceptance of family planning in high-risk communities. Additional interventions targeting early marriage and teen pregnancy will have positive outcomes, not only for young females, but also on the health of their future children. Other studies suggest that interventions that help women to become more financially independent or to contribute more to the food budget in their household, are beneficial to the woman and to the entire household. Women in resource-poor settings with limited education, like the women in this study, may find adapting certain behaviors particularly challenging. Providing education about how to best meet hygienic practices in areas where sanitation services or clean water are

not easily accessible would provide a beneficial impact on not only child health, but also

the health of the entire family.

REFERENCES

1. *Progress For Children: A World Fit For Children Statistical Review*. 2007 [cited 2008 June 30]; Available from: http://www.unicef.org/progressforchildren/2007n6/index_41505.htm.
2. *The Millenium Development Goals Report 2009*, I.-a.E.G.o.M. Indicators, Editor, Department of Economic and Social Affiars of the United Nations Secretariat: New York.
3. *Malnutrition*. Water Sanitation and Health 2001 [cited 2008 June 30]; Available from: http://www.who.int/water_sanitation_health/diseases/malnutrition/en/.
4. Pelletier DL, e.a., *A methodology for estimating the contribution of malnutrition to child mortality in developing countries.* J Nutr., 1994. **124**: p. 2106 S- 2122 S.
5. Scrimshaw, N.S., *Historical concepts of interactions, synergism and antagonism between nutrition and infection.* J Nutr, 2003. **133**(1): p. 316S-321S.
6. Caulfield, L.E., et al., *Undernutrition as an underlying cause of child deaths associated with diarrhea, pneumonia, malaria, and measles.* Am J Clin Nutr, 2004. **80**(1): p. 193-8.
7. Mata, L.J., et al., *Influence of recurrent infections on nutrition and growth of children in Guatemala.* Am J Clin Nutr, 1972. **25**(11): p. 1267-75.
8. Rice AL, S.L., Hyder AA, Black RE., *Malnutrition as an underlying cause of childhood deaths associated with infectious diseases in developing countries. .* Bulletin of the World Health Organization, 2000. **78**: p. 1207-1221.
9. Black, R.E., K.H. Brown, and S. Becker, *Malnutrition is a determining factor in diarrheal duration, but not incidence, among young children in a longitudinal study in rural Bangladesh.* Am J Clin Nutr, 1984. **39**(1): p. 87-94.
10. Rivera, J. and M.T. Ruel, *Growth retardation starts in the first three months of life among rural Guatemalan children.* Eur J Clin Nutr, 1997. **51**(2): p. 92-6.
11. Bhutta, Z.A., et al., *What works? Interventions for maternal and child undernutrition and survival.* Lancet, 2008. **371**(9610): p. 417-40.
12. Ruel, M.T., et al., *Impact of zinc supplementation on morbidity from diarrhea and respiratory infections among rural Guatemalan children.* Pediatrics, 1997. **99**(6): p. 808-13.
13. Bhutta, Z.A., *Addressing severe acute malnutrition where it matters.* Lancet, 2009. **374**(9684): p. 94-6.
14. Adair, L.S. and D.K. Guilkey, *Age-specific determinants of stunting in Filipino children.* J Nutr, 1997. **127**(2): p. 314-20.
15. Alaimo, K., C.M. Olson, and E.A. Frongillo, Jr., *Food insufficiency and American school-aged children's cognitive, academic, and psychosocial development.* Pediatrics, 2001. **108**(1): p. 44-53.
16. Pollitt, E., et al., *Nutrition in early life and the fulfillment of intellectual potential.* J Nutr, 1995. **125**(4 Suppl): p. 1111S-1118S.

17. Rose-Jacobs, R., et al., *Household food insecurity: associations with at-risk infant and toddler development.* Pediatrics, 2008. **121**(1): p. 65-72.

18. Cook, J.T. and D.A. Frank, *Food security, poverty, and human development in the United States.* Ann N Y Acad Sci, 2008. **1136**: p. 193-209.

19. Tomkins, A.M., D.T. Dunn, and R.J. Hayes, *Nutritional status and risk of morbidity among young Gambian children allowing for social and environmental factors.* Trans R Soc Trop Med Hyg, 1989. **83**(2): p. 282-7.

20. Bairagi, R., et al., *Alternative anthropometric indicators of mortality.* Am J Clin Nutr, 1985. **42**(2): p. 296-306.

