

Food security and social capital
in an urban informal settlement in Lima, Peru

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Abstract

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Background: Food insecurity is associated with poor nutrition and growth, low educational attainment, and other negative outcomes that perpetuate poverty. Although significant progress to reduce food insecurity in Peru has been made in recent decades, 7.5% of the population still experiences food insecurity. While many food security interventions have been focused on rural areas, migration to Peru's capital, Lima, has resulted in the dramatic growth of informal settlements. Little is known about food security in these areas and how food security relates to community characteristics.

Methods: This study was a food security assessment of 43 households in one informal settlement 30 km north of central Lima. We tested the hypothesis that residents with greater social capital, measured by trust, norms, and social networks, experience less severe food insecurity than those with lower social capital. We also examined the relationship between food insecurity and body size in mothers and their children 2-10 years old.

Results: Eighty-eight percent of households experienced some level of food insecurity and 35% were severely insecure. Structural social capital was significantly ($p=0.03$) associated with food insecurity, however, the directionality was the opposite as hypothesized; greater social capital was associated with greater food insecurity. We also found that 64% of mothers and 36% of children were overweight or obese. Food insecurity was not significantly associated with overweight or obesity in children ($p=0.12$) but there was a trend toward increased odds of overweight or obesity in children in households with greater food insecurity. Food insecurity was not a strong predictor of overweight and obesity in mothers, however, there was a significant association ($p=0.05$) between the length of time living in the community and the odds of overweight or obesity.

Discussion: Food insecurity is a significant issue in this community. The association between food insecurity and social capital may be a product of the survey tool; perhaps needier households have greater involvement in groups and seek help from individuals to address their needs. An alternative explanation is that households with greater social capital stretch their resources more thinly due to obligations to their social networks. While the association between food insecurity and overweight and obesity in this sample was weak, the association between overweight and obesity and length of time in the community may suggest that urban informal settlements are “obesogenic,” and lead to an increased risk of chronic disease. Food security and nutrition policy and programs that are community-driven and mobilize local assets, like income-generating projects and urban agriculture, are needed to address these complex issues.

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BACKGROUND

Food Security

Human innovation and cooperative social structure have enabled us to feed 7 billion people. However, hunger persists; an estimated 795 million people globally are food insecure.¹ Food insecurity is the lack of physical and economic access to sufficient, safe, nutritious, and culturally appropriate foods. It is associated with poor nutrition and growth, low educational attainment, and other negative outcomes that perpetuate poverty.² While alleviating poverty and food insecurity are major aims of U.S. foreign policy, the complexities of food insecurity and, in particular, the question of why some households suffer more than others, is only partially understood.³ Although substantial progress has been made in Peru, 7.5% of the population still experiences food insecurity.¹

Health Implications

Food insecurity, coupled with the intergenerational impacts of malnutrition, has left 20% of Peruvian children under 5 stunted.^{4,5} In addition, 9% of children under 5 are overweight or obese.⁴ Among adults ages 30-59, 62% are overweight or obese.⁶ This duality demonstrates the paradoxical effect that food insecurity has in rapidly changing nutritional environments in that one household can have members who are both under and overnourished.^{7,8} The global nutrition transition coincides with the epidemiological transition from infectious to chronic and non-communicable disease.⁹ While overweight and obesity lead to increased risk of cardiovascular disease, diabetes, and other related conditions, it can also obscure persistent micronutrient deficiencies that negatively impact growth, immune function, and reproductive outcomes.¹⁰

Urbanization

Peru has undergone over three decades of dramatic rural-to-urban migration, especially to its capital city, Lima, resulting in the growth of informal urban settlements. More than one-third of Lima's almost 10 million residents live in informal settlements, although estimates are difficult to ascertain.^{11,12} There has been little research on the health of residents in these settlements due to their informal status; when they are included in surveys, health indicators may be obscured by those of adjacent urban residents in recognized communities.¹³ Although the majority of food security research and intervention efforts have been focused on agricultural production in rural populations, researchers have also found significant food insecurity among the urban poor.¹⁴

Social Capital

Migration results in changes in social structures that can have significant effects on the health of individuals in both sending and receiving communities.¹⁵ The importance of social capital, or the trust, norms, and social networks in a community that can facilitate collective action, are burgeoning topics of inquiry in social science and public health discourses.¹⁶ While many researchers have proposed that external shocks, like increases in food prices, reduce social capital and weaken buffers created by sharing networks, others have suggested that even small differences in the willingness of contacts to help each other may impact the health of individuals in poor communities.¹⁷ Research that has focused specifically on women has found significant qualitative and quantitative evidence for the link between social capital, food security, and child nutritional status.^{18,19,20}

Research Aims

The purpose of this study was to conduct a food security assessment in an informal settlement in Lima, Peru. It also sought to explore how mothers' social capital impacts household food security and how food security, in turn, is associated with children's and their mothers' body sizes. It built upon the community-based participatory work on gardens, greenspaces, and health foraged by the Informal Urban Communities Initiative (IUCI) in one of the newest neighborhoods in Lomas de Zapallal (LdZ), Eliseo Collazos (EC). Specifically, this study accomplished the following:

- 1) Characterized food security status among households
- 2) Measured mothers' social capital
- 3) Assessed the body size of children and their mothers
- 4) Tested the hypothesis that households with greater structural and cognitive social capital have lower food insecurity than households with lower social capital
- 5) Tested the hypothesis that children in households with greater food insecurity exhibit poorer growth as measured by height-for-age (HAZ) and body mass index-for-age (BMIZ) than those with lower food insecurity
- 6) Tested the hypothesis that mothers in households with greater levels of food insecurity have greater body mass indexes (BMI) than those with lower food insecurity

See Figures 1 and 2 in the appendix for the conceptual models underlying hypotheses.

METHODS

Research Setting

This study was conducted in LdZ, an informal settlement in the Puente Piedra district 30 km north of the center of Lima, Peru. LdZ has a population of approximately 30,000 and was established by economic migrants in the mid-1990s. The particular community within LdZ where this study took place is called EC. EC was established in approximately 2005 and is comprised of 85 households. Residents have constructed homes on the steep slopes on the outskirts of LdZ. They have purchased their lots but do not have legal land tenure. Most households have electricity but lack access to municipal water and sanitation. Introduction to the study site was facilitated through members of the IUCI, a partnership between the University of Washington, Fundación San Marcos, and Architects without Borders-Seattle. IUCI has used participatory design methods for landscape, engineering, and health projects in LdZ since 2007.²¹ In 2013, IUCI assisted EC residents in constructing 29 household gardens.²²

Study Design

This study was a population survey of a target of 85 households in EC. Criteria for inclusion were households within the predefined borders of EC, previously determined by municipal authorities and community members, with at least one child between the ages of 2-10 years old and a literate biological mother who spoke Spanish. Households without a biological mother of children between the ages of 2-10 years old were excluded from the study. In addition, households with mothers who did not speak Spanish and/or were not capable of reading the consent form were excluded. The sampling strategy represents a community census of all eligible households. This study

was approved by the Institutional Review Board at the University of Washington and the Ethics Committee at the Universidad Nacional Mayor de San Marcos Faculty of Medicine.

Recruitment

Upon arrival in the community, we held a meeting at the community center in EC to explain the purpose and eligibility criteria for the study and answer questions from community members. A recruitment banner was posted on the community center, fliers were posted on select households with the permission of their owners, and fliers were distributed to each household. We obtained a complete roster of households, created and maintained by a community leader, and conducted door-to-door recruitment. We were assisted by a native Spanish-speaking public health student from the University of Washington and three Peruvian research assistants with advanced degrees in psychology and training in research methods.

Instruments

The study questionnaire included basic demographics, Spanish-language versions of the Household Food Insecurity Access Score (HFIAS),²³ Short Adapted Social Capital Access Tool (S-ASCAT),^{24,25} and questions on social networks adapted from the Young Lives multi-country child and adolescent health study¹⁹ (see appendix for full study instrument). Anthropometric measurements including height, weight, waist and hip circumference, mid-upper arm circumference (MUAC), and triceps skinfold thickness (TSF) were collected and recorded according to established methods.²⁶ Each household was assigned a household identification number.

Instrument pretesting was done with assistance from our community liaison, research assistants, a professional language expert, and a nutrition expert.²⁷ After an initial review with the community liaison, a cognitive interview sought feedback from one of the community's leaders on comprehension, interpretation, meaning, task difficulty, and alternative forms/variations of questions. Feedback was incorporated and given to translation specialists at an accredited language school in Lima and back-translated to English. Discrepancies were reconciled with the community liaison and pretests were conducted with four women living in the Puente Piedra district of similar ages and education levels as those in the study community. As a result of these pretests, additional revisions, including prompts for the participant and instructions to the interviewer, were made. The amended questionnaire was administered a second time to one of the original participants and an additional participant who was not included in the original pretest. After a final review with the community liaison and nutrition education specialist, the questionnaire was finalized.

Data Collection Procedures

Data was collected over twelve days in July 2015. Recruitment, consent and assent procedures, and data collection took place at participants' homes. Written consent was obtained from all adult study participants for data from the questionnaire and physical measurements of themselves and their children. Oral assent for physical measurements was obtained for children over the age of 5. If a child under the age of 5 did not appear to want to participate, their measurements were not obtained. After the consent process was completed, the questionnaire was administered and physical measurements of the mother and all of the children between the ages of 2-10 years old

in the household were taken. Participants were asked to remove their shoes and any heavy clothing for measurements. Standing height to the nearest tenth of a centimeter was measured using a Seca portable stadiometer and weight was measured using a Tanita BF-522W scale to the nearest tenth of a kilogram. Waist and hip circumferences were measured to the nearest tenth of a centimeter using a standard measuring tape. MUAC was measured on the left arm to the nearest centimeter using a specialized measuring tape from Perspective Enterprises. TSF was measured using a Graham Field Lange skinfold caliper on left arm and three consecutive measurements were averaged to the nearest millimeter. At the end of each interview, participants were thanked for their time and left with an index card with heights and weights. All households in EC, regardless of their participation in the study, were invited to a preventative health fair held at the end of the study at the community center. At the health fair, eight staff from the local health post spent three hours delivering services and each household that attended received a small bottle of cooking oil, a carton of milk, and a tin of tuna provided by the lead researcher.

