Challenges to food and nutrition security among low-income communities

A DISSERTATION
SUBMITTED TO THE FACULTY OF
THE GRADUATE SCHOOL
OF THE UNIVERSITY OF MINNESOTA
BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

Dr. Hikaru Hanawa Peterson

October 2021

Acknowledgments

I would like to thank my advisor (Hikaru Peterson) for her mentorship, for encouraging me to pursue my own research ideas, and for motivating me through difficult times; and my dissertation committee (Hikaru Peterson, Metin Cakir, Joe Ritter, and Melissa Laska) for reading drafts and providing feedback on my research. I am grateful for the professional development and research assistance opportunities offered to me by Deborah, Lauren, Adeel, and Kathy.

My doctoral research would have been impossible without the help of the people and organizations I worked with during my fieldwork and data collection. Thank you Nasibu and Dekow for believing in my work and helping me build connections with members and leaders of the Somali-American community all over the Midwest. My thanks are due to Hoda Ali, Ayan Abdinur, Jennifer Jimenez-Wheatley, Kelly Travis, Serdar Mamedov, Margo Druschel, Deb Pipes, Deeq Abdi, Hibo Jama, Barwaqo Aden, Cynthia Shabb, Sara Chlebik, Eryn Killough, Ahmed Osman, Nadine Holthaus, Graylen Becker, Lacey Studnicka, Abdiwali Sharif, Jennifer Freuh, Tammy Schatz, Hukun Abdullahi, Cani Aden, Lula Dayib, Abubakar Farah, Ezzat Alhaider and so many others – community members who participated in the study or helped me to recruit participants, translators who enumerated the participants and host organizations. I cherish the warmth with which I was welcomed everywhere – restaurants, mosques, and community centers and truly made to feel at home with cups of tea. I also want to thank Sue, Jane, Missy, Elaine, Karen for helping me manage the administrative parts of the project.

Finally, I want to thank my friends from all parts of the world for supporting and inspiring me day in and out. Alethea and Mark thank you for keeping me from getting homesick. I can never thank my parents and sister enough for being a constant source of strength and giving me free rein to venture off beaten paths.

Dedication

To mom

Abstract

This dissertation highlights challenges to food and nutrition security, and the practices households adopt to overcome these challenges. In the first essay, I use primary data to study social capital and food security through the case study of Somali refugee households in the Midwest. In the second essay, I evaluate the impact of two interventions designed to increase nutrition awareness -- succinct nutrition labels displayed on the shelf and nutrition education workshops -- on food purchase choices of shoppers in grocery stores in rural Kansas. In the third essay, I study how the store format choices of households receiving the Supplemental Nutrition Assistance Program (SNAP) benefits change over the benefit month and how additional benefits received are distributed across store formats and over the benefit month using SNAP administrative data from the Minneapolis-Saint Paul metro area.

I find that non-monetary constraints add to the costs households incur and that reducing these costs can improve food and nutrition security. In the Somali-American community, social capital enhances food security possibly by reducing obstacles that would have otherwise increased cost. Among rural residents reducing the cost of information empowers them to make healthier choices. SNAP recipient households tend to redeem more benefits at grocery stores indicating their preference for grocery stores, yet they make a small number of redemptions at convenience stores every month suggesting their need to rely on convenience stores. The findings of this doctoral research suggest that cash transfer programs are necessary to help families overcome financial constraints,

but creative solutions could help to overcome non-monetary challenges and reduce costs to access sufficient and nutritious foods and consequently promote more equitable health outcomes for all.

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Chapter 1: Introduction

> *"On a gold-gray morning in Mitchell County, Iowa, Christina Dreier sends her son, Keagan, to school without breakfast. He is three years old, barrel-chested, and stubborn, and usually refuses to eat the free meal he qualifies for at preschool… …If she sends Keagan to school hungry, maybe he'll eat the free breakfast, which will leave more food at home for lunch… …She's gone through most of the food she got last week from a local food pantry; her own lunch will be the bits of potato left on the kids' plates.*
>
> *… On this particular afternoon, Dreier is worried about the family van, which is on the brink of repossession. She and Jim need to open a new bank account so they can make automatic payments instead of scrambling to pay in cash. But that will happen only if Jim finishes work early. It's peak harvest time, and he often works until eight at night, applying pesticides on commercial farms for $14 an hour. Running the errand would mean forgoing overtime pay that could go for groceries."*
> (Web excerpt from McMillan 2014)

