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Social Networks, the Local Food Environment, and Maternal Food Choice for Children Ages 1 to 5 Years Old in Rural Mexico

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DEDICATION

I dedicate this research to my family. To my beloved mother, Dalma Azucena Guerra, thank you for being the foundation of my strength. Your compassion, discipline, optimism, and resilience have been engines to every goal that I set for myself, including pursing this degree. Thank you for the selflessness of your love. To my brother Iván, you are one of the most inspiring persons in my life. Thank you for teaching me teamwork since the early 90s when we meticulously planned transportation for my dolls on your toy trucks, and while the activities have slightly changed, the tenets of teamwork still apply. To my sister Lizvette, I admire your sharpness and ability to have childhood moments as if no time has passed. To my youngest sisters Katie and Heidy, missing important years of your childhood has been one of the hardest things about being across the country for so many years. Katie, you are one of the most dedicated and kindest humans I know. Heidy, you have always been a sparkle of joy, and I appreciated every single video call you made to me throughout the years to tell me about your day, show me your newest invention, and sometimes just to see my face. Words fall short to express the immense gratitude I have for my family and the honor it gives me to call each of them my mother, my brother, and my sister. They are my angels on this Earth and together form the bedrock that has infused me with strength and joy to rise above every challenge that I have found in my path. Thank you dearly to each of you.

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ABSTRACT

Children's nutrition is largely determined by the food choices their primary caregivers make. Food choice for children has important implications for nutrition, development, and the dietary habits and preferences that are formed during early life food exposure. Little is known about the food environments in which food choices are made and the role of social networks in maternal food choice during habit- and preference-forming years in contexts undergoing nutrition transitions and facing the double burden of malnutrition. The overall objective of this study was to gain an in-depth understanding about how mothers, as primary caregivers, make food choices for their children ages 1 to 5 years old in rural Mexico within their food environment and their social context. This objective was addressed in two specific aims. The first aim was to understand how mothers navigate their local food environment and what drives their acquisition. The second aim was to examine the role of mothers' social networks in the food choices that mothers make for their children.

In-depth interviews with 46 participants and market observations at 12 food sources were conducted in three rural communities between November and December 2016. The interviews inquired about mothers' experiences, knowledge, and meanings related to child feeding and their food acquisition using three listings (i.e., foods at home, sources from which foods were acquired, and projected food purchase). These

listings were used to conduct market observations at different food sources from which mothers acquired foods. The interviews also inquired about local beliefs about child feeding, and the individuals with whom mothers interacted and conversed about food and child feeding. All interviews were conducted in Spanish, audio-recorded, transcribed verbatim, and verified for quality. All market observations recorded field notes following each site visit. The aims were analyzed separately using the constant comparative method.

For the first aim, mothers portrayed a complex food environment consisting of retail, pantry programs, production, wild sources, and social ties. Access to these food sources depended on characteristics about the food sources and mothers' personal conditions. Mothers valued that their children were well-nourished and that the diets they provided were conducive to that. While mothers valued providing nourishing diets that could ensure adequate growth and development, they also valued responding to children's food preferences and requests. Mothers appraised what they could acquire from each food source, mitigated financial constraints by capitalizing on their time, and balanced child-centered values to provide nourishing diets and respond to food preferences.

For the second aim, the social context emerged as five interconnected networks. These networks were household family, non-household family, community, children's initial school, and health and pantry personnel. Each network had functions in food choice that ranged from shared food decision-making in the household family network to imparting formal dietary guidance in the health and pantry program personnel

network. Across the networks, professionals, participants' mothers and mothers-in-law, community senior women, and other women with children emerged as prominent figures whom mothers would turn to for child-feeding advice. These findings provide empirical evidence that social networks, as part of system of interconnected networks, have vital functions in establishing norms for food choices made for children.

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CHAPTER 1

INTRODUCTION

Malnutrition in childhood is a pervasive condition that restricts optimal child development and has important implications for adult life (Black et al., 2013; Hoddinott, Maluccio, Behrman, Flores, & Martorell, 2008). The double burden of malnutrition refers to the coexistence of undernutrition and overweight and obesity, and it has been accelerated by the nutrition transition that many low- and middle-income countries experience. In Mexico, the double burden of malnutrition manifests at the individual, household, and population level (Kroker-Lobos, Pedroza-Tobías, Pedraza, & Rivera, 2014; Perez-Escamilla et al., 2018).

The double burden of malnutrition is a particularly challenging public health problem because intuitively, undernutrition and obesity seem like polar opposite problems. Both forms of malnutrition, however, occur within the same environmental conditions and share the same behaviors (Doak, Adair, Monteiro, & Popkin, 2000; Kroker-Lobos et al., 2014). The challenge is heightened because these are the same countries that have historically battled undernutrition, especially among children. Countries have had great successes at reducing undernutrition among children under 5 years old and averting many of the consequences that come with this condition. Reducing undernutrition has required enduring commitment across different levels to

advance strategies, such as fortification of foods and supplementation, to abate micronutrient deficiencies and other manifestations of undernutrition (Allen, de Benoist, Dary, & Hurrell, 2006; Dewey & Adu-Afarwuah, 2008). While this battle continues, countries are advancing efforts to prevent and reduce obesity and related non-communicable diseases. In Mexico, policies have passed to limit unhealthy foods and beverages in school settings and to tax sugar-sweetened beverages (Kroker-Lobos et al., 2014). Most recently, front-of-package labeling was passed. While these are important efforts, there are two important considerations. One, the extent to which any strategy is implemented has important implications for how effective they can be. Two, and this is the thrust of this study, people make choices about the foods that they eat.

Little is known about food choice in contexts undergoing nutrition transitions and facing the double burden of malnutrition, especially food choice for children 5 years and younger. Food choice refers to what people eat, but how and why people eat the foods that they eat is a complex phenomenon that prevails from an interaction between external contexts, social interaction, and personal systems that trace through life course events and experiences (Furst, Connors, Bisogni, Sobal, & Falk, 1996; Sobal & Bisogni, 2009). During the first 5 years, children need important nutrients in their diets to foster adequate development but they are also forming important dietary preferences and habits that have implications for later life (Birch & Fisher, 1998; Dattilo et al., 2012).

1a. Research goals and specific aims

The overall goal of this study is to improve our understanding about what drives food choice for children during important years of growth, development, and dietary habit-formation. This developmental age may be a window of opportunity to foster healthy eating habits through the food choices children's caregivers make taking into account the contexts in which they live. This research has two specific aims:

Specific Aim 1: To understand how mothers navigate their local food environment and what drives their acquisition for foods fed to their children ages 1 to 5 years in rural Mexico, by answering:

Research Question 1: What characterizes the local food environment from which mothers acquire foods?

Research Question 2: What challenges do mothers experience in food acquisition?

Research Question 3: What do mothers value in their food acquisition for children?

Specific Aim 2: To understand the role of mothers' social networks in the food choices that mothers make for their children, by answering:

Research Question 1: What are mothers' social networks and their composition?

Research Question 2: What child-feeding functions do mothers' social networks serve?

Research Question 3: Who are the prominent authority figures across the networks in food choice for children?

1b. Justification of research

Little is known about what children are fed beyond the complementary feeding period in settings facing the double burden of malnutrition. The foods that children consume during these developmental years provide the nutrition needed for development and help establish preferences and habits that endure as children start to make their own food choices. The evidence that exists focuses on individual food choice but not how and why mothers make food choices for children. Understanding maternal food choice has important implications for how we think about food choice for children and the public health strategies that promote healthy eating.

1c. Overview

The next chapter (Chapter 2) provides an overview of the literature that was reviewed for this research. Chapter 3 describes the methodology was applied in the design of this study. Chapter 4 presents the results of this research in 2 distinct manuscripts. Chapter 5 presents a summary of the findings and a discussion about the implications of the findings and direction for future research.

CHAPTER 2

BACKGROUND AND SIGNIFICANCE

This chapter presents a synthesis of the literature reviewed for this research. It provides an overview of child malnutrition in low- and middle-income countries, the nutrition transition that many low- and middle-income countries face, and the double burden of child malnutrition in Latin America, and then more specifically in Mexico. Next, it summarizes fortification and supplementation strategies that have contributed to the reduction of undernutrition. This is followed by a summary of different food-based approaches aimed at fostering healthy diets within local food environments. This is followed by the theoretical framework that informed this research and concludes with gaps in the literature that this study aimed to bridge.

2a. Under-five child malnutrition and the nutrition transition

Under-five malnutrition

Malnutrition is an intractable impediment that restricts optimal child development, economic productivity, and upward mobility with consequences exerted at the individual, community, and national level (Black et al., 2013; Hoddinott et al., 2008; Thompson & Amoroso, 2014). Malnutrition derives from multiple determinants at different levels and encapsulates undernutrition and overweight and obesity.

Malnutrition in its undernutrition form is marked by insufficient intake of nutrient-rich foods, which leads to deficiencies of energy, protein, and micronutrients (United Nations Children's Fund, 2011). Micronutrients are vitamins and minerals vital to child physical and cognitive development that are not produced in the body and must be obtained through the diet. The most detrimental and prevalent micronutrient deficiencies among children under 5 are iron, iodine, folate, vitamin A, and zinc. It is estimated that more than 2 billion children under 5 suffer from one or more micronutrient deficiencies, of which the greatest burden is in low- and middle-income countries (Centers for Disease Control and Prevention, 2015). Undernutrition indicators include stunting and wasting. Stunted children are those who are too short for their age. This inadequate growth results from chronic or recurrent malnutrition that compromises children's physical and cognitive development and can have life-long effects (United Nations Children's Fund, World Health Organization, & World Bank, 2015). Wasted children are those who are too thin for their height. This condition results from sudden or acute malnutrition, which is when children are not getting sufficient caloric-intake and face a greater risk of death (United Nations Children's Fund et al., 2015). Malnourished children are particularly vulnerable to frequent and persistent disease, such as diarrheal disease and acute respiratory infections, which further undermines their nutritional status (Rice, Sacco, Hyder, & Black, 2000). In 2015, it was estimated that 159 million children under 5 were stunted and 50 million were wasted globally (United Nations Children's Fund et al., 2015).

Malnutrition also manifests as overweight and obesity. Overweight and obesity refer to excess fat accumulation that may increase the risk for non-communicable conditions such as cardiovascular disease, diabetes, musculoskeletal disorders, and some cancers (World Health Organization, 2015a). This condition results from an energy imbalance where the caloric expenditure is lower than the caloric consumption, which can be in part attributed to a global increase in the consumption of foods that are energy-dense and high in fat as well as increase in sedentary behavior (World Health Organization, 2015a). Overweight children are those who are too heavy for their height. In 2015, it was estimated that 41 million children under 5 were overweight globally (United Nations Children's Fund et al., 2015).

Nutrition transition in low- and middle-income countries

In low- and middle-income countries, undernutrition and obesity among children under 5 coexist in the same communities and sometimes within the same household (Popkin, 2001). Between 1990 and 2014, stunting rates in low- and middle-income countries steadily declined. During the same period, obesity rates among children increased among children 5 years and younger (United Nations Children's Fund et al., 2015). This double burden of malnutrition is a phenomenon that links to the nutrition transition in low- and middle income countries, which can be traced to the 1970s but its negative health effects did not begin to be recognized until the 1990s (Drewnowski & Popkin, 1997; Popkin, 1994).

Among the major underlying factors contributing to the nutrition transition in low- and middle-income countries are food systems changes. Food systems changes include the globalization of food production technology, lenient trade regulations, and supermarket expansion which are associated with changes in food distribution, sales, and consumption (Pinstrup-Andersen & Babinard, 2001; Popkin, Adair, & Ng, 2012). These food systems changes have had some benefits in low- and middle-income countries. For example, the expansion of supermarkets have been instrumental in Latin America in establishing food safety standards and have contributed to reducing the adverse effects of seasonality in urban areas (Balsevich, Berdegué, Flores, Mainville, & Reardon, 2003; Popkin et al., 2012). Despite some benefits, these systems-level changes have had adverse effects in dietary patterns through increased consumption of refined carbohydrates, edible oils, sweetened beverages, and animal-source foods while the consumption of legumes, coarse grains, fruits and vegetables has decreased (Drewnowski & Popkin, 1997; Popkin et al., 2012). These changes in dietary patterns are largely attributed to the increased availability and lower costs of low-calorie, high-fat foods (Popkin et al., 2012). The effects of this rapid dietary transition in low- and middle-income countries is particularly detrimental to children due to antecedents of inadequate nutrition, which may make children more susceptible to obesity from the time in-utero. This phenomenon is known as the fetal origins hypothesis, which is when the fetus experiences adaptations that enhance survival when nutrition is inadequate during pregnancy (Barker, 1995). In a postnatal environment abundant with empty-

calorie and high-fat diets, the in-utero adaptations may increase the risk for obesity and other chronic diseases (Barker, 1995; de Boo & Harding, 2006; Popkin et al., 2012).

The double burden of malnutrition among children in Latin America

Latin America has experienced one of the most rapid nutrition transitions in the world and as a result, many countries today face the double burden of malnutrition (Monteiro, Conde, & Popkin, 2004). Growing rates of obesity in Latin America were at one point in time associated with higher household incomes, but Brazil and Chile were among the first to experience an inverse relationship between income and obesity, where those in the lowest socioeconomic strata were the ones at greatest risk for obesity (Drewnowski & Popkin, 1997; Popkin, 1994).

Brazil, as one of the eight major economies in the world, was one of the first countries to experience and recognize the double burden of malnutrition (Conde & Monteiro, 2014). A study using national data from 1979 to 2009 assessed the double burden of malnutrition at three levels. The national level included stunting, underweight, and overweight prevalence. The household level included estimates of mothers' overweight and child stunting. The individual level included mother or child estimates of overweight, stunting, and anemia (Conde & Monteiro, 2014). The study showed that the prevalence of overweight was at least three times higher than the prevalence of undernutrition indicators and that there was low prevalence of overweight mother-underweight child dyads. At the individual level, there was no association between under-5 child stunting and anemia but there was an association

between under-5 child stunting and overweight. The study also showed that the incidence of overweight in children under 5 remained constant (Conde & Monteiro, 2014).

Much like other Latin American countries, Chile's nutritional profile has transitioned over the past 35 years. Child undernutrition and low birth weight fell to low figures by the mid-1990s. Inversely, obesity among children 6 years old and younger had a drastic increase of 57% between 1985 and 1995 (Albala & Vío, 2000). An earlier study of checkups for obese and normal-weight children aged 4 to 5 years in Santiago's health centers found that children who were obese had excess weight since birth and that by 36 months, those children were already obese (Kain, Albala, García, & Andrade, 1998).

The double burden of under- and overnutrition among children in Mexico

Mexico is one of the most thriving economies in Latin America, but much like Brazil and Chile, it has experienced the effects of the nutrition transition and presently battles the double burden of malnutrition. A study in Mexico that assessed the magnitude, distribution, and trends of undernutrition and overweight using national data from 1988, 1999, 2006, and 2012 found that stunting and wasting reduced to one fourth of what it was in 1988 (Rivera-Dommarco, Cuevas-Nasu, González de Cosío, Shamah-Levy, & García-Feregrino, 2013). The study also found that chronic undernutrition had declined by half since 1988, but the prevalence remained high at 13.6%. While undernutrition indicators declined from 1988 to 2012, obesity was on the rise. In 1988, the obesity prevalence among children under 5 was 7.8% but it increased

to 9.8% by 2012 (Rivera-Dommarco et al., 2013). Across the major regions of the country, the prevalence of chronic undernutrition among children under 5 years old remained disproportionately high in rural areas. In some rural regions, the prevalence was more than double that of urban areas. When comparing chronic undernutrition among indigenous and non-indigenous children under 5, inequity became evident. While chronic undernutrition steadily declined among the non-indigenous between 1988 and 2012 from 24.6% to 11.7%, respectively, the prevalence among indigenous children did not decline in the last decade and remained 33.5% (Rivera-Dommarco et al., 2013).

2b. Food fortification and supplementation to combat micronutrient deficiencies

Several approaches to combat micronutrient deficiencies have been implemented in low- and middle-income countries. The following section describes common structural approaches, namely food fortification and supplementation programs, that have contributed to prevent, even treat, micronutrient deficiencies.

Industrial food fortification

With support from international agencies and non-governmental organizations, governments have for many decades taken measures to eradicate micronutrient deficiencies. Food fortification is synonymous to food enrichment and it is defined as the purposeful addition of one or more essential nutrients to a particular food during its industrial processing, irrespective of whether the food naturally contains these

micronutrients (Allen et al., 2006). This strategy seeks to prevent and treat micronutrient deficiencies at the population-level or target segments of the population (Allen et al., 2006). Industrial-level fortification can take different forms, but the most common are mass fortification, market-driven fortification, and targeted fortification (Allen et al., 2006).

Mass fortification is synonymous with universal fortification and it refers to the addition of one or more micronutrients to foods that are widely consumed by the general population, such as grains, cereals, condiments, and milk (Allen et al., 2006). It is considered one of the most promising strategies for prevention of micronutrient deficiencies when there is a known risk to populations due to unacceptably low intake levels (Allen et al., 2006). This type of fortification is typically initiated, mandated, and regulated by the government sector (Allen et al., 2006). The most widely known fortification of this kind is salt iodization, which was extended to the salt consumed by animals (Allen et al., 2006).

Market-driven fortification refers to the fortification of processed foods, which is initiated by food companies and it is voluntary. Market-driven fortification is most common in developed countries and has been found to contribute to adequate intakes of certain micronutrients (Allen et al., 2006). One of the earlier studies that examined the benefits of a market-driven fortified food product in the United Kingdom, iron-fortified cereal, showed that preschool aged children who consumed iron-fortified breakfast cereal had improved iron-levels (Gibson, 1999). Similarly, the London Department of Health reported positive associations consumption of fortified processed

foods with calcium and vitamin D and improved nutrient levels (London Department of Health, 1998). While the aforementioned benefits largely remain in developed countries, the nutrition transition in low- and middle-income countries has increasingly extended the benefits to these countries through food companies penetrating low- and middle-income countries' markets. To this effect, concerns exist that market-driven fortification can divert diets to more processed foods. There is also concern for inadequate regulation of market-driven fortification.

Targeted fortification often resembles in-home fortification programs or complementary food supplementation. Targeted fortification programs serve specific segments of the population that may be either at greater risk of deficiencies or gain a greater benefit from consuming fortified foods (Allen et al., 2006). These efforts include the fortification of complementary foods for children under 24 months or rations for emergency feeding either through blended foods of specialized food products (Allen et al., 2006). The premise behind targeted fortification is tailoring to the needs of specific segments of the populations, which makes its implementation for *prevention* and *treatment* of micronutrient deficiencies more practical.