Statistical Analyses

STATA 14 (StataCorp, College Station, TX) was used for all analyses. The predictor of interest for aim 4 was social capital score as measured by the S-ASCAT tool. S-ASCAT scores were generated following the methodologies described by the designers of the tool and other researchers who have adapted it for use in low income countries.^{24,28,29} This tool measures structural social capital, or the quantity of social relationships, and cognitive social capital, defined as a person's perception of the quality of relationships.¹⁹ As such, structural and cognitive scores were tallied

separately as they represent distinct components of social capital. One point was given for each affirmative response to questions about group membership, support from the group, support from individuals, and engagement in citizenship activities. For the question on group support, even if an individual received material, emotional, and informational support from one group, they were only given one point for this response. Participants could receive a maximum of 30 points for structural social capital. Continuous scores were then categorized into three levels of social capital using quartiles. One point was given for each affirmative response to three of the cognitive social capital questions, but for one question, one point was given for a negative response. Participants could receive a maximum of four points for cognitive social capital. Continuous scores for cognitive social capital were dichotomized into low and high cognitive social capital if a participant received a score of ≤ 2 or >2 .

For aim 4, the key outcome was food insecurity score, which was also the predictor for aims 5 and 6. Food insecurity was measured with the HFIAS tool using methodologies described by the tool's designers.²³ One point was given for each affirmative response to the nine questions related to anxiety and uncertainty about household food supply, insufficient food quality, and insufficient food intake and its physical consequences. One to three points were given for each affirmative response to the nine questions depending on the frequency to which participants experienced the domain of food insecurity. Participants could receive a maximum of 27 points. The continuous score for food insecurity was grouped into four mutually exclusive levels of household food insecurity; food secure, mildly, moderately, and severely food insecure.

Body size was the outcome variable of interest for aims 5 and 6. Mothers' BMIs were calculated as weight/height² and were dichotomized according to the WHO's standards (underweight <18.5, normal weight 18.5-24.99, overweight 25-29.99, obese ≥ 30 .)³⁰ Children's Z-scores for height (HAZ), weight (WAZ), weight-for-height (WHZ), body mass index (BMIZ), MUAC, and TSF were calculated using the zanthro command in STATA. This command uses the WHO 2007 child growth charts as a reference to calculate age and sex-specific Z-scores for children ages 0-19 years old enabling comparisons across sites.^{31,32} Z-scores were then dichotomized into categories outlined for stunting (Z-score ≤ 2 SD HAZ), underweight (≤ 2 SD WAZ), and wasting (≤ 2 SD WHZ).³³ BMI was categorized the same way for children under 5 and those over 5 (severely thin Z-score ≥ -3 ; thin between -2, -3) but overweight was defined as a Z-score ≥ 2 for children under 5 and ≥ 1 for children over 5.^{32,34} Obesity was defined as a Z-score ≥ 3 for children under 5 and ≥ 2 for children over 5.^{32,34} Overweight and obesity were also assessed using age and sex standardized TSF measurements for children at the 85th and 95th percentiles and estimations of arm fat index (AFI) at the 85th and 95th percentiles.^{35,36}

Univariate and bivariate analysis were performed to address aims 1-3. Bivariate analyses consisted of one sample t-tests adjusted for unequal variance, one-way ANOVAs, and contingency tables using Fisher's exact. Multivariable linear and logistic regressions were performed for aims 4-6 using the analysis schema outlined in the appendix (Figure 3). Backward stepwise regression was used for model selection. Robust standard errors were used to avoid assumptions of equal variance and clusters by household were used to control for similar body size among related children.

RESULTS

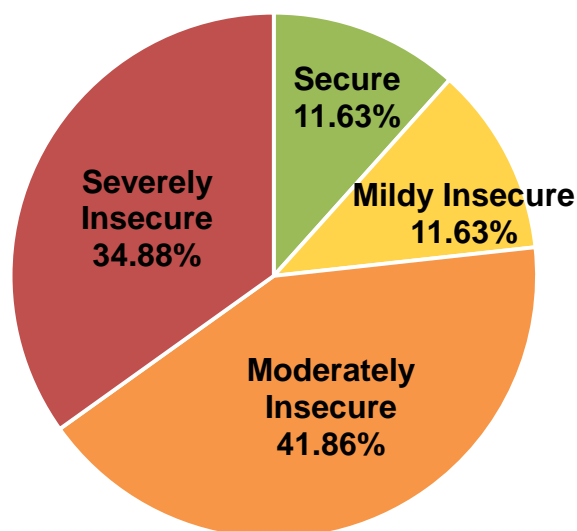
Residents' Characteristics

Forty-three households were enrolled in the study. Of the 85 households in the community, 52 fit the eligibility criteria. Nineteen households had no children living in their home, seven only had children under the age of 2, and five only had children over the age of 10. There were four refusals and we were unable to complete interviews with five households who were determined to be eligible but were not interviewed because of multiple missed appointments. The remainder of households did not have residents living in them at the time of the study. This resulted in enrollment of 82.3% of eligible households with a refusal rate of 7.7%. The 43 households were comprised of 204 individuals; 43 mothers and 161 household members. Table 1 in the appendix provides information on basic household characteristics. The community was mostly comprised of young adults and their offspring and there were no household members accounted for in this sample over the age of 55. The majority of residents in the community had employment that can be described as unstable and unsalaried work as independent laborers, transportation workers, or vendors. A few residents had more stable employment at stores or factories. As a result, most residents reported incomes between US \$33-160 per week.

Aim 1: Food Security

The range of food insecurity scores was 0-19 with a mean score of 7.26 ± 4.47 . Food insecurity was a prevalent issue; 88% of households experienced some level of food insecurity. An examination of the individual questions in the food insecurity instrument revealed that worrying about food was a common occurrence; 81.40% said they had worried about food in the past month. However, this preoccupation may not necessarily translate into a complete lack of consumption. Reporting on the last month, 23.26% of women said they did not have any food in their household at least once; 25.58% reported that they, or someone in their household, had gone to bed hungry; and 9.30% of women reported that they, or someone in their household, had gone a whole day and night without food. It seems as if households cope with insecurity by eating smaller meals (62.79%), meals comprised of a limited variety of foods (60.47%), undesired foods (62.79%), and foods that do not adhere to their preferences (72.09%).