Putting (or not putting) food on the table is just one of the several difficult choices low-income households must make. For instance, Christina chose to show Keegan some tough love and sent him to school hungry so she could stretch the food in her refrigerator a little longer. Limited access and financial challenges make it difficult for households such as Christina's to secure safe, healthy, and sufficient food for their household members. Financial constraints often add to other costs such as the price of information, storage, or transportation, and require families to choose between competing needs such as paying utility bills, rent, or buying groceries. In Christina's case, her husband negotiated a trade-off between risking repossession of their vehicle or taking a few hours off work and forgoing overtime pay that would put more food on the family's table. Improving food security and food choices of low-income Americans will benefit from a more nuanced understanding of how communities access

retail food establishments and choose from what is available, feasible, and known to them.

In this doctoral research, I present a more nuanced understanding of the challenges low-income households face and explore some solutions to overcome these challenges. I study food and nutrition security in three communities in the Midwest – the Somali refugee community in the Midwest, residents of small communities in rural Kansas designated as food deserts[1] *i.e.*, areas where people have limited access to a variety of healthy and affordable food, and Supplemental Nutrition Assistance Program (SNAP) recipient households in the Minneapolis-Saint Paul metropolitan area in Minnesota. In the first two essays, I study one possible solution to ensuring food or nutrition among these communities– support from social capital and making information readily available. In the third essay, I describe patterns of SNAP redemptions to postulate mechanisms that could explain the fluctuating quality and quantity of food consumed by SNAP recipients over the benefit month.

In the first essay, I examine the relationship between social capital and food security among low-income immigrant households. This essay is based on primary data for a sample of 249 Somali refugee households in seven Midwestern cities collected between August 2017 and December 2018. Since immigrant communities tend to have tight-knit social networks, community members help each other to access and understand food resources in a new country. Understanding the

1 The USDA defines food deserts as low-income census tracts where at least 500 people or 33% of the population is greater than half or one mile from the nearest superstore, or large grocery store for an urban area or greater than 10 or 20 miles for a rural area.

extent to which social capital can help mitigate food insecurity[2] can encourage policy geared toward facilitating community-based platforms and solutions to address food insecurity instead of individual or household levels.

In the second essay, I investigate the impact of two interventions designed to increase the nutrition awareness of grocery shoppers in two locally-owned grocery stores in rural Kansas on their food purchase choices. The study evaluates the impact of succinct nutrition labels displayed on the shelf and nutrition education workshops conducted by university extension educators. These stores were located in low-income low-access communities with a population of less than 2,500 classified as food deserts by the USDA. We hypothesized that because residents in rural food deserts are more isolated than their urban counterparts and have access to limited food retail establishments and other resources, making nutrition information available to them can help them make healthier food choices within the constraints they face. Being an important part of the food system, the vitality of independently-owned local grocery stores is crucial to the rural poor. As they may not be able to travel outside their communities to shop at bigger grocery stores, local grocery stores are the only food retail establishments that offer them some selection of fruits and vegetables.

In the third essay, I study how SNAP redemptions change over the benefit month across different retail store formats. I use SNAP administrative data from

2 The USDA defines food insecurity as households lacking access to enough food at all times for an active, healthy life for all household members.

the Minneapolis-Saint Paul metro area in Minnesota that documents household demographic information and benefits received and redeemed by the households over three years. We expect the additional SNAP benefits will help to smooth consumption over the benefit month and direct dollars from convenience stores to full-service grocery stores illustrating the the role played by different kinds of retail food establishments.

Through my dissertation, I attempt to expand our understanding of food and nutrition insecurity that has largely been viewed as a consequence of not having enough money and addressed as such by contemporary policymakers.

Chapter 2: Can social capital help immigrant families overcome food insecurity? A case study of refugee households in the Midwest.