Legislatively, industrial fortification is either mandatory of voluntary. Mandatory fortification requires government regulation to ensure that the foods fortified and the fortificants are effective and safe (Allen et al., 2006). Its implementation is often slow due to scarce resources and government regulation policies (Allen et al., 2006). The nutrients most widely implemented with mandatory fortification are iodine, iron, folic acid, vitamin A, and zinc (Food Fortification Initiative, 2016b). When a food

manufacturer chooses to fortify foods, this is known as voluntary fortification. There are cases in which the government and the industry voluntarily collaborate, but this tends to be during emergency feeding situations or in the development of specialized products designed to treat micronutrient deficiencies at the household level (Allen et al., 2006).

Complementary food supplementation

Complementary food supplementation refers to the addition of micronutrients to foods at the household level (Nestel et al., 2003; Sight and Life, 2012). These efforts have increasingly expanded in low- and middle-income countries and respond to the persistent micronutrient deficiencies among infants and young children, especially at the onset of complementary feeding (Newton et al., 2016). Complementary food supplementation entails feeding children nutritious foods that have been mixed with micronutrients, such as vitamin A, iron, and zinc just before consumption (Adu-Afarwuah et al., 2008; Davidsson, 2003). Among the most promising strategies are micronutrient powders and lipid-based nutrient supplements.

Micronutrient powders, often referred to as sprinkles, are powders packaged in single-dose sachets that are sprinkled and mixed with foods prepared in the household just before consumption. Evidence has shown that micronutrient powders are effective in improving iron status among children under 5 years old (Dewey & Adu-Afarwuah, 2008). In 2011, the World Health Organization recommended this specialized product for in-home food fortification to help reduce anemia among children under 24 months

old (World Health Organization, 2015b). In addition to the nutritional benefits, micronutrient powders also have relatively high adherence and acceptability and the single-dose packaging has contributed to their safe use (De-Regil, Suchdev, Vist, Walleser, & Peña-Rosas, 2011; Sight and Life, 2012).

Lipid-based nutrient supplements are specialized products that come in semi-solid pastes made from vegetable oil, groundnut paste, milk, sugar, and multiple micronutrients (Adu-Afarwuah, Lartey, Zeilani, & Dewey, 2011). Lipid-based nutrient supplements are mixed with foods prepared in the household to improve the energy and nutrient content. The fatty form of this product extends its shelf life and protects the nutritional content against oxidation. Its properties also make it tasteful for children, which contributes to high acceptability (Dewey, Yang, & Boy, 2009). Lipid-based nutrient supplements come in many different types targeted to different populations but two of the most commonly known are Plumpy'Nut and Nutributter.

The expansion of these specialized products has been largely made through French company Nutriset and Dutch company DSM. Both of the companies develop cost-effective micronutrient products to prevent and treat varying degrees of malnutrition (World Food Programme, 2016). As these specialized products have become increasingly utilized, they have become more affordable but sustainability for the prevention and treatment of micronutrient deficiencies remains a challenge.

Food fortification and supplementation in Mexico

Mexico is one of the leading countries in Latin America to implement mandatory fortification of staple foods. According to the Food Fortification Initiative, Mexico has legislation for mandatory fortification of wheat flour and maize. Mexico has 91 registered wheat flour mills, which produce 90% of the wheat flour that is distributed in the country and 100% is fortified with iron and folic acid. For maize, 40% is processed in industrial mills and 100% is fortified with iron, folic acid, niacin, riboflavin, and thiamin (Food Fortification Initiative, 2016a). While the fortification of these staple foods has been slow to implement, it has contributed to reducing the incidence of neural tube defects and played an important role in reducing anemia rates among children under 5 years old. In 2003, Mexico registered 34 incidents of NTDs per 10,000 births compared 8 incidents per 10,000 births in 2012 (International Centre on Birth Defects, 2003, 2012). Between 1999 and 2011, the anemia rate among Mexican children under five declined by about half and it was estimated to be 26% in 2011 (Villalpando, Shamah-Levy, Ramírez-Silva, Mejía-Rodríguez, & Rivera, 2003; World Health Organization, 2015).

Mass fortification of staple foods has clear health benefits at the population-level, particularly in the prevention of congenital defects and improved iron levels. Despite known benefits, it is challenging to assess how mass fortification impacts segments of the population because its implementation is not only slow, but there is no available data on where these fortified staple foods are distributed. In contrast, targeted fortification focuses on specific segments of the population and implements tailored strategies that account for the food products that are fortified as well as their access,

such as *LICONSA* in Mexico. *LICONSA* is a targeted fortification program of milk aimed at reducing malnutrition among low-income families. Recently, the Mexican federal government passed a policy that subsidizes the price of a liter of fortified milk to cost 15 cents in US dollars in 549 municipalities with low Human Development Index (LICONSA, 2019). One study evaluated the effect of *LINCOSA* milk on iron and zinc levels among children aged 3 to 5 years. The study compared children who consumed fortified milk to children who consumed non-fortified milk. Iron status was measured through hemoglobin and ferritin levels and zinc through serum levels and data were collected at baseline and 6 months later. The study found that children who consumed *LICONSA* had improved iron and zinc levels while those in the control group did not show significant differences (Grijalva-Haro et al., 2014).

Only limited evidence could be identified pertaining to the implementation and health benefits of micronutrient powders and lipid-based nutrient supplements in Mexico. The implementation of micronutrient powders is largely linked to the social development program PROSPERA. Earlier this year it was announced that the program would come to its end, but for over 20 years PROSPERA was premised on improving nutrition, health, and education of the low-income population in Mexico, particularly children (PROSPERA, 2016). Over the years, the program used different enrollment criteria in rural and urban areas and its participation had required and non-required components. Among its non-required components was the utilization of nutrition supplements, micronutrient powders. Leroy et al. (2008) evaluated enrollment and utilization of then-called *Oportunidades* as well as its required and non-required

components. They found that the probability of enrollment for children under 2 years old, i.e., children who would be eligible to receive nutrition supplements, was low. They also found the utilization of the nutritional supplements to be low. These findings were consistent with a prior study that found that supplement utilization was inadequate even when available (Leroy, Vermandere, Neufeld, & Bertozzi, 2008; Rivera, Sotres-Alvarez, Habicht, Shamah, & Villalpando, 2004).

2c. Food-based approaches to improve nutrition

Food-based approaches are nutrition-sensitive multi-sector strategies that seek to improve diet quality and reduce malnutrition by capitalizing and expanding the availability and access to nutritious foods (Ismail, Jarvis, & Borja-Vega, 2014). These strategies first seek to understand relevant factors that constrain the ability of groups in the population to acquire and use the necessary foods to have a nutritious diet and consequentially improve economic productivity (Ismail et al., 2014). These approaches couple the intrinsic value of foods with sectors, like agriculture, to help improve the food supply and sustain rural livelihoods. As such, nutrition-sensitive approaches serve as viable and sustainable long-term strategies to combat malnutrition (Ismail et al., 2014). When well-planned and supported, the social, economic, and nutrition benefits of these initiatives can be sustained over time due to their integration into local food environments and communities (Ismail et al., 2014). Until recent years, nutrition-sensitive strategies have not garnered much traction partly because the benefits take longer to manifest compared to nutrition-specific interventions (Ismail et al., 2014). For

the most part, it has been non-governmental organizations that have taken a lead in expanding food-based strategies.

Homestead food production

One nutrition sensitive strategy is the implementation of homestead food production programs to increase the availability and consumption of nutrient-rich foods year-round in poor households (Talukder et al., 2014). Helen Keller International has been the pioneer in expanding homestead food production programs throughout Asia. The homestead food production program involves home gardens and small animal husbandry along with a nutrition education component. The main objectives of homestead food production programs are to increase the year-round production and variety of fruits, vegetables, poultry, and eggs; improve consistent consumption of these foods through nutritional education programs; and, improve overall health of women and children for optimal development, nutrition, and disease prevention (Talukder et al., 2014). In a recent report, Talukder et al. (2014) evaluated the implementation process and impact of homestead food production programs in Bangladesh, Cambodia, Nepal, and the Philippines. They found that the homestead food production programs improved household garden practices, food production, dietary diversity, and as a whole, contributed to reducing anemia among preschool age children.

Community-based school feeding program

In 2006 in Guyana, a small country in South America, the Ministry of Education established the Hinterland community-based school feeding program in four regions that were predominantly indigenous and faced high rates of poverty and limited access to basic services. The goals of this program were to increase community participation in schools, increase school attendance, and improve the nutritional status of children in primary school (Ismail et al., 2014). Food in these regions comes from agriculture, hunting, fishing, and imports from coastal regions that tend to be expensive. An evaluation between 2007 and 2009 that compared schools with and without the feeding program found that in schools with the feeding program, stunting fell by 3%, school attendance increased by 4.3%, and participation in learning activities improved. Parents' involvement was in the food production and delivery, which provided employment for many households. On a community level, the program helped preserve food security during period of rapid-changing food prices. Post-evaluation, communities worked with the Ministry of Health to find more cost-effective ways to continue the program (Ismail et al., 2014).

The Growing Connection

The Growing Connection is another food-based strategy that operates through non-governmental organizations in 12 countries in Latin America and the Caribbean, Africa, Canada, and the United States. The goals of the program are to work with local communities and teach people how to garden and produce their own fresh food to

improve diets (Patterson & Álvarez Oyarzábal, 2014). The premise is that communities take ownership of this program by growing their own fruits and vegetables and having their voices heard to make adaptations to the recommended procedures. In Mexico, The Growing Connection program has been implemented in one of the poorest and most isolated communities, Huicholes. Among the adaptations to the Mexico environment was using hoop houses and tunnels to extend cropping season at high-altitude (Patterson & Álvarez Oyarzábal, 2014). There has been no evaluation of this program but community engagement suggested program continuity.

2d. Theoretical framework

Availability

Food availability refers to the quantity and quality of food supply that is available in the local food system through domestic production and imports (Scialabba, 2011). The food supply that is available in the local food environment combined with the perception of food availability are known to influence food consumption (Dibsdall, Lambert, Bobbin, & Frewer, 2003; Morland, Wing, Diez Roux, & Poole, 2002; Popkin, Duffey, & Gordon-Larsen, 2005). Food availability is closely tied to physical and economic access and it can be asserted that foods that are neither available nor accessible will not be consumed. This is the argument that Mela (1999) made, where he postulated that the concept of food choice begins with what is available, with the understanding that access to available foods can be physically and economically constrained. Food availability is therefore a fundamental determinant to food choice,

which is related to historical antecedents rooted in culture, community and family, and individual learning mechanisms (Mela, 1999).

Food Choice Process model

Food choice is a broad concept that in its most simplified form refers to what people eat. Eating is one of the most basic needs for survival. How and what we come to eat the foods that we eat is a complex phenomenon that prevails from an interaction between our external contexts, social interaction, and personal systems that trace through life course events and experiences (Furst et al., 1996; Mela, 1999).

Decision-making (elaborated in the sections that follow) is an interdisciplinary concept particularly studied in psychology, cognitive science, anthropology, and marketing (Isen & Means, 1983; Sobal & Bisogni, 2009). The decisions around food are complex and can be described as frequent, situational to food behaviors, and capable to change over time (Furst et al., 1996; Sobal & Bisogni, 2009).

The Food Choice Process model, Figure 2.1, was developed by an interdisciplinary team of experts from the Cornell Food Choice Research Group as a framework to understand the broad range of determinants and processes by which food choice decisions are made in a variety of food behaviors (Furst et al., 1996; Sobal & Bisogni, 2009).

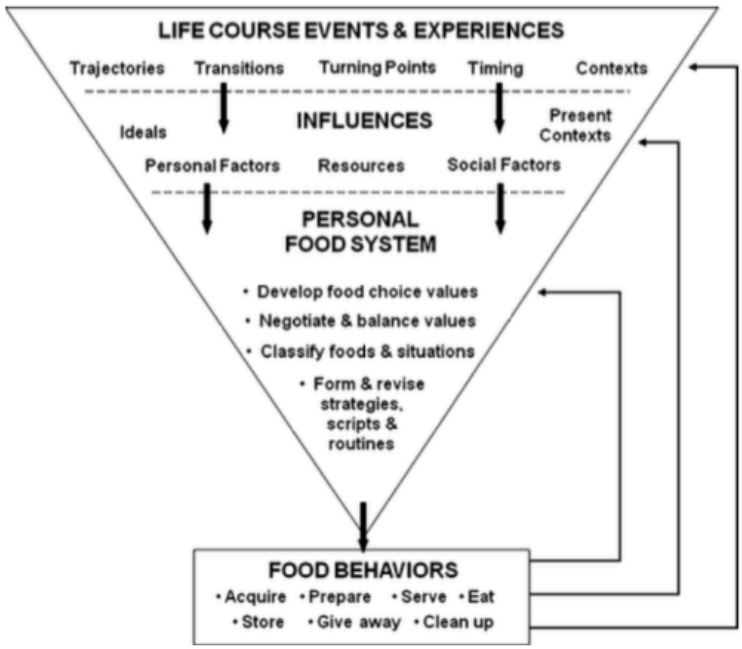

Figure 2.1. Food Choice Process model (Sobal & Bisogni, 2009)

Within this framework, life course refers to age-graded patterns embedded within context and history that have social pathway implications (Elder, 1985; Elder, Johnson, & Crosnoe, 2003). These social pathways are reflected in trajectories, which are sequences of roles and experiences that transition over time (Elder, Johnson, & Crosnoe, 2003). Transitions are the changes in a person's life that lead to different trajectories, and turning points are major transitions that involve substantial change in a person's food choices (Sobal & Bisogni, 2009; Wethington, 2005). Timing refers to when transitions or events occur in a person's life, which dictates how a person experiences that change (Elder et al., 2003). Timing can disturb experiences because there are normative age-graded and cultural norms that create expectations of when change should happen. When change happens unexpectedly, people may feel in conflict with

their personal scripts (see next section) and subsequently struggle adjusting to normative food choice expectations (Devine, Connors, Bisogni, & Sobal, 1998; Sobal & Bisogni, 2009). Finally, context refers to multi-level social and physical structures that facilitate or constrain personal agency in food choice decisions (Furst et al., 1996; Sobal & Bisogni, 2009).

The Food Choice Process model presents five non-exhaustive influence categories embedded within the life course. These sources of influence interact with one another, change over time, change between situations that include food behaviors, and ultimately shape how a person constructs decisions about food (Furst et al., 1996; Sobal & Bisogni, 2009). Ideals are the normative beliefs and behaviors shared by a group of people that establish norms to determine food behavior adequacy (Spradley, 1987; Sobal & Bisogni, 2009). Resources are the various forms of capital that facilitate or constrain food choice decisions (Furst et al., 1996; Sobal & Bisogni, 2009). Personal factors are a person's physiological, psychological, and social roles attributes (Furst et al., 1996; Sobal & Bisogni, 2009). With the exception of genetic predisposition, personal factors transform over a person's life course (Bove, Sobal, & Rauschenbach, 2003). Social factors include a person's networks and the role of those relationships in shaping food behavior decisions (Sobal & Bisogni, 2009). Finally, there is the role of the present context. People live within context over their life course, but contexts change and it is the present context in which people live that more proximally shapes decisions around food (Shepherd & Raats, 2006; Sobal & Bisogni, 2009).

Personal food systems are the cognitive processes by which food behavior decisions are made and what most proximately influences those decisions (Furst et al., 1996; Sobal & Bisogni, 2009). Some of these processes are conscious and require mindful consideration, such as those that involve values and the meanings people ascribe to foods and situations, and others are subconscious and automatic, such as those that simplify decisions (Shepherd & Raats, 2006; Sobal & Bisogni, 2009). Within the scope of conscious decisions are food choice values. Food choice values are the salient considerations and the meanings about those considerations that people weigh when making decisions about food (Connors, Bisogni, Sobal, & Devine, 2001). These same values and food meanings enable people to classify foods and situations. This classification process is what allows people to determine what is food in the first place, and then construe their decision from a multitude of situational considerations (Blake, Bisogni, Sobal, Devine, & Jastran, 2007; Sobal & Bisogni, 2009).

Within the scope of subconscious cognitive processes is the development of food strategies and scripts, which simplify food choice decisions by making them more automatic or habitual (Blake, Bisogni, Sobal, Jastran, & Devine, 2008; Falk, Bisogni, & Sobal, 1996; Sobal & Bisogni, 2009). Food choice strategies are heuristics, or practical guidelines, that people develop reflecting their food choice values, which are called upon when faced with recurrent eating situations (Blake et al., 2008; Connors et al., 2001; Falk et al., 1996; Sobal & Bisogni, 2009). Food scripts, further discussed in the next section, are the knowledge that a person holds about what to do in familiar situations

and specific food behaviors (Baldwin, 1992; Blake et al., 2008; Blake et al., 2009; Jastran, Bisogni, Sobal, Blake & Devine, 2009; Sobal & Bisogni, 2009).

Food choice schemas

Individuals' identities and roles are critical to understand how they make food choice decisions (Bisogni, Connors, Devine, & Sobal, 2002; Blake & Bisogni, 2003; Devine, Sobal, Bisogni, & Connors, 1999). In the 1980s, Olson postulated the value of integrating schemas in the study of how people make food choice decisions. This call was based on the understanding that people have existing and changing knowledge structures (Blake & Bisogni, 2003; Olson, 1981).

Schemas are the fundamental elements that serve as the basis from which human information processing occurs (Rumelhart, 1984). In simplified terms, schemas refer to knowledge that is packaged into units and stored in memory. These units contain information about when to retrieve that knowledge as well as a network of interrelations associated with various domains, including situations, actions, and objects (Rumelhart, 1984). There are six major features of schemas: (1) schemas have variables; (2) schemas can be embedded within schemas, as in procedures; (3) schemas represent multiple levels of knowledge based on life course experience; (4) schemas represent *our* knowledge; (5) schemas are actively changing structures; and, (6) schemas are our perceptual evaluation of information (Rumelhart, 1984; Rumelhart & Ortony, 1977).

Up to this point, schemas and the value of their theoretical application to the study of food choice decisions has been described. Within the scope of schemas are

meanings and scripts. Schemas have encoded meanings that develop from normal or typical situations that come to represent that particular concept (Rumelhart, 1984). Meanings, or beliefs, are closely linked to values and create a basis to understand how people draw from their knowledge structures to make decisions. Scripts are structures of sequential events that people develop for particular situations (Schank & Abelson, 1977). Scripts derive from two classes of knowledge, general and specific. General knowledge allows us to understand and interpret basic human actions with minimal effort, such as why someone drinks water. Specific knowledge allows us to identify situations in which we participate in a regular basis and retrieve relevant knowledge and relevant procedures that reduce the cognitive process and in effect automate behavior (Schank & Abelson, 1977).

The Food Choice Schemas model (Figure 2.2) integrates relevant constructs from the aforementioned Food Choice Process model, but its primary focus is a conceptual understanding of the cognitive processes involved in food choice decisions. In the model, cognitive processes are the linkage between sources of influence and food behavior decisions. Cognitive processes are the food choice schemas that individuals hold. Depending on situations, individuals have different food choice schemas for themselves and for their families (Blake & Bisogni, 2003). Food choice schemas are essentially the shells for food meanings and food scripts. Food meanings are the hierarchically organized beliefs and affects related to food and food scripts are the sequence of events, both which are invoked through by certain foods and eating situations (Blake & Bisogni, 2003).