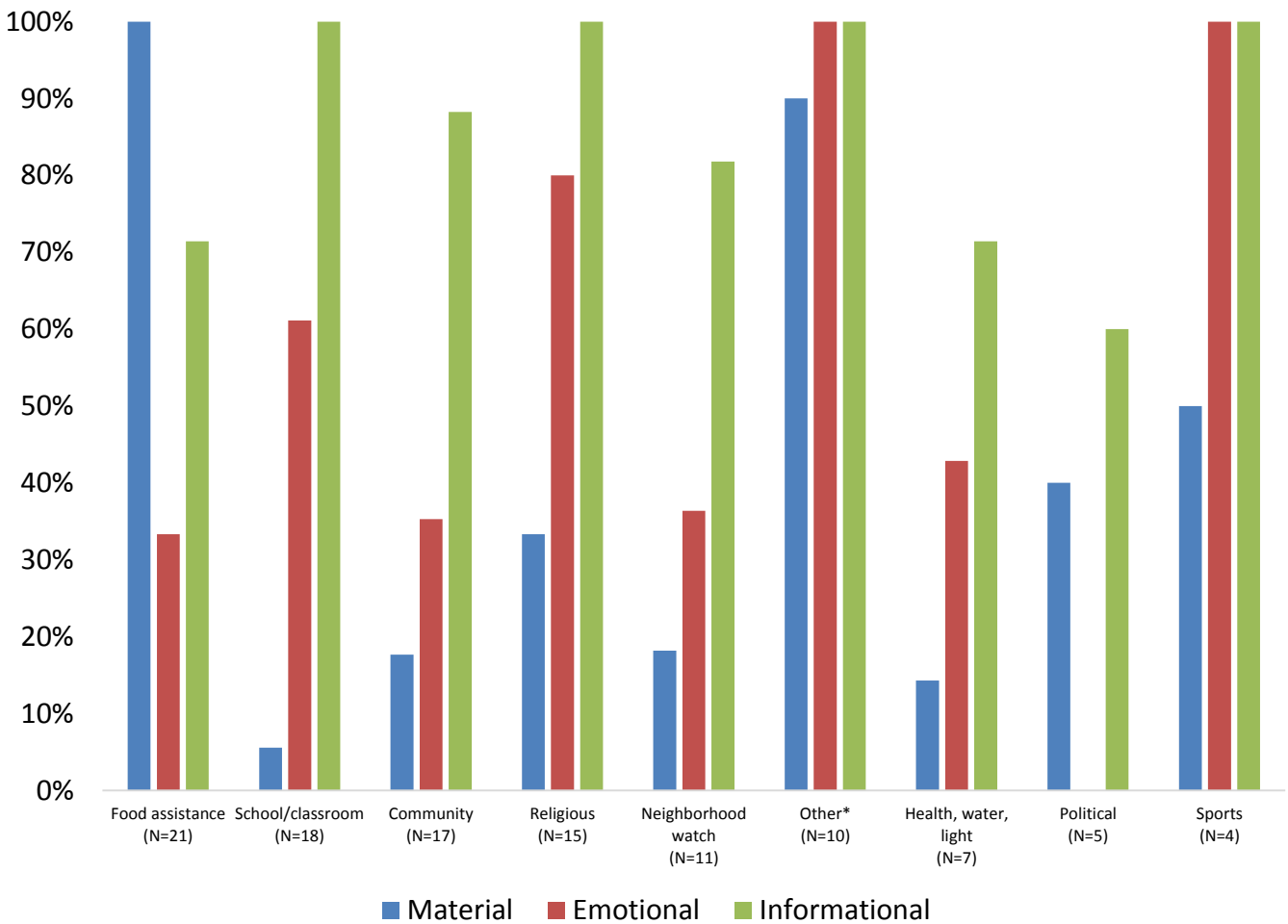
Figure 1. Food insecurity in EC



Aim 2: Social Capital

The range of structural social capital scores was 0-20 with a mean score of 8.98 \pm 5.15. Categorizing scores into quartiles, 27.91% of households had low structural social capital, 46.51% had medium structural social capital, and 25.58% had high structural social capital. Figure 1 illustrates the first component of structural social capital, group membership and support given by groups. The highest level of participation was in groups that provide food assistance, primarily the Vaso de Leche program. In addition, mothers reported receiving emotional and informational support from school or classroom groups and religious groups. Religious groups may also provide members with material support in the form of gifts during the Christmas season. Participation in community groups was high and served as a means to obtain information through meetings regarding neighborhood issues. The category "other" primarily represents the IUCI garden project and reflects that participants have been provided support in the form of materials for a garden.

Figure 2. Group membership and support from groups



The second and third components of structural social capital are support from individuals as depicted in Figure 4 in the appendix. Family, friends and neighbors were the most frequently cited sources of support, while government representatives were in the bottom ranking of individuals who have provided material, emotional, or informational support. Citizenship activities are the third component of structural social capital. In response to the question, “In the last 12 months, have you worked together to solve a problem in your community or done work together?” 65.12% responded affirmatively. However, only 37.21% of respondents had affirmative responses to

having spoken with local authorities or government officials about a problem in EC. This finding is consistent with the relative lack of participation and support received by government officials and political leaders and may be indicative of the collective action of family members, friends, and neighbors.

The other component of social capital, cognitive social capital, was measured by responses to four questions and was dichotomized into low and high cognitive social capital. In this sample, 62.79% had low social capital and 37.21% had high social capital. In response to the question, "Do you feel part of the community in EC?" 93.02% responded affirmatively and 41.86% responded that they got along with others in the community. However, 27.91% reported that they do not trust their neighbors and 44.19% felt their neighbors would take advantage of them given the chance.

Several other measures related to social capital were collected as modeled by the Young Lives study. Mothers reported whether or not they had family living in EC and 72.09% had 1-5 family members living in the community. Respondents were then asked, generally, if there was anyone who could help if they or someone in their household was having a problem like economic, family, or emotional issues. Twelve of the 43 households noted that they did not have anyone who could help, representing 27.09% of the households. Participants were also asked to think back to two years before the interview and report on whether they had more, less, or the same amount of support compared to the present. Twenty-eight percent noted that they had more support in the past, 25.58% said they had less support in the past, and 46.51% reported they had the same amount of support. Table 1 illustrates the characteristics of the individuals described as the three most important sources of support for mothers.

Respondents were asked to list the most important person first. In addition, participants reported on how many people they could rely on if they needed material help; 20.93% said they did not have anyone to rely on for this type of support, 58.14% said they could rely on 1-2 individuals, and 20.93% reported they could rely on 3-5 individuals.

Table 1. Characteristics of mothers' network contacts

	Mean age (SD)	Female (%)	Family (%)	Resides with (%)
1st person (N=31)	38.26 (11.90)	54.84	58.06	22.58
2nd person (N=26)	32.27 (12.71)	53.85	73.08	11.54
3rd person (N=19)	39.79 (13.75)	68.42	78.95	5.26

Aim 3: Children's and Mothers' Body Sizes

Measurements were taken for 65 children. Fifty-one percent were female and the median age was 6.5 ± 2.63 . Forty percent of children were 6-8 years old, 32.31% were 3-5 years old, 16.92% were 9-10, and 10.77% were 2 years old. Table 3 describes the body size of the children in this sample. HAZ was only calculated for children with height values that fit with the inclusion criteria for the reference data set, resulting in the exclusion of three children. For WAZ, one child was excluded because they did not have a weight recorded and seven were excluded because they did not fit inclusion criteria of the reference data set. WHZ was calculated for 36 children, 28 children whose height was greater than 120 centimeters were not included and one child without a weight recorded was also not included. BMIZ was calculated for all but one child whose weight was not recorded. Eleven percent of the children were stunted and 36% of children were overweight or obese.

Table 3 in the appendix displays the anthropometrics of 42 mothers, as one mother was excluded because she was pregnant at the time of data collection. BMIs ranged from 19.23-45.00 and the variance was large. Sixty-four percent of mothers were overweight or obese and almost three-quarters were at-risk for metabolic syndrome as predicted by central adiposity from waist circumference.

Table 2. Body size of children

<u>HAZ (N=61)</u>	
Mean (SD)	-0.89 ± 0.97
Stunted	11.29%
<u>WAZ (N=57)</u>	
Mean (SD)	0.19 ± 1.25
Underweight	5.26%
<u>WHZ (N=36)</u>	
Mean (SD)	0.94 ± -0.96
Wasted	0.00%
<u>BMIZ (N=64)</u>	
Mean (SD)	0.82 ± 1.16
Severely thin	1.56%
Thin	0.00%
Normal	62.50%
Overweight	31.25%
Obese	4.69%
<u>TSF (N=53)</u>	
Mean (SD)	11.94 ± 3.46 mm
Normal	79.25%
Overweight	15.09%
Obese	5.66%
<u>Arm Fat Index (N=53)</u>	
Mean (SD)	35.56 ± 6.93
Normal	79.25%
Overweight	16.98%
Obese	3.77%

Aims 4-6: Bivariate Analyses

Bivariate analyses of demographic variables revealed that younger mothers had higher levels of completed education ($p=0.01$) and had higher incomes than older mothers ($p=0.03$). Older mothers were more likely to have lived in EC longer than younger mothers ($p<0.01$) and were more likely to be wage-earners than younger mothers ($p<0.01$). In addition, older mothers were less likely to have family members in EC ($p=0.01$). Older mothers were also more likely to have participated in the IUCI garden project than younger mothers ($p=0.01$). No other statistically significant associations were found between demographic variables of interest. See the appendix for the full list of variables tested for demographics, social capital, and food insecurity.

Bivariate analyses examining social capital, food insecurity, the body size of mothers and children are displayed in Tables 3 & 4. In addition to what is shown in these tables, analyses found that participants in the IUCI garden project had higher structural social capital scores than non-participants ($p<0.01$). Children of younger mothers had greater BMIZ than older mothers ($p<0.01$). Although sample sizes are small overall and within each category, analyses also found that water treatment type was associated with both WHZ ($p=0.05$) and BMIZ ($p<0.01$) in children. Children in households that boiled their water had greater WHZ and BMIZ than children in households that used bleach, chlorine, or iodine and children in households that used these agents had greater WHZ and BMIZ than those that used other methods or did not treat water used for drinking and cooking. Children whose households participated in the IUCI garden project also had higher WHZ than the children whose households did not participate ($p=0.02$).

Table 3. Household characteristics and food insecurity score

	N	Mean (SD)	P
<u>Maternal age</u>			
20-29	17	5.47 (4.43)	<0.01
30-39	14	6.64 (3.56)	
40+	12	10.5 (2.85)	
<u>Weekly income</u>			
<100 soles	11	8.36 (4.86)	0.03
101-500 soles	28	7.60 (4.08)	
>500 soles	4	1.75 (2.21)	
<u>Time in EC</u>			
<6 years	13	4.69 (3.81)	0.01
>6 years	30	8.36 (4.32)	
<u>Someone to help household</u>			
No one	12	9.75 (1.19)	0.01
Someone	31	6.29 (.77)	
<u>Structural social capital</u>			
Low	12	6 (5.10)	0.04
Medium	20	6.45 (3.28)	
High	11	10 (4.76)	

Table 4. Children's and mothers' body size, social capital, and food insecurity

Children			
	N	Mean (SD)	P
<u>HAZ & eat a limited variety of foods</u>			
Yes	37	-1.07 (0.17)	0.05
No	24	-.605 (0.16)	
<u>WHZ & Support from neighbors</u>			
Yes	22	1.31 (0.19)	0.05
No	14	0.71 (0.22)	
Mothers' BMI			
<u>Support from friends</u>			
	N	Mean (SD)	P
Yes	17	24.25 (0.90)	<0.01
No	31	29.53 (0.94)	
<u>Support from family</u>			
Yes	29	26.20 (0.77)	0.05
No	13	30.06 (1.64)	
<u>Talk to local officials</u>			
Yes	16	25.90 (0.75)	0.03
No	26	29.81 (1.46)	
<u>Structural social capital</u>			
Low	12	26.48 (4.28)	0.02
Medium	19	29.62 (5.68)	
High	11	24.54 (2.43)	

Aims 4-6: Multivariable Analysis

Table 5 displays the results of the multivariable analysis examining the association between social capital and food security. The simple model displays the coefficients of the regression between both types of social capital and food insecurity. The full model included the adjustments for demographic variables noted in Figure 3 and in Table 4 of the appendix. The stepwise model included structural and cognitive social capital and mothers' age, household size, and participation in the IUCI garden project as the most significant predictors of food insecurity. With the full model, the relationship between structural social capital and food insecurity was statistically significant. Although the association between food insecurity and cognitive social capital was not statistically significant, a larger sample size may result in statistical significance. The magnitude of the association between structural social capital and food insecurity was relatively strong; controlling for demographic variables and cognitive social capital, a one unit increase in structural social capital was associated with a one-third unit increase in food insecurity. For cognitive social capital, controlling for demographic variables and among individuals with the same structural social capital, there was a 1.57 decrease in food insecurity when someone had high cognitive social capital compared to low cognitive social capital. The two types of social capital have different associations with food insecurity, and although it is not possible to determine causality, structural social capital may have a detrimental effect on food security where cognitive social capital may have a protective effect.