Summary

In this chapter, I review non-monetary constraints to food security, assess food insecurity and social capital in a low-income immigrant community, and estimate the relationship between food insecurity and social capital. The analysis is based on a primary dataset of 249 Somali refugee households in seven cities in the Midwestern United States (U.S.). We use a natural experiment where host cities of incoming refugees are exogenously predetermined to conduct our analysis. We confirm high levels of food insecurity in the study community and mitigating effects of objective social capital on food insecurity. Impacts of cognitive social capital and informal interactions were ambiguous, while structural social capital was ineffective in enhancing food security.

Introduction

In 2016, over 43 million people residing in the U.S. - which equals 13.4% of the American population - were born in another country (U.S. Census Bureau 2017). These persons were more prone to food insecurity than their native-born counterparts (Kasper et al. 2000; Hadley and Sellen 2006; Hadley, Zodhiates and Sellen 2007; Weigel et al. 2007). Studies have pointed out that food insecurity was twice as high among children whose parents were not English-proficient as compared to English-proficient parents (Capps et al. 2009), and children born to immigrant parents were more vulnerable to food insecurity than

children born to native-born parents (Quandt et al. 2006; Capps et al. 2009; Chilton et al. 2009).

Although food insecurity is highly correlated with income poverty (Coleman-Jensen et al. 2018), it is also associated with factors other than income such as logistic and linguistic difficulties (Hadley and Sellen 2006; Dubowitz et al. 2007; Hadley et al. 2007; Vahabi and Damba 2013; Sanou et al. 2014). Social capital *i.e*., benefits incurred from the exchange of information and other intangible non-monetary support offered within the social network or cultural community can help to overcome some of these barriers.[3] Immigrants with higher social capital are more likely to benefit from services offered within the cultural community including childcare, shared household items, rides to the grocery store, and help with administrative processes. They are likely to have easier access to specialty stores that stock familiar food items and learn about new locally available foods and resources from earlier waves of immigrants from their cultural community. Social capital can thus stretch meager monetary resources to reduce spells of food insecurity and also help to consume healthy food within the constraints they face, leading us to hypothesize that social capital can help to overcome some of the non-monetary constraints that low-income immigrant households face.

[3] There is no consensus among scholars on the definition of social capital. Durlauf and Fafchamps (2005) offer an overview of the concept and its evolution in the *Handbook of Economic Growth*. Our definition is most similar to Lin (2002) who defines social capital as *"resources embedded in social networks and accessed and used by actors for actions"* and Just (2013) who defines it as "*durable social relationships one has and can draw upon as resources for goods – tangible, emotional or informational*".

This paper presents a case study of the Somali refugee community in the Midwest. We first review non-monetary barriers to food security and different dimensions of social capital and then examine the relationship between social capital and food security for indications of a causal relationship. We make three contributions to the literature. Firstly, we highlight the degree of food insecurity in a population underrepresented in national data—a low-income immigrant community. Additionally, we use several different measurements of social capital instead of focusing on just one measure like the previous studies on the topic, which enables us to clarify the nature of social capital fostered in the study community. Finally, unlike previous studies that did not demonstrate causal effects or were based on samples of native-born populations, this paper uses a natural experiment to estimate the causal effects of social capital on food security specifically among immigrant households.

Our findings confirmed a high degree of food insecurity and limited reliance on community resources such as emergency food assistance in the study community. We also found that not all dimensions of social capital had the same effects on mitigating food insecurity. Objective social capital measured as the size of the Somali population in the urban center had a significant impact on food security, and subjective social capital measured as perceived community support and informal interaction with community members had a small but significant impact on food security in the study community in some models. Because of the experimental approach used in our analysis, we claim causality of objective social capital but the impact of the subjective measures of social capital

should be interpreted with caution due to the possible sources of endogeneity. The results demonstrate the need to further explore the supporting roles played by differing sorts of social capital held in low-income immigrant communities.

The rest of the paper is organized as follows. In the next section, we review non-monetary challenges that contribute to food insecurity. We then discuss the study design, data collection methods and the methods used to analyze the data. This section also includes a discussion of how the key variables used in the analysis and sample weights were constructed. We end with a discussion of the results and concluding remarks.

