

The Influence of Household Economic Status and Food Consumption Patterns on Obesity Rates  
in Peru – Evidence from a Field Study in 11 Communities of Madre de Dios

by

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Thesis submitted in partial fulfillment of  
the requirements for the degree of  
Master of Science in the Global Health Program  
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ABSTRACT

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## **Abstract**

The globalization contributes to rapid economic development and great changes of lifestyle in Madre de Dios of Peru, both of which have influenced the health status of local people in direct and indirect ways. The high overweight and obesity rate has become one of the biggest health challenges in this region. This study quantitatively analyzed the impact of household economic status and food consumption patterns on overweight and obesity, and tried to establish their relationship with local economic activities. People living in mining communities are more likely to be overweight or obese due to increased family incomes and lack of health knowledge. The large consumption of soda and alcohol are positively associated with overweight and obesity. In addition, lack of physical activities is also one of the risk factors of overweight and obesity.

## **Dedication**

To my beloved father.

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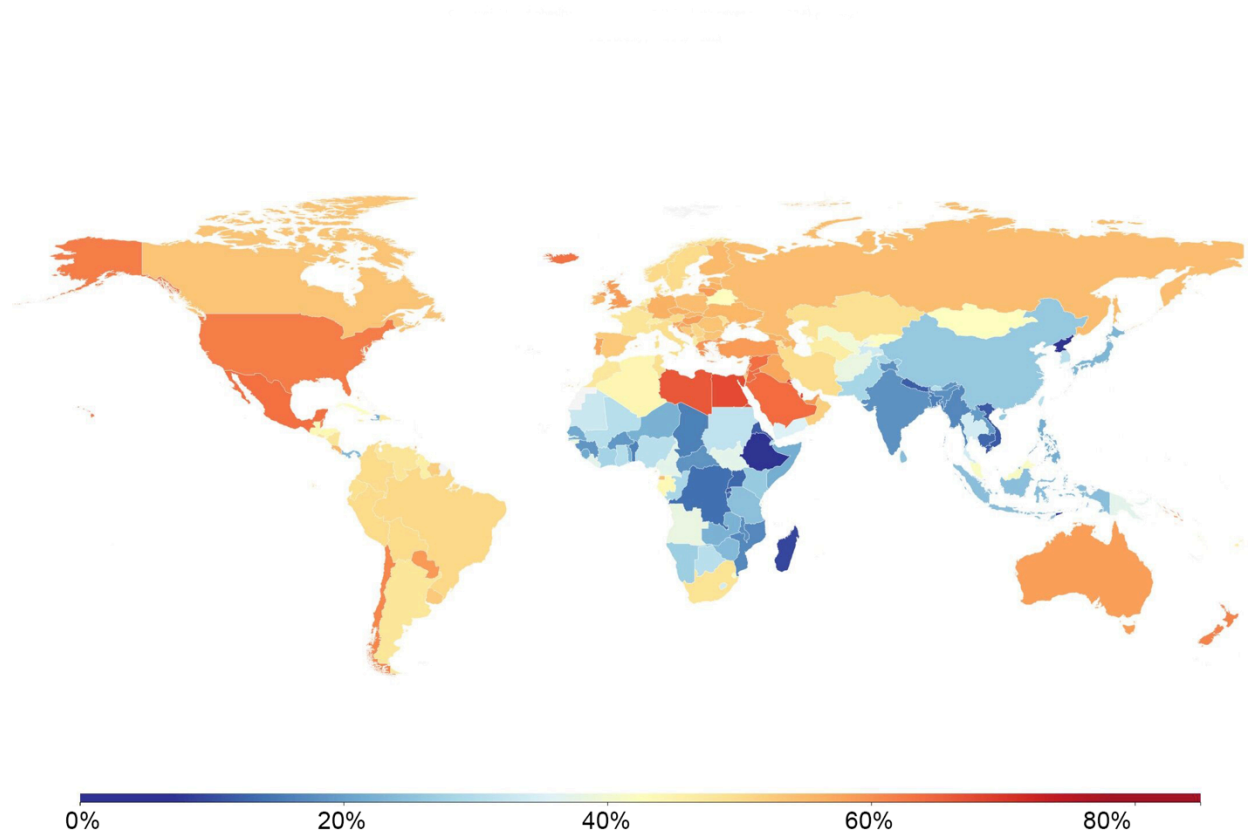
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# 1. Introduction

The overweight and obesity epidemic has become a global health concern. Body Mass Index (BMI) is one of the most widely accepted indicators of overweight and obesity. BMI is defined as a person's weight in kilograms divided by the square of his or her height in meters. According to the guidelines of the World Health Organization, a person with a BMI between 25 and 30 is considered overweight, and a person with a BMI of 30 or more is usually considered obese (WHO, 2000). The number of overweight and obese people all over the world has increased dramatically in the past few decades—from 694 million in 1980 to 1730 million in 2013. In 1980 the overweight and obese represented 27% of the worldwide population. By 2013, the percentage had increased to 36.5% (Institute for Health Metrics and Evaluation, 2014). Figure 1 shows the worldwide prevalence of overweight and obesity in those over twenty years of age. These conditions have now become a problem not only for high-income countries but also for mid- and low-income countries. As shown in Figure 1, most high-income countries have a high prevalence of overweight and obesity—over 40%, and some are even higher such as 67.4% of United States and 68.5% of Iceland. Many mid- and low-income countries also have a high prevalence of overweight and obesity. For example, Egypt, as a lower middle-income country, has the prevalence at 73.6%. What is noteworthy is that the prevalence of overweight and obesity in each South American country is over 50%. For example, it is 66.1% in Chile and 63.9% in Paraguay. Overweight and obesity has become a serious health problem in South America. The prevalence of overweight in South American countries is as high as, or even

higher than that in the United States(Filozof, Gonzalez, Sereday, Mazza, & Braguinsky, 2001).



**Figure 1: Overweight and obesity prevalence for both sexes adults (20+) in 2013<sup>1</sup>**

Overweight and obesity is one of the major risk factors of many chronic diseases, such as hypertension(Dyer & Elliott, 1989), Type II Diabetes(Larsson, Bjorntorp, & Tibblin, 1981; Lew & Garfinkel, 1979), coronary heart disease(Eckel & Krauss, 1998), and some types of cancers(Chute

---

<sup>1</sup> Source: <http://www.healthdata.org>.

et al., 1991). Overweight and obesity has also become one of the leading causes of attributable global mortality and burden of disease. By 2004, overweight and obesity led to 4.8% of attributable mortality and 2.3% of disability adjusted life years (DALYs) (WHO, Global Health Risk Report). In addition, overweight and obesity is associated with increased health expenditure over the lifetime (Van Baal et al., 2008).

### **1.1 Overweight and Obesity in Peru**

Peru, a high-middle income country<sup>2</sup>, is one of the fastest growing countries in Latin America with a GDP per capita of 6550.9 US dollars. It has a population of 30.97 million: 21.7% rural and 78.3% urban. There are great disparities of development between rural and urban areas. The percentage of the rural population living below poverty line (\$1 a day)<sup>3</sup> in 2013 was 16.1% while it was only 8% for the urban population (World Bank, 2015). Disparities are also huge between regions. By 2014, there are 14.3% population living in poverty in coast region, 33.8% in highland region and 30.4% in jungle region (PERU Instituto Nacional de Estadística e Informática, 2016).

Like many other South American countries, Peru is undergoing a rapid demographic and epidemiological transition. There are a reduction in the prevalence of infectious diseases and malnutrition, and an increase in chronic disease (Gillespie, Mason, & Martorell, 1996). The

---

<sup>2</sup> High-middle income country has a gross national income (GNI) per capita of \$4126-\$12736 (World Bank, 2015).

<sup>3</sup> Poverty line: A threshold under which an individual is considered to be living in poverty. It is calculated by taking the poverty threshold from each country and converting it to dollars, given the value of the goods needed to sustain one adult.

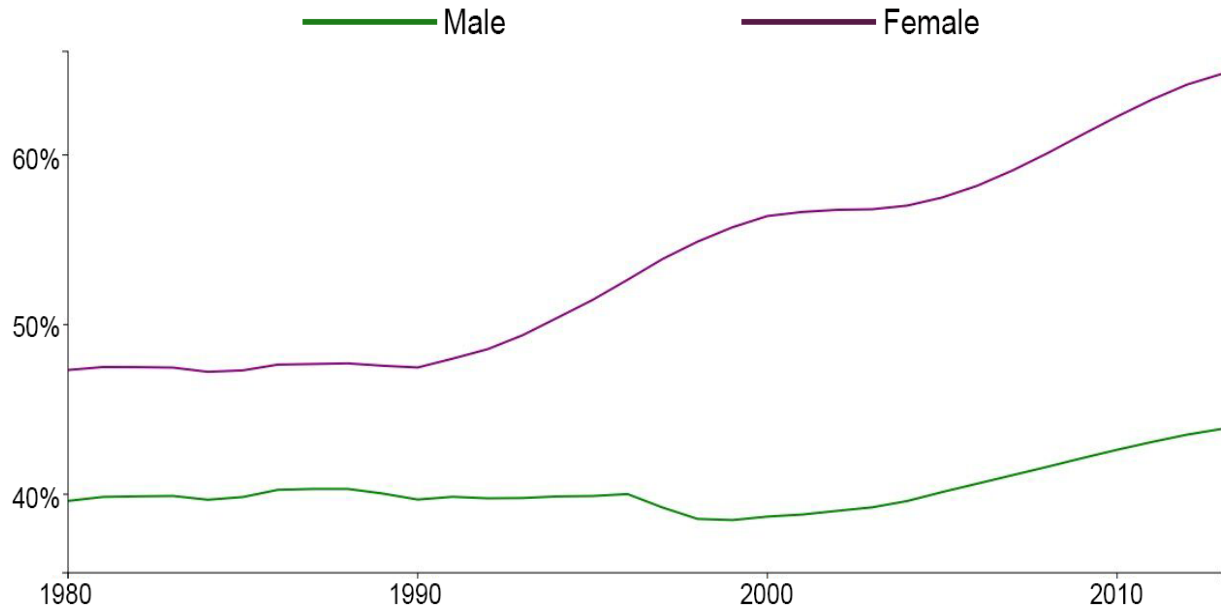
epidemic of overweight and obesity is becoming a major public health problem in Peru (Filozof et al., 2001). A WHO 2004/2006 survey of 5039 adults aged 15-49 in both rural and urban Peru showed that 12.5% of adults were obese and 43.4% were overweight (World Health Organization's Global Database, 2016). By 2008, the prevalence of obesity among males and females aged over 20 was 11.1% and 21.7%, respectively (World Health Organization, 2015). The prevalence of overweight and obesity in adults in 2013 was 54% (Institute for Health Metrics and Evaluation, 2014). Figure 2 presents the trend of overweight/obesity prevalence for both sexes adults (age 20+) from 1980 to 2013. It has been increasing steadily since 1990. Females increased from 47% in 1990 to 65% in 2013. Compared with females, males have a relatively lower overweight and obesity prevalence, 40% in 1990 to 44% in 2013.