Table 6 displays the association between food insecurity and children's and mothers' body sizes. The simple models display the coefficients and odds ratios of the

regression between food security and body size. The full models included the adjustments for demographic variables noted in Figure 3 and Table 4 in the appendix. The stepwise models were different for each model. Food insecurity did not appear to be associated with children's HAZ. However, food insecurity may be associated with children's BMIZ as the stepwise regression found that controlling for mothers' age, a one unit increase in food insecurity was associated with a .05 unit increase in BMIZ ($p=0.06$). This finding is supported by the results of the stepwise logistic regression in that controlling for mothers' age, every one unit increase in food insecurity increased the odds of being overweight or obese by 11%. While these relationships did not reach statistical significance and had relatively small magnitudes, perhaps a larger sample would reveal more.

Neither the simple nor full linear or logistic regression models showed a statistically significant association between food insecurity and overweight and obesity among mothers. The stepwise regression for mothers' BMIs eliminated all variables except time living in EC, where every additional year living in EC was associated with a .55 unit greater BMI ($p=0.03$). The stepwise logistic regression also eliminated all variables except time living in EC and participation in the IUCI garden project. Controlling for participation in the garden project, each additional year living in EC was associated with a 34% higher odds of overweight and obesity ($p=0.05$). In the full logistic regression model, controlling for food insecurity and demographic variables, each additional year living in EC was associated with a 55% higher odds of overweight and obesity ($p=0.05$).

Table 5. Multivariable association between food insecurity and social capital

	<u>Simple Model</u>			<u>Full Model</u>			<u>Stepwise</u>		
	Coef.	95% CI	P	Coef.	95% CI	P	Coef.	95% CI	P
Structural SC	0.28	(-0.01, -0.57)	0.06	0.34	(0.04, 0.63)	0.03	0.33	(0.04, 0.62)	0.03
Cognitive SC	-1.91	(-4.50, 0.67)	0.14	-1.57	(-4.07, 0.94)	0.21	-1.81	(-4.09, 0.48)	0.12

Table 6. Multivariable association between food insecurity and body size

	<u>Simple Model</u>			<u>Full Model</u>			<u>Stepwise</u>		
	Coef.	95% CI	P	Coef.	95% CI	P	Coef.	95% CI	P
Children's HAZ	-0.03	(-0.06, 0.02)	0.21	-0.02	(-0.10, 0.05)	0.49			
Children's BMIZ	0.01	(-0.05, 0.07)	0.69	0.05	(-0.02, 0.11)	0.15	0.05	(0, 0.11)	0.06
Mothers' BMI	0.14	(-0.20, 0.49)	0.40	0.07	(-0.33, 0.48)	0.72			

	<u>Simple Model</u>			<u>Full Model</u>			<u>Stepwise</u>		
	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
Children's overweight /obesity	1.05	(0.92, 1.21)	0.44	1.11	(0.97, 1.23)	0.13	1.11	(0.97,1.27)	0.12
Mothers' overweight/ obesity	0.99	(0.85, 1.17)	0.95	.90	(0.71, 1.13)	0.36			

DISCUSSION

Key Findings

This study's greatest strength is that it directly tested the association between social capital and food insecurity in a way that had not been done before in an urban informal settlement. The results indicated that social capital, as measured by the S-ASCAT tool, was relatively strong; households in EC participated in community groups, engaged in citizenship activities, and received help from individuals. However, cognitive social capital in this sample was lower than that of the Young Lives study which reported that over half of Peruvians had high cognitive social capital.¹⁹ Food insecurity was prevalent in EC and greater than the reported food insecurity of 56% in the Young Lives study.³⁷ However, food insecurity prevalence in EC was similar to an assessment of 99 households in an urban informal settlement in Peru that reported that 80% of residents experienced some level of food insecurity.⁵ The multivariable models suggested that both structural and cognitive social capital were associated with food security. However, the results indicated that structural social capital had a negative effect on food security where cognitive social capital had a positive effect.

The results regarding the association between food insecurity and children's body sizes were ambiguous. One group of researchers in Peru found that a ten point increase in the food insecurity score was associated with a 0.14 SD decrease in HAZ.⁵ However, the Young Lives group found that while food insecurity did predict lower HAZ in Peru, BMIZ did not differ by food insecurity category in any of the countries included in the study.³⁷ Researchers noted that while household dietary diversity mediated the relationship between food insecurity and anthropometry, other important individual and

community-level predictors like water, sanitation, hygiene, and infections were not examined.³⁷ The Young Lives researchers also directly examined the relationship between maternal social capital and children's anthropometry and found no significant associations in the Peruvian sample.¹⁹ However, in other countries, they found negative associations between citizenship activities, group membership, and mothers' mental health outcomes.¹⁹ Ruminating on the ambiguous results of the association between social capital and children's anthropometry, the researchers rhetorically ask if mothers reach out because their children are not growing properly, or if their children are not growing properly because their mothers are burdened by their activities.¹⁹ This question directly relates to the negative association between structural social capital and food insecurity found in this study and should be explored further.

In addition, the association between food insecurity and body size among mothers was not significant. These findings mirror those of a recent study examining food insecurity and adult and adolescent overweight/obesity among women in Ecuador.²⁰ However, the statistically significant and relatively large magnitude of association between length of time in the community and mothers' BMI is intriguing. Evidence that food insecurity is greater among older mothers and individuals who have lived in EC for a longer period of time provides a rationale for additional investigations that incorporate life course perspectives on food insecurity, overweight and obesity, and other factors that may be creating an "obesogenic" environment in this community.^{38,39}

Study Limitations

This study had several key limitations. First, its small sample size limits the interpretation of findings. However, the trends provide an impetus to further test these

hypotheses in a larger sample. Second, the instruments used to measure both social capital and food insecurity may not accurately represent these indicators in this setting. Although the S-ASCAT was validated in Peru and has been used in several studies, some have found that individuals interpret the questions differently and recommend that researchers engage in qualitative explorations of the instrument in each setting in which it is used.^{24,40} In our experience pretesting the tool, we found that some aspects of the instrument were confusing to respondents and that “help,” “support” and “assistance” may mean different things to different individuals. Similarly, there is a rich literature that compares and contrasts the variety of food security tools used by researchers and global nutrition programs.^{41–43} Different tools capture distinct dimensions of food insecurity and, like the social capital tool, researchers recommend that they be pretested in each setting.²³ In addition, there is a lack of consensus about how experiential measures of food insecurity are correlated with dietary intake and how they, in turn, are associated with nutritional health.³ Finally, the standards used for the body size of children are a subject of debate in nutrition research and surveillance.^{34,44,45} As the prevalence of overweight and obesity in children has increased, this discourse has intensified around thresholds that accurately represent chronic disease risk.⁴⁶ Similarly, although BMI is the most widely-used anthropometric measurement employed to describe disease risk in adults, researchers have highlighted BMI’s weak correlation with cardiometabolic health indicators like blood pressure, lipids, and insulin.⁴⁷

Implications

To address these limitations, future research with a larger sample size should be undertaken. Qualitative research to examine the validity of the concepts in both the S-

ASCAT and the HFIAS should be conducted. In addition to further elucidating the associations between social capital and food insecurity, this research may benefit from an examination that includes deeper inquiry into social networks. Both qualitative and quantitative techniques can be employed to explore the characteristics of network members, strength and directionality of ties, and resource flows between network members.^{48,49} A social network analysis may shed light on the surprising finding that structural social capital may have a detrimental effect on food insecurity while having someone to help your household in a time of material need has a positive effect. In addition, it may inform findings from this study that link relationships between mothers' age, length of time in the community, food insecurity, and mothers' body size. Additional inquiries can also further illuminate why participants in the IUCI garden project had lower food insecurity than non-participants. Finally, this type of research could further our understanding of the disparities in social capital among individuals with different socioeconomic statuses and between rural and urban settings.¹⁹ Dietary data collection and additional biomarkers to assess chronic disease risk and micronutrient deficiencies should also be included in an effort to deepen the implications of findings that link social capital, social networks, food insecurity, and health.⁵⁰

This research informs public health nutrition policy and programs by indicating that, in addition to targeting individual households, community-level characteristics should be considered in project design and implementation. The Peruvian Ministry of Health has several programs aimed at reducing food insecurity and preventing malnutrition among children.⁵¹ However, surveillance and feeding programs like Salud Escolar and Vaso de Leche do not consider how community characteristics like social

capital and social networks may influence material resource flows, information sharing, and child feeding practices.^{52,53} Programs that address poor nutrition in adults should also consider community-based approaches that are customized to local contexts.⁵⁴ Researchers note that many efforts to address food insecurity have been unsuccessful because they have not included marginalized communities at every stage of the program planning process.⁵⁵ Programs that harness and build upon community capacity through income-generating activities and access to food, like urban agriculture projects, may be effective and empowering approaches to addressing these complex issues.^{56,55,57}