Background

In 2020, 13.8 million American households (11.8%) were food insecure *i.e.,* they lacked consistent access to food for an active healthy life (Coleman-Jensen et al. 2021). Food insecurity is partly attributed to socio-economic factors. Single-parent households, Black- and Hispanic-headed households, and low-income households experience higher rates of food insecurity as compared to the national average (Coleman-Jensen et al. 2018). Among immigrant communities too, poverty-driven food insecurity has been documented (Kasper et al. 2000; Hadley and Sellen 2006; Hadley et al. 2007; Vahabi and Damba 2013). Welfare programs like the Supplementary Nutrition Assistance Program (SNAP) and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) help low-income families to address financial constraints to food security.

Although food insecurity is more prevalent among low-income households as compared to the national average (Coleman-Jensen et al. 2018), financial constraints alone do not completely explain it. In 2017, among households below 185% of the poverty threshold, 30.8% of the households were food insecure while the remaining 69.2% were food secure (Coleman-Jensen et al. 2018). Non-monetary barriers that aggravate food insecurity have not been accounted for in the measurement of food insecurity and programs designed to alleviate it (Dubowitz et al. 2007). Qualitative research from social sciences has highlighted some of the non-monetary challenges to ensure food sufficiency and satisfaction that low-income households face. These barriers are discussed below.

Logistical barriers

Logistical barriers to food access and availability are common concerns shared by both immigrant and native low-income communities. These challenges include lack of childcare facilities and the difficulty related to watching small children and shopping or cooking at the same time and time constraints due to long and erratic work hours to make ends meet which increased reliance on pre-prepped meals (Dubowitz et al. 2007). An additional logistical challenge unique to immigrant families is limited access to familiar foods and resources (Vahabi and Damba 2013; Sanou et al. 2014) making it difficult to find foods that were regularly consumed in home countries in their new host countries.

Transportation barriers are among the most researched logistical barriers (Weinberg 1995; Kaufman et al. 1997; Rose and Richards 2004; Kirkup et al. 2004; Lake and Townshend 2006; Dubowitz et al. 2007; Burns et al. 2011;

Andress and Fitch 2016). Car ownership directly impacts the food security status of households. Households with no cars are likely to be more food insecure as compared to households with access to a personal vehicle (Burns et al. 2011). Lack of personal vehicles compromises the ability to access food because households have to rely on public transit systems whose schedules may be inconvenient, walk along non-pedestrian roads or neighborhoods prone to crime, or shop at stores that are easily accessible even if they offer fewer choices at higher price points (Morris, Ellinger and Haas 1990; Kaufman 1999; Boehmer et al. 2006; Andress and Fitch 2016).

Cultural barriers

Cultural barriers include difficulties arising from shifting to a new system and can be loosely classified as linguistic barriers and knowledge gaps. For instance, a pilot study of a convenience sample of 33 Liberian refugees and asylum seekers in the U.S. found that hunger was more likely to be indicated in households where the primary shopper experienced linguistic and shopping difficulty. Their findings were based on interviews conducted using a structured questionnaire (Hadley and Sellen 2006). Hadley et al. (2007) expanded the above study to 101 West African refugee households, of which 53% indicated being food insecure. They reaffirmed the findings of the previous study that food insecurity was not just associated with socio-economic factors such as income and employment but also factors such as difficulty navigating the shopping environment and language barriers (Hadley et al. 2007). These findings were also supported by Vahabi and Damba (2013). Based on interviews with a

convenience sample of 70 Latin Americans who had immigrated to Toronto less than 5 years before the study, they observed that language barriers reduced choices available to the shoppers if they could not easily read labels and identify products or ingredients, or were unable to get help to locate products in the store (Vahabi and Damba 2013).

Knowledge gaps include challenges such as unfamiliarity with food and cooking techniques of the host country, grocery retail environment, the local nutrition discourse (Sanou et al. 2014), and limited knowledge of locally available community food resources and services (Vahabi and Damba 2013). Sanou et al. (2014) conducted a literature review of 49 peer-reviewed articles and government publications examining the health of immigrants living in Canada at national, provincial, and local levels. They reaffirmed that immigrants faced challenges as they were often unfamiliar with Canadian food and cooking techniques, grocery procurement patterns, and the Canadian nutrition discourse. They also had limited access to preferred foods and time constraints. The paper suggested that unfamiliarity with and lack of awareness of the nutritional value and preparations of ethnic foods posed a challenge to health and nutrition professionals working with immigrant clients.