21. Olson, C.M., *Nutrition and health outcomes associated with food insecurity and hunger.* J Nutr, 1999. **129**(2S Suppl): p. 521S-524S.

22. Bank, W., *Poverty and hunger: Issues and options or food security in developing countriies.   ,* W. Bank, Editor. 1986: Washington DC, USA.

23. Gonzalez, W., et al., *Development and validation of measure of household food insecurity in urban Costa Rica confirms proposed generic questionnaire.* J Nutr, 2008. **138**(3): p. 587-92.

24. Cook, J.T., et al., *Food insecurity is associated with adverse health outcomes among human infants and toddlers.* J Nutr, 2004. **134**(6): p. 1432-8.

25. Kaiser, L.L., et al., *Food security and nutritional outcomes of preschool-age Mexican-American children.* J Am Diet Assoc, 2002. **102**(7): p. 924-9.

26. Skalicky, A., et al., *Child food insecurity and iron deficiency anemia in low-income infants and toddlers in the United States.* Matern Child Health J, 2006. **10**(2): p. 177-85.

27. Oh, S.Y. and M.J. Hong, *Food insecurity is associated with dietary intake and body size of Korean children from low-income families in urban areas.* Eur J Clin Nutr, 2003. **57**(12): p. 1598-604.

28. Jeyaseelan, L. and M. Lakshman, *Risk factors for malnutrition in south Indian children.* J Biosoc Sci, 1997. **29**(1): p. 93-100.

29. Mozumder, A.B., et al., *The effect of birth interval on malnutrition in Bangladeshi infants and young children.* J Biosoc Sci, 2000. **32**(3): p. 289-300.

30. Gribble, J.N., N.J. Murray, and E.P. Menotti, *Reconsidering childhood undernutrition: can birth spacing make a difference? An analysis of the 2002-2003 El Salvador National Family Health Survey.* Matern Child Nutr, 2009. **5**(1): p. 49-63.

31. Espo, M., et al., *Determinants of linear growth and predictors of severe stunting during infancy in rural Malawi.* Acta Paediatr, 2002. **91**(12): p. 1364-70.

32. Odunayo, S.I. and A.O. Oyewole, *Risk factors for malnutrition among rural Nigerian children.* Asia Pac J Clin Nutr, 2006. **15**(4): p. 491-5.

33. Ojofeitimi, E.O., et al., *A study on under five nutritional status and its determinants in a semi-rural community of Ile-Ife, Osun State, Nigeria.* Nutr Health, 2003. **17**(1): p. 21-7.

34. Nestel, P., et al., *Undernutrition among Honduran children 12-71 months old.* Rev Panam Salud Publica, 1999. **6**(4): p. 256-65.

35. Ricci, J.A. and S. Becker, *Risk factors for wasting and stunting among children in Metro Cebu, Philippines.* Am J Clin Nutr, 1996. **63**(6): p. 966-75.

36. Hartikainen, H., et al., *Seasonality of gestational weight gain and foetal growth in rural Malawi.* East Afr Med J, 2005. **82**(6): p. 294-9.

37. Brown, K.H., R.E. Black, and S. Becker, *Seasonal changes in nutritional status and the prevalence of malnutrition in a longitudinal study of young children in rural Bangladesh.* Am J Clin Nutr, 1982. **36**(2): p. 303-13.

38. Gelander, L., J. Karlberg, and K. Albertsson-Wikland, *Seasonality in lower leg length velocity in prepubertal children.* Acta Paediatr, 1994. **83**(12): p. 1249-54.

39. Maleta, K., et al., *Seasonality of growth and the relationship between weight and height gain in children under three years of age in rural Malawi.* Acta Paediatr, 2003. **92**(4): p. 491-7.

40. Tomkins, A.M., et al., *Seasonal variations in the nutritional status of urban Gambian children.* Br J Nutr, 1986. **56**(3): p. 533-43.

41. Vaahtera, M., et al., *Epidemiology and predictors of infant morbidity in rural Malawi.* Paediatr Perinat Epidemiol, 2000. **14**(4): p. 363-71.

42. Wright, J., et al., *Seasonal aspects of weight-for-age in young children in Zimbabwe.* Public Health Nutr, 2001. **4**(3): p. 757-64.

43. Xu, X., et al., *Seasonality of growth in Shanghai infants (n=4128) born in 11 consecutive years.* Eur J Clin Nutr, 2001. **55**(8): p. 714-25.

44. Madzingira, N., *Malnutrition in children under five in Zimbabwe: effect of socioeconomic factors and disease.* Soc Biol, 1995. **42**(3-4): p. 239-46.