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APPENDIX

Figure 1. Conceptual framework for social capital and children's body size

(Adapted from De Silva & Harpham, 2007)¹⁹

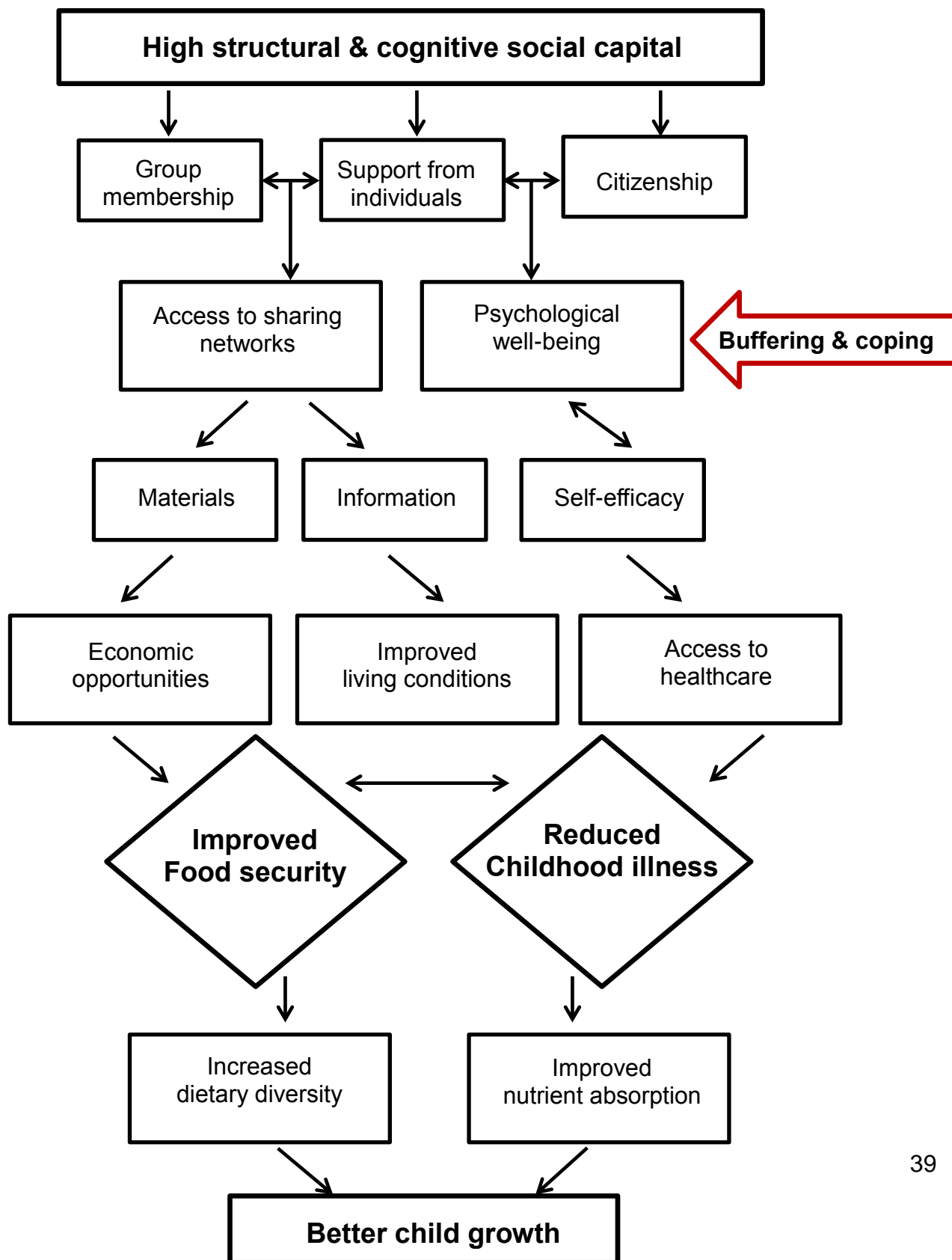


Figure 1 outlines the proposed pathway between high structural and cognitive social capital and improved child growth outcomes. It links the benefits of the measures of social capital, group membership, support, and group belonging to increased access to resources and feelings of empowerment. These resources and self-efficacy lead to avenues for income-generation and other ways to improve living conditions and access to healthcare. Greater income can precipitate improved food security which can increase dietary diversity, and both food security and access to healthcare can lead to reduced illness which, in turn, can improve nutrient absorption. This model has been adapted from the original to expand upon aspects of social networks and poor growth.

Figure 2. Conceptual framework for social capital and mothers' body size

(Adapted from Laraia, 2013)⁵⁸

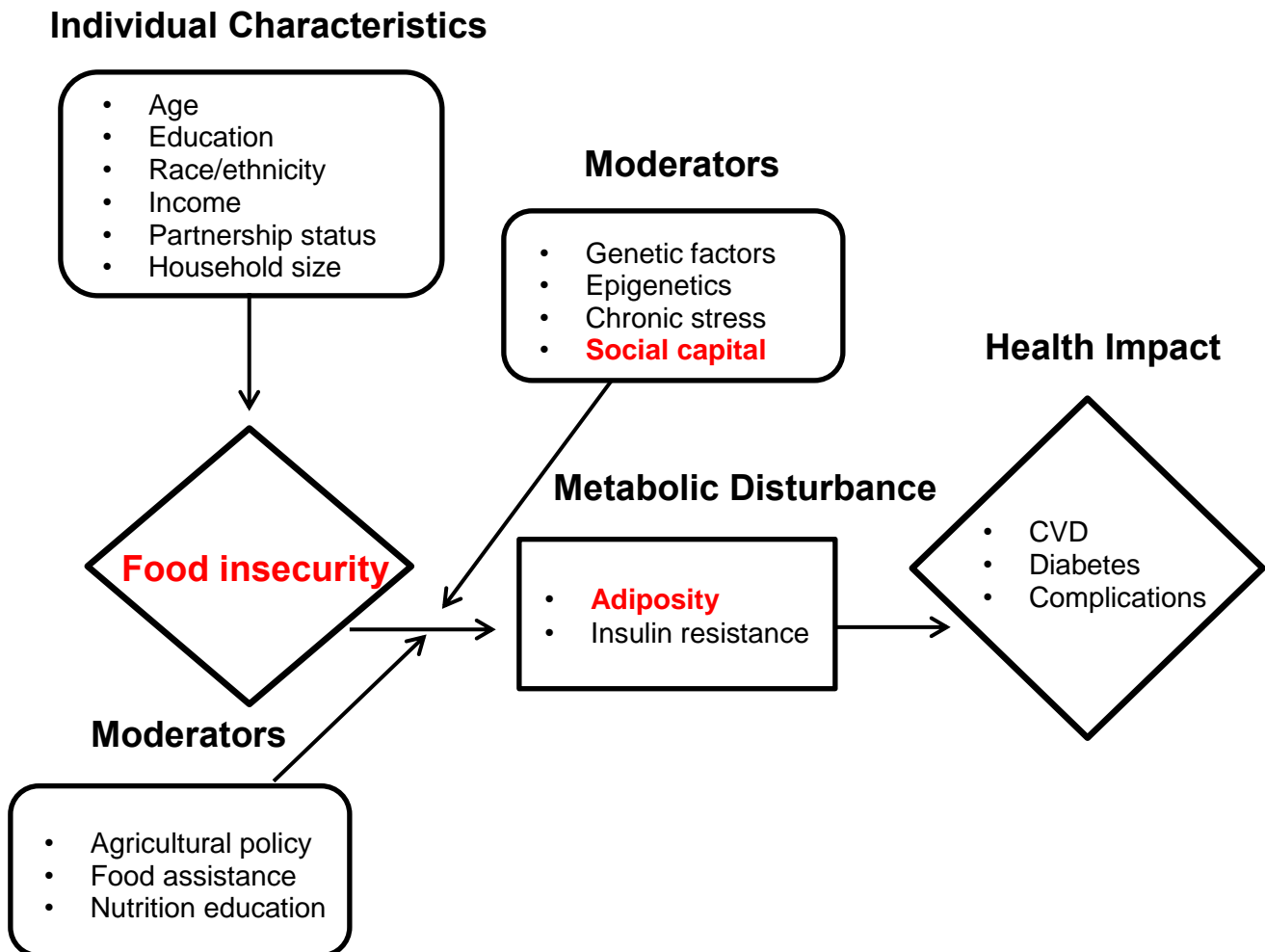


Figure 2 displays the links between household food insecurity and chronic disease outcomes. Individual characteristics predict vulnerability to food security and moderators at both the macro-level, like food assistance programs, and the micro-level, like social capital, impact adiposity. In turn, adiposity precipitates chronic disease. This model has been adapted from the original to expand upon moderators.