Social capital in immigrant communities

Social capital among immigrant communities is nurtured in ethnic enclaves or networks of people from similar ethnic, cultural, or national backgrounds (Portes and Jensen 1987; Edin, Fredriksson, and Åslund 2003; Qadeer and Kumar 2017; Xie and Gough 2011). It can serve as information

channels (Borjas and Hilton 1996; Devillanova 2008), provide reciprocal services like direct food aid and emotional support (Ahluwalia, Dodds, and Baligh 1998; Qadeer and Kumar 2017), and improve labor market outcomes (Borjas 1992; 1995; Damm 2009; Patel and Vella 2013). For instance, recent immigrant waves had a higher probability of receiving benefits than earlier waves, and the types of benefits received by earlier immigrants influenced the types of benefits received by newly arrived immigrants (Borjas and Hilton 1996). Information transmitted through social networks fostered the utilization of services or welfare benefits among different immigrant communities (Borjas and Hilton 1996; Devillanova 2008). Evidence of support provided within ethnic enclaves prompted us to hypothesize that social capital in immigrant communities could alleviate some non-monetary challenges to food access discussed above and reduce food security among community members.

Food insecurity and social capital

The literature associating food security with social capital is still in a nascent stage with only a few exploratory studies examining the question in the context of immigrant households. Several studies have used qualitative methods to study the relationship between food security and social capital. These studies examined the informal mechanisms used by low-income households to reduce food insecurity and highlighted the importance of life skills such as creating a personal support system and gaining knowledge of community resources (Swanson et al. 2008; Sano et al. 2011). Swanson et al. (2008) examined themes from open-ended interviews and revealed that food

insecure women in rural areas benefitted from both formal and informal mechanisms to curb food insecurity. Moreover, study participants who had skills in joining clubs or organizations, and the ability to create a personal support system were significantly more likely to be food secure. Sano et al. (2011) found that while mothers from food-secure families had slightly higher income, they also had additional life skills and knowledge of community resources unlike mothers in the food insecure group to whom help from friends and family was not always readily available. Their findings were based on purposively sampled 10 recent immigrant Latino mothers from Oregon and Iowa who were age 18 and older with at least one child 12 years old or younger, who lived in households that had incomes at or below 200% of the federal poverty line at the baseline interview.

Studies that found a strong correlation between social capital and food security using quantitative methods include a study of 330 low-income households in Connecticut (Martin et al. 2004), a study by Walker et al. (2007) based on a sample of 235 cross-sectional, self-administered, mailed surveys conducted in Athens County, Ohio and a study of purposively sampled low-income families (n=326) in rural Louisiana (Swanson et al. 2008). Martin et al. (2004) showed that community-level social capital was significantly associated with decreased odds of experiencing hunger and having a household member participate in a social or civic organization was associated with higher levels of social capital in terms of reciprocity among neighbors, which contributed to food security. Walker et al. (2007) found that food security and social capital were

positively correlated with a correlation coefficient of 0.337. None of them established a causal relationship between social capital and food security.

Other studies found no significant association between social capital and food security (Morton et al. 2005; Garasky, Morton and Greder 2006; Kirkpatrick and Tarasuk 2010) suggesting that food insecurity was mainly driven by poverty. Morton et al. (2005) estimated a logistic regression model and found that despite significant amount of food sharing among respondents the odds of being food insecure did not decline, but if residents perceived they had strong community responses to food-related problems such as food banks and soup kitchens, the risk of being food insecure was significantly reduced. Garasky et al. (2006) found that household food insecurity was inversely related to higher levels of informal social support but acquiring food from family and friends or other food assistance sources was not related to food security. Both these studies were based on a sample of over 600 mail-back surveys from Iowa. Kirkpatrick and Tarasuk (2010) suggested neighborhood interventions to improve food access or social cohesion might not prove effective in mitigating food insecurity that stemmed from resource constraints. Their results were based on data gathered from 484 low-income families who had children and who lived in rental accommodations in 12 high-poverty neighborhoods in Toronto and analyzed using logit regression models. These studies nonetheless highlighted instances of food sharing, *i.e.*, obtaining food from friends and family (Garasky et al. 2006) and reduced risk of being food insecure when community responses to food-related problems were perceived to be adequate (Morton et al. 2005).