A study showing the nutrition transition in Peru revealed that Madre de Dios was in the Stage 3 of nutrition transition - completed transition<sup>4</sup>, and the prevalence of overweight for women aged 15-49 in Madre de Dios was over 60% in 2010 (Chaparro & Estrada, 2012). According to a survey of 69526 participants in the National Household Survey 2009-2010, the highest prevalence of overweight and obesity (77.4%) was observed in the Department of Madre de Dios among all departments of Peru. Decreasing physical activities and increasing poor dietary habits caused by economic activities, such as mining, tourism and trade, are

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<sup>4</sup> Nutrition transition: the transition from undernutrition as the main nutritional concern to overweight and obesity. There are 3 stages in nutrition transitions: 1) **Stage 1**: a geographic area is in Stage 1 when the undernutrition rate is high, and overweight and obesity is just starting to emerge; 2) **Stage 2**: a geographic area is in Stage 2 when the geographic area suffers from double-burden of undernutrition and overweight/obesity; 3) **Stage 3**: a geographic area is in Stage 3 when the geographic area the undernutrition rate is low, but the prevalence of overweight and obesity is high (Chaparro & Estrada, 2012).

considered to be two main reasons for the area's highest prevalence of overweight and obesity (Álvarez-Dongo, Sánchez-Abanto, Gómez-Guizado, & Tarqui-Mamani, 2012).



**Figure 2: Overweight and obesity prevalence for both sexes adults (20+) of Peru 1980-2013<sup>5</sup>**

## **1.2 Risk factors of overweight and obesity**

Overweight and obesity are disorders resulting from the accumulation of excessive body fat. There are three main factors influencing body weight: metabolism, diet, and physical activity (Roland L. Weinsier, Gary R. Hunter, Adrian F. Heini, Michael I. Goran, & Susan M. Sell,

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<sup>5</sup> Source: <http://vizhub.healthdata.org/obesity/>.

1998). High caloric intake and low physical activity will increase the risk of obesity (Walker S. Carlos Poston II, John P. Foreyt, 1999). In high-income countries, the relatively decreased financial cost of consuming a calorie and the increased opportunity cost of burning a calorie are two main reasons for the obesity epidemic (Powell, Auld, Chaloupka, O'Malley, & Johnston, 2006). With the development of the food industry, processed food has become much cheaper than before while the price of healthier unprocessed food, such as fruits and vegetables, has become more expensive. The labor needed to prepare in-home food has become more expensive, leading to the increased consumption of high-calorie processed food and away-from-home meals. In addition, it has become more difficult to get enough physical activity. As work becomes more sedentary, individuals have to use their limited leisure time to get physical exercise (Pratt, 2012).

There are some other reasons for the high prevalence of overweight and obesity in low- and mid-income countries (LMICs). Filozof (2001) revealed that people in LMICs are replacing their diets high in complex carbohydrates and fibers, for diets high in energy and fat. The rapid urbanization and the mass media in LMICs may contribute to the shift of diet. This change of diet is also accompanied with reduced level of physical activities, resulting in increasing overweight and obesity in LMICs. In addition, Neel et al. (Neel, Weder, & Julius, 1998) suggested a "thrifty genotype" hypothesis. When hunter-gatherer ancestors had to fight to survive, they developed a mechanism to conserve energy and withstand famine. This mechanism becomes disadvantageous when food is abundant and diets are changed. People do



not have a genomic background to cope with the high-energy and high-fat diets, and overweight and obesity may be one of the consequences.

### **1.3 Food consumption patterns**

Food consumption patterns are associated with individual, household and regional characteristics. Rising income and improved access to abundant food will change food consumption patterns greatly (Regmi, Deepak, Seale Jr, & Bernstein, 2001). The same study revealed that the food share of total income decrease when income increases. People with lower incomes are more sensitive to changes of food price. Therefore, an increase in food price is likely to have a bigger impact on food consumption patterns in LMICs (Food and Agricultural Organization, 2015). Ruel et al. (2010) discussed several mechanisms in low-income areas to cope with increasing food prices, such as switching to cheaper and lower-quality staple foods, skipping meals and reducing overall food intake, decreasing consumption of non-staple foods (e.g., meat eggs, etc.), and increasing consumption of street food.

In addition, rising income is considered to change the composition of food demand, especially in LMICs. In LMICs, cereal consumption accounts for a large share of food expenditure. When the income rises, people will shift some low-valued cereal consumption to higher-valued livestock products. While in high-income countries where livestock product consumption is already high, people only make relatively small adjustments when income rises. (Regmi et al., 2001)

## **1.4 Social economic status and obesity**

Social economic status (SES) is considered to be a determinant for obesity. However, the relationship between SES and obesity has changed. (Sobal & Stunkard, 1989) concluded that SES has a positive relationship with obesity in developing countries. In contrast to the situation of developed countries, obesity would be a disease for people with high SES in developing countries. However, the obesity increase in developing countries has been faster than before (Popkin, 2002). Evidences show that in some developing countries, such as Brazil, obesity is increasing faster in the group with lower SES (Monteiro, Conde, & Popkin, 2004). The association of SES and obesity need to be updated. Obesity in developing countries can no longer be a problem only for higher SES groups. The obesity burden begins to shift towards low SES groups in developing countries (Monteiro, Moura, Conde, & Popkin, 2004).

## **1.5 Study aim and hypothesis**

My study aims to estimate the prevalence of overweight/obesity in communities in the Department of Madre de Dios, Peru. With the hypothesis that overweight/obesity prevalence is higher in those families with easier and cheaper access to high-energy-dense foods, this study also aims to explore the impact of household economic status and food consumption patterns on overweight and obesity.

## **2. Methods**

### **2.1 Data**

Data for this study comes from two sources: (1) Data of household demographic information and individual biometric information (height, weight) come from an observational study conducted in Madre de Dios, Peru between August 2011 and April 2012-- "Migration along the Highway in Peru: Exploring linkages between population, health and environment". This study is the collaboration among Naval Medical Research Unit Six (NAMRU-6), Duke University, UNC-Chapel Hill and Direction Regional de Salud (DIRESA) Madre de Dios. William Pan is the principle investigator. This study enrolled 1671 people in 560 households and 46 communities. It collected data on migration patterns, changes of environment, family structure and socioeconomic status, and health status including child nutrition, and chronic and infectious diseases. Individual height and weight were measured in households. Height was measured with a standard height bar, and weight was measured with a weighing machine. (2) Data on family food consumption, food price and physical activities comes from my questionnaire survey conducted between June 2015 and July 2015.

### **2.2 Setting**

My study was conducted in 11 communities along the Interoceanic Highway in Madre de Dios of Peru, a southeastern Amazon region on the border of Brazil and Bolivia (Figure 3). Madre de Dios had a population of 137,316 in 2015, among which 57.43% are male(PERU

Instituto Nacional de Estadística e Informática, 2016). Seventy percent of Madre de Dios population are in-migrants mainly from neighboring regions of Cusco and Puno (IIAP, 2001). Madre de Dios, one of the world's 7 "hottest hotspots of biodiversity", has abundant natural resources. It contains 15% of Peru's forest areas and has an enormous concentration of natural species. The economy of Madre de Dios mainly depends on natural products and raw materials, such as cotton, coffee, cacao beans and Brazil nuts (Gobierno Regional de Madre de Dios, 2015). Puerto Maldonado is the capital of Madre de Dios region, and is the only big cities in this region. Tourism and related boat construction are major sources of economic income in Puerto Maldonado.

In 2005, Peru and Brazil agreed to build the Interoceanic Highway (IOH) to connect rural farms in the Amazon to the Pacific and Atlantic Ocean ports. The IOH was completed in 2011 and officially opened in 2012. It transects Madre de Dios and has increased the connectivity in this region. Previous study shows that the IOH has begun to have impacts on health, directly or indirectly, by changing nutritional status and health-seeking behaviors (Álvarez-Dongo et al., 2012). Meanwhile, the IOH brings improvements of roads and infrastructure access, which confer economic growth and may ultimately lead to greater outreach and utilization of social services (Jacoby, 2000; Rudel & Richards, 1990).

Madre de Dios is the third largest producer of gold in Peru (Brooks, Sandoval, Yopez, & Howard, 2007). Since 2000, with the rapidly increased global demand for gold and increased price of gold, the illegal mining activities in Madre de Dios increased massively, bringing great

impacts on local environments and human well-beings(Gardner, 2012; Swenson, Carter, Domec, & Delgado, 2011). Gold mining, as a high-reward but high-risk activity, continues to attract many residents to participate.

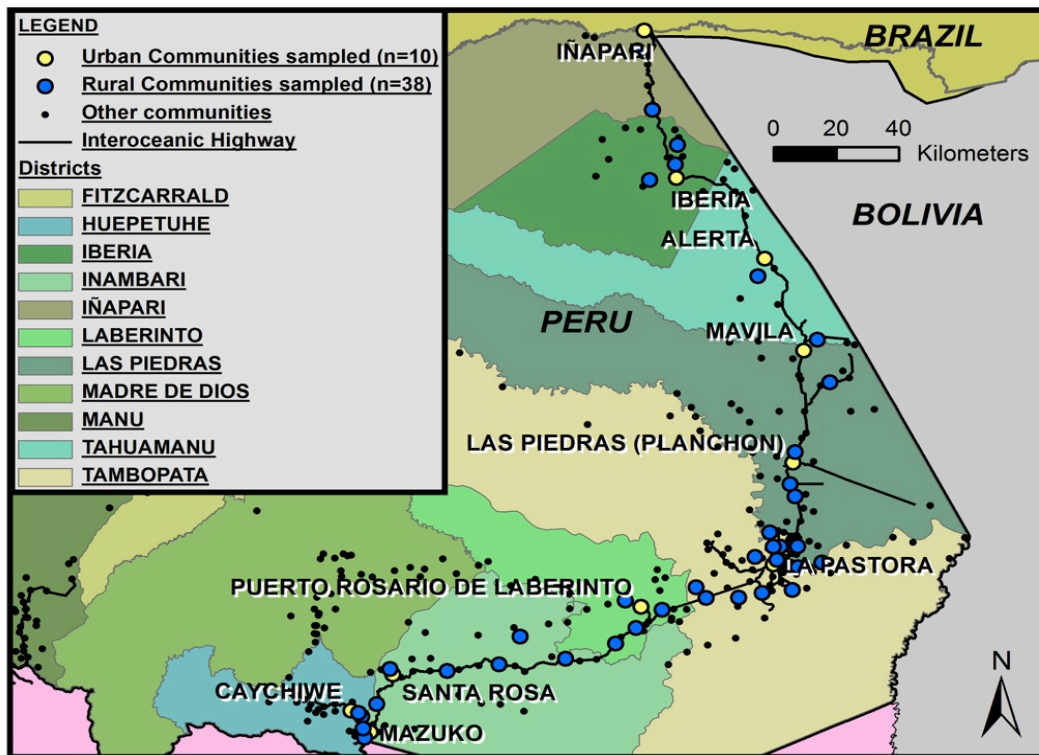


Figure 3: Map of sampled communities in Madre de Dios in 2011 study of “Migration along the Highway in Peru: Exploring linkages between population, health and environment”

### 2.3 Participants of questionnaire survey

As shown in Figure 3, there are 48 sampled communities in the 2011 study of “Migration along the Highway in Peru: Exploring linkages between population, health and environment”, including 10 urban and 38 rural communities. There are gold mining activities in the area of

HUEPETUHE. Communities are divided into rural and urban communities by administrative division. Mining community is defined as a community whose distance to gold ores with mining activities is less than 40km; not-mining community is defined as a community whose distance to gold ores is more than 40km. All sampled communities in 2011 study were divided into 4 categories according to their location (see Table 1): 5 are rural mining communities; 3 are urban mining communities; 33 are rural not-mining communities; and 7 are urban not-mining communities.