Figure 3. Model for multivariable analysis

(Adapted from Humphries et al., 2015)³⁷

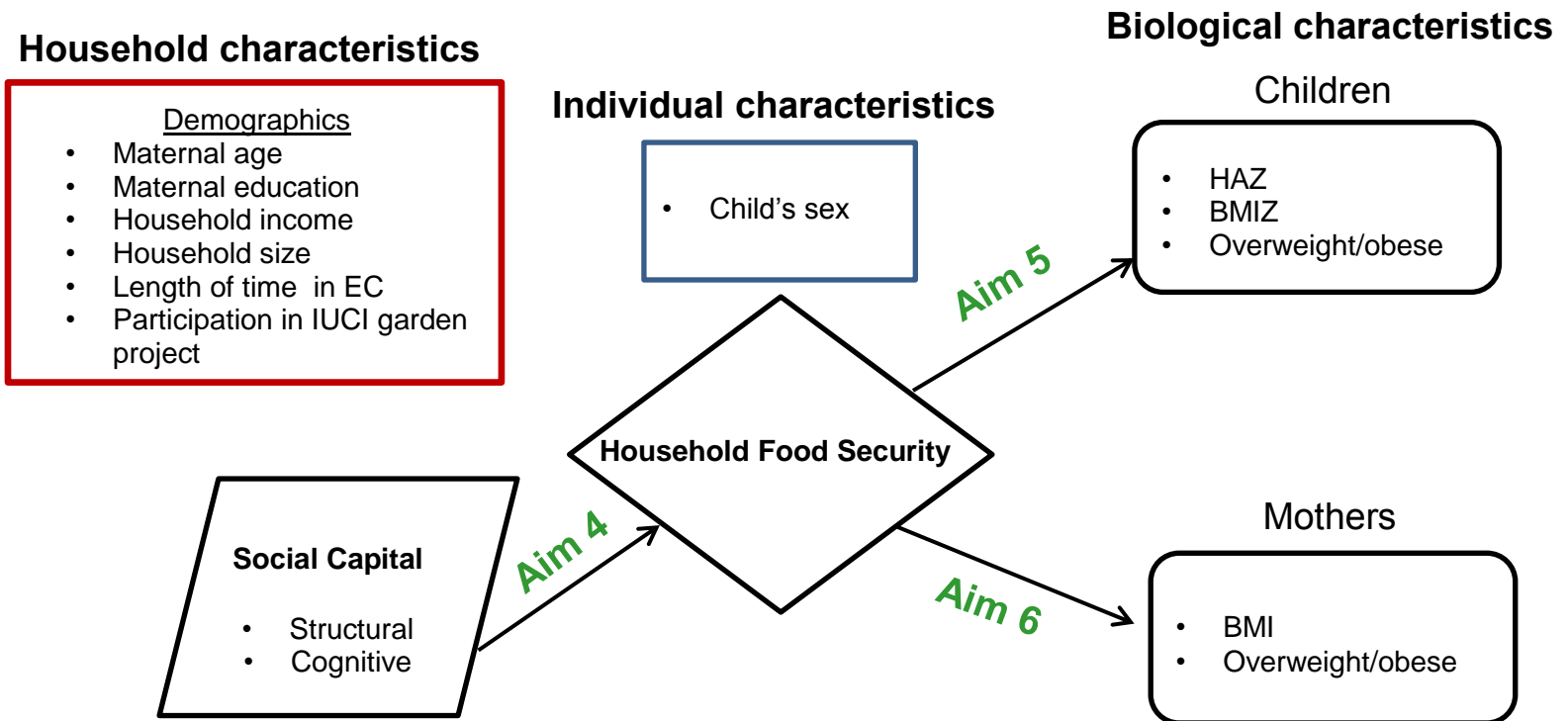


Figure 3 outlines the model for multivariable analysis for each study aim by expanding upon the conceptual models used in this study with the predictors, outcomes, and other variables measured. This was adapted from the original model by substituting in variables measured in this study. Household characteristics, the red box, represents potential confounders of the relationship between social capital (predictor) and food security (outcome) and the relationship between food security (predictor) and children and mothers' body size (outcome). Individual characteristics, the blue box, are a potential confounder of the relationship between household food security and children's body size. Biological characteristics are children and mothers' body size.

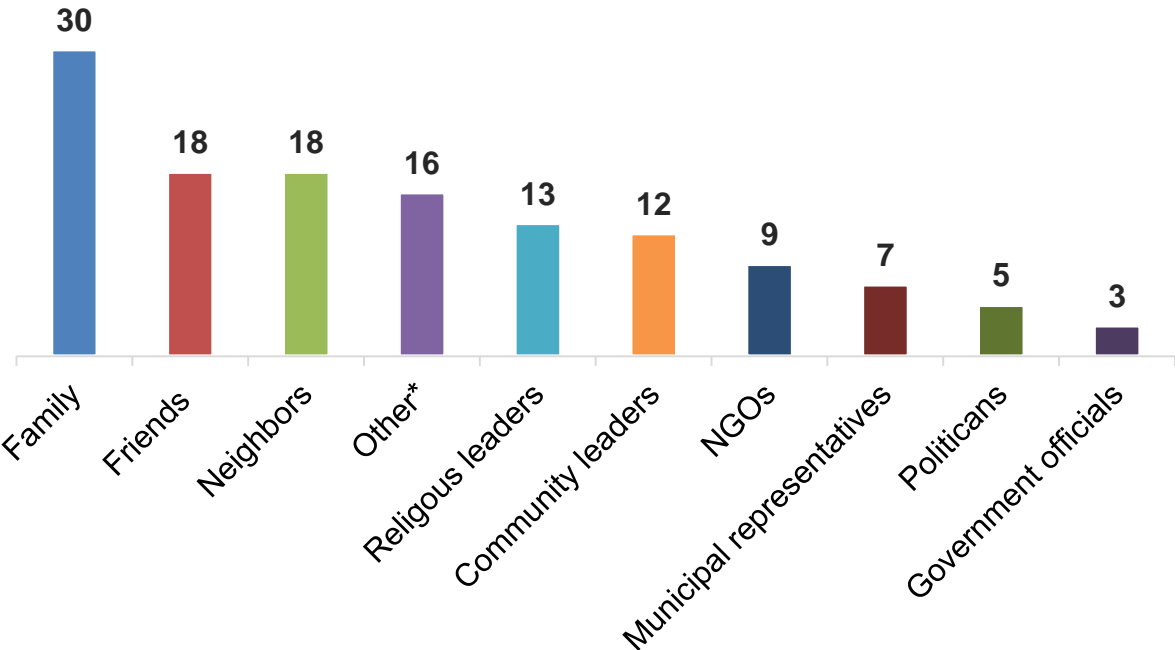
Table 1. Household characteristics

<u>Household size (Mean ±SD)</u>	4.74 ± 1.88
Fewer than 6	55.81%
Greater than 6	44.19%
<u>Sex</u>	
Female	51.96%
Male	48.04%
<u>Age (Mean ± SD, year)</u>	19.54 ± 14.95
Under 18	51.47%
Over 18	48.53%
<u>Employment</u>	
Wage-earner (& over 18)	62.62%
Non-wage earner (& over 18)	37.38%
<u>Household income</u>	
Fewer than 100 soles	25.58%
100-500 soles	65.12%
Greater than 500 soles	9.30%
<u>Water storage</u>	
Tanks	41.86%
Drums/cylinders/buckets	58.14%
Cover with secure lid	74.42%
Cover with plastic, cardboard, wood, or other materials	25.58%
<u>Sanitation</u>	
Improved	79.07%
Unimproved	20.93%
<u>Diarrhea in past 2 weeks</u>	
Yes	27.91%
No	72.09%

Table 2. Mothers' characteristics

<u>Age (Mean \pm SD, year)</u>	34.14 \pm 7.86
20-29 years old	39.53%
30-39 years old	32.56%
40+ years old	27.91%
<u>Marital status (%)</u>	
Living together	55.81%
Single	20.93%
Married	16.28%
Separated	4.65%
Divorced	2.33%
<u>Education (%)</u>	
No formal education	13.95%
Primary school	41.86%
Secondary school	39.53%
Technical school	4.65%
<u>Language (%)</u>	
Spanish only	62.79%
Spanish & Quechua	37.21%
<u>Previous residence (%)</u>	
Lomas de Zapallal	37.21%
Lima	55.81%
Outside Lima	6.98%
<u>Time in community</u>	
Fewer than 2 years	2.33%
2-5 years	16.28%
6-9 years	62.79%
10+ years	18.60%
<u>Health insurance (%)</u>	
Enrolled	74.42%
Not enrolled	25.58%
<u>Participation in IUCI garden project (%)</u>	
Yes	58.14%
No	41.86%

Figure 4. Support from individuals



*IUCI garden project, groups at Christmas

Table 3. Mothers' body size

<u>BMI</u>	
Mean (SD)	27.49 ± 5.02
Normal	35.71%
Overweight	35.71%
Obese	28.57%

<u>Waist Circumference</u>	
At-risk	71.43%
Not at-risk	28.57%

<u>Waist-to-Hip Ratio</u>	
At-risk	92.86%
Not at-risk	7.14%

<u>Arm Fat Index</u>	
Mean (SD)	36.35 ± 9.52
Normal	95.24%
Overweight	4.65%

Table 4. Full models for multivariable analysis

Food insecurity			
	Coef.	95% CI	P
Structural social capital	0.34	0.40, 0.63	0.03
Cognitive social capital (high)	-1.57	-4.07, 0.94	0.21
Maternal age	0.24	-0.03, 0.52	0.08
Maternal education	-0.84	-4.20, 2.52	0.62
Income (high)	0.71	-2.99, 4.41	0.70
Household size	-0.51	-1.02, -0.01	0.04
Length of time in EC	0.26	-0.42, 0.93	0.45
Participant in garden project	-2.65	-5.33, 0.02	0.05
Food insecurity & children's HAZ			
	Coef.	95% CI	P
Food insecurity	-0.30	-0.10, 0.05	0.49
Maternal age	0.00	-0.05, 0.06	0.97
Maternal education	0.11	-0.59, 0.80	0.76
Income (high)	0.01	-0.93, 0.95	0.98
Household size	-0.04	-0.17, 0.08	0.49
Length of time in EC	0.01	-0.23, 0.26	0.92
Participant in garden project	-0.37	-0.95, 0.22	0.21
Child's sex	-0.19	-0.73, 0.35	0.48
Food insecurity & children's BMIZ			
	Coef.	95% CI	P
Food insecurity	0.05	-0.02, 0.11	0.15
Maternal age	-0.06	-0.12, 0.00	0.04
Maternal education	0.03	-0.61, 0.67	0.92
Income (high)	0.14	-1.14, 1.43	0.83
Household size	-0.03	-0.17, 0.10	0.62
Length of time in EC	0.06	-0.11, 0.22	0.50
Participant in garden project	0.08	-0.56, 0.72	0.81
Child's sex	-0.11	-0.66, 0.44	0.68