None of the studies, however, established a causal relationship between social capital and food security possibly, because social capital is susceptible to being endogenous (Durlauf and Fafchamps 2005). Accumulating social capital necessitates investing significant resources such as time to nurture relationships or membership dues to gain access to exclusive organizations. Socio-economic factors such as income can thus directly influence how much social capital an individual or a household can accumulate. In this study, we expand on the existing literature by examining the relationship between social capital and food security for indications of causality and identifying which dimensions of social capital mitigate food insecurity.

Study Design

This study is based on primary data collected in the Midwest. Although nationally representative data sets such as the Current Population Survey (CPS) document the food security status of households, these cannot be used to evaluate the impacts of social capital among immigrant communities due to three main reasons. The CPS does not distinguish between refugee and non-refugee households. Non-refugee households have the freedom to choose their host city, which could be influenced by their social connections. This implies they are not randomly assigned a social network, but rather it is possible that non-refugee households self-select their location and the associated social network causing the model to be endogenous. Additionally, the CPS documents the migration status of the households within the U.S. only for one year preceding the interview. Hence it is not possible to distinguish between households who have

not migrated within the U.S. and those who have (secondary migrant households). Finally, the CPS is not representative of very specific and small sub-groups of populations. For example, the number of all Somali households represented in the December 2013 CPS is less than 100 (U.S. Census Bureau 2014b). The lack of existing data suitable to answer the research question necessitated designing a study to collect primary data.

Sample selection

Unlike other immigrants, refugees cannot choose their host city in the U.S. (Epatko 2017); it is predetermined by a complex administrative process. Individuals are admitted for resettlement to the U.S. by the State Department based on referrals made primarily by the United Nations High Commissioner for Refugees after an extensive screening and security clearance process until the annual quota is filled (Bruno 2018). To place admitted individuals, the Refugee Processing Center works with a committee representing nine private voluntary agencies authorized to resettle refugees in the U.S. This committee does not meet the refugees in person but reviews the biodata of cases to allocate a host city based on the capacity of local affiliates of the authorized agencies to resettle refugees (Bruno 2017). Then, refugees are assigned to each agency based on the capacity of the agency as determined by the Bureau of Population, Refugees and Migration (Eby et al. 2011).

Refugees thus find varying sizes of ethnic enclaves in the cities they are placed in. Because their host cities are exogenously determined, their case constitutes a natural experiment. A similar premise and identification strategy

were used previously to estimate the causal impacts of ethnic capital. The exogeneity of the Swedish refugee placement policy was used by Edin et al. (2003) to study the impact of ethnic capital on earnings of immigrants, and by Aslund et al. (2011) to study the effects on achievement at schools among refugee children in Sweden. Damm (2009) exploited a spatial dispersal policy of the Danish government to study the impact of the size of the ethnic enclave on earnings.

Somali refugee households in the Midwest were selected as the target population for two reasons. Firstly, the Somali refugee community is one of the biggest refugee groups in the Midwest particularly in the Minneapolis-Saint Paul metro area making it easier to establish connections with this group. Secondly, many Somali households in the country are low-income. The median income for the West North Central Census region that comprises Minnesota, Iowa, Nebraska, Kansas, Missouri, South Dakota, and North Dakota was $68,053 in 2016; the median income for the Somali community in the same region was $21,925 (U.S. Census Bureau 2017). Being a low-income community, food insecurity is a pressing issue in the community.

We drew our sample from seven Midwestern urban centers: Des Moines, Iowa; Omaha, Nebraska; Mankato, Saint Cloud, and Rochester in Minnesota; and Grand Forks-East Grand Forks and Fargo-Moorhead in both North Dakota and Minnesota (Figure 2.1). The Minneapolis-Saint Paul metropolitan area was excluded because there is no urban center comparable in size and the Somali population it is home to in the Midwest. Once the urban centers were selected,

we identified venues where community members gather such as mosques, non-profit community development centers, English as Second Language (ESL) classes, grocery stores, restaurants, and malls. We connected with as many of these organizations as possible and consulted with key informants and community leaders who work with the target population to identify events, organizations, and locations frequented by the community. The final sites for recruiting participants were determined by the availability and cooperation of local partners. While this may have resulted in some selection bias, challenges connecting with the community discussed below necessitated the use of a convenience sample.