Based on the number of communities in each category, 2, 5, 2, 2 communities were randomly selected respectively in each category for 2015 questionnaire survey (see Table 2). In each selected community, 4 households were randomly selected. There were 44 selected households in 2015 survey, 108 individuals in total.

**Table 1: Number of communities in different areas in 2011 study**

	Rural	Urban
Mining	5	3
Not-Mining	33	7

**Table 2: Number of selected communities in different areas in 2015 survey**

	Rural	Urban
Mining	2	2
Not-Mining	5	2

## **2.4 Procedures**

Both the inform consent (English version see Appendix 1, Spanish version see Appendix 2) and the designed questionnaire consent (English version see Appendix 3, Spanish version see Appendix 4) were translated into Spanish by two different bilingual people separately, and then proofread into one final version.

One experienced Peruvian field worker named Yerko Rios was recruited to help conduct the survey. He had participated in the 2011 study of “Migration along the Highway in Peru: Exploring linkages between population, health and environment”, having abundant knowledge of and good relationship with each community in this study. Considering the knowledge and research ability Yerko already had, three 2-hour research trainings were given to him on three different days. The main purposes of training sessions were to give him a better understanding of my study, go through every question of the questionnaire, and explain potential problems he may face and discuss effective solutions. Research ethics were also highlighted during the trainings. After the trainings, pilot surveys were conducted in four households.

The trained field worker located and visited each selected household based on their GPS information. The interviewee was the person who is the head of the household or who is in charge of food purchasing. The inform consent was read and explained in Spanish to the interviewee and their families before the survey. No compensation was offered. The interviewee had the right to ask any questions before, during and after the interview. They could also stop the interview at any time without giving any reasons. The field worker then asked interviewees

each question on the questionnaire and helped them finish the questionnaire. It took 0.5-1 hour to finish the questionnaire.

All study procedures were approved by the Institutional Review Board at NAMRU-6.

## **2.5 Measures**

Overweight and obesity is measured in two different ways. One is the continuous variable BMI. The other measurement method is the dichotomy variable Obe. Obe is a dummy variable for overweight/obesity status. Obe=1 if a person's BMI  $\geq 25$  and Obe=0 if BMI  $< 25$ .

The family yearly income is the sum of each family member's working salary and any other sources of income. All yearly consumptions are calculated based on weekly consumption. The weekly consumptions are asked in the questionnaire. Yearly consumption=weekly consumption\* 52 weeks.

## **2.6 Analysis**

All data were entered into laptops within 48 hours and were preserved in the research group's online Box system for analysis. All data were re-entered and checked one week later. Stata Version 13 and Excel were used for data analysis.

Two regression models were used to analyze impacts of selected independent variables on overweight and obesity. In the multivariate linear regression model, the continuous variable BMI is the dependent variable. In the logistic regression model, I set the dichotomous variable



Obe as the dependent variable. Stepwise regression method ( $p < 0.20$ ) was used to selected variables for regression models.

### 3. Results

#### 3.1 Sample description

The description of 11 selected communities is shown in Table 3. The column of Location represents the location of communities. There are 7 rural communities and 4 urban communities; 4 mining communities and 7 not-mining communities. After dropping households without BMI data, there are 36 selected households left. Considering the fact that the criteria of overweight and obesity for children and adolescents are different from that of adults, 8 individuals younger than 18 years old were dropped. 100 individuals were left, among whom 51% are overweight or obese.

**Table 3: Description of 11 communities**

Community Name	Location		Number of Households	Number of Individuals	Number of Overweight/obese Individuals
	Rural/Urban	Mining/Not-mining			
Puerto Punkiri	Rural	Mining	4	9	6
Puerto Mazuko	Rural	Mining	2	6	4
Mazuko	Urban	Mining	2	5	2
Santa Rosa	Urban	Mining	4	11	8
Bajo Madre de Dios	Rural	Not-mining	3	7	6
San Francisco de Asis	Rural	Not-mining	3	6	2
Chonta	Rural	Not-mining	3	4	2
Ramon Gonzales	Rural	Not-mining	4	15	4
Otilia	Rural	Not-mining	3	10	4
Laberinto	Urban	Not-mining	4	14	9
Planchon	Urban	Not-mining	4	13	4

## 3.2 Comparison of overweight and obesity

### 3.2.1 Overweight and obesity prevalence by location

The overweight/obesity prevalence rate of each community is shown in Figure 4. The community Ramon Gonzales has the lowest total overweight/obesity prevalence rate of 27%, and the community Bajo Madre de Dios has the highest total prevalence rate of 86%. Both of these two communities are rural and not-mining communities. There are only 3 communities with total overweight/obesity prevalence rates smaller than 40%- San Francisco de Asis, Ramon Gonzales and Planchon. All of these 3 communities are not-mining communities.

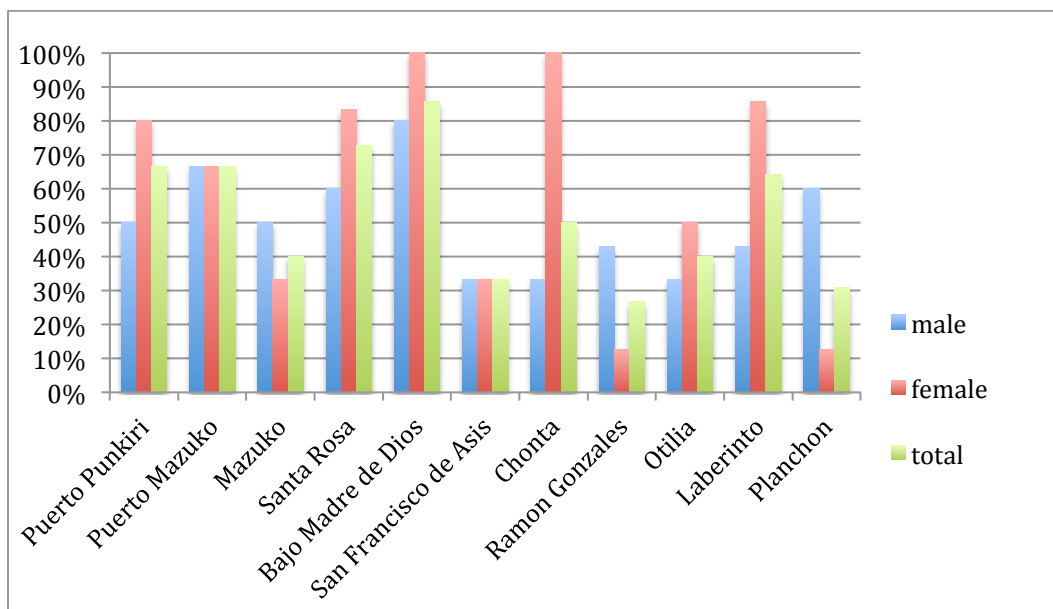
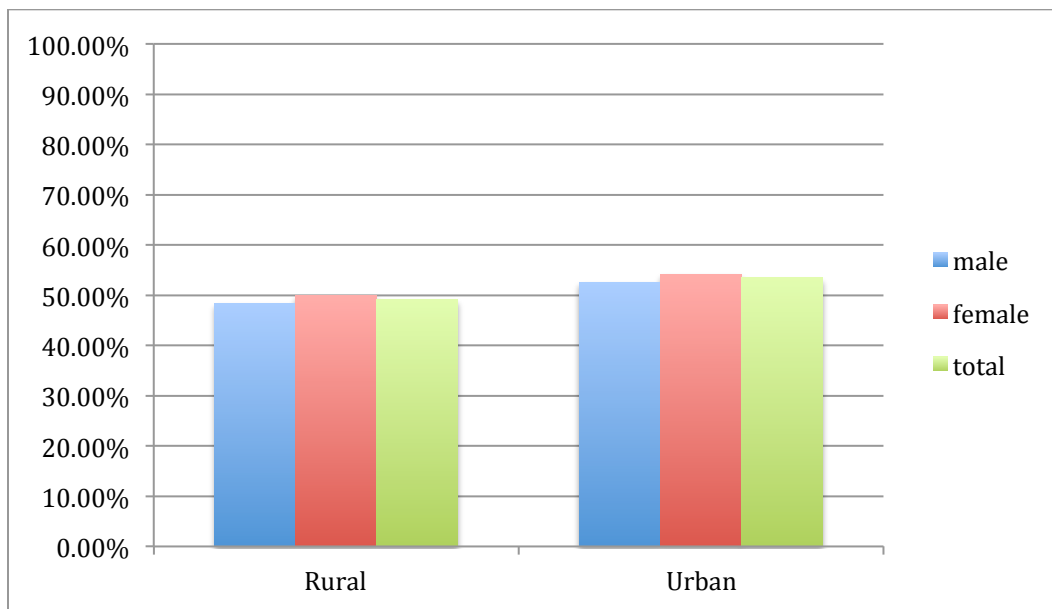


Figure 4: Overweight/obesity prevalence rates of 11 communities<sup>1</sup>

<sup>1</sup> Note: (1) Male overweight/obesity prevalence rate = (Number of overweight/obese males (BMI ≥ 25) in each community/ Number of males in each community)\*100%. (2) Female overweight/obesity prevalence rate = (Number of overweight/obese females (BMI ≥ 25) in each community/ Number of females in each community)\*100%. (3) Total overweight/obesity prevalence rate = (Number of overweight/obese individuals (BMI ≥ 25) in each community/ Number of individuals in each community)\*100%

I categorized all 11 communities into two groups: rural community group and urban community group. As shown in Figure 5, the total overweight/obesity prevalence rates of the rural and urban group are 49.12% and 53.49%, respectively. By gender, the male overweight/obesity prevalence rate of the rural and urban group are 48.39% and 52.63%, and the female prevalence rate of rural and urban group are 50.00% and 54.17%, respectively.