45. Larrea, C. and I. Kawachi, *Does economic inequality affect child malnutrition? The case of Ecuador.* Soc Sci Med, 2005. **60**(1): p. 165-78.

46. Marshall, W.A., *Evaluation of growth rate in height over periods of less than one year.* Arch Dis Child, 1971. **46**(248): p. 414-20.

47. Waterlow, J.C., *Relationship of gain in height to gain in weight.* Eur J Clin Nutr, 1994. **48 Suppl 1**: p. S72-3; discussion S73-4.

48. Jalil, F., et al., *Growth disturbance in an urban area of Lahore, Pakistan related to feeding patterns, infections and age, sex, socio-economic factors and seasons.* Acta Paediatr Scand Suppl, 1989. **350**: p. 44-54.

49. Costello, A.M., *Growth velocity and stunting in rural Nepal.* Arch Dis Child, 1989. **64**(10): p. 1478-82.

50. Maleta, K., et al., *Timing of growth faltering in rural Malawi.* Arch Dis Child, 2003. **88**(7): p. 574-8.

51. Rivera, J.A. and J.P. Habicht, *The recovery of Guatemalan children with mild to moderate wasting: factors enhancing the impact of supplementary feeding.* Am J Public Health, 1996. **86**(10): p. 1430-4.

52. CIA. *Honduras.* [cited 2008 June 30]; Available from: <https://www.cia.gov/library/publications/the-world-factbook/geos/ho.html#Econ>

53. de Onis, M., E.A. Frongillo, and M. Blossner, *Is malnutrition declining? An analysis of changes in levels of child malnutrition since 1980.* Bull World Health Organ, 2000. **78**(10): p. 1222-33.

54. MFEWS. *Honduras: Food Security Update May 2006.* Available from: http://ocha-gwapps1.unog.ch/rw/RWFiles2006.nsf/FilesByRWDocUNIDFileName/HMYT-6QTQ8V-fews-hnd-26may.pdf/$File/fews-hnd-26may.pdf.

55.   Heck, J.E., A. Bazemore, and P. Diller, *The shoulder to shoulder model-channeling medical volunteerism toward sustainable health change.* Fam Med, 2007. **39**(9): p. 644-50.

56.   Rikimaru, T., et al., *Risk factors for the prevalence of malnutrition among urban children in Ghana.* J Nutr Sci Vitaminol (Tokyo), 1998. **44**(3): p. 391-407.

57.   Imamura, M., et al., *Factors associated with teenage pregnancy in the European Union countries: a systematic review.* Eur J Public Health, 2007. **17**(6): p. 630-6.

58.   Malamitsi-Puchner A , B.T., *Adolescent pregnancy and perinatal outcome.*
. Pediatr Endocrinol Rev, 2006
3(Suppl 1): p. 170-1.

59.   Popkin, B.M., et al., *Nutrition, lactation, and birth spacing in Filipino women.* Demography, 1993. **30**(3): p. 333-52.

60.   Puccini, R.F., et al., *[Morbidity and malnutrition risk factors in children followed up by a child health care program].* J Pediatr (Rio J), 1997. **73**(4): p. 244-51.

61.   Baer, R.D. and L. Madrigal, *Intrahousehold allocation of resources in larger and smaller Mexican households.* Soc Sci Med, 1993. **36**(3): p. 305-10.

62.   Shariff, Z.M. and G.L. Khor, *Household food insecurity and coping strategies in a poor rural community in Malaysia.* Nutr Res Pract, 2008. **2**(1): p. 26-34.

63.   Pfeiffer, J., *Cash income, intrahousehold cooperative conflict, and child health in central Mozambique.* Med Anthropol, 2003. **22**(2): p. 87-130.

64.   Pfeiffer, J., S. Gloyd, and L. Ramirez Li, *Intrahousehold resource allocation and child growth in Mozambique: an ethnographic case-control study.* Soc Sci Med, 2001. **53**(1): p. 83-97.

65.   Fantahun, M., et al., *Women's involvement in household decision-making and strengthening social capital-crucial factors for child survival in Ethiopia.* Acta Paediatr, 2007. **96**(4): p. 582-9.

66.   Radebe, B.Z., et al., *Maternal risk factors for childhood malnutrition in the Mazowe District of Zimbabwe.* Cent Afr J Med, 1996. **42**(8): p. 240-4.

67.   Hindin, M.J., *Women's input into household decisions and their nutritional status in three resource-constrained settings.* Public Health Nutr, 2006. **9**(4): p. 485-93.