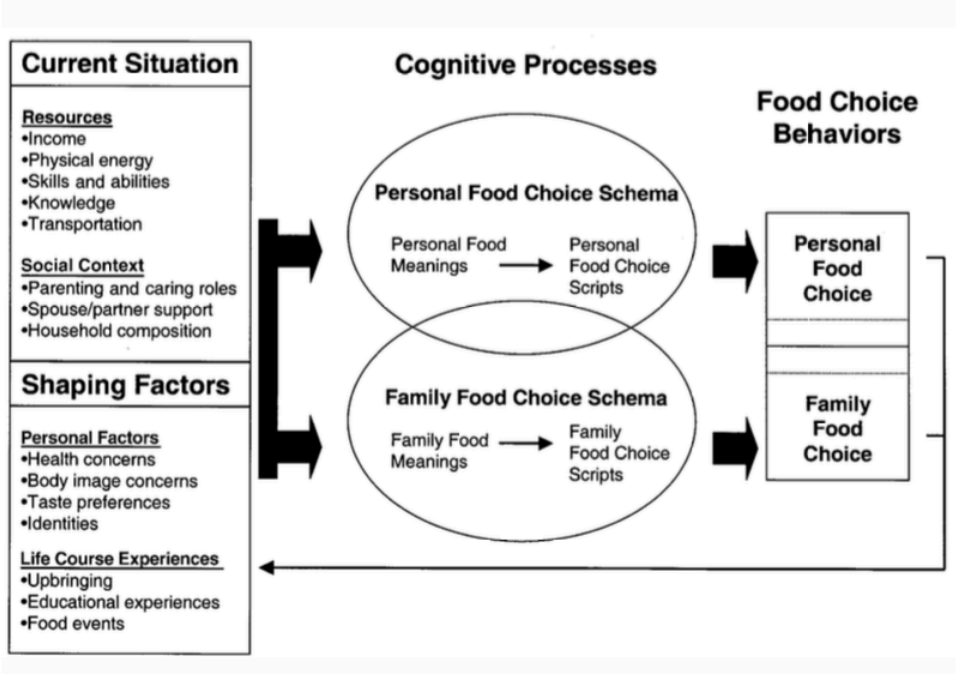

Figure 2.2. Food Choice Schemas model (Blake & Bisogni, 2003)

2e. Gaps in the literature

The literature reviewed for the proposed research indicates that substantial progress has been made in low- and middle-income countries to eradicate child undernutrition through various strategies, but the nutrition transition has been rapidly increasing child obesity in places previously known for undernutrition. The nutrition transition across many low- and middle-income countries has shown that food system structures have been changing and that these changes have implications for foods that are available, acquired, and consumed. Little is known about local food environments in Mexico and other low- and middle-income countries facing the double burden of malnutrition. Understanding what constitutes local food environments has important

implications for the double burden of malnutrition because these environments are primary contexts in which individuals make food choices.

A major gap in the literature pertains to the near absence of food choice for children through at least age 5 in low- and middle-income countries. As articulated earlier, adequate nutrition during the first 1,000 days is critical for optimal development, but children remain sensitive to nutrition past the age of 2 years old (Leroy, Ruel, Habicht, & Frongillo, 2014). Starting around age 1, if not younger, children are transitioning into diets that mirror those of the family but little is known about what children are fed during these important developmental years, and why. Furthermore, children's diets during the first 5 years are not only important for their nutrition, but are critical to the formation of dietary preferences and habits. During early childhood, children are learning important behaviors that start to form habits and preferences that have important implications for their own behavior in later years (Birch, Savage, & Ventura, 2007; Dattilo et al., 2012).

2f. Research goals and specific aims

The present research responds to gaps in the literature by improving our understanding about what drives food choice for children during important years of growth, development, and dietary habit-formation in a country affected by the double burden of malnutrition. This research has two specific aims:

Specific Aim 1: To understand how mothers navigate their local food environment and what drives their acquisition for foods fed to their children ages 1 to 5 years in rural Mexico, by answering:

Research Question 1: What characterizes the local food environment from which mothers acquire foods?

Research Question 2: What challenges do mothers experience in food acquisition?

Research Question 3: What do mothers value in their food acquisition for children?

Specific Aim 2: To understand the role of mothers' social networks in the food choices that mothers make for their children, by answering:

Research Question 1: What are mothers' social networks and their composition?

Research Question 2: What child-feeding functions do mothers' social networks serve?

Research Question 3: Who are the prominent authority figures across the networks in food choice for children?

CHAPTER 3

RESEARCH DESIGN AND METHODS

This qualitative research used in-depth interviews with mothers if children ages 12 to 59 months old, market observations at points of sale, and semi-structured interviews at points of sale. The setting, study and sampling design, recruitment, measurement, data management, and ethical approval for the overall research are presented first, followed by the sampling design, measurement, and analytical strategy for each manuscript.

Setting

The State of Mexico is located in south-central Mexico and is the most populated state in the country (Figure 3.1) (State Population Council, 2018). In 2015, the population in the State of Mexico was estimated to be 16,225,409, which is about 13.5% of the national population, and had an average household size of 4 people. For every 100 households, 91 of them are family households. The State of Mexico is divided into 125 municipalities and has 5,296 urban and rural localities (National Institute of Statistics and Geography, 2017). In 2010, 13% of the population was estimated to live in rural localities (National Institute of Statistics and Geography, 2010). Rural localities are defined as those with a population of 2,500 or less (State Population Council, 2018).

Figure 3.1. State of Mexico (National Institute of Statistics and Geography, 2019)

Study design and sampling

The sampling design of this study was purposeful. Purposeful sampling is a qualitative method that selects informant-rich cases for in-depth inquiry (Patton, 2002). The sample for this research was divided into 3 data collection procedures: in-depth interviews with mothers or primary caregivers, food availability assessment at points of sale, and interviews at points of sale (Figure 3.2).

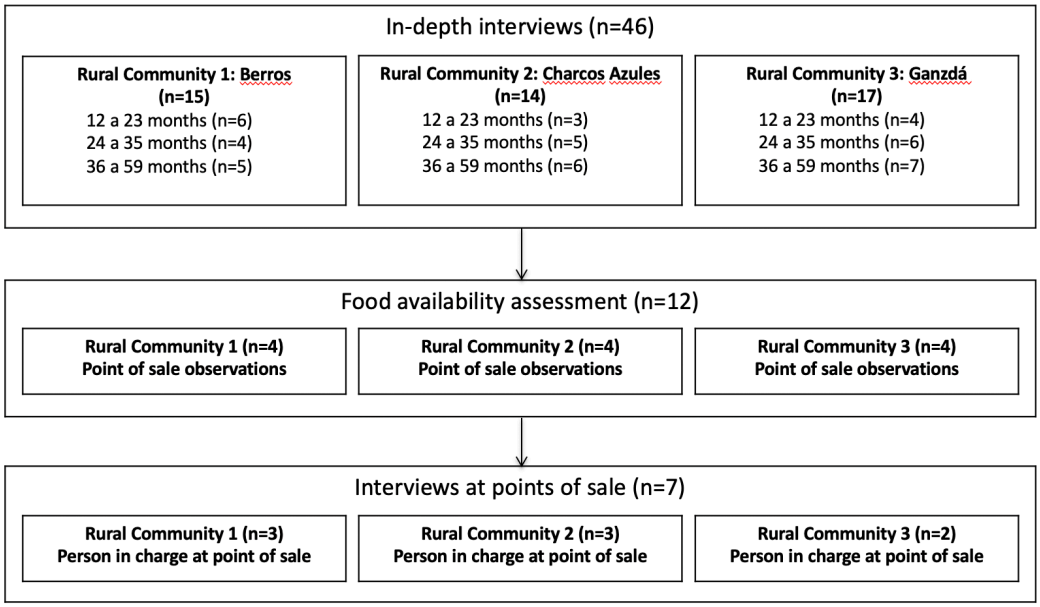

Figure 3.2. Sampling design

In-depth interviews were conducted with 46 participants in three rural communities in the State of Mexico between November and December 2016. Criteria for inclusion were that participants be the primary caregiver of a child between the ages of 12 to 59 months, be able to communicate in Spanish, and be 15 years or older. To operationalize the study in the State of Mexico, dissertation committee member Anabelle Bonvecchio helped establish a collaboration with the non-governmental organization *Un Kilo de Ayuda*. *Un Kilo de Ayuda* operates in rural communities across 6 states in Mexico and its primary focus is optimizing early childhood development through age 5. *Un Kilo de Ayuda* provided housing and transportation during data collection and helped establish rapport in the communities. As part of this collaboration, *Un Kilo de Ayuda* requested to include Ganzdá (rural community 3), where a community development program that includes 5 components (i.e., an orchard, a henhouse with 40 egg-producing hens, an ecological stove, a dry bathroom, and a cistern) was been implemented to 28 families. To allow for comparisons within the community, the sample in Ganzdá was split into mothers who had the program and mothers who did not have the program. Per an agreement with *Un Kilo de Ayuda* leadership, a program-oriented report or presentation will be prepared for *Un Kilo de Ayuda* upon completion of analyses and acknowledgements will be made in publications and presentations.

Food availability assessment were market observations made at publicly accessible points of sale. These observations were made after near completion of data collection of in-depth interviews to obtain a representative list of foods (an average of 55 foods) that mothers from each community acquired and the respective retail food

sources from which those foods were acquired. The food availability assessment checked if a listed food was available and price. Field notes were taken following each site visit.

Interviews at points of sale were conducted with store owners or individuals in charge at points of sale where a food availability assessment was made.

Recruitment

For in-depth interviews, recruitment was conducted with support from *Un Kilo de Ayuda*, a national non-government organization that targets children under 5 years old in rural communities of Mexico to promote healthy growth and development through nutritional components that include a pantry. The study communities were selected based on municipality, community size using *Un Kilo de Ayuda* enrollment as a proxy, and interviewer mobility to the communities. One community was selected based on request by *Un Kilo de Ayuda* given a recent community development program that was being piloted. *Un Kilo de Ayuda* personnel introduced the interviewer at health and community centers and provided a list of program enrollment for the selected communities who met child-age criteria. Mothers were invited to participate in the study by approaching them in waiting areas at health and community centers, asking mothers with whom contact was made if they knew other women with children of similar age-range, using the enrollment list provided by *Un Kilo de Ayuda*, and canvassing the communities. Interviews were conducted by the first author (LIR) in Spanish, audio-recorded, primarily done in mothers' homes, and lasted an average of 75

minutes. Oral consent was obtained prior to each interview and no incentives were provided to participants.

For food availability assessment the first author (LIR) visited publicly accessible retail food sources that mothers had mentioned either by name or type, and this was applied given that many of the retail food sources did not have names. Given the public setting, permission was infrequently necessary but in smaller stores, the observer asked for permission explaining that the list were foods that local people purchased. When prices were not visible, the observer asked those in charge and tended to make small purchases.

For interviews at points of sale, store owner or managers were invited to participate in a short interview about the foods that they sold. The busyness of the food source was considered given that oftentimes only one person was managing the store. Due to skepticism of being interviewed and audio-recorded, participants were shown the interview guide to ease their concerns. The interviews had an average duration of 12 minutes.

Measurement

For in-depth interviews, we developed a semi-structured interview by adapting modules from the Cornell Food Choice Research Group and constructing new ones applicable to the study objectives (Appendix A). The interview guide was pretested in a comparable rural community in Mexico. The interview guide included 10 modules. Questions about *programs* were added during data collection once it was evident that

there was a prominent participation in social development and various pantry programs. Questions about *socio-demographic characteristics* intended to identify sample characteristics and provide context for the interview. Questions about *personal factors* inquired about mothers' personal experiences with food and child feeding. The module on *sources of food* incorporated three listings about foods available in the home for consumption, sources from which those listed foods were acquired, and projected food purchase depending on frequency of food shopping. The listings were followed by questions that elaborated on why foods were acquired from the respective food sources, what was needed to acquire those foods, and mothers' intentions for food acquisition. The module on *foods fed to child* integrated a recent-history recall about the foods fed to the child in the prior day and asked mothers to describe the child and reasons for feeding those foods. Questions about *strategies* inquired about different activities that mothers use during child feeding. Questions about *knowledge and food meanings* inquired about mothers' child-feeding knowledge, their perception of good and not so good foods for children, and their affective reactions to providing those foods to children. Questions about *beliefs and social norms* inquired about broader beliefs in the community about child feeding and what mothers made of those common beliefs. The module on *social channels and networks* integrated a name generator and interpreter instrument to inquire specifically about each individual with whom mothers had conversations about food. The module on *food decisions* was about what mothers take into account when feeding their children, and it was intentionally left at the end to provide mothers context from what was covered during the interview.

For food availability assessment, we adapted the ProPAN Market Survey (Appendix B). ProPAN is a design, implementation, and evaluation tool for programs to improve child nutritional status (Pan American Health Organization, 2013). This instrument was designed to capture the extent to which a variety of foods reported during the in-depth interviews were available in publicly accessible retail food sources that mothers reported as sources from which they acquired foods.

For interviews at points of sale, we developed a short semi-structured interview guide (Appendix C) to inquire about what drove supply, including they ways by which the stores were stocked, top- and low-selling items and types of payment accepted.

Data management

To protect the identity of participants, all audio-recordings and transcriptions were assigned a unique identifying number. While in the field, all electronic data were stored in a password-protected computer. All paper material has been stored in a locked cabinet in a secured location. All electronic data are stored in a secured electronic cloud only accessible by the first author and dissertation chair.

Ethical approval

Ethical approval for this study was obtained from the Institutional Review Boards for Human Participants at the University of South Carolina.

Aim 1. Understand how mothers navigate their local food environment and what drives their acquisition for foods fed to their children ages 1 to 5 years in rural Mexico.

Aim 1. Sampling design

In-depth interviews with 46 participants and market observations as 12 food sources were conducted in three rural communities in the State of Mexico between November and December 2016. Data collection was conducted with support from *Un Kilo de Ayuda*, a national non-government organization that targets children under 5 years old in rural communities of Mexico through nutritional components that include a pantry. The study communities were selected based on municipality, community size using *Un Kilo de Ayuda* enrollment as a proxy, and interviewer mobility to the communities. One community was selected based on request by *Un Kilo de Ayuda* given a recent community development program that was being piloted.

For in-depth interviews, criteria for inclusion were that participants be the primary caregiver of a child between the ages of 12 to 59 months, be able to communicate in Spanish, and be 15 years or older. *Un Kilo de Ayuda* personnel introduced the interviewer at health and community centers and provided a list of program participants who met child-age criteria. Mothers were invited to participate in the study by approaching them in waiting areas at health and community centers, asking mothers with whom contact was made if they knew other women with children of similar age-range, using the enrollment list provided by *Un Kilo de Ayuda*, and canvassing the communities. All interviews were conducted by the first author (LIR) in

Spanish, audio-recorded, primarily done in mothers' homes, and lasted an average of 75 minutes. Oral consent was obtained prior to each interview and no incentives were provided to participants.

For market observations, a list of publicly accessible food sources that mothers reported was generated when approximately 75% of all in-depth interviews were completed. Food sources were visited by the first author to obtain an environmental perspective about access to food sources and food availability that mothers reported.

Aim 1. Measurement

The interview guide was developed by adapting modules from the Cornell Food Choice Research Group, constructing new ones applicable to the study objectives, and pretesting the interview guide in a comparable rural community in Mexico. The modules examined personal factors, knowledge and food meanings, sources of food, and program participation. Personal factors inquired about mothers' personal experiences with food and child feeding. Knowledge and food meanings inquired about mothers' child-feeding knowledge, their perception of good and not so good foods for children, and their affective reactions to providing those foods to children. The sources of food module incorporated three listings about foods available in the home for consumption, sources from which those listed foods were acquired, and projected food purchase depending on frequency of food shopping. The listings were followed by questions that elaborated on why foods were acquired from the respective food sources and what was needed to acquire those foods. Program participation was added in the early stages of

data collection when it was evident that participation in social development and pantry programs was prominent.

The food availability assessment used in the market observations was generated using the sources of food module from the interviews with mothers. For each community, a list of all foods that mothers reported in the module, along with where those foods were acquired, was created and used to conduct market observations in publicly accessible sites. Field notes were recorded following each site visit.

Aim 1. Analytical strategy

The interview guide was adapted throughout data collection to include emerging topics that were not initially considered. After the completion of data collection, all interviews were transcribed verbatim in Spanish and verified for quality. Quality was verified by listening to each audio-recording in its entirety while simultaneously reading its transcription and making corrections as needed. All verified transcriptions were coded using NVivo Version 12. Data were analyzed by the first author (LIR) using the constant comparative method in grounded theory in which new data are constantly compared to existing categories to develop the scope of that category or create new categories to identify salient themes from the data (Glaser, 1965). Seven steps were systematically conducted for this analysis: (1) open coding of 3 interviews from different communities to establish a preliminary codebook and determine feasibility of analyzing communities together; open coding is an interpretative process of comparing raw data line by line for similarities and differences to assign conceptual labels (Corbin & Strauss,

1990), (2) open coding of all interviews applying constant comparison of newly coded text with existing coded text and revising codes as applicable or creating new ones, (3) gradual stratification by food source type with relevant characteristics about the food sources, (4) visual examination of coded categories using hierarchy charts, (5) thematic organization conducted manually using exported files for each food source type to determine adequacy of food source classification and sub-classification, (6) multiple peer consultations throughout process presenting coding strategy, coded text, and visual aids and (7) final examination of selected text for thematic representation. Field notes from market observations were coded post complete analysis of in-depth interviews to verify food source characterization.

Aim 2. The objective of this study was to understand how mothers' social networks contribute to the food choices that mothers make for their children.

Aim 2. Sampling design

In-depth interviews were conducted with 46 participants in three rural communities in the State of Mexico between November and December 2016. Data collection was conducted with support from *Un Kilo de Ayuda*, a national non-governmental organization that targets children under 5 years old in rural communities of Mexico to foster healthy growth through nutritional components that include a pantry. The study communities were selected based on community municipality, community size using *Un Kilo de Ayuda* enrollment as a proxy, and interviewer mobility

to the communities. One community was selected based on request by *Un Kilo de Ayuda* given a recent community development program that was being piloted. Criteria for inclusion were that participants be the primary caregiver of a child between the ages of 12 to 59 months, be able to communicate in Spanish, and be 15 years or older. *Un Kilo de Ayuda* personnel introduced the interviewer at health and community centers and provided a list of program participants who met child-age criteria. Mothers were invited to participate in the study by approaching them in waiting areas at health and community centers, asking mothers with whom contact was made if they knew other women with children of similar age-range, using the list provided by *Un Kilo de Ayuda*, and canvassing the communities. All interviews were conducted by the first author who is fluent in Spanish, audio-recorded, primarily done in mothers' homes, and had an average duration of 75 minutes. Oral consent was obtained prior to each interview and no incentives were provided to participants.