The Chi-square was used to test whether the location of urban/rural has a significant impact on overweight and obesity. Results show that urban/rural does not have a significant impact on overweight and obesity.

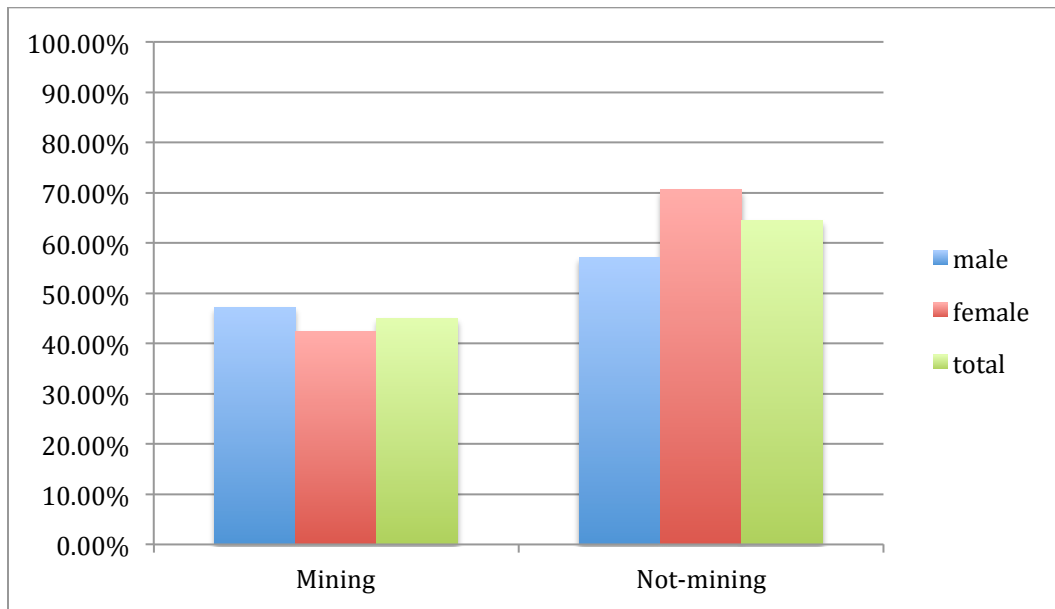


**Figure 5: Overweight/obesity prevalence rates in rural and urban community groups<sup>1</sup>**

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<sup>1</sup> Note: (1) Male overweight/obesity prevalence rate = (Number of overweight/obese males (BMI ≥ 25) in each group/ Number of males in each group)\*100%. (2) Female overweight/obesity prevalence rate = (Number of overweight/obese females (BMI ≥ 25) in each group/ Number of females in each group)\*100%. (3) Total overweight/obesity prevalence rate = (Number of overweight/obese individuals (BMI ≥ 25) in each group/ Number of individuals in each group)\*100%.

If all communities are categorized into mining and not-mining group, results are shown in Figure 6. The total overweight/obesity prevalence rates of mining and not-mining group are 44.93% and 64.52%, respectively. The Chi-square test shows that mining/not-mining have a significant impact on total overweight and obesity prevalence. By gender, the male overweight/obesity prevalence rates of mining and not-mining group are 47.22% and 57.17%, respectively, and the female overweight/obesity prevalence rates of mining and not-mining group are 42.42% and 70.59%, respectively. The Chi-square test shows that mining/not-mining does not have a significant impact on overweight and obesity prevalence of female or male.



**Figure 6: Overweight/obesity prevalence rates in mining and not-mining community groups<sup>2</sup>**

<sup>2</sup> Note: (1) Male overweight/obesity prevalence rate = (Number of overweight/obese males (BMI ≥ 25) in each group/ Number of males in each group)\*100%. (2) Female overweight/obesity prevalence rate = (Number of overweight/obese females (BMI ≥ 25) in each group/ Number of females in each group)\*100%. (3) Total overweight/obesity prevalence rate = (Number of overweight/obese individuals (BMI ≥ 25) in each group/ Number of individuals in each group)\*100%.

### 3.2.2 Overweight and obesity prevalence by gender

As shown in Figure 7, the male overweight/obesity prevalence rate is 44.00%, and the female overweight/obesity prevalence rate is 58.00%. The Chi-square test shows that gender does not have a significant impact on overweight and obesity.

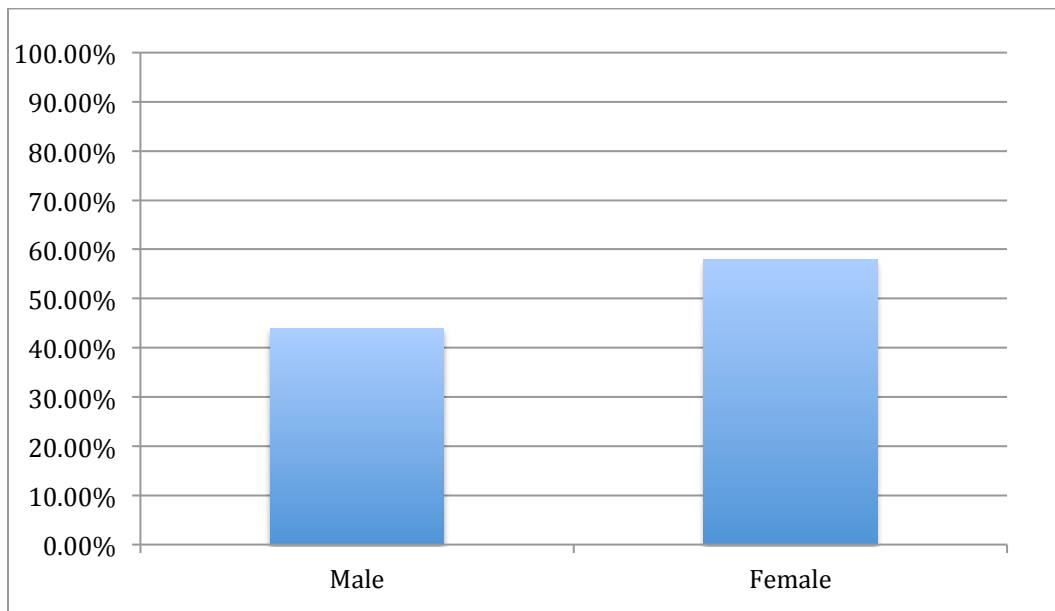


Figure 7: Overweight/obesity prevalence rate of male and female<sup>3</sup>

### 3.2.3 Overweight and obesity prevalence by income

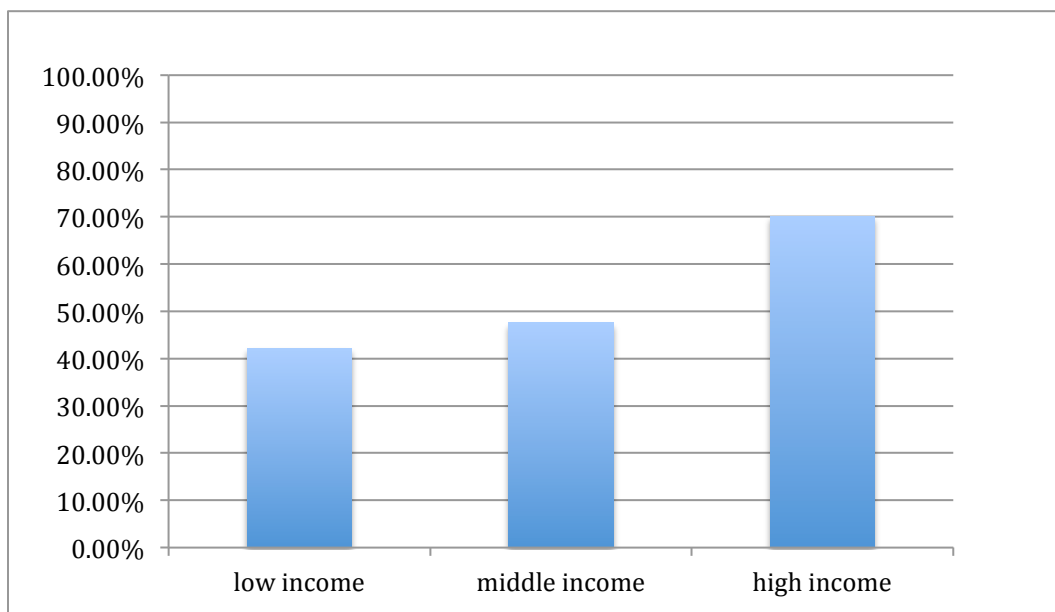
All individuals were divided into three income groups based on their family income: low-income group if the individual's family income is not more than 10000 Sol; middle-income

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<sup>3</sup> Note: Overweight/obesity prevalence rate = Number of overweight/obese individuals (BMI  $\geq$  25) in all selected households in each gender/ Number of individuals in all selected households in each gender.

if the individual's family income is more than 10000 Sol and is not more than 20000 Sol; high-income if the individual's family income is more than 20000 Sol.

As reported in Figure 8, the overweight/obesity prevalence rates of low-, middle-, and high-income groups are 42.11%, 47.54% and 70.00% respectively. The low-income group has the lowest overweight/obesity rate and the high-income has the highest overweight/obesity rate. The results of Chi-square test show that family income does not have a significant impact on overweight and obesity.



**Figure 8: Overweight/obesity prevalence rates of three income groups<sup>4</sup>**

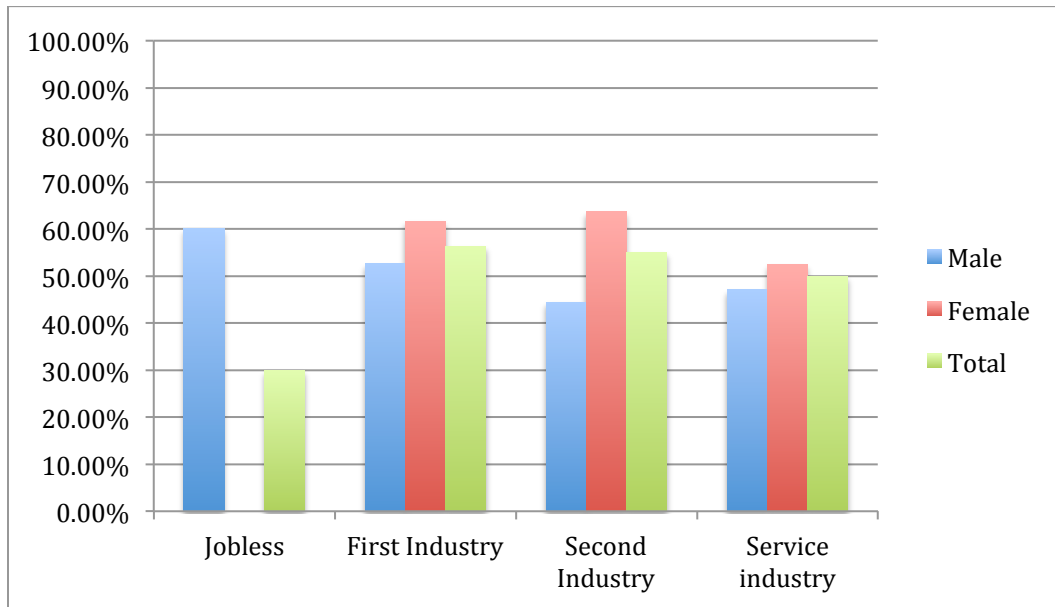
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<sup>4</sup> Note: Overweight/obesity prevalence = Number of overweight/obese individuals (BMI  $\geq$  25) in all selected households in each income group/ Number of individuals in all selected households in each income group.