Food insecurity & mothers' BMI			
	Coef.	95% CI	P
Food insecurity	0.06	-0.33, 0.48	0.72
Maternal age	-0.10	-0.40, 0.20	0.50
Maternal education	-2.27	-5.71, 1.17	0.19
Income (high)	0.22	-3.29, 3.73	0.90
Household size	0.11	-0.99, 1.20	0.84
Length of time in EC	0.73	-0.40, 1.50	0.06
Participant in garden project	-1.18	-4.66, 2.31	0.50
Food insecurity & children's overweight/obesity			
	OR	95% CI	P
Food insecurity	1.11	0.96, 1.28	0.13
Maternal age	0.91	0.80, 1.02	0.12
Maternal education	0.94	0.26, 3.44	0.93
Income (High)	1.11	0.18, 6.99	0.91
Household size	1.06	0.71, 1.57	0.77
Length of time in EC	1.11	0.80, 1.54	0.54
Participant in garden project	0.74	0.18, 3.10	0.68
Child's sex	1.85	0.48, 7.12	0.37
Food insecurity & mothers' overweight/obesity			
	OR	95% CI	P
Food insecurity	0.90	0.71, 1.13	0.36
Maternal age	1.00	0.88, 1.13	0.99
Maternal education	0.38	0.07, 2.02	0.26
Income (high)	0.69	0.11, 4.29	0.69
Household size	0.81	0.53, 1.25	0.35
Length of time in EC	1.55	1.02, 2.34	0.04
Participant in garden project	0.31	0.06, 1.54	0.15

Variables for bivariate analyses

Mothers'/household characteristics

- Maternal age: Continuous, 20-29 years old, 30-39 years old, <40 years old
- Maternal education: Primary completed, secondary or higher
- Maternal occupation: Wage-earner vs. non-wage earner
- Languages: Spanish only, Spanish & Quechua
- Region of birth: Ancash, Cajamarca, Lima, Other
- Health insurance: Enrolled, not enrolled
- Family in the community: Yes/No
- Household size: Continuous and <5 members, >5 members
- Income: <100 soles, 101-500 soles, >500 soles, and ≤100 soles, >100 soles
- Length of time in EC: Continuous and ≤6 years, >6 years
- People who can help household: None, 1-2 people, and 3-5 people
- More, less or the same support as two years previous
- Water treatment: Not treated/other, boil, bleach, chlorine, or iodine
- Sanitation: Improved, unimproved
- Diarrhea in the past two weeks: Yes/No
- Previous participation in garden project: Yes/No
- Did you build garden?: Yes/No
- Do you use garden to feed your family?: Yes/No

Household Food Insecurity Access Scale (HFIAS)

- All nine questions individually: Yes/No

S-ASCAT Structural social capital

- Participant in food group: Yes/No
- Participant in community group: Yes/No
- Participant in religious group: Yes/No
- Participant in school group: Yes/No
- Participant in other group: Yes/No
- Received help family: Yes/No
- Received help friends: Yes/No
- Received help neighbors: Yes/No
- Received help others: Yes/No
- Problem solve with community: Yes/No
- Talk to local officials about a problem: Yes/No

S-ASCAT Cognitive social capital

- Feel part of EC: Yes/No
- People in EC get along: Yes/No
- Trust people in EC: Yes/No
- People in EC would take advantage of you: Yes/No

IUCI garden project data

- 25 participated in garden project before July 2015
- 20 built gardens
- 19 used garden to feed families

Range of food items grown in gardens: 1-10

Mean: 3.68

Standard deviation: 2.47

Median: 3

Item	Frequency
Lettuce	6
Onion	6
Radish	5
Tomato	5
Beans	4
Carrot	4
Cedron	3
Cilantro	3
Pepper	3
Toronjil	4
Aloe vera	2
Chamomile	2
Hierba luisa	2
Medicinal herbs	2
Passion fruit	2
Potato	2
Aguaymanto	1
Aromatic herbs	1
Caigua	1

Item	Frequency
Cauliflower	1
Chili Pepper	1
Chinese Onion	1
Corn	1
Fruit	1
Herbs	1
Mango	1
Oregano	1
Papaya	1
Parsley	1
Plantains	1
Potato	1
Sugar cane	1
Wheat	1

Survey Instrument

Food Security and Nutrition Assessment in Eliseo Collazos, Lima, Peru Participant Survey

Administrative Data																	
A1	Interview Date	<table style="margin-left: auto; margin-right: auto;"> <tr> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> </tr> <tr> <td style="text-align: center;">DD</td> <td style="text-align: center;">MM</td> <td colspan="4"></td> <td style="text-align: center;">YY</td> </tr> </table>									DD	MM					YY
DD	MM					YY											
A2	Interview Length (24 hour clock)	Begin <table style="display: inline-table; vertical-align: middle;"> <tr> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> </tr> </table> End <table style="display: inline-table; vertical-align: middle;"> <tr> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> </tr> </table>															
A3	Household Identification Number	<table style="border: 1px solid black; width: 40px; height: 20px; margin-left: auto;"></table>															

SECTION 1: DEMOGRAPHICS AND HOUSEHOLD RESOURCES

Do you have any questions before we begin? I am going to start by asking you some questions about you and your household.

1. a. What is your date of birth?

DD	MM	19			YY		

b. CALCULATE THE AGE OF THE PARTICIPANT:

--	--

 YEARS

Household Roster: Please tell me the sex and age of each individual besides yourself who currently lives in your home. I am interested in everyone who usually sleeps and shares meals in the household, uses the household address as their permanent address, **or** spends at least 6 months of the year living in the household. Please include people who may currently be in an institution due to their health (hospital, nursing home etc.) for a short or long period.

	A. Sex (M=Male F=Female)	B. Date of Birth (DD/MM/YY)	C. Relationship to participant
H1			
H2			
H3			
H4			
H5			

To confirm, repeat the list to participant.

2. How long have you been living in Eliseo Collazos?

years			months

3. Before moving to Eliseo Collazos where did you live?

(1) Another neighborhood in Lomas de Zapallal (2) Lima (3) Outside of Lima, specify: _____

4. In which region where you born?

01: Amazonas	06: Cajamarca	11: Ica	16: Loreto	21: Puno
02: Ancash	07: Callao	12: Junín	17: Madre de Dios	22: San Martín
03: Apuríma	08: Cusco	13: La Libertad	18: Moquegua	23: Tacna
04: Arequipa	09: Huancavelica	14: Lambayeque	19: Pasco	24: Tumbes
05: Ayacucho	10: Huánuco	15: Lima	20: Piura	25: Ucayali
26: Fuera de Perú				

5. What is your marital status?

- (1) Single (never married) (2) Married (3) Separated (4) Divorced
 (5) Widowed (6) Cohabiting (8) other, specify: _____

6. What languages do you speak? **Please indicate all that apply.**

- (1) Spanish (2) Quechua (3) other, specify: _____

7. What is the highest level of education you have attained?

- (1) No formal schooling (4) Superior- not university (Technical School)
 (2) Primary school completed (5) Superior- university
 (3) High school completed (6) Postgraduate degree

If participant indicates no formal schooling then ask the following, if formal schooling then SKIP to 9:

8. In what languages can you read and write? **Please indicate all that apply.**

- (1) Spanish (2) Quechua (3) other, specify: _____ (5) None

Read options out loud to participants.

9. During the last **12 months**, what has been your **main** occupation?

(1) Homemaker/caring for family	(5) Nongovernment employee
(2) Self-employed	(6) Retired
(3) Student	(7) Unemployed (cannot work)
(4) Government employee	(8) Employed (can work)

10. During the last **12 months**, who in your household has worked and earned money?

1. _____

2. _____

3. _____

4. _____

b. What is each person's main occupation?

Refer to job types in #9.

1. _____

2. _____

3. _____

4. _____

11. During the past week, what were the total earnings of the household?

Please include the income of all men, women, and children.

(1) Less than 100 soles

(4) Refused

(2) Between 101 y 500 soles

(99) Unknown

(3) Between 501 y 1000 soles

12. a. Are you enrolled in any of the following: ESSALUD, Seguro Integral de Salud, or another type of health insurance?

(1) Yes (0) No (99) Unknown

b. If Yes: In what?

(1) ESSALUD (2) Seguro Integral de Salud (SIS) (3) Armed or Police Forces (4) Private Health Insurance

13. a. Did you participate in the IUCI "Gardens, Greenspace, and Health" Project?

(1) Yes (0) No

b. If Yes: Did you build a garden?

(1) Yes (0) No

Read options to participants.

14. a. What is the main source of cooking/drinking water of your household?