68.   Laraia, B.A., et al., *Psychosocial factors and socioeconomic indicators are associated with household food insecurity among pregnant women.* J Nutr, 2006. **136**(1): p. 177-82.

69.   Setswe, G., *Prevalence and risk factors for malnutrition among children aged 5 years and less in the Lefaragatlha village of Bophuthatswana.* Curationis, 1994. **17**(3): p. 33-5.

70.   Quelin, G., et al., *[Risk factors for malnutrition in 0-59-month-old infants in 2 districts of Niger].* Med Trop (Mars), 1991. **51**(3): p. 335-42.

71.   Weinreb, L., et al., *Hunger: its impact on children's health and mental health.* Pediatrics, 2002. **110**(4): p. e41.

DEMOGRAPHICS QUESTIONNAIRE	**Baseline Assessment** Version February 6, 2009

INTERVIEWER: Now I am going to ask you some questions about yourself and your home.
[Interviewer: circle the answers and code to the right] [Do not read the answers to the questions unless otherwise indicated]

Background Questions

1. Are you the mother of the participating child?
　　　(1) yes　*[GO TO # 2]*　　(2) no

1.1 (If no) What is your relationship to the child?
　　　(1) Grandmother
　　　(2) Aunt/uncle
　　　(3) Neighbor
　　　(4) Brother/sister
　　　(5) Other (specify)_____

2. Are you the primary caregiver for the child?
　　　(1) yes　　　(2) no

Questions about the <u>Mother or Legal Caretaker</u>

<u>I would like to start by asking you about you and your family.</u>
[This questionnaire can only be answered by the mother or legal care taker]
Note to interviewer: If the respondent is not the baby's mother, please ask her/him to answer the questions about him/her as legal care taker of the child.

[If the interviewee does <u>not know</u> the answer, mark with an "X"]

3. How old are you? _____

4. Did YOU ever go to school?
　　(1) yes　(2) no [GO TO #7]

5. What level did you reach at school?
　　[read the answers if the mother needs help to answer]
　　1. Primary School (1st to 6th grade)
　　2. Secondary School/Common cycle (7th to 9th grade)
　　3. Career/diversified
　　4. University
　　5. Other_____

6. **How many school years did you complete in your education? [You may help the mother by referring to her answer to the question above]**

    Years_____

7. **What is your marital status?** *[Read the answers]*
    1. Single
    2. Married
    3. Not married, living together
    4. Divorced/separated
    5. Widowed

Questions about you (the Mother or Legal Guardian)

8. **At what age did you have your first child? _____**

9. **How many pregnancies have you had till now? _____**

10. **How many live children do you have? _____**

11. **In your house, who provides the household with money to buy food?**
    [Do not read the answers. Mark all that apply]
    11.1 __ Legal guardian (you)
    11.2 __ Spouse/Partner
    11.3 __ Grandfather/mother of child
    11.4 __ Father/mother of child
    11.5 __ Other_____

12. **As you know, some women take up jobs for which they are paid in cash or kind, others sell things, have a small business or work on the family farms or in family business.**

     Are you currently doing any of these things or any other work?

     (1) yes   (2) no *[GO TO #13]*

If yes, then what type of job is it? [Mark all that apply with an "X"]

12.1 __ Farm laborer	12.4__ Professor	12.7__Other professional
12.2 __ Business owner	12.5 __ Cook	12.8__ Child caretaker
12.3 __ Secretary	12.6__ Promoter	12.9 __ Cleaning lady

12.10 __ Otro _____

DEMOGRAPHICS QUESTIONNAIRE	**Baseline Assessment** Version February 6, 2009

Socioeconomic Particulars

13. **How many people live in your home?** _____

14. **Number of adults who live in your home who are older than 18?**
     _____

15. **Number of other children (not yours) who live ore eat in your home?**
     _____

Thank you very much for your participation and for the time dedicated to this.

Appendix Two

CHILD HEALTH STATUS IN THE PAST MONTH	Version January 21, 2009
Participant ID:	__ __ __ __ __
Date:	2009 / ___ ___ / ___ ___ Month Day
Encounter:　　　　**1　3　5　7　9　11　13**	
Place:	
Interviewer:	

INTERVIEWER: I will be asking you some questions about your baby and his/her health status in the past thirty days.