The ESL classes were especially a good recruiting ground for several reasons. Firstly, several programs offered walk-in ESL classes that did not require students to pre-register or attend regularly. Besides, classes of varying levels of English proficiencies were offered, allowing us to recruit a diverse range of participants whose English ranged from beginner to advanced levels. Most organizations offered anywhere between four to six levels, with level zero at the beginner level and the highest level for the most proficient group of students who were preparing for the General Education Diploma (GED) examinations. Secondly, on most occasions, students planned on staying until the class ended so they were not in a rush to finish the survey enumeration if it was concluded during class time. Since the enumerations took anywhere between 20 to 40 minutes depending on the interpreter, the length of enumeration often became a deterrent when recruiting participants at other locations such as grocery stores.

And finally, it was easier to build trust with the community and encourage participation if the study was introduced by ESL teachers and community leaders instead of the researchers.

Participation in the study was voluntary, and the study was approved by the Institutional Review Board of the University of Minnesota. Participants who completed the survey were offered $20 gift cards as a token of appreciation for their time and cooperation.

Data collection

Data were collected from August 2017 to November 2018. The ideal window to collect data was March to May and September to November, because the children were in school, more adults were able to attend classes, and the weather was not a constraint for both the researchers and the participants. Data collection was put on hold between December 2017 and March 2018 when travel was difficult. Data collection also slowed during the summer due to sparser attendance in the ESL classes. Some students stopped attending classes during the summer to care for children, take vacations or travel, and participate in Ramadan celebrations.

The survey instrument developed for data collection included sections adapted from the Food Security Supplement (FSS) and Civic Engagement Supplement (CES) of the CPS to obtain measurements for the household food security status and social capital. It was bilingual (English and Somali) and was designed such that the left-hand page was the Somali translation of the right-hand page in English. This was necessary as the most popular system to

transcribe Somali texts is using the Latin script with some adaptations. While most community leaders and the younger American-educated Somali population spoke English, a large proportion of study participants were not fluent in English. Field research staff fluent in both Somali and English were hired to enumerate. Some interpreters preferred to read and enumerate using the Somali version of the instrument; however, most interpreters preferred to read and translate the English version into Somali and use the Somali version only as a reference. Due to several dialects (although the dialect from Northern Somalia is the most widely spoken, standard dialect), it was helpful for interpreters to refer to both the survey scripts to check their interpretations. To minimize interpretation inconsistencies, a brief training was conducted with the interpreters to ensure their comprehension of the instrument was the same as that of the researchers. Most interpreters also worked at factories, had other regular jobs, or were students at community colleges. With their lives in continually transient phases, attrition among enumerators was high. Over 25 enumerators were employed for the study.

The survey was pretested by students attending ESL classes in the Minneapolis-Saint Paul metro area. Surveys were initially administered to small groups of subjects at a time. However, many subjects were not proficient in either English or Somali and needed one-on-one help to complete the survey. This low respondent-to-facilitator ratio was especially crucial when the data collection sites were loud or during outdoor events as it was more difficult for participants to hear the facilitator. One-on-one enumeration was also necessary for surveys

completed at ESL classes because, in a group, subjects discussed questions amongst themselves and influenced each other's opinions. Hence, after the first round of data collection, one-on-one enumerations were conducted. In ESL classes, one student stepped out of the class at a time to take the survey.

Methods

In this section, we describe the methods used to analyze the data. A discussion of the empirical model is followed by definitions of key variables and construction of sample weights.

Empirical model

The model below is used to estimate the impact of different types of social capital on food security. Specifically, the core equation we estimate is

$$Y_{ij} = \alpha + \mathbf{V_{ij}}\boldsymbol{\beta_v} + \mathbf{X}_{ij}\boldsymbol{\beta_x} + \beta_j j + e_{ij} \quad (1)$$

Here, Y_{ij} is the level of food security and $\mathbf{V_{ij}}$ is a measure of social capital of household *i* residing in location *j*. The coefficient on **V**, $\boldsymbol{\beta_v}$ reflects the impact of social capital on food security, if any. We expect immigrant households with higher levels of social capital to be more food secure compared to their counterparts with lower social capital. The expected sign of $\boldsymbol{\beta_v}$ consistent with our hypothesis would thus be positive, *i.e.,* with increased social capital, the food security level of the household would increase. The vector of control variables (**X**) includes household income level or a proxy for income, whether the household owns a car, whether the household relocated within the U.S., and the year the survey was administered. The term *j* represents location-specific fixed

effects. Parameters α and β are to be estimated, and e is the error term. We also create weights to replicate the distribution of households with Somali ancestry in the West North Central U.S. in the 2017 five-year sample of the American Community Survey (ACS) based on key variables. The construction of weights is elaborated after a discussion of the key variables.