Aim 2. Measurement

The interview guide was developed by adapting modules from the Cornell Food Choice Research Group and creating new ones applicable to the study objectives. This semi-structured interview guide was pretested in a comparable rural community in Mexico. The modules included knowledge and food meanings, beliefs and social norms, and social channels and networks. The module on knowledge and food meanings inquired about participants' child-feeding knowledge, their perception of good and not so good foods for children, and how and where they acquired that knowledge.

Questions on beliefs and social norms inquired about broader beliefs in the community about child feeding and what participants made of those common beliefs. Social channels and networks integrated a name generator and interpreter instrument to inquire specifically about each individual with whom mothers had conversations about food.

Aim 2. Analytical strategy

The interview guide was adapted throughout data collection to include emerging topics not initially considered. Upon completion of data collection, all interviews were transcribed verbatim in Spanish and verified for quality. Quality was verified by listening to the audio-recordings in their entirety while simultaneously reading the transcriptions and making corrections as needed. All verified transcriptions were coded using NVivo Version 12. Data were analyzed using the constant comparative method in grounded theory in which new data are constantly compared to existing categories to develop the scope of that category or create new categories to identify salient themes from the data (Glaser, 1965). Eight steps were systematically conducted for this analysis: (1) simultaneous open coding and codebook development by the first author (LIR) using research questions as guide; open coding is an interpretative process of comparing raw data line by line for similarities and differences to assign conceptual labels (Corbin & Strauss, 1990), (2) peer consultation of codebook and coding technique after initial coding of 9 transcriptions (approximately 20% of all interviews), (3) gradual categorization during coding to designate specific network functions as distinct

networks emerged, (4) gradual categorization during coding to designate emergent hierarchies based on participant descriptions of network members identified as trusted sources of child-feeding advice, (5) completion of coding applying iterative techniques that compared newly coded text to existing codes to determine whether content fit within the scope of a code or a new code was needed and integrated two additional peer consultations, (6) review of all coded text for thematic categorization addressing research questions with ongoing peer consultation, (7) visual examination of coded categories using hierarchy charts, and (8) final examination of selected text for thematic representation.

CHAPTER 4

RESULTS

4.1. Manuscript 1

Maternal food acquisition for children ages 1 to 5 years old through an exploration of their local food environment in rural Mexico

Reyes, L.I., Frongillo, E.A., Blake, C.E., Moore, S., Gonzalez, W., Bonvecchio, A. To be submitted to *Appetite*.

Abstract

Children's nutrition is largely determined by the food choices their primary caregivers make, but little is known about the food environments in which food choices are made during habit- and preference-forming years in contexts experiencing the double burden of malnutrition. The objective of this study was to understand how mothers navigate their local food environment and what drives their acquisition for foods fed to their children ages 1 to 5 years in rural Mexico. In-depth interviews with 46 participants and market observations at 12 food sources were conducted in three rural communities between November and December 2016. The interviews inquired about mothers' experiences, knowledge, and meanings related to child feeding and their food acquisition using three listings (i.e., foods at home, sources from which foods were acquired, and projected food purchase). These listings were used in market observations at different food sources from which mothers acquired food. All interviews were conducted in Spanish, audio-recorded, transcribed verbatim, verified for quality, and analyzed using the constant comparative method. Mothers portrayed a complex food environment consisting of retail, pantry programs, production, wild sources, and social ties. Access to these food sources depended on characteristics about the food sources and mothers' personal conditions. Mothers valued that their children were well-nourished and that the diets they provided were conducive to that. While mothers valued providing nourishing diets that could ensure adequate growth and development, they also valued responding to children's food preferences and requests. Mothers appraised what they could acquire from each food source, mitigated financial

constraints by capitalizing on their time, and balanced child-centered values to provide nourishing diets and respond to food preferences.

Introduction

Malnutrition in childhood is a pervasive condition that restricts optimal child development and has important implications for adult life (Black et al., 2013; Hoddinott et al., 2008). The double burden of malnutrition refers to the coexistence of undernutrition and overweight and obesity, which can occur at the individual, household, and population level (Kroker-Lobos et al., 2014; Perez-Escamilla et al., 2018). The double burden of malnutrition is most prevalent in low- and middle-income countries, including most Latin American countries, where it characterizes the nutrition transition that many of these countries continue to experience (Kroker-Lobos et al., 2014; Perez-Escamilla et al., 2018). In Mexico, the past 30 years have been marked by decreases in undernutrition among children under 5 years old but also by increases in overweight and obesity in the same age-group (Kroker-Lobos et al., 2014; Rivera-Dommarco et al., 2013).

Adequate nutrition in early childhood paves the road for healthy development (Black et al., 2013). In 2008, *The Lancet* series on maternal and child undernutrition was instrumental in positioning nutrition during the first 1,000 days of life as a global priority (Bhutta et al., 2008; Black et al., 2008; Bryce, Coitinho, Darnton-Hill, Pelletier, & Pinstrup-Andersen, 2008; Morris, Cogill, & Uauy, 2008; Victora et al., 2008). In 2013, *The Lancet* released a follow-up series that was encompassing of the double burden of

malnutrition and assessed national and global nutrition efforts, which extended beyond the first 1,000 days (Bhutta et al., 2013; Black et al., 2013; Gillespie, Haddad, Mannar, Menon, & Nisbett, 2013; Ruel & Alderman, 2013). Efforts extending beyond the first 1,000 days are important because while the first 2 years of life may be the most sensitive to children's thriving potential, children remain sensitive to nutrition through at least age 5 (Leroy et al., 2014). In the first 5 years of life, children are developing cognitive, socioemotional, and physical skills that establish the foundation to achieve optimal potential (Grantham-McGregor et al., 2007). During these years, children gain exposure to different foods as they transition into the family diet and begin forming habits and preferences that can imprint dietary behavior in later-life (Birch & Fisher, 1998; Dattilo et al., 2012). In the context of double burden of malnutrition, understanding food choice for children during these developmental years may offer important evidence to synchronize efforts that continue to reduce undernutrition and prevent obesity and non-communicable diseases.

Food choice refers to what people eat and how and why they come to eat these foods. Food choice is a complex phenomenon that originates from an interaction between external contexts, social interaction, and personal systems that trace through life course events and experiences (Furst et al., 1996). The Food Choice Process model has contributed to the understanding of how individuals make food choice decisions (Furst et al., 1996). Food choice begins with what is available, with the understanding that access to available foods can be constrained (Mela, 1999). Food choice is situational

to food behaviors that include acquisition, storage, preparation, serving, eating, cleaning up, and giving away (Bisogni et al., 2007; Sobal & Bisogni, 2009).

What young children eat is largely determined by the food choices that their mothers as primary caregivers make, but little is known about how and why mothers make food choices for children. In individual food choice, cultural ideals are the learned "expectations, standards, hopes and beliefs" that are shared by a group and offer points of reference as people develop food choice values, which are the salient considerations in the decision-making process (Furst et al., 1996, p. 252; Sobal & Bisogni, 2009). Existing evidence supports that what mothers know about child feeding, including their hopes for their children, are important to the food choices made for children (Dutta, Sywulka, Frongillo, & Lutter, 2006; Jensen, Frongillo, Leroy, & Blake, 2016; Monterrosa, Pelto, Frongillo, & Rasmussen, 2012). While mothers use what they know and other ideals to make food choices for their children, personal and environmental conditions may constrain food choice (Monterrosa et al., 2012). Furthermore, child preference, demand, and temperament have also been found to influence food choice for children (Birch, 1999; Blake & Bisogni, 2003; Blake et al., 2008; Gibson, Wardle, & Watts, 1998; Stifter, Anzman-Frasca, Birch, & Voegtline, 2011).

The formation of dietary preferences and habits that occur in early childhood highlights the need to understand food choice for children across different food behaviors because early-life dietary habits establish the foundation of dietary behavior in adult life (Birch & Fisher, 1998; Nicklaus, Boggio, Chabanet, & Issanchou, 2004). In the context of the double burden of malnutrition that has been accelerated by the nutrition

transition in Mexico, examining food acquisition within the food environment to understand how and why food choices are made for children may have important implications. Food environment refers to the context that provides opportunities and constraints where people acquire the foods that will be consumed (Food and Agriculture Organization of the United Nations, 2016; Turner et al., 2017).

This study aimed to understand how mothers navigate their local food environment and what drives their acquisition for foods fed to their children ages 1 to 5 years in rural Mexico. To address this aim, we were guided by three research questions: (1) What characterizes the local food environment from which mothers acquire foods? (2) What challenges do mothers experience in food acquisition? (3) What do mothers value in their food acquisition for children?

Methods

Study design and sampling

In-depth interviews with 46 participants and market observations at 12 food sources were conducted in three rural communities in the State of Mexico between November and December 2016. Data collection was conducted with support from *Un Kilo de Ayuda*, a national non-government organization that targets children under 5 years old in rural communities of Mexico through nutritional components that include a pantry. The study communities were selected based on municipality, community size using *Un Kilo de Ayuda* enrollment as a proxy, and interviewer mobility to the communities.

For in-depth interviews, criteria for inclusion were that participants be the primary caregiver of a child between the ages of 12 to 59 months, be able to communicate in Spanish, and be 15 years or older. *Un Kilo de Ayuda* personnel introduced the interviewer at health and community centers and provided a list of program participants who met child-age criteria. Mothers were invited to participate in the study by approaching them in waiting areas at health and community centers, asking mothers with whom contact was made if they knew other women with children of similar age-range, using the enrollment list provided by *Un Kilo de Ayuda*, and canvassing the communities. All interviews were conducted by the first author (LIR) in Spanish, audio-recorded, primarily done in mothers' homes, and lasted an average of 75 minutes. Oral consent was obtained prior to each interview and no incentives were provided to participants.

For market observations, a list of publicly accessible food sources that mothers reported was generated when approximately 75% of all in-depth interviews were completed. Food sources were visited by the first author to obtain an environmental perspective about access to food sources and food availability that mothers reported. Ethical approval for this study was obtained from the Institutional Review Boards for Human Participants at the University of South Carolina.

Measurement

The interview guide was developed by adapting modules from the Cornell Food Choice Research Group, constructing new ones applicable to the study objectives, and

pretesting the interview guide in a comparable rural community in Mexico. The modules examined personal factors, knowledge and food meanings, sources of food, and program participation. Personal factors inquired about mothers' personal experiences with food and child feeding. Knowledge and food meanings inquired about mothers' child-feeding knowledge, their perception of good and not so good foods for children, and their affective reactions to providing those foods to children. The sources of food module incorporated three listings about foods available in the home for consumption, sources from which those listed foods were acquired, and projected food purchase depending on frequency of food shopping. The listings were followed by questions that elaborated on why foods were acquired from the respective food sources and what was needed to acquire those foods. Program participation was added in the early stages of data collection when it was evident that participation in social development and pantry programs was prominent.

The food availability assessment used in the market observations was generated using the sources of food module from the interviews with mothers. For each community, a list of all foods that mothers reported in the module, along with where those foods were acquired, was created and used to conduct market observations in publicly accessible sites. Field notes were recorded following each site visit.

Analytical strategy

The interview guide was adapted throughout data collection to include emerging topics that were not initially considered. After the completion of data collection, all

interviews were transcribed verbatim in Spanish and verified for quality. Quality was verified by listening to each audio-recording in its entirety while simultaneously reading its transcription and making corrections as needed. All verified transcriptions were coded using NVivo Version 12. Data were analyzed by the first author (LIR) using the constant comparative method in grounded theory in which new data are constantly compared to existing categories to develop the scope of that category or create new categories to identify salient themes from the data (Glaser, 1965). Seven steps were systematically conducted for this analysis: (1) open coding of 3 interviews from different communities to establish a preliminary codebook and determine feasibility of analyzing communities together; open coding is an interpretative process of comparing raw data line by line for similarities and differences to assign conceptual labels (Corbin & Strauss, 1990), (2) open coding of all interviews applying constant comparison of newly coded text with existing coded text and revising codes as applicable or creating new ones, (3) gradual stratification by food source type with relevant characteristics about the food sources, (4) visual examination of coded categories using hierarchy charts, (5) thematic organization conducted manually using exported files for each food source type to determine adequacy of food source classification and sub-classification, (6) multiple peer consultations throughout process presenting coding strategy, coded text, and visual aids and (7) final examination of selected text for thematic representation. Field notes from market observations were coded post complete analysis of in-depth interviews to verify food source characterization.

Characteristics of the communities and sample

The three communities in this study were Charcos Azules, Los Berros, and Ganzdá and belonged to the municipalities of San Felipe del Progreso, Villa de Allende, and Acambay, respectively. The National Institute of Statistics and Geography classified these communities as rural localities. The population in these localities ranged between 500 and 2500 people and were characterized by high levels of marginalization (National Institute of Statistics and Geography, 2015c, 2015a, 2015b). Mexico's National Institute of Statistics and Geography determined the level of marginalization based on educational attainment of the population 15 years and older and household markers such as access to tubed water, electricity, refrigeration, dirt flooring, bathrooms, and number of residents per household (National Institute of Statistics and Geography, 2013). Mexico's government agencies use level of marginalization as an indicator of lagged social development and prioritization for allocation of social development resources (National Council of Policy and Social Development Evaluation, 2012).

Forty six participants were recruited for this study. The sample was distributed across the three communities in Los Berros (33%), Charcos Azules (30%), and Ganzdá (37%). About half (54%) of children were female. For children's age, 28% were between 12 to 23 months old, 33% were between 24 to 35 months old, and 39% were between 36 to 59 months old. In the oldest age-group, one child turned out to be 66 months once age was verified. The average participant age was 31 years old. For education, 49% of the participants had completed secondary school, 38% had completed primary school, and 13% did not complete primary school. Most mothers were married or living

in common law arrangements (98%). The majority of participants were homemakers (78%) and the rest were employed at least part-time outside of the home. About half (52%) of children's fathers worked away from home, which meant returning home anywhere from every weekend to every few months. The average household size was 5 members. Almost two thirds of participants (63%) had a refrigerator at home. Most participants were beneficiaries of at least one government or non-government program that consisted of nutritional guidance and/or a pantry. Most participants were beneficiaries of included *Un Kilo de Ayuda* (96%), but many also participated in other programs such as PROSPERA (48%), CAVIN (39%), and other small-scale government pantries (33%).

Results

Portrayal of the local food environment

The local food environment from which mothers acquired foods was spatially complex and temporally dynamic. This food environment consisted of market and non-market food sources. We classified these food sources into five primary food sources: retail, pantry programs, production, wild sources, and social ties.

Retail

Retail food sources required the purchase of food. The sources that mothers reported varied in proximity, size, variety of products, and prices. Mothers described

five different retail sources: ambulatory vendors, corner stores, medium stores, open markets, and supermarkets (Figure 4.1).

Ambulatory vendors were individuals from neighboring and central towns who went through the communities to sell food products by car, foot, or horse. These vendors primarily offered a variety of produce although some vendors exclusively sold one product such as poultry or fish. Some of these vendors also offered deep fried snacks, which were sold in small clear bags. Mothers emphasized the convenience of these vendors to acquire produce and rarely discussed pricing, except to note that pricing was better than that of corner stores.

Corner stores or *"tienditas"* were the most proximal to mothers' homes. These stores were often unmarked and tended to sell dairy products, ultra-processed meats (e.g. ham, hot dog meat), sugar-sweetened beverages (e.g., juices, soda), eggs, and a limited selection of produce that lacked freshness and often for prices higher than at any other retail source. Mothers relied on these sources primarily for small-quantity purchase of foods including those needing refrigeration and requested by the child.

Medium stores or "next town stores" were an in-between option that was closer than open markets, smaller than supermarkets, and had better selection and prices than corner stores. These stores were usually located in nearby communities that could be reached by foot. These stores offered much of the produce that mothers reported, but market observations also revealed a prominent presence of junk foods, such as colorful aisles of chips, cookies and tall coolers with sodas and juices.

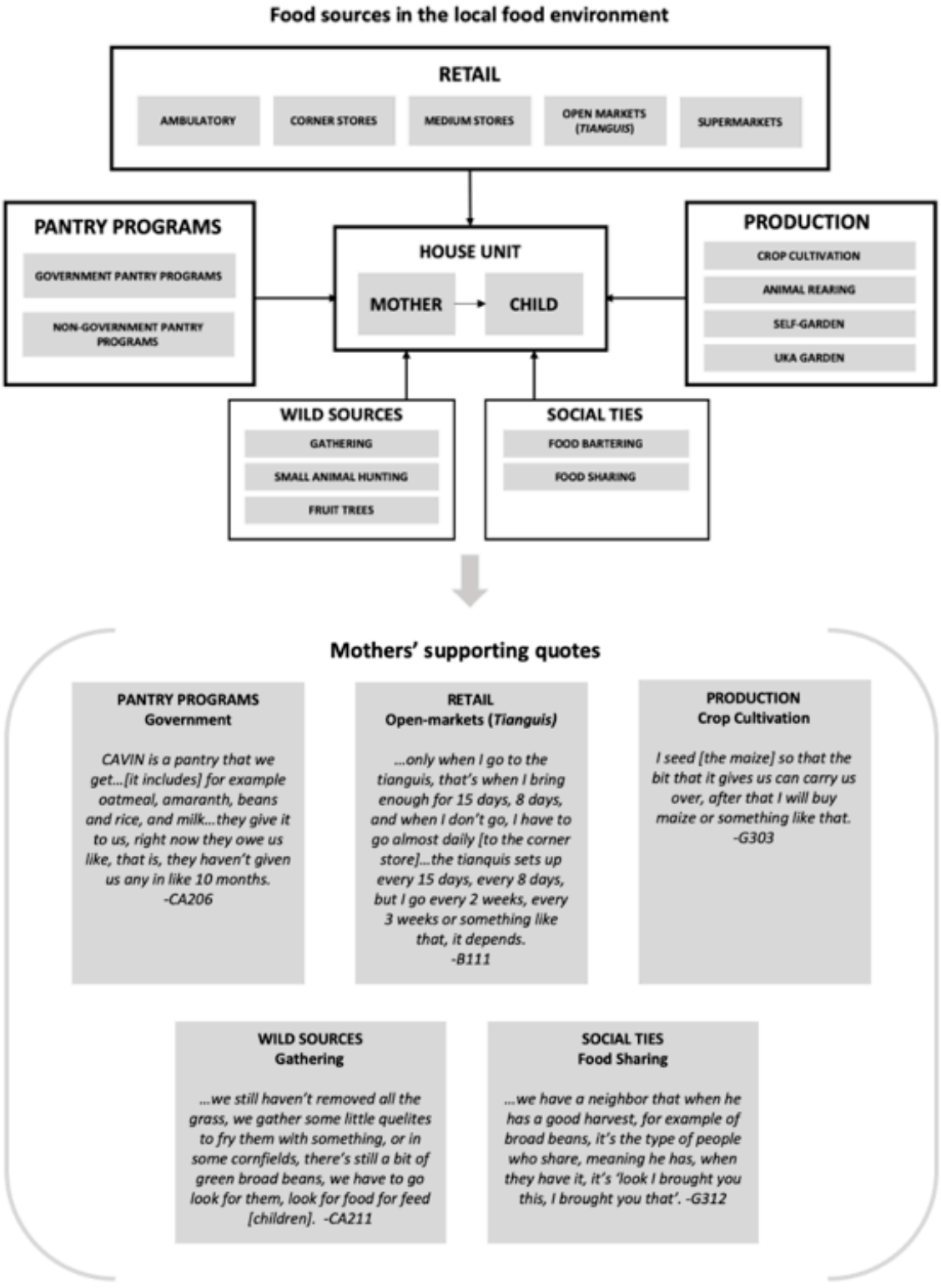

Figure 4.1. Food sources in the local food environment and mothers' supporting quotes

Open markets or "tianguis" usually took place in a central part of the municipality once per week. These markets were the furthest in distance from mothers' homes and access required a significant investment in time, strategic planning and money beyond that allocated for food purchases to cover travel expenses. Mothers commonly made these trips weekly or every other week. These markets were highly regarded for the variety, freshness, and affordability of produce, but also offered a variety of legumes, flesh animal-source foods (i.e., meats, poultry, and fish), ultra-processed meats, dairy products (e.g., cheese, cream, yogurt), prepared foods and non-food products.