1.In general, how has your child's health status been during this month? 　1. Excellent 　2. Good 　3. Regular 　4. Poor	____
2. Was he/she sick during this month? 　☐ 1. Yes　　　　　　☐ 2. No (GO TO #4)	____
3. What illnesses did he/she have during this month? [DO NOT READ THE RESPONSES TO THE MOTHER. MARK EACH OPTION WITH AN "X" IF IT APPLIES.] _**3.1** fever　　　　_**3.6** diarrhea　　　_**3.11** pain/ear infection _**3.2** influenza/cold　_**3.7** poor appetite　_**3.12** headache _**3.3** cough　　　　_**3.8** vomit　　　　_**3.13** sore throat _**3.4** constipation　_**3.9** mange/lice　　_**3.14** fracture _**3.5** rash　　　　　_**3.10** anemia　　　_**3.15** other _____	
[CODE the answers to questions 4-8 and 13-15 with a numeric value ex. 3 days is coded as 3, code with **0** for 'no days' and with **X** for 'Does not know'. Do not probe using numbers.]	

CHILD HEALTH STATUS IN THE PAST MONTH	Version January 21, 2009
4. During this month, how many days did your child have diarrea? _____	____
5. During this month, how many days did your child experienced vomiting? _____	____
6.During this month, how many days did your child have difficulty breathing? _____	____
7. During this month, how many days did your child have a cough? _____	____
8.During this month, how many days did your child have a fever? _____	____
9. Did you give medicines to your child during this month? ☐ 1. Yes ☐ 2. No (GO TO # 12)	____
10. What medicines did you give him/her? _____ _____	
11. What did you give them for? DO NOT READ THE ANSWERS TO THE MOTHER. MARK WITH AN "X" IF IT APPLIES. __**11.1** Fever __**11.2** Pain __**11.3** Cough __**11.4** Infection/worms/parasites __**11.5** Prevention (vitamins/nutrition/health monitoring) __**11.6** OTHER _____	

12. How has your child's appetite been during this month?
 	
  1. Excellent
  2. Good
  3. Regular
  4. Poor
	____

13. How many times have you taken your child to the health center/clinic during this month? _____	____
14. How many times have you taken your child to the local healer during this month? _____	____
15. How many times have you taken your child to the hospital during this month? _____	____

Appendix Three

FOOD SECURITY QUESTIONNAIRE[1]	Baseline Assessment Version February 11, 2009

1. In the last month, have you worried that in your home there was not enough food and you could not obtain more?
1. Many times
2. Sometimes
3. Never

2. In the last month, did you or any adult in your home have to limit the variety of food because of lack of resources?
1. Many times
2. Sometimes
3. Never

3. In the last month, did you or any adult in your home have to eat the same food for several days in a row because you didn't have food to prepare another or different meal?
1. Many times
2. Sometimes
3. Never

4. In the last month, did you have to serve less food because there wasn't resources to obtain enough food?
1. Many times
2. Sometimes
3. Never

5. In the last month, because there was not enough food at home, were you unable to prepare 1 of the meals of the day?
1. Many times
2. Sometimes
3. Never

6. In the last month, did you or any adult in your home have to skip 1 of the meals of the day because there was not enough food?
1. Many times
2. Sometimes
3. Never

7. In the last month, did you or any adult in your home have to go to sleep without eating because there was not enough food at home?
   1. Many times
   2. Sometimes
   3. Never

8. In the last month, did you or any adult in your home have to go a whole day without eating because there was not enough food?
   1. Many times
   2. Sometimes
   3. Never

9. In the last month, did you have to stop giving the children the food they should have because you couldn't obtain it?
   1. Many times
   2. Sometimes
   3. Never

10. In the last month, because there was not enough food at home, did you have to serve less food to the children?
   1. Many times
   2. Sometimes
   3. Never

11. In the last month, did any of the children have to skip 1 of the meals of the day because there was not enough food at home?
   1. Many times
   2. Sometimes
   3. Never

12. In the last month, did any of the children have to go to sleep without eating because there was not enough food at home?
   1. Many times
   2. Sometimes
   3. Never

13. In the last month, did any of the children have to go a whole day without eating because there was not enough food?
   1. Many times
   2. Sometimes
   3. Never

14. In the last month, in order to have food in your home, did you have to do things that make you feel ashamed?
   1. Many times
   2. Sometimes
   3. Never

[1]González W, Jiménez A, Madrigal G, Muñoz L, Frongillo EA. Development and Validation of Measure of Household Food Insecurity in Urban Costa Rica Confirms Proposed Generic Questionnaire. J Nut. 2008;138:587–592.