Piped water

(1) Inside the house

(2) Outside the house

(3) Public standpipe

(8) Tanker truck/water carrier

(9) Other, specify: _____

Covered well (or with pump)

(4) Inside the house

(5) Public/communal well (7) Public/communal well

Uncovered well

(6) Inside the house

b. Is the water supply available all day?

(1) Yes (0) No (99) Unknown

c. In the past 2 weeks, has the water supply been interrupted for a day or more?

(1) Yes (0) No (99) Unknown

15. a. In your household, do you usually drink water directly from the pipe, well, or other source without treating it?

(1) Yes (0) No (99) Unknown

b. If No: How do you treat the water that you usually use for drinking?

- (1) Boiling (2) Use bleach/chlorine (3) Use a water filter
(4) Solar disinfection (5) Let it stand (6) Use bottled water
(8) Other, specify: _____

16. What kind of toilet is your household using most?

- (1) toilet connected to the sewage system (2) toilet connected to a well/septic tank (3) improved latrine
(4) unimproved latrine (5) No sanitation (in a field) (8) Other, specify _____

17. a. In the past 2 weeks, has any member of your household had diarrhea?

- (1) Yes (0) No (99) Unknown

b. If Yes: Which individuals from the roster experienced diarrhea?

Person	Diarrhea
Participant	
H1	
H2	
H3	
H4	
H5	

SECTION 2: SOCIAL NETWORKS AND SOCIAL CAPITAL

Now I am going to ask you several questions about your community. When I refer to your community, I mean Eliseo Collazos. Please remember that your responses are confidential and will not be associated with your name.

Read each group type and note the responses in the table. If the participant indicates that they have been a member of a group ask if they received support from that particular group.

18. In the last 12 months, have you been an active member of any of the following types of groups in your community?

Group Code	Group Type	Member? (1) Yes (0) No (99) Unknown	If yes, in the last 12 months, did you receive from the group any emotional help, economic help or assistance in helping you know or do things? (1) Yes (0) No (99) Unknown
01	Community organization		
02	Food-related group		
03	Political group		
04	Religious group		
05	Sports group		
06	group Health, water, or electricity group		
07	High school		
08	Monitoring/self-defense groups		
09	Other (specific):		

Read the groups/individuals in the table and note if the participant has received help.

19. In the last 12 months, have you received any help or support from any of the following, this can be emotional help, economic help, or assistance in helping you know or do things?

Group code	Group type	Support code (1) Yes (0) No (99) Unknown
01	Family	
02	Neighbors	
03	Friends who are <u>not</u> neighbors	
04	Community leaders	
05	Religious leaders	
06	Politicians	
07	Government officials/civil service	
08	Municipal representatives	
09	Charitable organizations/NGOs	
10	Other (specify)	

20. In the last 12 months, have you joined together with other residents of Eliseo Collazos to address a problem or common issue?

(1) Yes (0) No (99) Unknown

21. In the last 12 months, have you talked with a local authority or governmental organization about problems in Eliseo Collazos?

(1) Yes (0) No (99) Unknown

22. In general, can the majority of people in Eliseo Collazos be trusted?

(1) Yes (0) No (99) Unknown

23. Do the majority of people in Eliseo Collazos generally get along with each other?

(1) Yes (0) No (99) Unknown

24. Do you feel as if you are really part of Eliseo Collazos?

(1) Yes (0) No (99) Unknown

25. Do you think the majority of people in Eliseo Collazos would try to take advantage of you if they got the chance?

(1) No (0) Yes (99) Unknown

We have just talked about help in your community in general, now I would like to ask more about your personal experience with help.

26. If you or any other household member had a problem in your life, is there someone, outside of your household, who would help you?

(1) Yes (0) No (99) Unknown

27. Who are the people (**not** including household members) who would be most likely to help you? You can give up to three answers but please list the person most likely to help you first.

A. Sex (M=Male F=Female)		B. Age (Years)	C. Relationship to participant
C1			
C2			
C3			

28. Suppose you were in need of material support. How many people do you think you could rely on in this situation?

- (1) 1-2 people (2) 3-5 people (3) 6-10 people
(4) 11-15 people (5) 16-20 people (6) 21-30 people
(7) over 30 people (8) none (99) unknown

29. Now think back two years ago, are there more, less, or about the same number of people you could rely on in time of material need?

- (1) more (2) less (3) about the same
(99) unknown

30. a. Do you have relatives living in this community (**excluding** those in your own household?)

(1) Yes (0) No (99) Unknown

b. If Yes, how many relatives?

- (1) 1-5 people (2) 6-10 people (3) 11-20 people
(4) 21-30 people (5) over 30 people
(99) unknown

SECTION 3: FOOD SECURITY

I would like to ask you some questions about access to food in your household. Please remember that your responses are confidential and will not be associated with your name.

31. In the past **four weeks**, did you worry that your household would not have enough food?

(1) Yes (0) No (99) Unknown

If Yes: How often did this happen in the past four weeks?

1 = Rarely (once or twice in the past four weeks)

2 = Sometimes (three to ten times in the past four weeks)

3 = Often (more than ten times in the past four weeks)

32. In the past **four weeks**, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?

(1) Yes (0) No (99) Unknown

If Yes: How often did this happen in the past four weeks?

1 = Rarely (once or twice in the past four weeks)

2 = Sometimes (three to ten times in the past four weeks)

3 = Often (more than ten times in the past four weeks)

33. In the past **four weeks**, did you or any household member have to eat a limited variety of foods due to a lack of resources?

(1) Yes (0) No (99) Unknown

If Yes: How often did this happen in the past four weeks?

1 = Rarely (once or twice in the past four weeks)

2 = Sometimes (three to ten times in the past four weeks)

3 = Often (more than ten times in the past four weeks)

34. In the past **four weeks**, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?

(1) Yes (0) No (99) Unknown

If Yes: How often did this happen in the past four weeks?

1 = Rarely (once or twice in the past four weeks)

2 = Sometimes (three to ten times in the past four weeks)

3 = Often (more than ten times in the past four weeks)

35. In the past **four weeks**, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?

(1) Yes (0) No (99) Unknown

If Yes: How often did this happen in the past four weeks?

1 = Rarely (once or twice in the past four weeks)

2 = Sometimes (three to ten times in the past four weeks)

3 = Often (more than ten times in the past four weeks)

36. In the past **four weeks**, did you or any household member have to eat fewer meals in a day because there was not enough food?

(1) Yes (0) No (99) Unknown

If Yes: How often did this happen in the past four weeks?

1 = Rarely (once or twice in the past four weeks)

2 = Sometimes (three to ten times in the past four weeks)

3 = Often (more than ten times in the past four weeks)

37. In the past **four weeks**, was there ever no food to eat of any kind in your household because of lack of resources to get food?

(1) Yes (0) No (99) Unknown

If Yes: How often did this happen in the past four weeks?

1 = Rarely (once or twice in the past four weeks)

2 = Sometimes (three to ten times in the past four weeks)

3 = Often (more than ten times in the past four weeks)

38. In the past **four weeks**, did you or any household member go to sleep at night hungry because there was not enough food?

(1) Yes (0) No (99) Unknown

If Yes: How often did this happen in the past four weeks?

1 = Rarely (once or twice in the past four weeks)

2 = Sometimes (three to ten times in the past four weeks)

3 = Often (more than ten times in the past four weeks)

39. In the past **four weeks**, did you or any household member go a whole day and night without eating anything because there was not enough food?

(1) Yes (0) No (99) Unknown

If Yes: How often did this happen in the past four weeks?

1 = Rarely (once or twice in the past four weeks)

2 = Sometimes (three to ten times in the past four weeks)

3 = Often (more than ten times in the past four weeks)

SECTION 4: PHYSICAL MEASUREMENTS

Participant ID ____

40. Height in centimeters |__|_|_|_|_|_|_|_|_| cm
41. Weight in kilograms |__|_|_|_|_|_| kg
42. Bio-impedance |__|_|_|_|_| %
43. Are you pregnant? (1) Yes (0) No |__|
44. CALCULATE BMI (kg/m²): |__|_|_|_|_|
45. Waist circumference |__|_|_|_|_|_|_|_| cm
46. Hip circumference |__|_|_|_|_|_|_| cm
47. Mid-upper arm circumference |__|_|_|_|_| cm
48. Triceps skinfold thickness |__|_|_|_|_| mm

Child 1 ID ____

49. Date of Birth |__|_|_|_|_|_|_|_|_|_|_|_|_|
50. Height in centimeters |__|_|_|_|_|_|_|_|_| cm
51. Weight in kilograms |__|_|_|_|_|_| kg
52. Bioimpedance |__|_|_|_|_| %
53. Mid-upper arm circumference |__|_|_|_|_| cm
54. Triceps skinfold thickness |__|_|_|_|_| mm

Child 2 ID ____

55. Date of birth |__|_|_|_|_|_|_|_|_|_|_|_|_|
56. Height in centimeters |__|_|_|_|_|_|_|_|_| cm
57. Weight in kilograms |__|_|_|_|_|_| kg
58. Bio-impedance |__|_|_|_|_| %
59. Mid-upper arm circumference |__|_|_|_|_| cm
60. Triceps skinfold thickness |__|_|_|_|_| mm

Child 3 ID ____

61. Date of birth |__|_|_|_|_|_|_|_|_|_|_|_|_|
62. Height in centimeters |__|_|_|_|_|_|_|_|_| cm
63. Weight in kilograms |__|_|_|_|_|_| kg
64. Bio-impedance |__|_|_|_|_| %
65. Mid-upper arm circumference |__|_|_|_|_| cm
66. Triceps skinfold thickness |__|_|_|_|_| mm

Thank you so much for you time and participation!

Give participant compensation and inform them about end-of-study celebration.