Supermarkets ranged in size and were located in central parts of the municipality, often easily accessible from open markets. Supermarkets were the least accessed food source and purchases were primarily for cereal, pasta, rice, and yogurt.

Pantry programs

Pantry programs were offered by government and non-government organizations. Mothers cited receiving pantries from CAVIN, *Un Kilo de Ayuda*, CAMEX, PAL, FAO, *Canasta Básica*, and *Programa Alimentario* although it was unclear whether some of these pantries remained active based on when they were last received or lack of knowledge about when and if mothers would receive future pantries. Mothers primarily discussed CAVIN and *Un Kilo de Ayuda*, which were directed to caregivers of children under 5 years old. These programs had specific requirements to qualify for enrollment and maintain participation, such as attending informational sessions and

workshops, which periodically included taking anthropometric measurements of children. Mothers did not cite program eligibility restrictions based on participation in more than one pantry. Pantries were delivered by the respective organization at local community centers, which sometimes doubled as health centers. Mothers found components of the pantry programs beneficial but participating in these programs required an investment of time.

Government pantry programs had no monetary cost to mothers. Mothers described receiving some nutritional information but taking children's anthropometric measurements (i.e., weight and height) was the most common requirement to maintain participation. The most commonly reported government pantry was from CAVIN, a state pantry program directed to caregivers of children under 5 years old who were either underweight or at risk of becoming underweight. This program was fairly recent to the study communities and mothers reported substantial delays that exceeded 9 months to receive pantries. During the data collection period, a pantry delivery took place that included a pantry box for each delayed month, plus one for the month in which it was delivered. Thus, some interviews portrayed accounts of not receiving pantries in several months and others portrayed mothers' experiences receiving 10 months' worth of product. Mothers who received the delayed pantries were not offered accommodations to assist transporting the product to their homes. There were two cases in which mothers were not informed on time and consequentially missed retrieving their pantries. The food products provided were beans, rice, canned tuna, oatmeal, amaranth, and dried fruit.

The *non-government pantry program* most discussed was *Un Kilo de Ayuda*. The program was also directed to caregivers of children under 5 years old. The program was delivered by an assigned nutritionist to each community every 2 weeks. It was organized to provide nutritional information and workshops, provide a nutritional package (i.e., a pantry), and take periodic anthropometric measurements (i.e., weight, height, and hematologic tests). The pantry contained 10 products consisting of beans, rice, *amanene* (fortified nutritional supplement), marzipan, oil, sugar, and 3 bags of fortified powdered milk of approximately 200g each. The package had a recovery cost to mothers of $3.5 US dollars. Mothers could choose to take only a milk package, which contained 5 bags of fortified milk and had a reduced recovery cost of $1.5 US dollar. Mothers were not required to take the nutritional package, but program eligibility required that they attend the biweekly sessions where nutritional information and workshops were provided.

Production

Production refers to foods that were grown and raised locally that were used for self-consumption, selling, or bartering for other products. Production involved cultivating crops and vegetable gardens and raising animals. Cultivating crops tended to be a family effort partly explained by the living arrangements in which multiple generations resided in the same household or land. Data collection coincided with the annual harvest season of maize, beans, broad beans, and oats. One community had a community development program, which was a recent pilot program from *Un Kilo de*

Ayuda that facilitated building a vegetable garden and a henhouse on the land where a child under 5 years old resided. The pilot program provided essential construction material, 40 hens, and seeds. Production was primarily intended for self-consumption but the program also encouraged the sale of excess goods for economic productivity to maintain and re-investment into these components. Mothers who had this program (n=6) reported consistent egg production and harvested vegetables such as lettuce, cabbage, beets, carrots, among some aromatic herbs. Independent of this program, some mothers had small gardens where they tried to grow commonly used products in their cooking such as tomatoes, squash, and cilantro. Mothers reported that the cold temperatures, or "*the frost*", made it difficult for their gardens to produce, but this did not extend to their annual crops. Across the three communities, mothers tended to raise animals like chickens, ducks, turkeys, rabbits, sheep, and cows.

Wild sources

Wild sources refers to the gathering of local plants and herbs, hunting and fishing of small animals, and picking fruits from local fruit trees. Mothers most commonly gathered *quelites*, which were edible herbs that had been consumed by generations and grew naturally in cornfields. Mothers also gathered leaves for teas. Fishing and hunting were less common practices but tended to be done by male relatives, and included rabbits and squirrels. Picking fruits from local trees was rare but applied to pear trees when they were in season.

Social ties

Social ties refers to the bartering or sharing of foods. This was a common practice among neighbors and relatives. Food bartering was the trade of one product for another and included some crops, garden products, and foods received through pantry programs especially if there was a surplus. Food sharing was a form of reciprocal gifting, where there was no agreement to trade but rather a reciprocal practice with certain people to share food products or a plate of prepared food recognizing that they would do the same.

Challenges to food acquisition

Mothers experienced challenges in acquiring foods in their local food environment, and these challenges primarily emerged in their interface with retail food sources. Among the challenges that mothers cited in accessing food sources was distance. Retail sources that offered an assortment of food variety tended to be further in distance. Mothers had closer retail options, but closer stores tended to restrict variety, quality, and increase prices. Mothers also experienced constraints that constellated around limited economic resources. Mothers discussed mitigating these constraints as "*finding the economy"* and "*finding a way"*, which was how mothers described going extra lengths to acquire foods. Mothers explicitly used this language when discussing how they capitalized on their time by traveling long distances to find foods for better prices and of better quality, which they equated with longer shelf-life. The ability to make this work, however, depended on other conditions, such as mothers'

ability to step away from other obligations, ability to travel with their children or find reliable support to look after them, and sufficient money that could be allocated to food expenses at once.

> *We bring everything if we go to the square [tianguis] on Mondays, sometimes with 500 pesos we bring everything for the whole week…that's if we go there, but if we go around here it is more because it is more expensive, things are more expensive [here]…to go to all the way to Ixtlahuaca sometimes you have [the money] and sometimes you don't, and when we don't, we suck it up a little, but then when we have it we go to get it.*
>
> *-CA202*

> *[I make it to Fresno] walking…[it takes me] 30 to 40 minutes…[I go] because there are more…like more things…[prices] are sometimes cheaper by one peso, two pesos [compared to here], like that, and sometimes you look for the economy, you know, and well maybe you save five pesos and now you have enough for something else. -CA208*

Values for child nourishment and food acquisition

Mothers valued providing their children with nourishing diets that could ensure good health, growth, and development. The importance of providing adequate

nourishment reflected traces to mothers' own experiences with food scarcity and served as a motive to prevent such dire experiences for their children.

> *What's most important to me, put it this way, is that for example, for my children, you know, to eat, that what they eat above all that is helping them, not for them to eat just to eat…[this is important to me], well because, like right now he's growing, he has to, now well, he has to eat well, we go back to the same thing, anemia, or that he's in plain development and he has to, I mean eat, how could I put it?, he has to eat adequately so that it helps him in everything, because he is, right now his little bones, his brain, everything is starting to, more than anything to develop, and [what I feed him] will help with that a lot. -B110*

Mothers' value for their children to be well-nourished revealed uncertainty about whether or not they were providing adequate diets and how these diets may contribute to a nutritional status or underweight or anemia.

> *Well, I just don't know now with his weight that, whether he's doing okay or he's not doing okay, I don't know if what I'm giving him [to eat] if it's good for his health because since he came out with low, meaning with that [low weight], the truth is I got a little worried because then I don't know if I'm giving him a good nutrition or not, or what is what I'm missing. -B107*

Mothers wanted to prevent underweight and anemia, and this extended to how they perceived junk foods. Some mothers talked about their children "*losing hunger*", or not wanting to eat, and this was related to children not accepting the meals they provided but also pointed to views that junk foods displaced appetite for healthier choices and were in a way related to underweight status.

> *They talked to us that we shouldn't give junk foods to children because well, it's wrong, because those are what, that is that with the same junks they eat, they stop eating and they no longer eat the food that you give them, and then that's why they lose weight. -G314*

Mothers used the nutritional status monitoring by medical personnel and pantry programs as a way to verify whether their feeding practices were conducive to good nourishment.

> *When I take her to the health center, they weigh her and tell me that she is very good with her weight and with her height. I look at her and she has strength, in other words she is very active, that's what I feel, it makes me feel that everything that I am feeding her is a healthy nutrition for her. -CA206*

As part of ensuring adequate nourishment for their children, mothers valued providing diets that never lacked a vegetable or a fruit, at least once in a while offered a

flesh animal-source food, and regularly included milk. The value mothers placed on providing nourishing diets was important to how mothers acquired foods from the different food sources in their food environment.

Never lack a vegetable or a fruit

Mothers described striving to ensure that their children never lack a vegetable or a fruit in their diet. Vegetables were most commonly provided to children as part of a meal. It was customary to have one main family meal, but mothers prioritized giving vegetables and fruits to children with more frequency than that of adults.

> *I [make separate foods] for my baby, in my house we only get to eat two meals, lunch and comida [late afternoon main meal], but for my baby, around noon I give him his fruit, since we sow vegetable pears at the house, I boil him a little one. -B101*

Mothers placed value on having vegetables and fruits in their home for children to have. A primary way mothers achieved this was by making trips to open markets as these were viewed as sources that provided the most affordable options and most fresh produce. When mothers were unable to make it to these preferred food outlets or these foods ran out, mothers relied on corner stores and ambulatory vendors, even if they had to purchase smaller quantities.

…sometimes we buy from the [vendor]…I buy a little from this man so my children don't go without vegetables or fruit, especially fruit. -CA204

Mothers also discussed the practice of bartering. Mothers primarily used any excess products they received through pantry programs, such as beans, as a means to get vegetables from neighbors who grew them. To a lesser extent but also common, mothers also bartered their crops although they often spoke of preserving them so that they carry the family through the next harvest season.

The nopales that grow around here, there are many people that have nopales, we trade nopales for a kilo of beans or rice, whatever people ask. -CA203

Provide children flesh animal-source foods once in a while

Mothers valued providing flesh animal-source foods in their children's diets. Mothers regularly fed their children eggs, but mothers did not bring up eggs as part of the diet they sought to provide for their children. Mothers perceived flesh animal-source foods as good for their children to have because they helped children grow and develop healthy, but also because these foods were natural sources of nourishment both in how they were raised and in relation to ultra-processed meats.

I feel that [these foods] are natural, let's say fish, which is something I make fresh for her, well I feel that it's more natural than giving her a hot dog frank or ham,

ranch chicken is also a bit more natural because people still feed them maize and they don't give them food that are already chemicals, and well I also give her her vegetables, those also help a lot, the atole, I make her atole with maize, so that she goes on developing little by little. -B103

Flesh animal-source foods were expensive and most mothers could not afford to include them regularly in their children's diets. Despite the financial constraint, mothers relied on non-market food sources to provide these foods even if it was infrequently.

…At least once a week for the children to eat chicken…money is not enough but at least once a week we should give them at least a piece of chicken. -B114

In addition to price, flesh animal-source foods were not readily available for purchase at corner stores unless they were ordered in advance. This form of ordering system was also practiced with ambulatory vendors. It was also common for mothers to rely on their social ties to obtain these foods. For example, relatives or neighbors sometimes offered to sell meats from the animals they raised. Fathers who worked away from home also tended to bring these foods when they returned home, which ranged in frequency of once a week to a few months.

…my husband brought the beef, because the truth is that stores near here no, [don't sell it], that's why sometimes he brings it, because they have to eat some

of it one way or another, for us as adults it passes, but they are growing and still need it, and for the chicken a vendor comes every Friday. -CA210

A common practice that mothers used to optimize their ability to provide flesh animal-source foods to their children was to raise their own animals. Mothers described buying small chicks, sometimes by the dozen, and raising them by feeding them maize until they were big enough to eat. Chicken was prized for its perceived benefits and it was also the flesh animal-source food that children preferred. While mothers raised animals primarily for consumption, they also used animals as a way to acquire other foods through selling them.

I buy chickens like the ones that got scampered, those small chicks are mine, I buy little chicks and I raise them from when they are very little with bits of maize, and when they are big we eat them. -B104

Provide milk regularly

Milk was a highly valued food that mothers perceived as essential for their children to have. Milk was provided to children as a beverage and in preparations like *atoles* (i.e., gruel-like drinks).

…Children should drink milk at a minimum until they are 5 years old, that's the date and I cannot go without giving them milk. -CA209

Despite the time that participating in pantry programs required of mothers, obtaining milk for their children was an incentive. In the case of *Un Kilo de Ayuda*, mothers did not always have the financial means to pay the recovery cost of the standard 10-product pantry or need all of the products especially when government pantries were delivered with months' delay. In these situations, mother continued attending biweekly sessions but prioritized getting the milk package (i.e., five bags of fortified powdered milk), which had a reduced recovery cost.

> *…In the [government] pantry, sometimes they give me up to 10 kilos of rice, if I take the [Un Kilo de Ayuda] package every 2 weeks, everything accumulates. Sometimes I take only the milk for my child. -B106*

Mothers rarely purchased milk from retail sources, and while the *Un Kilo de Ayuda* package was not free, mothers valued being able to get milk for their children at a fraction of what they would otherwise pay at stores.

> *…I notice when I buy milk alone at the store, one little bag of milk costs me 20 pesos…the truth is that doing the math, I cannot buy with 70 pesos [at the store] all of the things that I get here [from the pantry]. -CA201*

Other child-centered values in food acquisition

While mothers primarily talked about what they valued for their children's diets, their discourse of food acquisition revealed other child-centered values. Mothers valued satisfying children's preferences. Satisfying children's food preferences meant providing foods that children liked in order to improve food acceptance, but it also meant yielding to children's food requests especially when children accompanied food shopping. Mothers reported that children most commonly asked for prepared foods, deep fried snacks sold in clear bags, cookies, candies, and drinkable yogurt.

> *[My daughter asks for], for example cereal, I mean we also buy it [at the store], so it's also cereal, gelatin, and as for candies it's chocolates, everything she sees that is chocolate…[I buy it for her] because I say, when I was a child, I tell you, I also wished for a candy and well my mom truly didn't buy me any, and well it feels ugly, I mean it feels ugly for you to want something and not to be able to eat it, so then that's why I do it. -CA201*

Mothers yielded to children's requests to satisfy children's preferences, but sometimes mothers also yielded to children's food requests to distract children during long walking commutes or to avoid tantrums during food shopping, even if it was foods that mothers otherwise did not want children to have.

I take my son because, with whom would I leave him?...he asks me [for things]…sometimes I buy him Negrito [candy bar], some chetitos [deep fried snacks] or something like that, but that's only when we go out, because when we're at home, no, I don't buy him any of that…[I buy him that] maybe out of temptation, sometimes to leave it alone, 'I'll buy it for you as long as you let me buy the things and don't go around crying', because when you don't buy it for them, you see there are children who throw tantrums, he's one of them, he gets angry because I don't want to buy him those things. Then well, I end up buying him the things and like that, then I carry him and he lets me keep buying the rest of the things. -CA202

Discussion

Mothers' present and local food environment consisted of market and non-market food sources that provided the context to understand how mothers made food acquisition choices, including where, what, how, and why they acquired foods that were ultimately fed to their children. Choosing a specific food source (i.e., retail, food pantry, production, wild sources, and social ties) depended on external characteristics about the food sources (e.g., distance, prices, variety) and mothers' personal conditions (e.g., time, money, support). Mothers' access to one source also depended on what they could acquire from others. For example, mothers infrequently acquired foods from retail sources that they could acquire through their production and/or pantry programs. The food environment also had a social element. For example, social ties, whether within

the household or external to the household, facilitated production through increased human capital to seed, irrigate, and harvest annual crops. These social ties also facilitated access to hard to come by foods, such as flesh animal-source foods, through animal rearing that could be gifted, exchanged, or sold to mothers. These findings are consistent with a recent framework that postulates that food environments in low- and middle-income countries experiencing nutrition transitions have external and personal domains that are in a continuous and complex interaction that is paramount to the foods that are acquired and consumed (Turner et al., 2018, 2017).

Limited financial resources to acquire foods was common, but mothers talked about *"finding the economy"* and *"finding a way"* to describe food acquisition behavior that largely capitalized on their time. This was evidenced in the time invested in extended travel to medium stores or open markets, attendance to pantry sessions, production of their crops and gardens, and gathering foods. When possible, mothers leveraged their time to mitigate some of the financial constraints they faced to acquire the foods they believed provided a nourishing diet for their children while managing to feed the family as a whole.

Mothers valued that their children were well-nourished and that the diets they provided were conducive to that. Diets that never lacked a vegetable or a fruit, at least once in a while offered a flesh animal-source food, and regularly included milk was what mothers perceived provided their children with nourishment that could not only prevent underweight and anemia in the present, but foster good health, growth, and development. This cognitive processing in which certain foods and situations invoke

food meanings (i.e., beliefs and affects related to food) is known to guide food choice across different food behaviors, which include food acquisition (Connors et al., 2001; Blake & Bisogni, 2003; Blake et al., 2007; Sobal & Bisogni, 2009). The importance given to children's nourishment has been documented as part of cultural values in ethnographic work in Mexico related to breastfeeding and complementary feeding practices (Guerrero et al., 1999; Monterrosa et al., 2012). This existing evidence, however, has not extended to how these values may influence food acquisition.