### **3.2.3 Overweight and obesity prevalence by occupation of the household head**

Occupations of household heads are categorized into 4 groups: Jobless, First Industry, Second Industry and Service Industry. Occupations of First Industry include farmer, fisherman, logger, rancher and miner. Occupations of Second Industry include employed worker and welder. Occupations of Service Industry include police, teacher, businessman, taxi driver and carrier.

Figure 9 shows overweight/obesity prevalence rates of 4 groups of people with different occupations of their household heads. The total overweight/obesity prevalence rates of Jobless group, First Industry group, Second Industry group and Service Industry group are 30.00%, 56.25%, 55.00% and 50.00%, respectively. The Chi-square test shows that occupation of household head has a significant impact on overweight and obesity at 10% level ( $p=0.09$ ). By gender, the male overweight/obesity prevalence rates of Jobless group, First Industry group, Second Industry group and Service Industry group are 60.00%, 52.63%, 44.44%, and 47.06%, respectively. The Jobless group has the highest prevalence rate among 4 groups. The Chi-square test shows that occupation of household head does not have a significant impact on male overweight and obesity prevalence. The female prevalence rates of 4 groups are 0.00%, 61.54%, 63.64%, and 52.38%, respectively. The Chi-square test shows that occupation of household head has a significant impact on female overweight and obesity prevalence at 1% level ( $p=0.009$ ).



**Figure 9: Overweight/obesity prevalence rate by occupation of household head<sup>5</sup>**

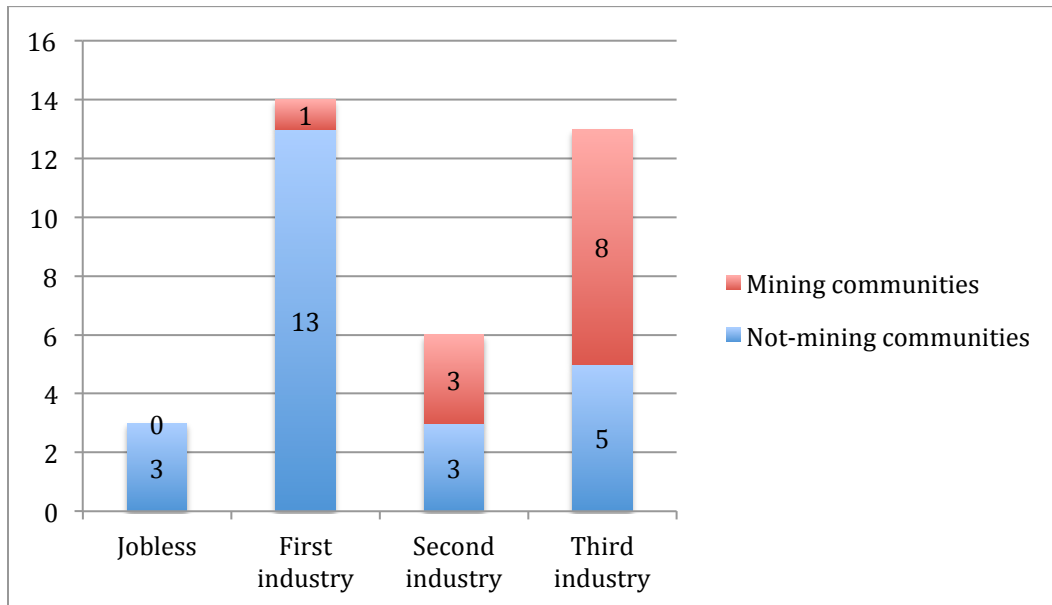
### **3.3 Description of key variables**

The distributions of household head occupations are different in mining and not-mining community (see Figure 10). All jobless household heads are from not-mining communities, and no household heads are jobless in mining communities. In addition, for household heads who are in the first industry, most of them are from not-mining communities. The numbers of household head in the second industry from mining and not-mining communities are same. For household heads who are in the service industry, more are from mining communities.

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<sup>5</sup> Note: (1) Male overweight/obesity prevalence = (Number of overweight/obese males (BMI ≥ 25) in each group/ Number of males in each group)\*100%. (2) Female overweight/obesity prevalence = (Number of overweight/obese females (BMI ≥ 25) in each group/ Number of females in each group)\*100%. (3) Total overweight/obesity prevalence = (Number of overweight/obese individuals (BMI ≥ 25) in each group/ Number of individuals in each group)\*100%.





**Figure 10: Distribution of household head occupations in mining and not-mining communities**

Descriptive statistics of key variables are reported in Table 5. Columns (1)-(3) represent the name of variable, the description of variable, and the mean and the standard deviation of variable, respectively. As shown in Table 5, the sample average BMI is 24.38. The mean of variable Male is 0.50, which means there are 50 males and 50 females in my study. By location, there are 57 individuals living in rural areas and 43 living in urban areas; 31 individuals living in mining communities and 69 living in not-mining communities. Considering the different number of family members in each household, the average family yearly income per capita was calculated, which is 5742.65 Sol. The average individual weekly time spent on sports is only 0.72 hour, which is very short compared with the average individual weekly hour of watching TV, 15.05 hours. Soccer and volleyball are the two most popular sports in those communities.

**Table 4: Descriptive statistics of key variables**

(1) Variable	(2) Description	(3) Mean (Standard Deviation)
BMI	Individual Body Mass Index= Weight (kg)/Height <sup>2</sup> (m <sup>2</sup> )	24.38 (±6.16)
Obe	Dummy variable for overweight/obesity status (1 if overweight/obese)	0.51 (±0.50)
Gender	Dummy variable for fender (1 if male, 0 if female)	0.50 (±0.50)
Rural	Dummy variable for rural (1 if living in rural area, 0 if living in urban area)	0.57 (±0.50)
Mining	Dummy variable for mining (1 if live in areas with mining activities)	0.31 (±0.46)
Occupation	Dummy variable for occupation of household head (0 if jobless, 1 if First Industry, 2 if Second Industry, 3 if Service Industry)	0.57 (±0.73)
Income	Family Yearly Income (unit = Sol)	15951.81 (±11309.33)
Income per capita	Dummy variable for family yearly income per capita (1 if income per capita is not more than 5000 Sol, 2 if income per capita is more than 5000 Sol and is not more than 10000 Sol, 3 if income per capita is more than 10000 Sol)	5742.65 (±4635.69)
Food	Family yearly consumption on food (Sol)	1400.00 (±513.14)
Soda	Family yearly consumption on soda (Sol)	501.22 (±1066.42)
Alcohol	Family yearly consumption on alcohol (Sol)	719.33 (±1054.28)
Oil	Family yearly consumption on oil (Sol)	136.63 (±97.47)
Salt	Family yearly consumption on salt (Sol)	21.03 (±14.65)
Other Food	Family yearly consumption on other food (Sol)	741.11 (±1166.16)
Smoking	Family yearly consumption on other smoking (Sol)	21.67 (±84.65)
Others	Family yearly consumption on other goods (Sol), including seed, fertilizer, pesticide, animal medicine, fishing tool, coal, gasoline and electric power.	1882.67 (±1236.80)
Weekly sports time	Individual weekly hours of sports (unit = hour)	0.72 (±1.89)
TV	Individual weekly hours of watching TV (hour)	15.05 (±13.10)

The average family income per year is 15951.81 Sol (6099.97 USD). The average total food consumption is 1400.00 Sol (535.36 USD) each year, accounting for 8.77% of family income (see Table 5).

**Table 5: Family income and consumption**

Variable	Mean (Sol <sup>6</sup> )	C/Y (%)	FC <sub>i</sub> /FC (%)
Income (Y)	15951.81	-	-
Consumption (C)			
Total Food Consumption (FC)	1400.00	8.77	-
Consumption on soda (FC1)	501.22	3.14	35.80
Consumption on oil (FC2)	136.62	0.85	9.76
Consumption on salt (FC3)	21.03	0.13	1.50
Consumption of other food (FC4)	741.11	4.65	52.94
Consumption on alcohol (AC)	719.33	4.51	-
Consumption on smoking (SC)	21.67	0.14	-
Consumption on others	1882.66	11.80	-

Within the total food consumption, 501.22 Sol (191.67 USD) are spent on soda, accounting for 35.80% of total food consumption or 3.14% of family income. Yearly consumption on alcohol is 719.33 Sol (275.07 USD), accounting for 4.51% of family income. The average alcohol consumption is high and is more than half of the total food consumption. According to the results of the questionnaire, Cosqueña beer is the only kind of alcohol that families or individuals mentioned that they consume. Cosqueña is a popular Peruvian-brand beer. The average retail price of each bottle of Cosqueña beer is about 6 Sol. This means on average, each family consumes about 120 bottles of beer each year. Compared with alcohol

<sup>6</sup> "Sol" is the currency unit of Peru, the exchange rate for Sol/US\$ is around 0.382 in March, 2016.

consumption, the average smoking consumption is only 21.67 Sol, only accounting for 0.14% of total consumption. Considering the fact that the average price of each pack of cigarettes is around 5 Sol, families consume 4 packs of cigarettes each year on average. In addition, families spend a large amount of money (1882.67 Sol) on other goods for production and life, such as seed, fertilizer, pesticide, animal medicine, fishing tools, coal, gasoline and electric power.

### 3.4 Regression results

The sign of estimated coefficient are same across the linear regression and the logistic regression, indicating the robust of the results.

**Table 6: Main results of linear regression**

Independent variable	Coefficient	P value
Male	-1.55	0.16
Mining	2.55	0.03**
Income per capita	1.78	0.02**
Sports time	-0.69	0.02**
Soda spending	0.26	0.002***
Alcohol spending	0.08	0.05*
Adjusted R-square		0.28
Sample Size		100

Note: \* significant at 10% level, \*\* significant at 5% level, \*\*\* significant at 1% level.

The main results of the linear regression are shown in Table 6-1. In the linear regression, the coefficient of Male is negative, meaning that being male has a negative impact (although statistically insignificant) on BMI. Men tend to have lower BMI than women. The coefficient of Sports hour is also negative and it is significant at 1% level. Compared with individuals who

spend fewer hours on sports every week, individuals who spend more hours on sports are likely to have lower BMI. The coefficient of Mining is positive and it is significant at 5% level, meaning that living in mining communities has a positive impact on BMI. People living in mining communities are more likely to have higher BMI than people living in not-mining communities. Income per capita is positively associated with BMI. Increasing income per capita is related to higher BMI. In addition, both Soda spending and Alcohol spending have significantly positive impacts on BMI. Increasing soda spending or alcohol spending is related to increased BMI.

**Table 7: Main results of logistic regression**

Independent variable	Coefficient	Odds Ratios	P value
Male	-0.87	0.42	0.09*
Mining	1.30	3.66	0.03**
Income per capita	0.56	1.75	0.11
Sports time	-1.04	0.35	0.01***
Soda spending	0.13	1.14	0.02**
Alcohol spending	0.05	1.05	0.09*
Pseudo R-square		0.28	
Sample Size		100	

Note: \* significant at 10% level, \*\* significant at 5% level, \*\*\* significant at 1% level.

The main results of the linear regression are shown in Table 6-2. The logistic regression yields similar results. The odds ratio (OR) of Male is less than 1, showing that being male is a protective factor of being overweight and obese. Men are less likely to be overweight and obese compared with women. The OR of Sports time is also less than 1. Exercising is also a protective factor of being overweight and obese. Individuals who spend more hours exercising are less

likely to be overweight and obese. The OR of Mining is more than 1. Living in mining communities is a risk factor of overweight and obesity. People living in mining communities are more likely to be overweight/obese than people living in not-mining communities. However, results of two regression models are opposite to results in the descriptive analysis, in which the overweight/obesity rate is higher in not-mining communities than in mining communities. Although not significant, Income per capita is also a risk factor of overweight and obesity. Individuals with higher income per capita are more likely to be overweight/obese. In addition, the ORs of Soda spending and Alcohol spending are more than 1. The consumptions of soda and alcohol are two important risk factors of overweight and obesity. Increasing alcohol or soda consumption is related to increased possibility of being overweight/obese.

## **4. Discussion**

### ***4.1 Gold mining increases income.***

In the descriptive analysis, which did not control for the effects of other variables, mining communities have a lower overweight and obesity rate than not-mining communities. However, results are opposite to the result in the regression models that mining communities have a higher overweight and obesity rate. This indicates the importance of controlling for other variables.

Regression models reveal the negative impact of gold mining on health. The overweight and obesity rate is higher in mining communities than in non-mining communities. Gold mining contributes to the increasing overweight and obesity rate, both directly and indirectly. Gold mining provides relatively higher rewards compared with other local jobs. Although gold mining is high-risk, it continues to attract many local male laborers in communities nearby and greatly increases the family income. Family income is one of the most important determinants of food consumption. A previous study has shown that high income enable families to buy food as they like, while low income pressures families to purchase the food lowest in cost (Andreyeva, Long, & Brownell, 2010). Families in mining communities with higher incomes can afford the food they like, such as fried chicken and hamburgers. In Madre de Dios, local economies are mainly dependent on agriculture and there is no developed food industry. Processed and calorie-dense food, such as fried chicken and hamburgers, are not cheap. These foods are less affordable to families in not-mining communities with lower income. More access

to processed and calorie-dense food increases people's risk of being overweight and obese in mining communities.

This situation is different from that in many high-income countries. For example, in the United States, with developed technologies and mass production of food, processed and calorie-dense food are cheap and more attractive to the poor population (Cutler, Glaeser, & Shapiro, 2003). Meanwhile the rich population can afford prudent and healthier diet based on lean meats, fish, fresh vegetables and fruits. This is one of the reasons why the highest overweight and obesity rate occurs in the population group with the lowest income in the United States (Drewnowski & Specter, 2004).

#### ***4.2 Local agriculture is changing.***

On average, households in low-income countries spend up to 62% of their income on food, while the expenditure is 6-30% in high- and mid- income countries (Cornelsen et al., 2015). However, in this study, family total food expenditure accounts for only 8.77% of family income on average, which is similar to the level in high-income countries. This can be explained by the fact that families, especially families in rural communities, rely on products they produce by themselves. While in mining communities, occupations of household head are mainly in second and service industry. They have less time on agriculture, and rely more on purchased food.

Agricultural growth plays an important role in increasing local food availability, stimulating the local economy, and reducing the cost of food for consumers (Irz, Lin, Thirtle, &



Wiggins, 2001). However, in Madre de Dios, agriculture faces challenges. With the rapid urbanization and mass gold mining and logging, local residents are facing the loss of substantial amounts of farming land. Also, the cost of agriculture is high. On average, each family spends 11.8% of family yearly income on goods for production and life, such as seeds, fertilizer, pesticides, and animal medicine. When the price/cost of producing and consuming nutrient rich non-staples, such as vegetables and fruits, increases, it is easier for people, especially low-income ones, to switch to low-quality, cheaper staple foods (Cornelsen et al., 2015). The increased food price/cost in Madre de Dios reduces people's access to food like vegetables and fruits, especially for low-income people.

#### ***4.3 Health behaviors need to be changed.***

The large amount of soda consumption has become one of the main reasons for the high overweight and obesity rate in Madre de Dios. Local people like the taste of soda and enjoy the happiness soda provides to them, especially on hot days. They also have easy and cheap access to soda. The building of the Interoceanic Highway and the rapid development of Internet and TV networks have brought economic globalization to each community and influenced local life. International food companies bring there cheap processed food, as well as their advertisements. For example, Coca Cola is everywhere in Madre de Dios and it is affordable for most families. In this study, family expenditure on soda accounted for up to 35.8% of total food expenditure.

Even worse, soda is provided to students as daily refreshment in some primary schools and kindergartens (see Appendix 5).

Alcohol consumption is another risk factor of high overweight and obesity rates. On average, families spend 4.65% of family income on alcohol, the percentage is even higher than soda. Almost all alcohol consumers in my study are male and they drink alcohol in the bar. Madre de Dios is basically a male dominated society, in which men are the person who work outside of the home and earn money for the family (Smith, 2008). Therefore, men are usually the decision makers of their families and can freely decide how much money to spend on alcohol. Drinking alcohol is considered to be a good way to relax and reduce pressures. Men like to drink in the bar, chatting with friends and watching sports games.

Lack of physical activities is also responsible for the high overweight and obesity rates in Madre de Dios. There are two possible reasons for the low rated of exercise. First, people perform much less hard manual labor than before, and work becomes more sedentary. People cannot get as much amounts of physical activity as they did previously. Women usually stay at home and keep the house. They spend many hours watching TV every day but seldom go outside for exercise. Lack of physical activity can also be one of the reasons for females' higher overweight and obesity rate compared to males' in my study, which is consistent with results of other studies in Peru (Chaparro & Estrada, 2012). Second, there are few sports infrastructures and grounds available in each community. Although soccer is very popular in Peru, people can hardly find a soccer field, which increases the difficulties of getting enough physical activity.

#### ***4.4 Implications for further research***

Because of the lack of price data and income data in the past years, it is difficult to compare their dynamic effects on obesity. Long-term and wider-range research of the impact of globalization on local economies and obesity prevalence should be done. It is also important to study Peruvian social and cultural backgrounds, and individual habits and food preferences, which have great impact on food consumption and obesity.

#### ***4.5 Study strengths and limitations***

This study explores reasons for the high overweight and obesity rate in Madre de Dios through not only the use of quantitative data, but also through the observation and interaction with local people in the field. Those local experiences contribute to a better understanding of the social, economic and cultural background, and their connections to overweight and obesity.

However, the study results are subject to several limitations. First, the sample size is limited, which may reduce the accuracy of the regression results. Second, BMI data were collected in 2011. Individuals' BMI may have changed in the past 4 years, leading to result errors. Third, only 6 factors in the regression model were considered and other related factors may have been neglected. Fourth, both family income and food expenditure are self-reported, which can be inaccurate because of memory bias or other reasons. Fifth, yearly food consumption is calculated based on the consumption of last week, which may not be in a good position to account for the possible seasonal fluctuation of consumption pattern of a year. Sixth,

this is a cross-sectional design and cannot explain impacts of dynamic changes of price or family income on consumption and obesity.

## 5. Conclusion

Against the background of globalization, Madre de Dios has witnessed rapid economic development and great changes of lifestyle. Also, like many other places in South America, Madre de Dios is challenged by high overweight and obesity rates. This study quantitatively analyzed the impact of household economic status and food consumption patterns on overweight and obesity, and tried to establish their relationship with local economic activities.

Mining has a statistically significant positive impact on overweight and obesity. People living in mining communities are more likely to be overweight or obese. Soda consumption has become one of the important reasons for the high overweight and obesity rate in Madre de Dios. Large amounts of family income are spent on soda. Alcohol—most of which is consumed by men—also accounts for a large percentage of family income and is positively related to overweight and obesity. In addition, lack of exercise has a statistically significant negative impact on overweight and obesity. Individuals without enough physical activities are more likely to be overweight or obese.

Globalization has changed local life greatly and has influenced local health in direct and indirect ways. On the one hand, the rise of international gold prices makes local mining flourish. Mining increases family income and people have more money to buy the food they like. However, without enough health knowledge, males spend much money on alcohol, and families spend large amounts of money on restaurant food such as fried chicken and hamburgers, all of which increase the possibility of being overweight or obese. Furthermore,

increasing mining leads to the loss of farming land. This reduction and the high costs associated with farming make it more difficult and expensive to produce vegetables and fruits. On the other hand, globalization and the convenient transport system bring Western processed food. Nationwide advertisements make these foods more and more popular among Peruvians. People spend a large percentage of family income on soda products, such as Coca Cola.

In sum, although economic growth has brought prosperity, this prosperity has come with unwanted health challenges. Healthy and balanced diets and enough physical activities can reduce the risk of overweight and obesity. Individuals, communities and the government should work closely to decrease the high overweight and obesity rate in Madre de Dios.

# Appendix 1: Inform consent (English)

Duke University and the US Naval Medical Research Unit #6

## CONSENT FORM: HOUSEHOLD

**Study Title:** Migration, health and environmental change along the Interoceanic Highway

**Principal Investigator:** William Pan

IRB #: 2705

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### Introduction

We would like to invite you to participate in a study to examine the relationship between family income, food purchasing and prices, and obesity. We are conducting this survey because the number of people who are considered overweight or obese in Madre de Dios has rapidly increased over the past few years. Your house was scientifically selected at random during our previous study about population, environment and human health in Madre de Dios, when we surveyed your family in 2011-12 and again this past year in 2014. In this study, we are only re-visiting a small number of households and communities that were previously visited. Please read this form and ask me anything before you agree to participate. This study is collaboration between Duke University in the United States, the DIRESA of Madre de Dios, and the US Naval Medical Research Unit-6 located in Lima, Peru.