Mothers also considered other values in their food acquisition. Mothers valued satisfying children's preferences and responding to children's requests, which resulted in the regular acquisition of a variety of unhealthy foods particularly when children joined food shopping. These findings are consistent with studies conducted with children of similar ages in the United States which have found that yielding to child preferences and requests increases the acquisition and consumption of unhealthy foods (Davison et al., 2015; O'Dougherty, Story, & Stang, 2006). Satisfying children's preferences and providing a nourishing diet, however, were not mutually exclusive. Meeting children's preferences was also related to food acceptance and providing foods that children liked meant that children were more likely to eat it, which traced to mothers' drive to prevent underweight and anemia. Responding to a preference that also provided a composed diet was evidenced, for example, in mothers' efforts to provide chicken in their children's diets. Mothers cited chicken as the flesh animal-source food that their children preferred and their acquisition largely reflected yielding to that preference.

This duality of responding to children's food preferences in food acquisition needs further investigation, especially in contexts of double burden of malnutrition where the nutrition transition is likely to continue transforming food environments. Our findings showed that mothers give primacy to their children's diets in food acquisition, but in many ways this food acquisition responds to only one part of malnutrition risk. Mothers recognized unhealthy foods and tried to limit acquisition, but they did this with much less priority than their efforts to provide nourishing diets. The scarcity of discourse about obesity suggests that mothers may not perceive obesity as a prominent risk for their children. The way mothers talked about junk foods, such as displacing appetite instead risks for obesity, is one cue into how distant obesity risk might be perceived. There was also lack of recognition of some healthy foods that mothers were already providing, such as eggs. Eggs were widely available in their food environment and fed to children, but mothers did not bring up eggs as part of the nourishing diets they sought to provide.

Among the strengths of this study was the in-depth exploration of mothers' local food environment and drivers of their food acquisition, which is a food behavior largely understudied in young children in contexts facing the double burden of malnutrition. We constructed an interview guide with modules that provided entry points for a comprehensive examination of mothers' food environment, what and why they fed the foods to their children, and how they went about acquiring those foods. The richness of these findings is largely attributed to the adaptability of the interview guide to integrate themes not initially considered and this permitted a comprehensive depiction of

mothers' local food environment. The majority of participants were beneficiaries of *Un Kilo de Ayuda*. This program offered a biweekly pantry, periodically provided dietary guidance, and monitored children's weight, height, and anemia status. The regularity of this program may be related to the extent that mothers relied on pantry programs as a food source, especially for powdered milk, the extensive discourse relating to underweight and anemia, and what mothers valued in a nourishing diet. Rural communities in Mexico have the highest participation in government and non-government pantry program, many of which are directed to children under 5 years old, and these are the populations where the highest rate of underweight remains in the country (Gutiérrez et al., 2012). Additionally, fortified powdered milk has long been used, and continues to be used, as a strategy to prevent undernourishment among low-income families in Mexico (LICONSA, 2017). The perception of what composes a nourishing diet may also be related to a traditional diet or normative dietary patterns. A study that examined national expenditure patterns in Mexico between 1984 and 2014 showed that the expenditure for vegetables had consistently been more than double that of meats (Garza-Montoya & Ramos-Tovar, 2017).

In conclusion, this study expands evidence on how food choice is made for children through an in-depth exploration of mothers' local food environment and their food acquisition. Mothers portrayed a complex food environment consisting of retail, pantry, production, wild, and social food sources in which access depended on external and personal conditions. Mothers capitalized on the economy of their time to mitigate financial constraints to acquire foods for children in the context of acquiring foods for

the family. Mothers valued that their children were well-nourished and that the diets they provided were conducive to that. While mothers valued providing nourishing diets that could ensure adequate growth and development, they also valued responding to children's food preferences and requests. Responding to children's food preferences and requests in retail food sources led to the regular acquisition of unhealthy foods. Even if responding to children's food preferences did not necessarily interfere with providing sufficiently composed diets, yielding to children's requests in a food environment abundant with unhealthy foods, raises concerns about how this yielding during food acquisition may contribute to the formation of unhealthy dietary patterns as children continue to grow. In the context of the double burden of malnutrition and changing food environments that Mexico faces, building healthy eating habits through healthy food choices from early age may be important to prevent obesity and non-communicable diseases in later life.

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4.2. Manuscript 2

Functions of social networks in maternal food choice for children ages 1 to 5 years old in rural Mexico

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Abstract

Food choice for children has important implications for nutrition, development, and the dietary habits and preferences that are formed during early life food exposure. Food choice for children has been studied as parent-child dyad dynamics, but little is known about the extended system of relationships in maternal food choice for children. The objective of this study was to understand the role of mothers' social networks in the food choices that mothers make for their children ages 1 to 5 years old in rural Mexico. In-depth interviews were conducted with 46 participants between November and December 2016. The interviews inquired about participants' child-feeding practices, personal and local beliefs about child feeding, and the individuals with whom they interacted and conversed about food and child feeding. All interviews were conducted in Spanish, audio-recorded, transcribed verbatim, verified for quality, and analyzed using the constant comparative method. The social context emerged as five interconnected networks. These networks were household family, non-household family, community, children's initial school, and health and pantry personnel. Each network had functions in food choice that ranged from shared food decision-making in the household family network to imparting formal dietary guidance in the health and pantry program personnel network. Across the networks, professionals, participants' mothers and mothers-in-law, community senior women, and other women with children emerged as prominent figures whom mothers would turn to for child-feeding advice. These findings provide empirical evidence that social networks, as part of system

of interconnected networks, have vital functions in establishing norms for food choices made for children.

Introduction

Childhood malnutrition is a global health problem with long-lasting implications for children's health and overall wellbeing (Dewey, 2003). Malnutrition manifests as undernutrition and overweight and obesity (World Health Organization, 2016). The coexistence of these two forms of malnutrition is known as the double burden of malnutrition, and it has been accelerated by the nutrition transition that many Latin American countries have experienced in the past decades (Monteiro, Conde, & Popkin, 2004). In Mexico, the past thirty years have been marked with a steady decline in undernutrition among children under 5 years old, but this progress has been accompanied by a growing challenge of overweight and obesity in the same age-group (Gutiérrez et al., 2012; Kroker-Lobos et al., 2014).

While it is well-established that adequate nutrition during early childhood is essential for optimal development, little is known about the food choices made on children's behalf as they transition into the family diet. Beyond specific nutritional needs, early childhood is a period in which children gain exposure to different tastes and textures that cue children to accept or reject certain foods (Birch, Gunder, Grimm-Thomas, & Laing, 1998). As children continue to be exposed to foods, they learn important dietary behaviors that start to form habits and preferences that imprint later-life individual behavior (Dattilo et al., 2012).

The well-established Food Choice Process model helps explain how individuals make food decisions. The model postulates that individuals' lived experiences serve as the foundation for how they view the world, that the social and physical contexts in which they live and navigate can reinforce and challenge beliefs and the ability to make choice, and that personal systems are the cognitive processes by which individuals negotiate their values and call upon past experiences to facilitate decisions (Furst et al., 1996; Sobal & Bisogni, 2009). The Food Choice Process model posits that *influences*, which are categorized as cultural ideals, personal factors, resources, social factors, and present contexts, are salient circumstances that are considered and reconsidered in food decision-making (Furst et al., 1996; Sobal & Bisogni, 2009). While inductively developed for individual choice, the Food Choice Process model is a useful framework to examine relevant circumstances in the food choices that mothers make for young children.

Social networks are an important part of the social context in which food choice is made. The system of relationships that individuals have with one another has the capacity to constrain or facilitate food choice decisions (Furst et al., 1996; Pachucki, Jacques, & Christakis, 2011). Little is known about the role of social networks in the food choices that are made on behalf of children ages 1 to 5 years old, which is a transitional period for children into the family diet. Evidence from Latin America and other collectivist cultures suggests that food choice for children involves social dynamics that extend beyond the mother-child dyad and include family systems, cultural systems, and social hierarchies (Aubel, 2012; McGadney-Douglass & Douglass, 2008; Romo, López,

López, Morales, & Alonso, 2005). This evidence, however, has primarily focused on infants. Understanding the role of social networks in setting norms about food choice for children ages 1 to 5 years old might be particularly important in collectivist cultures like Mexico, especially in the context of the nutrition transition. The objective of this study was to understand the role of mothers' social networks in the food choices that mothers make for their children by answering three research questions. First, what are mothers' social networks and their composition? Second, what child-feeding functions do mothers' social networks serve? Third, who are the prominent authority figures across the networks in food choice for children?

Methods

Study design and sampling

In-depth interviews were conducted with 46 participants in three rural communities in the State of Mexico between November and December 2016. Data collection was conducted with support from *Un Kilo de Ayuda*, a national non-governmental organization that targets children under 5 years old in rural communities of Mexico to foster healthy growth through nutritional components that include a pantry. The study communities were selected based on community municipality, community size using *Un Kilo de Ayuda* enrollment as a proxy, and interviewer mobility to the communities. Criteria for inclusion were that participants be the primary caregiver of a child between the ages of 12 to 59 months, be able to communicate in Spanish, and be 15 years or older. *Un Kilo de Ayuda* personnel introduced the

interviewer at health and community centers and provided a list of program participants who met child-age criteria. Mothers were invited to participate in the study by approaching them in waiting areas at health and community centers, asking mothers with whom contact was made if they knew other women with children of similar age-range, using the list provided by *Un Kilo de Ayuda*, and canvassing the communities. All interviews were conducted by the first author who is fluent in Spanish, audio-recorded, primarily done in mothers' homes, and had an average duration of 75 minutes. Oral consent was provided prior to each interview and no incentives were provided to participants. Ethical approval for this study was obtained from the Institutional Review Boards for Human Participants at the University of South Carolina.

Measurement

The interview guide was developed by adapting modules from the Cornell Food Choice Research Group and creating new ones applicable to the study objectives. This semi-structured interview guide was pretested in a comparable rural community in Mexico. The modules included knowledge and food meanings, beliefs and social norms, and social channels and networks. The module on knowledge and food meanings inquired about participants' child-feeding knowledge, their perception of good and not so good foods for children, and how and where they acquired that knowledge. Questions on beliefs and social norms inquired about broader beliefs in the community about child feeding and what participants made of those common beliefs. Social channels and networks integrated a name generator and interpreter instrument to

inquire specifically about each individual with whom mothers had conversations about food.

Analytical strategy

The interview guide was adapted throughout data collection to include emerging topics not initially considered. Upon completion of data collection, all interviews were transcribed verbatim in Spanish and verified for quality. Quality was verified by listening to the audio-recordings in their entirety while simultaneously reading the transcriptions and making corrections as needed. All verified transcriptions were coded using NVivo Version 12. Data were analyzed using the constant comparative method in grounded theory in which new data are constantly compared to existing categories to develop the scope of that category or create new categories to identify salient themes from the data (Glaser, 1965). Eight steps were systematically conducted for this analysis: (1) simultaneous open coding and codebook development by the first author (LIR) using research questions as guide; open coding is an interpretative process of comparing raw data line by line for similarities and differences to assign conceptual labels (Corbin & Strauss, 1990), (2) peer consultation of codebook and coding technique after initial coding of 9 transcriptions (approximately 20% of all interviews (3) gradual categorization during coding to designate specific network functions as distinct networks emerged, (4) gradual categorization during coding to designate emergent hierarchies based on participant descriptions of network members identified as trusted sources of child-feeding advice, (5) completion of coding applying iterative techniques that compared

newly coded text to existing codes to determine whether content fit within the scope of a code or a new code was needed and integrated two additional peer consultations, (6) review of all coded text for thematic categorization addressing research questions with ongoing peer consultation, (7) visual examination of coded categories using hierarchy charts, and (8) final examination of selected text for thematic representation.

Participant characteristics

Forty six participants were recruited for this study. All participants were the children's mothers, except one who was the child's grandmother. About half (54%) of children were female. For children's age, 28% were between 12 to 23 months old, 33% were between 24 to 35 months old, and 39% were between 36 to 59 months old. In the oldest age-group, one child turned out to be 66 months once age was verified.
The average participant age was 31 years old. For education, 49% of the participants had completed secondary school, 38% had completed primary, and 13% did not complete primary school. Most mothers were married or living in common law arrangements (98%). Most participants reported their occupation as homemakers (78%), and the remaining (22%) reported at least part-time employment outside of the home. About half (52%) of children's fathers worked away from home, which meant returning home anywhere from every weekend to every few months. The average household size was 5 members. Most participants were beneficiaries of at least one government or non-government program that consisted of nutritional guidance and/or a pantry. Most participants were beneficiaries of *Un Kilo de Ayuda* (96%), the national

government social development program PROSPERA (48%), a state pantry program referred as CAVIN (39%), and other small-scale government pantries (33%).

Results

Maternal social networks and their composition

The social networks that participants described in relation to child feeding were largely interconnected and embedded within the social space of their communities. The set of participants' networks consisted of household family, non-household family, community, children's initial school, and health and pantry personnel (Figure 4.2). The household family network was composed of participants' spouses, mothers, sisters, in-laws, and older children who lived in the same dwelling and often ate from the same pot. The non-household family network was composed of participants' mothers, in-laws, siblings, cousins, aunts and uncles, and nieces and nephews who lived in a separate dwelling and did not share regular meals together. The community network was composed of distant relatives, friends, and neighbors who lived within participants' vicinity. The initial school network was composed of teachers, other mothers, and children. The health and pantry personnel network was composed of doctors, nurses, and PROSPERA and *Un Kilo de Ayuda* personnel who operated out of community centers.

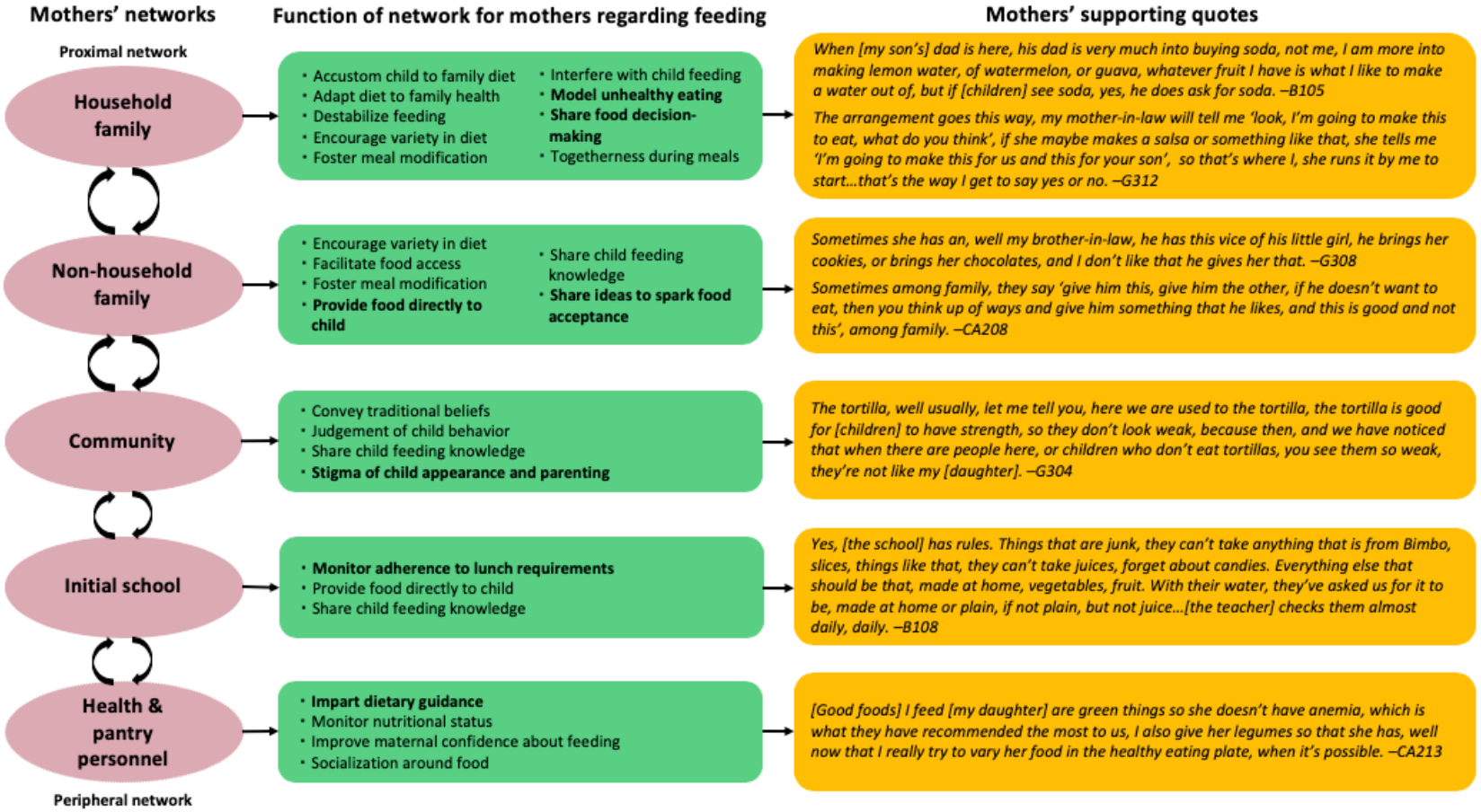

Figure 4.2. Maternal social networks and functions

Function of social networks for mothers and food choice

Participants described the functions that each network had for the feeding of their children. Functions are herein defined as the enacted and encouraged actions by the networks that assisted in establishing normative child-feeding behavior, including food choice. These functions ranged from directly intervening on feeding behavior in the most proximal network, i.e., household family, to providing formal feeding and nutritional guidance in the most peripheral network, i.e., health and pantry personnel. Some networks had functions that no other network had, but some functions emerged across the networks and share function labeling (e.g., share child-feeding knowledge).

Household family. Among the functions that participants expressed was receiving *encouragement to provide variety in children's diets*. This occurred through conversations, often when planning and preparing meals, but also by directly providing foods and money to participants. Another function was *sharing decisions about feeding* through fathers' engagement in child feeding and collective meal preparation with other household women. Members also *fostered meal modifications for children*, such as reducing spiciness of family meal to ensure that children could safely and comfortably eat. Participants also discussed functions that *interfered with feeding* by undermining participants' requests against certain foods, *modeled unhealthy eating* that participants considered increased child request for foods that they did not want children to have, and *destabilized feeding* by disrupting feeding routines that they established for their children. For example, some participants cited that when children's fathers returned home periodically from their employment, they tended to have soda during family

meals and witnessing this behavior increased children's request for soda. During fathers' periodic returns, participants also perceived a destabilization of feeding routines because fathers tended to "satisfy whims" of children by providing junk foods and were overall more permissive with children. Other functions were related to family dynamics that channeled values relevant to feeding. These functions included *adapting family meals to accommodate the health needs* (e.g. diabetes) of other household members, while simultaneously working to *accustom children to family diets* within the context of reinforcing relevant family values such *eating together as a family.*

Non-household family. Among the functions that participants described was receiving *encouragement to provide variety in children's diets* through conversations. Participants also expressed that non-household relatives s*hared knowledge about child feeding* with them, such as specific benefits of providing certain food to children, and *ideas to spark children's food acceptance*, e.g., creative meal preparations. Members of this network also *facilitated access to certain foods* by offering foods to participants that were sometimes difficult to find in the immediate environment. These members also *directly provided foods to children*, both acceptable foods and foods that participants did not want their children to have.