### Purpose

The purpose of this survey is to determine the influence of household income and food prices on obesity. To do this we will ask you a few questions about your income, jobs, types of food you eat, your farm if you have one and some other related questions. In addition, we will carry out a market food price survey to study the average price of each food you mentioned during in the interview. This information can help us understand the influence of household income and food price on family obesity rate. The results of the study may help decrease the obesity rate in this area.

### Procedures

If you agree to participate, we will ask a few questions to the person in your family who is mainly in charge of purchasing and preparing food in your family. The interview will take a maximum of 1 hour. Questions include information on household income, jobs, types of food consumed, farm production (if you have one), and related questions.

### Risks

There are no risks to participating in this survey. You are free to answer as many or as few questions as you want. This interview will take about 1 hour.

### Benefits

We hope this study can provide evidence about social and economic factors to help decrease the obesity rate in this community and in this Region.

### Compensation

You will not receive money or gifts for taking part in this study.

### Confidentiality

All of your responses to the survey are confidential and surveys will be stored in locked cabinets. Only members of the research group will have access to your responses. Nothing will be shared with anyone outside of our research group that will include your personal identification, such as your name.

### Right to Refuse or Withdraw

Taking part in this research study is completely voluntary. You can refuse to participate in the study. You also stop the interview at any time if you feel uncomfortable during the interview. There will be no harm or penalty to you or your family if you do so.

### Who to Contact

If you have any questions and want to talk to anybody in the research group, or if you think there are some misconduct in the research, you can contact the principle investigator William Pan

([william.pan@duke.edu](mailto:william.pan@duke.edu) or 65 234250) or the chair of the Ethics committee at NAMRU-6, Claudio Rocha (971137374 or 01-614.4141 Ext 235). They can answer your questions and help you.

**Certificate of Consent**

Print Name of Participant \_\_\_\_\_

If you have read this document and you have been given the chance to ask any questions now or at a later time OR if the document has been read and explained to you and you <b>agree to participate</b> , please sign or make your mark below.	
_____	_____
Signature or Mark of Subject indicating agreement to answer the survey	Date
_____	_____
Signature of Person Obtaining Consent	Date
_____	_____
Witness to Consent if Subject Unable to Read or Write	Date
<i>(Must be different than the person obtaining consent)</i>	

***If illiterate***

If the participant is illiterate, a literate person must sign. Participants who are illiterate should include their thumb print as well.

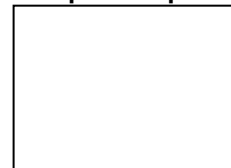
I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness \_\_\_\_\_

Signature of witness \_\_\_\_\_

Date:

**Thumb print of participant**





## Appendix 2: Inform consent (Spanish)

Universidad de Duke y la Investigación Médica Naval de los EE.UU. Unidad # 6

### FORMULARIO DE CONSENTIMIENTO: HOGAR

**Título del estudio:** La migración, la salud y el cambio ambiental a lo largo de la Carretera Interoceánica

**Investigador Principal:** William Pan

IRB #: 2705

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#### **Introducción**

Nos gustaría invitarle a participar en un estudio para examinar la relación entre el ingreso familiar, la compra de alimentos y los precios, y la obesidad. Estamos llevando a cabo este estudio porque el número de personas que se consideran sobrepeso u obesos en Madre de Dios se ha incrementado rápidamente en los últimos años. Su casa fue seleccionada científicamente al azar durante nuestro anterior estudio sobre la población, el medio ambiente y la salud humana en Madre de Dios, cuando encuestamos a su familia en 2011-12 y otra vez en el año pasado en el año 2014. En este estudio, sólo estamos re-visitando un pequeño número de familias y comunidades que fueron visitadas previamente. Por favor, lea este formulario y hágame cualquier pregunta antes de aceptar participar. Este estudio es una colaboración entre la Universidad de Duke en Estados Unidos, la DIRESA de Madre de Dios, y de la Unidad-6 US Naval de Investigación Médica ubicada en Lima, Perú.

#### **Propósito**

El propósito de este estudio es determinar la influencia de los ingresos del hogar y de los precios de los alimentos sobre la obesidad. Para ello vamos a hacerle unas preguntas sobre sus ingresos, el empleo, los tipos de alimentos que usted come, su granja, si usted tiene uno y algunas otras preguntas relacionadas. Además, vamos a llevar a cabo una encuesta de los precios de los alimentos en el mercado para estudiar el precio medio de cada alimento que usted ha mencionado durante la entrevista. Esta información puede ayudar a comprender la influencia de los ingresos familiares y precios de los alimentos sobre la tasa de obesidad familiar. Los resultados del estudio pueden ayudar a disminuir la tasa de obesidad en esta área.

#### **Procedimientos**

Si está de acuerdo en participar, vamos a hacer algunas preguntas a la persona en su familia que se encarga principalmente de la compra y preparación de alimentos en su familia. La entrevista tendrá un máximo de 1 hora. Las preguntas incluyen información sobre los ingresos de los hogares, puestos de trabajo, tipos de alimentos consumidos, la producción agrícola (si lo tiene), y otras preguntas relacionadas.

#### **Riesgos**

No hay riesgos para participar en esta encuesta. Usted es libre de responder a tantas o tan pocas preguntas que desee. Esta entrevista tomará alrededor de 1 hora.

#### **Beneficios**

Esperamos que este estudio pueda proporcionar evidencia sobre los factores sociales y económicos para ayudar a disminuir la tasa de obesidad en esta comunidad y en esta región.

#### **Compensación**

No recibirá dinero o regalos por participar en este estudio.

#### **Confidencialidad**

Todas sus respuestas a la encuesta son confidenciales y las encuestas se almacenarán en armarios cerrados con llave. Sólo los miembros del grupo de investigación tendrán acceso a sus respuestas. Nada será compartido con nadie fuera de nuestro grupo de investigación que incluirá su identificación personal, como su nombre.

#### **Derecho a denegar o retirar**

La participación en este estudio de investigación es completamente voluntaria. Usted puede negarse a participar en el estudio. También puede detener la entrevista en cualquier momento si se siente incómodo durante la entrevista. No habrá ningún daño o pena para usted o su familia, si lo hace.

**A quién contactar**

Si usted tiene alguna pregunta y desea hablar con alguien en el grupo de investigación, o si le parece que hubo mala conducta en la investigación, usted puede ponerse en contacto con el investigador principal William Pan ([william.pan@duke.edu](mailto:william.pan@duke.edu) or 65 234250) o el presidente del comité de ética en NAMRU-6, Claudio Rocha (971137374 or 01-614.4141 Ext 235). Ellos pueden responder a sus preguntas y ayudarle.

**Certificado de Consentimiento**

Imprimir Nombre del Participante \_\_\_\_\_

Si usted ha leído este documento y se le ha dado la oportunidad de formular las preguntas ahora o en un momento posterior, o si el documento ha sido leído y explicado a usted y usted está **de acuerdo en participar**, por favor de firmar o hacer su marca a continuación.

_____	_____
Firma o marca de Asunto indicando el acuerdo para responder a la encuesta	Fecha
_____	_____
Firma de la persona que obtiene el consentimiento	Fecha
_____	_____
Testigo de consentimiento si Asunto Incapaz de leer o escribir <i>(Debe ser diferente de la persona que obtiene el consentimiento)</i>	Fecha

**Si analfabeta**

Si el participante es analfabeto, una persona alfabetizada debe firmar. Los participantes analfabetos deben incluir su huella digital también.

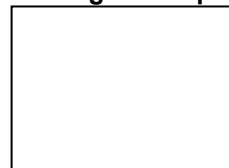
He sido testigo de la lectura exacta del documento de consentimiento al participante potencial, y el individuo ha tenido la oportunidad de hacer preguntas. Confirмо que el individuo ha dado su consentimiento libremente.

Escriba el nombre de los testigo \_\_\_\_\_

Firma del testigo \_\_\_\_\_

Fecha:

**Huella digital del participante**



## Appendix 3: Questionnaire (English)

Household Code:		Date: / /		Name of interviewer:	
Name of Interviewee:					
Relationship to the head of the family:					
Number of family members:		(number of adults:		number of children: )	
1. How much does your family usually spend on food each month?					
2. Does your family buy food from a market?					
<input type="checkbox"/> No (If no, please go directly to question 3)					
<input type="checkbox"/> Yes (If yes, please complete the following table)					
List <b>10</b> kinds of food you usually purchase at the market during the <b>wet season (November-March)</b>	How many kilograms does your family usually buy during the wet season?	What's the average price of each kilogram	Name of the market	How far is the market from your house in min/km?	How do you travel there? (e.g. walking, bike, motorcycle)
(1)					
(2)					
(3)					
(4)					
(5)					
(6)					
(7)					
(8)					
(9)					
(10)					
List <b>10</b> kinds of food you usually purchase at the market during the <b>dry season (April-October)</b>	How many kilograms does your family usually buy during the wet season?	What's the average price of each kilogram	Name of the market	How far is the market from your house in min/km?	How do you travel there? (e.g. walking, bike, motorcycle)
(1)					
(2)					
(3)					

(4)					
(5)					
(6)					
(7)					
(8)					
(9)					
(10)					

3. Does any of your family members eat the following food in the past 1 week?

- No (If no, please go directly to question 4)  
 Yes (If yes, please complete the following table)

Name of family members												
	Unit	Price/unit	Unit	Price/unit	Unit	Price/unit	Unit	Price/unit	Unit	Price/unit	Unit	Price/unit
Soda												
Ice cream												
Chip												
Candy												

4. Did any of your family members eat in a restaurant in the past 1 week?

- No (If no, please go directly to question 5)  
 Yes (If yes, please complete the following table)

Family member who eat in a restaurant	How many times did he/she eat in a restaurant for lunch?	How much did he/she pay each time on average? (Meal+ alcohol)	How much did he/she pay for alcohol at lunch?	How many times did he/she eat in a restaurant for dinner?	How much did he/she pay each time on average? (Meal+ alcohol)	How much did he/she pay for alcohol at dinner?

5. Does anyone in your family smoke?

<input type="checkbox"/> No (If no, please go directly to question 6) <input type="checkbox"/> Yes (If yes, please complete the following table)				
Family member who smokes	How many cigarettes does he/she smoke every week? (pack/single cigarettes)	What is the brand of the cigarettes?	How much is each pack of cigarettes/ each cigarette?	Where does he/she get the cigarettes?
6. Does anyone in your family drink alcohol (not at meal)?				
<input type="checkbox"/> No (If no, please go directly to question 7A) <input type="checkbox"/> Yes (If yes, please complete the following table)				
Family member who drink alcohol	How many bottles/glasses of alcohol does he/she drink (not at meal) every week?	The type/ brand of alcohol	How much is each bottle/glass of alcohol?	Where does he/she get the alcohol?
7A. Did your family grow crops in the past 1 year?				
<input type="checkbox"/> No (If no, please go directly to question 7B) <input type="checkbox"/> Yes (If yes, please complete the following table)				
Name of crop	How many kilograms did you grow in total in the past 1 year?	How many kilograms were used for personal consumption in the past 1 year?	How many kilograms were sold in the past 1 year?	What is the average price for selling each kilogram of the food?