Community. Participants indicated that this network also engaged in *knowledge sharing about child feeding*, including benefits and harms that certain foods could have for children. There was another layer to this knowledge sharing that *propagated traditional beliefs* about foods, such as the concepts of 'cold' or 'heavy' foods, traditional food-related remedies, and a common belief and practice to feed children

broths instead of more solid textures. Participants also described functions that took on a more comparative modality, in which participants perceived and casted *child behavior judgement* to and from community members with evidence of *stigma based on child appearance*, primarily related to underweight or signs of weakness, and *stigmatized parenting practice* that led to those conditions or could cause future conditions, including chronic conditions.

Initial school. The function of this network emerged from participants whose children attended initial school (n=11). Children spent an average of four hours during weekdays in a school setting. Participants conveyed that schools had *existing lunch requirements* that discouraged junk snacks such as candies, chips, and packaged foods, and promoted homemade lunches that included vegetables and fruits. Children's lunches were monitored by teachers and a healthy eating committee that was formed of volunteer children's mothers. The healthy eating committee *shared knowledge* with other mothers about unhealthfulness of junk foods, sometimes citing gaining this knowledge through talks provided through pantry programs and PROSPERA. Participants also discussed *direct food provision* through school-sponsored snacks or food exchange among children of foods brought from home.

Health and pantry personnel. One of its functions was to *impart dietary guidance*. This occurred in group settings through periodical talks and workshops, as well as one-on-one guidance through well-child visits and under special circumstances. *Children's nutritional status was monitored* by health personnel and by *Un Kilo de Ayuda* personnel as a component of their pantry program eligibility. Participants discussed

children's nutritional status as indicative of their feeding performance as mothers. This monitoring showed links to maternal *confidence about feeding* through signs of pride when children had normal results and reinforced their feeding practices, but also insecurity when results were abnormal and urged them to seek guidance. This network also offered opportunity for participants to *socialize around food*, which reinforced content formally imparted by professional personnel, and offered opportunities to taste each other's recipes given that mothers often organized to bring prepared foods to program events.

Network authority figures in maternal food choice

Social hierarchies emerged in the authority about child feeding that participants assigned to some members of their networks. Participants identified attributes about these authority figures that gave them a status of trusted sources when it came to child-feeding advice.

Health and pantry program personnel were widely viewed by participants as trusted and reliable sources for child-feeding advice. Participants referred to these individuals as experts and cited their formal education in the trust that participants placed on them, despite common push-back from other network members that contradicted this expert guidance.

…To my baby, I didn't give him anything that a doctor wouldn't tell me was okay, precisely because they know, I mean, no one is going to come and tell me that

the neighbor knows more than the doctor, I mean, if the doctor tells me 'this isn't good for him' then it isn't good for him. -B105

Participants' mothers were also widely cited as respected and trusted figures in child feeding. Participants cited age, experience raising children, and their own experiences being raised by their mothers. Participants valued the care their mothers demonstrated for their children, and mothers often linked this behavior to their own childhood experiences with their mothers, sometimes highlighting various struggles that their mothers surpassed.

My mother always took care of me, she would feed me in the morning, she would put let's say one or two tacos or a sandwich so I could eat it when I got hungry. But yes, when I would return home she would already have made something to eat. She was always always like that, they say that what is taught is learned and to this date, it's the same with my children. -CA204

Mothers-in-law were another child-feeding authority figure for some participants. Participants cited a familial relationship in which respect was extended to mothers-in-law as senior women. Participants who had fewer of their own family members around or felt inexperienced tended to accept mothers-in-law as authority figures in child feeding and adhered to their advice and observed behavior.

When he was younger, my mother-in-law started giving him food when he was about one month and a half, she started giving him tastes of bean broth…and as she went on teaching me, I did the same, from the moment I saw that she fed him, same, he started asking to be fed, what I mean is that he drank milk, but he also wanted to eat. -CA210

The position of mothers-in-law was different among participants who felt more confident about child feeding or had more of their own family within closer proximity. These participants were less likely to seek input from mothers-in-law and more likely to push back against input if it did not align with what they believed was a better way to feed their children.

My mother-in-law gets very upset, she says…'when you want me to give him candies, I won't give him any', 'don't give him any', yes, she does get upset, but the reality is that I try to take care of my children, how I feel is best, then they tell me 'well when we raised you', yes, but we were different, like, I don't know, the fact that we were raised so abruptly we got used to it, but now times are different, now give children candies and in a little while they will have that diabetes and things like that. -B105

Participants further expressed that senior community women and other women with children were also figures whose input they respected and attributed this to their

long-standing experience and relatability as mothers. Some senior community women also served as liaisons, or *vocales*, for programs like PROSPERA and *Un Kilo de Ayuda*. To this, there were also attributes that participants dismissed. Some participants tended to dismiss input from younger people and those who participants perceived as inexperienced or uninformed.

> *There are people that [I pay more attention to than others], that I say, maybe those women have experience, meaning people who are older, because someone who is younger than I am and tells me something, well I don't think so because, I mean, I think maybe not, I mean no. -B111*

Participants appraised attributes of these authority figures and expressed strong views about them. All of these individuals were part of an interconnected system of networks and rarely did participants only rely on one or another, and instead expressed striking a balance with all of the input they receive, what they make of it, and eventually weighing their children's responses, resources available, and situations in which interactions occur and food choice is made.

> *[I learned what I know] from my mother, yes. She's the one who taught me since, like I'm telling you, since I was little. Like I was the oldest, I was the one who went on noticing how she fed my siblings, or what she did, and all of that. And when I worked, when I worked house-work, well I used to see it with the older ladies, or*

what was what they said that they gave to their children and what sat well with them. And the talks that they used to give to us…with the nurses that sometimes they come to give us talks, that is how I went on learning more. Or my aunts who are older are the ones that, where I went on noticing her with her children. -B107

The interconnectedness of the networks also created tension for participants. This tension arose when the figures that participants relied on as feeding advisors conflicted in the views expressed about feeding. There was also tension when people whose input participants rarely considered, typically community members, tried to dismiss or challenge the views of those participants viewed as authority figures. This tension had the capacity to cause uncertainty, but also served as a mechanism for participants to assert the advice they accepted about feeding.

…It's like we learn from our mothers, they teach us to eat a little bit of everything, and well that everything has a benefit, and well, practically, the Kilo has helped me, it would be in different forms, same, to take advantage of foods, because before when we were little, [people] would say that the broth of beans was what was the benefit and it turns out that it isn't, it's just pure salt. Now here at the Kilo, what helps is the bean itself, not the broth. What I mean is that it's a lot of differences in what you learn and what you bring…before that's what my mom sometimes told us 'no, the bean broth is good for children' or 'I used to give it to you'. But after that, I entered the Kilo…and that's the thing, that also in

bits, in bits you know something, but we complete that also with the same talks, those from the Kilo. -B112

Discussion

Social networks are the relationships that individuals have with one another that form social structures and can influence health behavior, and this extends to the food choices that individuals make across different food behaviors (Berkman, Glass, Brissette, & Seeman, 2000; Furst et al., 1996; Pachucki et al., 2011). The current study advances knowledge about the role of social networks in food choice by examining maternal social networks, functions of each network, and network authority figures in child feeding. Network composition transcended networks, e.g., sisters-in-law could belong to the household family, non-household family, community, or initial school networks.

Across the five networks, we identified twenty six functions by which networks had a role in establishing norms about the food choices made for children. Some functions were ways by which networks supported or disrupted maternal food choice. For example, shared decision-making was how children's fathers and other household women engaged in decisions about what children would eat. In contrast, the direct provision of foods to children that participants disapproved and modeling unhealthy eating behavior were ways that mothers perceived a disruption. Some functions reinforced values and beliefs. For example, accustoming children to the family diet and adapting family meals due to health needs were ways to reinforce a family value of eating together. Conveying traditional beliefs was one way to reinforce beliefs about

what, when, and why to give children certain foods based on tradition. Some functions were about social comparison, such as judgement of child behavior and different forms of stigma, and provided participants points of reference to avoid. In contrast, some functions provided the gold standard to meet, such as dietary behavior that adhered to formal dietary guidance and initial school requirements.

Across the social network structure, hierarchies emerged in which authority regarding child feeding was explicitly assigned to some network members. Participants assigned authority to health personnel, their own mothers, their mothers-in-law, senior community women, and other women who were also mothers. The perception of health personnel as authority figures for formal child-feeding guidance is well-established, and this evidence has been used in strategies to improve child nutrition across different settings (Bhutta et al., 2013; McLorg & Bryant, 1989; Pelto et al., 2004; Penny et al., 2005). The prominent role of senior women in infant and young child feeding has also been studied (Aubel, 2012; Bezner Kerr, Dakishoni, Shumba, Msachi, & Chirwa, 2008; Bryant, 1982). One of the earliest studies that examined the impact of social networks on infant feeding practices found that participants of Latin descent relied heavily on their relatives as feeding advisors for their children, especially their mothers and mothers-in-law, but were highly skeptical of feeding advice from neighbors and friends (Bryant, 1982). Existing evidence, however, has rarely examined the role of these child-feeding advisors in food choice as part of a complex and interconnected system of networks in which one advisor might offer advice that conflicts with that of another or can reinforce aligning advice.

The interconnectedness of the networks can be leveraged to promote healthy food choices for children. Although each network had unique functions, all networks relied on interpersonal communication which was a way by which child-feeding knowledge was transferred across the networks. Interpersonal communication, or conversation, is a powerful mechanism that not only diffuses information, but helps verify one's beliefs, and can reinforce and modify social norms (Southwell & Yzer, 2009; Suls & Wheeler, 2000). Innovation diffusion theory postulates that how new information spreads largely depends on how networks are connected (Valente, 1995; Valente & Fosados, 2006). A recent study found that mothers with more connected networks engaged in more information diffusion about infant and young child feeding and that this diffusion reinforced promoted messages and contributed to improved feeding practices (Nguyen et al., 2019). In addition to how information diffuses within and across networks, the integration of feeding advisors into strategies that aim to promote healthy eating might be a promising avenue to synchronize messaging that can modify existing beliefs and norms beyond the specific networks. Media use (e.g., TV, Internet, social media) was not prominent among study participants in part due to the environmental infrastructure that did not support it. The cases in which media use emerged, participants expressed learning about foods from a TV segment or using the Internet to search information about child feeding. Internet penetration, which is the baseline requirement for many forms of media, is expected to continue to improve in a global scale (The Nielsen Company, 2018). While not yet prominent, future media access

will likely surge in prominence as a source for feeding advice that should be considered in the promotion of healthy dietary patterns.

These findings should be considered with regard to the strengths and limitations of this study. Among the notable strengths is the in-depth exploration of individuals who directly and indirectly, individually and collectively, had a role in the food choices that participants made for their children. This examination integrated a social networks instrument, i.e., the name interpreter, which is commonly used in quantitative formats. This instrument was carefully crafted into an open-ended format that combined with other qualitative techniques facilitated an organic emergence of rich descriptions about individuals, experiences, and spaces that were relevant to the food choices that mothers made for their children. Despite the rigor in the study design, an important limitation to consider is that the majority of participants were beneficiaries of *Un Kilo de Ayuda*. This program had biweekly presence in the communities and periodically offered dietary guidance and anthropometric monitoring. The regularity of this program may be related to the extent that participants expressed deference to network members. Although we acknowledge this potential, it is noteworthy that about 42% of the rural population in Mexico participates in at least one program that includes a nutritional component and deference to health personnel has been widely recorded (Gutiérrez et al., 2012; McLorg & Bryant, 1989; Pelto et al., 2004).

In conclusion, this study provides empirical evidence that social networks, as part of an organized system of relationships, have vital functions in the food choices that are made for children ages 1 to 5 years old. Through these functions, each network

had a role in establishing norms that mothers considered in the food choices made for children. Across the networks, mothers assigned authority to individuals that established hierarchies for child-feeding advice. While the advice mothers received was sometimes reinforced across referents, there was an absence of harmonization that sometimes created tension. These findings have important implications for how we think about food choice for children, but also for strategic planning where network functions and member hierarchies across interconnected networks can be leveraged to promote healthy food choices as children advance to making their own food choices.

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CHAPTER 5

SUMMARY, IMPLICATIONS AND RECOMMENDATIONS

Summary of major findings

The purpose of this study was to gain an in-depth understanding about how mothers, as primary caregivers, make food choices for their children ages 1 to 5 years old in rural Mexico within their food environment and their social context. This qualitative study involved in-depth interviews, market observations with field notes, and short interviews with store owners. The research questions and development of the semi-structured interview guides and the market observations were informed by literature review, existing conceptual frameworks, and consultation with committee members.

The first aim of this study was to understand mothers' food acquisition for children ages 1 to 5 years old through an exploration of their local food environment. Through in-depth interviews and market observations, we classified mothers' portrayal of their local food environment as retail, pantry programs, production, wild sources, and social ties. Mothers considered external characteristics about the sources related to the distance of each food source from their home, prices offered at the respective food sources, and the variety and quality of the food available. Mothers' ability to access the different food sources depended on personal conditions such as money available to

dedicate to food, time needed to make it to each food source, and different support that could facilitate their food acquisition. Mothers' interface with retail sources had spatial constraints (i.e., distance to make it to the stores) and limited financial resources, which they tried to mitigate by capitalizing on their time. This interface of consumer and environment has been studied in other settings, and that work has made a call for further exploration of how individuals interact with their food environment due to potential implications for food choice and nutrition (Herforth & Ahmed, 2015; Turner et al., 2018, 2017). In this interface with the food environment, there was a deeper layer driving mothers' food acquisition. Mothers' food acquisition brought to light food choice values, or salient considerations, that prioritized children's nourishment and a diet composition believed to foster adequate growth and development, and that also responded to children's food preferences and requests. Responding to children's food preferences and requests led to the regular acquisition of unhealthy foods particularly when children joined during food purchases.

The second aim of this study was to understand the role mothers' social networks in the food choices made for children ages 1 to 5 years old. Through in-depth qualitative interviews, mothers depicted that the social networks with which they interacted about child feeding were largely interconnected and embedded within the social space of their communities. Mothers' networks consisted of household family, non-household family, community, initial school, and health and pantry personnel. The networks were composed of participants' spouses, their own mothers, fathers, in-laws, older children, siblings, cousins, aunts and uncles, nieces and nephews, friends,

neighbors, teachers, non-relative children, and professionals. Each network had vital functions for the food choices that were made for children. For example, some functions were about how networks provided support that assisted mothers in the feeding of their children by sharing decisions about feeding or encouraging variety in children's diet. Others were about how networks foment social comparison and provide points of reference to avoid by recognizing that child behavior, appearance and feeding practice is judged, even stigmatized. In addition to these specific functions that helped establish normative dietary behavior, mothers also identified members of their networks whom they view as authority figures for child feeding. These were individuals whose feeding advice mothers tended to seek, accept, or at least consider given different attributes about these individuals such as education, expertise, older age, and overall maternal experience.

Strengths and limitations

A strength of this study is the in-depth exploration of mothers' local food environment and drivers of their food acquisition, which is a food behavior largely understudied in young children in contexts facing the double burden of malnutrition. The same rigor was applied to the in-depth exploration of individuals who individually and as a collective had a role in the food choices that participants made for their children. For the first aim, we constructed an interview guide with modules that provided entry points for a comprehensive examination of mothers' food environment, what and why they fed the foods to their children, and how they went about acquiring

those foods. The richness of these findings is largely attributed to the adaptability of the interview guide to integrate themes not initially considered and this permitted a comprehensive depiction of mothers' local food environment. Furthermore, we carried out market observations that provided an environmental perspective to mother's portrayal. For the second aim, we integrated a social networks instrument, i.e., the name interpreter, which is commonly used in quantitative formats. This instrument was carefully crafted into an open-ended format that combined with other qualitative techniques facilitated an organic emergence of rich descriptions about individuals, experiences, and spaces that were relevant to the food choices that mothers made for their children.

Despite the rigor in the study design, an important limitation is that most participants were beneficiaries of *Un Kilo de Ayuda*. This program had biweekly presence in the communities and periodically offered dietary guidance and anthropometric monitoring. The regularity of this program may be related to the extent to which mothers relied on pantry programs as a food source, especially for powdered milk, the extensive discourse relating to underweight and anemia, and what mothers valued in a nourishing diet. This regular presence might also be related to the extent to which participants expressed deference to network members. Nevertheless, the rural population in Mexico has the highest participation rate in government and non-government pantry program where about 42% of the rural population participates in at least one program that includes a nutritional component (Gutiérrez et al., 2012). Many of these programs are directed to children under 5 years old and the rural population is

where the highest rate of underweight remains in the country (Gutiérrez et al., 2012). Additionally, fortified powdered milk has long been used, and continues to be used, as a strategy to prevent undernourishment among low-income families in Mexico (LICONSA, 2017). Mothers' perception of what constitutes a nourishing diet may also reflect traditional diets given national food expenditure patterns in Mexico for the last 30 years that coincide with the composition that mothers valued for their children (Garza-Montoya & Ramos-Tovar, 2017). Lastly, there is long-standing evidence that about deference to health personnel in contexts without such prominent programmatic presence (McLorg & Bryant, 1989; Pelto et al., 2004).

Conclusion and implications for future research

Understanding food environments and the social context in which food choice is made for children during a transitioning period into the family diet has important implications for public health. In the local food environment that mothers portrayed, pantry programs were one prominent food source from which mothers acquired foods. This finding has implications for how we think about food sources and what constitutes the food environment, especially in rural settings stricken by poverty. Pantry programs were not only sources from which mothers acquired foods, but these were also sources from which they acquired knowledge and skills that they could use in the feeding of their children. Unexpectedly to an extent, but not when we understand the context, mothers also relied heavily on results of anthropometric measurements (i.e., weight, height, and hematologic tests) because results were ways to verify that the food choices

they were making for their children were providing a nourishing diet. The prominence of pantries as a food source also relates to the authority that was widely given to the pantry personnel network, which functioned to provide mothers the gold standard guidance of what children should be receiving in their diets. While pantry programs might not fit with typical ideas of what constitutes food environments, in this population's present reality pantry programs were prominent food sources not only through the foods that mothers acquired, but through the guidance they received. Food environment research in low- and middle-income countries that are experiencing nutrition transitions is scant, and as the double burden of malnutrition continues to affect many of these countries, there has been a call to expand evidence emphasizing that what constitutes food sources is a dynamic spectrum that includes market and non-market sources that can change over time with climate, technology, and infrastructure (Turner et al., 2017).

Mothers' values for providing nourishing diets responded to preventing an underweight and anemic nutritional status, but not to the formation of dietary habits that has the potential to increase risk for obesity and non-communicable diseases. It is unknown to what extent pantry programs and the recently cancelled social development program PROSPERA provided dietary guidance that cautioned about the risks of consuming different types of unhealthy foods, but this study found that obesity and non-communicable diseases were not viewed as primary concerns for children even if mothers recognized that these risks exist. This finding is not surprising considering the intergenerational experience with undernutrition in these communities. Mothers'

personal experiences were about hunger and food scarcity. Personal experience is powerful, and bringing in the social comparison that emerged in the examination of social networks, we can see that undernutrition continued to be the prominent issue at the community level. If undernutrition is what mothers view as the primary nutritional problem that could affect their children, then prioritizing obesity risk might be particularly difficult because outside of our public health lens, undernutrition and obesity might still be viewed as opposite problems. Although mothers did not discuss explicitly the formation of dietary preferences and habits, mothers yielded to children's preferences and requests during food acquisition and some functions of the networks tapped into habit formation, such as accustoming children to the family diet. This subtle but important evidence suggests that a potential messaging strategy to divert the acquisition and consumption of unhealthy food might be through reinforcing the formation of dietary preferences and habits during early age.

The emergence of feeding advisors across the network structure may be key to promoting healthy choices that can foster healthy dietary habits. The finding that professionals and older kin women are viewed as authority figures in feeding is well-known, but prior evidence has examined independent networks which in some ways assumes that mothers only turn to that advisor for guidance. These findings expand existing evidence by looking at the interconnected networks with which mothers interact about child feeding. Across the networks, mothers have multiple figures whose feeding advice they consider. This multiplicity has important implications for the promotion of healthy eating because the guidance that mothers might receive from one

referent might be contradicted by another, with the potential to create uncertainty among mothers and tension in the networks. Efforts to promote heathy dietary habits and prevent obesity can be inclusive of other referents as active participants, which may help to reinforce messaging. This suggestion should not be taken to mean that a simplistic solution is to provide guidance to referents in addition to mothers, but rather to consider that there are important referents to whom mothers turn, and depending on the strategies pushed forth, they might be supportive allies.

Shared decision-making in food choice for children occurred in the household family network where, depending on family dynamics, different family members participated in the decisions about what children would eat and at times served as alternative decision-makers for children. In multigenerational households, other women, especially grandmothers, participate and sometimes act as the primary deciders in the feeding of children (Aubel, 2012; Bezner Kerr et al., 2008). In this study, participants' mothers and mothers-in-law were actively engaged in children's diets, but fathers were also engaged in the feeding of children. Fathers perhaps were not participating in the preparation of meals, but mothers described that fathers were preoccupied with what children ate and in their returns home, fathers brought foods for children that aligned with what mothers valued as nourishing diets and engaged in conversations with mothers about children's diets. While some fathers modeled unhealthy eating habits and sometimes destabilized feeding routines, what mothers portrayed about fathers reflected a level of unawareness that something as simple as drinking soda in front of children or giving children a little taste may contribute to

children's preferences. Furthermore, and based on mothers' accounts of the foods that fathers sometimes provide to children, satisfying children's preferences may also be a guiding force in the foods choices that fathers made. Children's fathers have infrequently been considered as active participants in children's nutrition outside of providing monetary resources, but they may have a complementary role in children's diets. A recent study from Malawi found that men were supportive figures in the feeding of children and were engaged in the caregiving, food acquisition, and even food preparation (Mkandawire & Hendriks, 2019).

While this study contributes to our understanding about how mothers make food choices for children within their local food environment and social context, much research is still needed in Mexico and other settings experiencing the double burden of malnutrition through nutrition transitions. The participation of alternative caregivers in food choice as part of a collective effort is understudied. Future research should distinguish the role that alternative caregivers have across different food behaviors because food acquisition, preparation, serving, or providing foods to children represent different involvement in food choice. Children's fathers may be especially important to include in future research because, as this study and the one from Malawi showed, fathers are not passive figures in the food choices for children.

A major public health concern that emerged from this study was how distant the reality of obesity risk was perceived. There were legitimate and powerful life course experiences to support why undernutrition was perceived as such a prominent concern, and even though mothers recognized and tried to limit unhealthy foods, the perceived

risk of providing various types of unhealthy foods did not seem sufficient to deviate acquisition of those foods. Some cues that we can take from the minimal discourse about obesity risk was that mothers perceived the provision of unhealthy foods as infrequent despite evidence that provision was regular, that unhealthy foods were provided to satisfy child preferences and requests, and that provision of these foods was a dyadic behavior, meaning that someone had to give a food to the child in order for the child to eat it. What did not emerge was recognition that the provision of these foods contributes to the formation of unhealthy dietary habits, that food environments had changed from when mothers were growing up in the same communities, or that excess weight was an active problem among the adults in the study communities. The study communities had strong programmatic presence and these strategic efforts have made tremendous strides to reduce undernutrition, but it may be timely for efforts reframe the impending issue of overweight and obesity by not only looking at children's nutritional status, but consider the nutritional and health status of the family to identify at-risk children. Efforts that target children beyond the exclusive breastfeeding period should also consider the integration of environmental strategies that extend beyond nutritional guidance, not just in mass communication, but into the food sources which is the first contact with unhealthy foods.

In recent years, Mexico has advanced policy that prohibits the sale of junk food in school settings, passed a tax on soda, and passed policy for front-of-package labeling. While findings from this study support that local initial schools have some form of policy about the foods that children can bring to school, it is unknown how the national policy

has been implemented in the school settings, for example, vendors in the schools. Investigating how the soda tax changes the availability of soda and other sugar-sweetened beverages in the retail food sources from which mothers acquire foods is important. From observations in food markets, branded food companies have their own system to manage supply at the food sources, and understanding the range of how different foods make it to the stores may be important to help explain food availability from the supplier's perspective. Such investigations, however, should give consideration to the plausibility that new food sources may emerge as these policies are implemented. Research that examines how front-of-package labels influence the acquisition of those products must also consider unlabeled junk foods which are widely available in the rural food environment.

An overall important consideration for future research on food choice in Latin America and other developing regions is what Julio Berdegué from the Food and Agriculture Organization of the United Nations postulated in a panel at the biannual *Sociedad Latinoamericana de Nutrición* November of 2018. He said that we cannot ignore traditional diets and the economy of time in strategies that seek to foster healthy diets. Findings from this dissertation research support that in many ways, food choice for children reflects traditional dietary practices and that time is a valuable resource that mothers use to mitigate economic constraints that allows them provide nourishing and desirable diets for children. In Mexico and other low- and middle-income countries, large-scale changes are underway that are transforming the physical and social environments in which individuals make food choice for themselves and for others,

including children. As these changes continue, it is essential for public health efforts to be adaptive to population needs and inclusive of the historical nutritional context in order to effectively foster healthy eating and ultimately prevent and reduce both faces of malnutrition.

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APPENDIX A

SEMI-STRUCTURED INTERVIEW GUIDE WITH MOTHERS

Name of participant: _____ Participant ID: _____

Child date of birth: _____ Child age: _____

Community/Municipality: _____ Interview date: _____

Beneficiary of:

☐ PROSPERA ☐ PAL Sin Hambre ☐ CAVIN

☐ UKA ☐ Other: _____ ☐ None

Programs

1. IF PROSPERA/PAL: What do your benefits include? What is required from you to maintain these benefits?
2. IF CAVIN: What products does CAVIN provide? How often do you receive them? What do you do with those products?
3. IF UKA: Since when do you participate in UKA? Do you receive the UKA package? How often? What do you do with the products from the package? How often are the workshops?
4. IF OTHER: Could you tell me what you receive? Is it from the government or a civil association (NGO)?
5. Besides what you already mentioned, does anyone else in your household receive any other support? Which ones?

Socio-demographic Characteristics

I am now going to ask you some basic questions.

6. How old are you?
7. Did you attend school?
   [IF YES: What grade did you complete?]

8. Do you breastfeed CHILD?
   [IF NO: Until when did you breastfeed him/her?]
9. What is your marital status?
10. What do you do for a living?
11. What does your spouse/partner do for a living?
12. Who lives in your household? Who spends the most time at home?
13. Who prepares the food in your household? Who eats from the foods prepared at home?
14. Where do you store food?
15. Where does the water that is used to prepare foods come from?
16. Do you have electricity? Do you have a refrigerator?

Personal Factors (Adapted from Cornell Food Choice Research Group)

The next questions are about you to help me get to know you a little better.

17. Can you tell me about yourself? How do you spend your time? Have you always lived here?
18. What foods did you eat as a child? What foods did you eat then that you no longer eat?
19. Did you grow up with siblings? Were they older or younger than you? Did you look after them? Please tell me about that.

Sources of Food

Now we are going to change the topic a bit and talk about where the foods that are consumed in your home come from.

20. In general, who provides money for the food? And who is in charge of bringing the food home?
21. At this moment, what foods are in your home? And drinks?

List of foods				

22. How did you get them? Where did you buy them?
23. Besides buying them, are there foods that you get in some other way? For example, in addition to buying them, sometimes people plant what they eat, raise animals, exchange food, receive food as gifts and/or through programs.

List of sources			

24. Could you tell me what is harvested here during this time of the year? Do you or anyone in your family harvest anything? What do you do with what you harvest?
25. Of the foods that are consumed at home, what foods are more expensive during this season? What do you do when these are more expensive?
    [PROBE: Besides the price, is there any other reason why you find it difficult to get some foods?]
26. How far is it where you buy food? Why do you go there? What are the prices like there?
27. How often do go food shopping? When is the next purchase? How much do you plan to spend? Can you give me a list of the things you plan to buy?
    [PROBE: If someone else goes food shopping, do you know what they are going to buy?]

Shopping list				

28. Of the things you plan to buy, is there anything you plan to buy because you know that CHILD likes? What?
    [PROBE: When someone else goes food shopping, do they bring anything in particular to CHILD? What do they bring him/her?]
29. Does CHILD tag along when you go food shopping? Does he/she ask you for things when he/she joins? Like what? Do you buy it? Why?

30. Does CHILD watch TV? Does he/she ask you for foods that he/she sees on TV? Like what?

Foods Fed to Child

Now I would like us to talk about CHILD.

31. I would like to get to know CHILD, what can you tell me about him/her? What does he/she do during the day?
32. Does CHILD have siblings? How old are they?
33. When you have to go step out, what happens with CHILD?
34. What does CHILD like to eat? And what does he/she dislike?
35. How do you know what CHILD likes? How do you communicate with CHILD?
36. How many times does CHILD eat in a day?
37. Who decides what CHILD eats?
38. Did CHILD spend most of the day with you yesterday?
39. Can you tell me what CHILD ate yesterday starting from the moment he/she woke up until bedtime. Please include drinks and anything that you gave him/her to eat, anything that someone else gave him/her, and anything that he/she grabbed on his/her own.

Time	Food	Time	Food	Time	Food

40. How did you decide to give him/her these foods?
41. Did CHILD ask you for anything besides what you gave him/her? What?

Strategies

42. Can you describe your experience feeding CHILD from the time he/she was younger? Do you serve him/her in his/her own plate? Does he/she eat on his/her own? Since when?
43. Where does CHILD eat? Who else eats with him/her?

44. Could you tell me what you do before feeding CHILD?
45. Are there things that you do to make it easier to feed CHILD? Why do you do this?
46. What do you do when you want CHILD to eat something that he/she does not like? Has he/she ever had a tantrum? What do you do when that happens?
47. Are there times when you use foods as rewards? Like what situations? What do you give him/her?
48. Now let's talk about punishments. Are there foods that you take away or give to CHILD when you punish him/her? What? What does CHILD do in order for you to punish him/her?

Knowledge and Food Meanings (Adapted from Cornell Food Choice Research Group)

Now I want to know what you think about feeding children like CHILD.

49. Where did you learn the things that you do to feed CHILD?
50. What do you feed CHILD because you think it is good for him/her? What makes these foods good for him/her?
51. What does it mean to you knowing that you are feeding your child these foods?
52. Are there things that CHILD eats that are not so good for him/her? Like what?

Beliefs and Social Norms

Let's now talk about what people around here believe.

53. What are some foods you have heard are good to feed children like CHILD? What do people say about these foods?
54. What are some foods you have heard may be bad for children like CHILD? Have you ever given these to him/her? Why?
55. Are there contradictory beliefs about feeding children like CHILD within the community? Like what? What do you think about this?
56. Earlier we talked about foods that you ate as a CHILD. Are there foods from your childhood that you still feed to CHILD? Like what? And what do you no longer feed him/her? Why?

Social Channels and Networks

The next questions are about the people that you know.

57. Can you tell me with whom you talk about food?
    [IF NEEDED: This can include talking about meal preparations, what you spend when you go to the store, the options at the store among others.]
58. Can you name up to 3 people with whom you talked about food in the last two weeks?

N1. _____

N2. _____

N3. _____

59. I am now going to ask you some questions about the people you named.

	N1: _____	**N2:** _____	**N3:** _____
What did you talk about with __ when you saw each other?			
How often do you do this?	☐ Daily ☐ Weekly ☐ Twice per month ☐ Monthly	☐ Daily ☐ Weekly ☐ Twice per month ☐ Monthly	☐ Daily ☐ Weekly ☐ Twice per month ☐ Monthly
Does __ have children? **[IF YES: How many?]**	☐ Yes ☐ No Quantity: _____	☐ Yes ☐ No Quantity: _____	☐ Yes ☐ No Quantity: _____
Does __ give you suggestions about what to feed your child? **[IF YES: ¿What does he/she tell you?**	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Do you feel that you learn something when you have these conversations with __? **[PROBE: Tell me something that you have learned from __?**	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
How are you related to __?	☐ Mother ☐ Sister/Brother ☐ Spouse/Partner ☐ Other: _____	☐ Mother ☐ Sister/Brother ☐ Spouse/Partner ☐ Other: _____	☐ Mother ☐ Sister/Brother ☐ Spouse/Partner ☐ Other: _____
How old is __?	Age: _____	Age: _____	Age: _____
Did __ attend school?	☐ Yes	☐ Yes	☐ Yes

[IF YES: What grade did __ complete?]	☐ No Grade: _____	☐ No Grade: _____	☐ No Grade: _____
Where does __ live? **[IF OTHER: How far does __ live from here?]**	☐ Same home ☐ Same land ☐ Other Minutes: _____ ☐ Walking ☐ Car ☐ Other: _____	☐ Same home ☐ Same land ☐ Other Minutes: _____ ☐ Walking ☐ Car ☐ Other: _____	☐ Same home ☐ Same land ☐ Other Minutes: _____ ☐ Walking ☐ Car ☐ Other: _____
Has __ ever given you food? **[PROBE: What has he/she given you?**	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

60. Before moving to other questions, I am going to ask whether the persons we just talked about know one another. Please answer each question by saying "yes" or "no."

Does __ know __?

	N1 _____	**N2** _____	**N3** _____
N1 _____		☐ Yes ☐ No ☐ Don't know	☐ Yes ☐ No ☐ Don't know
N2 _____	☐ Yes ☐ No ☐ Don't know		☐ Yes ☐ No ☐ Don't know
N3 _____	☐ Yes ☐ No ☐ Don't know	☐ Yes ☐ No ☐ Don't know	

Food Decisions

61. What do you take into account when you prepare foods? Why?
62. How do you take CHILD's tastes into account when you feed him/her?
63. How do you take into account what people close to you believe when you decide what to feed CHILD?
64. Now that we have talked about what you feed CHILD, what is most important to you when you decide what you feed CHILD? Why?
65. Is there anything else you would like to add that maybe I did not ask?

APPENDIX B

FOOD AVAILABILITY ASSESSMENT

Adapted from ProPAN Market Survey Form (Form I-5.1)

1. Name of establishment: _____
2. Type of establishment: _____
3. Location: _____
4. Date: _____ 5. Time: _____

Food Code	Key Food Name	Available (✓: Yes / ✗: No)	Price (Unit / Lb.)

Additional Observations:

APPENDIX C

SEMI-STRUCTURED INTERVIEW GUIDE AT POINT OF SALE

5. Name of establishment: _____
6. Type of establishment: _____
7. Community: _____
8. Date: _____ 5. Time: _____

Supply

1. What kinds of things do you sell at this store?
2. How do you decide what to sell at this store?
3. What sells very good?
4. What doesn't sell very good?
5. What is hard for you to make available to clients during this time of the year?
6. Who or which company supplies your store? [PROBE: How often?]
7. Do you purchase from local growers? [PROBE: What? Why?]
8. What do you do when you run out of something? [PROBE: How long does it take for you to restock?]
9. What forms of payment do you accept? [PROBE: Do you accept vouchers? PROSPERA card?

APPENDIX D

ORAL INFORMED CONSENT FORM

Title: Understanding the Local Food System and Mothers' Food Choice Decisions on Behalf of Children Under Five

This interview is part of a dissertation research study conducted by Ligia Reyes, a PhD student at the University of South Carolina. The objective of the study is to understand how mothers decide what to feed their children under five years old and the different sources from which they get food.

During the interview, I will ask you questions about you, your child, and people in your circle to gain an understanding about where, what, and how foods come into your household and how you make decisions about feeding your child. The interview will be audio-recorded. With most people, the interview will take between 60 and 90 minutes to complete.

Risks: Your participation in this interview does not pose any risk to your physical or mental health, other than the slight discomfort of talking with an interviewer and being audio-recorded.

Benefits: As a result of your participation in this study, you will not obtain any direct benefit. The information you provide will help us gain a better understanding of how mothers in your community make food decisions on behalf of young children. In expression of our gratitude for your time, you will receive a small gift.

Confidentiality: Your participation in this study is **confidential**. The results of this study will appear in scientific publications and presentations in an anonymous way. This means that your name and any other identifying information will not be disclosed in any of the findings presented.

Agreement to Participate: Your participation in this study is completely **voluntary.** You have the right to deny or discontinue participation at any moment. Your decision to participate or to not participate in this study will not affect any services that you currently receive.

If you have any questions, comments, or concerns with regards to this study, please contact Ligia Reyes by calling phone number 311-226-4770 or sending an email to lreyes@email.sc.edu.

Oral Informed Consent

I have read all the information described in this form to the study participant in his/her native language. I have also granted the opportunity to make questions and I have answered these questions in an adequate way. Therefore, the participant has agreed to participate in the study.

_____

Name and Signature of Interviewer Obtaining Consent Date

APPENDIX E

POST INTERVIEW PI CONTACT CARD

Title: Understanding the Local Food System and Mothers' Food Choice Decisions on Behalf of Children Under Five

Thank you for your participation in this study. As mentioned before the interview, the interview is part of a dissertation research study conducted by Ligia Reyes, a PhD student at the University of South Carolina. The objective of the study is to understand how mothers decide what to feed their children under five years old and the different sources from which they get food in your community.

If you have any questions, comments, or concerns with regards to this study and your participation, please contact Ligia Reyes by calling **311-226-4770** or sending an email to **lreyes@email.sc.edu.**

Date: dd/mm/yy