7B. Did your family raise any of the following animals in the past 1 year?

- No (If no, please go directly to question 7C)  
 Yes (If yes, please complete the following table)

Name of animal	How many did you raise in the past 1 year?	How many were used for personal consumption in the past 1 year?	How many were sold in the past 1 year?	What is the average price for selling each animal?
CATTLE (ADULT)				
CATTLE (CALVES)				
SHEEP				
MULES / HORSES				
BIRDS / CHICKENS				
TURKEYS / DUCKS				
PIGS				
GUINEA PIGS				

7C. Did your family sell the following animal products in the past 1 year?

- No (If no, please go directly to question 7D)  
 Yes (If yes, please complete the following table)

	how many units did your family produce in the past 1 year?	How many units were used for personal consumption in the past 1 year?	How many units did you sell in the past 1 year?	What's the average price for each unit?
Eggs				
Milk				
Cheese				

7D. Did your family fish in the past 1 year?

- No (If no, please go directly to question 7E)

<input type="checkbox"/> Yes (If yes, please complete the following table)						
Name of fish (list up to 5 most common types of fish)	How many kilograms did you fish in the past 1 year?	How many kilograms were used for personal consumption in the past 1 year?	How many kilograms were sold in the past 1 year?	What is the average price for selling each kilograms of fish?		
7E. Did your family pay for the following things in the past 1 year?						
<input type="checkbox"/> No (If no, please go directly to question 8) <input type="checkbox"/> Yes (If yes, please complete the following table)						
Type of things you paid for in the past 1 year		How much have you spent on it in the past 1 year?				
Seed						
fertilizer						
pesticide						
animal medicine						
fishing tool						
coal						
gasoline						
electric power						
8. Please complete the following table about work.						
Family member who has a job	Job	How many hours/days does he/she work every week?	What's the average salary for each hour/day?	Average distance from home to working place (min/km)	How does he/she go to work? (e.g. walking, bike, motorcycle)	Weekly traffic payment

9. Please complete the following table about sports.						
Family member	Type of sports	How many times will he/she play every week?	How long will he/she play each time?			
10. How many free days do you have per month?						
11. Please complete the following table about leisure activities.						
Family member	Does he/she <b>watch TV?</b> (If yes, how many hours every day)					
12. At what time do your family members usually have dinner?		Adults:				
		Children:				
13. At what time do your family members usually sleep?		Adults:				
		Children:				



## Appendix 4: Questionnaire (Spanish)

Código de Casa:		Fecha: / /		Nombre del entrevistador:	
Nombre del entrevistado:					
Relación con el jefe de la familia:					
Número de miembros en la familia: (adultos:                      niños:                      )					
1. En general, cuanto dinero su familia gasta en alimentos cada mes?					
2. Su familia compra la comida de un mercado?					
<input type="checkbox"/> No (Si no, ir directamente a la pregunta 3)					
<input type="checkbox"/> Si (Si sí, completa la siguiente tabla)					
Lista 10 tipos de comida que compra en general en el mercado durante <b>temporada de lluvias (Noviembre-Marzo)</b>	Cuantos kilos en general su familia compra durante temporada húmeda?	Que es el promedio precio de cada kilo?	Nombre del mercado	A que distancia de su casa es el Mercado (min o km)?	Como va al mercado? (caminando, bicicleta, etc.)
(1)					
(2)					
(3)					
(4)					
(5)					
(6)					
(7)					
(8)					
(9)					
(10)					
Lista 10 tipos de comida que compra en general en el mercado durante <b>temporada verano (Abril-Octubre)</b>	Cuantos kilos en general su familia compra durante temporada verano?	Que es el promedio precio de cada kilo?	Nombre del mercado	A que distancia de su casa es el Mercado (min o km)?	Como va al mercado? (caminando, bicicleta, etc.)
(1)					
(2)					

(3)					
(4)					
(5)					
(6)					
(7)					
(8)					
(9)					
(10)					

3. Alguna persona de su familia ha comido algunos de estos alimentos en la semana pasada?

- No (Si no, ir directamente a la pregunta 4)  
 Si (Si sí, completa la siguiente tabla)

Nombre de la persona												
	Unidad	Precio/Unidad	Unidad	Precio/Unidad	Unidad	Precio/Unidad	Unidad	Precio/Unidad	Unidad	Precio/Unidad	Unidad	Precio/Unidad
Gaseosas												
Heladas												
Chips												
Golosinas												

4. Alguna persona de su familia ha comido al restaurante en la semana pasada?

- No (Si no, ir directamente a la pregunta 5)  
 Si (Si sí, completa la siguiente tabla)

Nombre de la persona que ha comido al restaurante	Cuántas veces el/ella ha comido al restaurante para el almuerzo?	Cual fue el medio precio de la comida? (Alimentos y bebidas)	Cuanto el/ella paga para alcohol durante el almuerzo?	Cuántas veces el/ella ha comido al restaurante para la cena?	Cual fue el medio precio de la comida? (Alimentos y bebidas)	Cuanto el/ella paga para alcohol durante la cena?

<p>5. Alguna persona de su familia fuma?</p> <p><input type="checkbox"/> No (Si no, ir directamente a la pregunta 6)</p> <p><input type="checkbox"/> Si (Si sí, completa la siguiente tabla)</p>					
Persona de la familia que fuma	Cuántos tabaco o cigarro el/ella fuma cada semana (packs o tabaco individual)	Que es la marca del tabaco o del cigarro?	Cuanto cuesta cada packs de tabaco o cada cigarro individual?	Donde el/ella consigue el tabaco o el cigarro	
<p>6. Alguna persona de su familia consume alcohol (fuera de las comidas)?</p> <p><input type="checkbox"/> No (Si no, ir directamente a la pregunta 7A)</p> <p><input type="checkbox"/> Si (Si sí, completa la siguiente tabla)</p>					
Persona de la familia que consume alcohol	Cuántos vasos de alcohol el/ella toma (fuera de las comidas) cada semana?	Tipo/marca del alcohol	Cuanto cuesta cada vaso de alcohol?	A donde el/ella consigue el alcohol?	
<p>7A. Su familia cuanto cultivos cosechado en el año pasado?</p> <p><input type="checkbox"/> No (Si no, ir directamente a la pregunta 7B)</p> <p><input type="checkbox"/> Si (Si sí, completa la siguiente tabla)</p>					
Nombre del cultivo	Cuántos kilos	Cuántos kilos	Cuántos kilos	Cual es el	

	creen en total en el año pasado han cosechado?	fueron utilizados para su consumo personal en el año pasado?	fueron vendido en el año pasado?	precio promedio para vender cada kilo de comida?

7B. Su familia ha criado algunos de estos animales en el año pasado?

No (Si no, ir directamente a la pregunta 7C)

Si (Si sí, completa la siguiente tabla)

Nombre del animal	Cuántos ha criado en el año pasado?	Cuántos fueron utilizados para su consumo personal en el año pasado?	Cuántos fueron vendido en el año pasado?	Cual es el precio promedio para vender cada animal?
GANADO				
TERNEROS				
OVEJA				
MULAS/CABALLOS				
PAJAROS/				
POLLOS				
CERDOS				
CONEJILLO				

7C. Su familia ha vendido algunos de estos productos de origen animals en el año pasado?

No (Si no, ir directamente a la pregunta 7D)

Si (Si sí, completa la siguiente tabla)

	Cuántas unidades su familia ha producido en el año pasado?	Cuántas unidades fueron utilizados para su consume personal en el año pasado?	Cuántas unidades fueron vendido en el año pasado?	Que es el precio medio para vender cada unidad?
Huevos				

Leche						
Queso						
7D. Su familia ha pescado en el año pasado?						
<input type="checkbox"/> No (Si no, ir directamente a la pregunta 7E) <input type="checkbox"/> Si (Si sí, completa la siguiente tabla)						
Nombre del pescado (listar hasta 5 tipos más comunes de peces)	Cuántos kilos ha pescado en el año pasado?	Cuántos kilos fueron utilizados para su consumo personal en el año pasado?	Cuántos kilos fueron vendido en el año pasado?	Que es el precio medio para vender cada kilo de comida?		
7E. Su familia paga para las siguientes cosas en el año pasado?						
<input type="checkbox"/> No (Si no, ir directamente a la pregunta 8) <input type="checkbox"/> Si (Si sí, completa la siguiente tabla)						
Tipos de cosas que paga por en el año pasado		Cuanto paga para estos en el año pasado?				
Semilla						
Fertilizante						
Pesticida						
Medicina para los animales						
Accesorios para pescar						
Carbón						
Gasolina						
Energía eléctrica						
Comida para los animales						
8. Por favor, completa la siguiente tabla sobre su trabajo.						
Persona de la familia que tiene un trabajo	Trabajo	Cuántas horas/día el/ella trabaja cada semana?	Que es el promedio salario por cada hora/día?	Media distancia de su casa a su trabajo (min o km)	Como el/ella va a su trabajo? (caminando, bicicleta, moto, etc.)	Cuanto gasta en trasporte cada semana?


8. Por favor, completa la siguiente tabla sobre sus deportes.

Persona de la familia	Tipo de deporte	Cuántas veces el/ella hace este deporte cada semana?	Cuánto tiempo el/ella hace este deporte cada semana?

9. Cuantos días libres tiene por mes?

10. Por favor, completa la siguiente tabla sobre sus actividades de descanso.

Persona de la familia	El/ella mira la televisión? Si sí, cuantas horas cada día)

11. A que hora en general los miembros de su familia cenan?

Adultos:

Niños:

12. A que hora en general los miembros de su familia duermen?

Adultos:

Niños:

## Appendix 5: A photo taken in a kindergarten of Madre de Dios



June 2015

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## Appendix 6: Descriptive statistics of other related variables in the questionnaire

Variables	Mean (Standard Deviation)
Age of individual (years old)	37.33 ( $\pm 14.69$ )
Weight of individual (kg)	61.77 ( $\pm 14.11$ )
Height of individual (cm)	155.86 ( $\pm 8.27$ )
Individual weekly times of eating in a restaurant	0.24 ( $\pm 0.69$ )
Bottles of alcohol each individual consumes every week	0.83 ( $\pm 2.29$ )
Individual weekly times of doing sports	0.44 ( $\pm 1.08$ )
Individual average hours of sports each time	0.37 ( $\pm 0.73$ )
Family yearly income from crops (Sol)	2051.81 ( $\pm 4003.64$ )
Family yearly income from animals (Sol)	175.56 ( $\pm 749.87$ )
Family yearly income from animal products (Sol)	49.44 ( $\pm 219.63$ )
Family yearly income from fish (Sol)	1252.78 ( $\pm 7516.67$ )
Family yearly income from working salary (Sol)	12422.22 ( $\pm 9366.42$ )



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