Key variables

The key variables in the equation are food security, social capital, and socio-economic status, which are in turn described below.

Food security: We use the definition of food security purported by the Economic Research Service of the U.S. Department of Agriculture (USDA), *i.e.,* access at all times to enough food for active healthy life (Coleman-Jensen et al. 2018). The USDA module of survey questions adopted by the CPS to measure food insecurity is the most common measure of food insecurity used in the literature (Martin et al. 2004; Walker et al. 2007) and is used for this study. The module includes 10 questions grouped into three stages to determine the intensity of food insecurity in the household. The counts of affirmative responses equal the raw food insecurity scores.

We apply a Rasch model to convert the raw food insecurity scores into Rasch scores to represent the relationship between items used to measure the latent variable (food insecurity) and the ability of the respondent. The Rasch model provides a way to convert ordinal observations into logistic measures (Rasch 1960; Fischer and Molenaar 2012; Wright and Mok 2004). It is based on the assumption that the most effective predictor of an individual response is the

relationship between the level of intensity of food insecurity of the respondent and their ability to procure food. The order of the respondents and the items used to measure food insecurity are invariant (Rasch 1960; Smith Jr 2001; Iramaneerat, Smith Jr and Smith 2008), *i.e.*, a person with higher levels of food insecurity should always have a higher probability of having an affirmative response to any item indicative of food insecurity than a person who is more food secure, irrespective of which items they encounter, and items indicating higher levels of food insecurity should always have a lower probability of being affirmative than items indicating less severe food insecurity, regardless of the level of food insecurity of the respondents.

Let $\tilde{Y}_{ij}$ be the food insecurity level of household *i* residing in location *j* and let $\tilde{Y}_{ijk}$ represent the unobserved outcome for item *k* of the 10-item food insecurity module. Let $\tilde{y}_{ijk}$ be the observed value of $\tilde{Y}_{ijk}$ such that $\tilde{y}_{ijk}$ = 1 if the response is affirmative and zero otherwise. The Rasch method fits the model using the slope-intercept form such that the probability of household *i* with latent trait level θ_i providing an affirmative response to item *k* is expressed as

$$\mathrm{P}\left(\tilde{Y}_{ijk} = 1 \middle| a, \theta_i, b_k\right) = \frac{\exp\{a(\theta_i - b_k)\}}{1 + \exp\{a(\theta_i - b_k)\}} \qquad (2)$$

where ***a*** represents discrimination, *i.e.*, how steeply the rate of an affirmative response to an item on the food insecurity module changes with the household's ability to procure food, and b_k represents the intensity of item *k*.

Let p_{ijk} = P ($\tilde{Y}_{ijk}$ = 1|*a, θ*$_i$, *b*$_k$) and q_{ijk} = 1 − p_{ijk}. Conditional on θ_i, the item responses are assumed to be independent, so the conditional density for household *i* is given by

$$f(\tilde{y}_i \mid \mathrm{B}, \theta_i) = \prod_{k=1}^{K} p_{ijk}^{\tilde{y}_{ijk}} \; q_{ijk}^{1-\tilde{y}_{ijk}} \qquad (3)$$

where $\tilde{y}_i$ = ($\tilde{y}_{1i}$, ..., $\tilde{y}_{Ki}$), B = *(a, b*$_1$*, . . . , b*$_K$ *)*, and *K* = 10 since there are 10 items. The likelihood for household *i* is computed by integrating the latent variable from the joint density

$$\mathrm{L}_i(\mathrm{B}) = \int_{-\infty}^{\infty} f(\tilde{y}_i \mid \mathrm{B}, \theta_i)\, \varphi(\theta_i)\, d\,\theta_i \qquad (4)$$

where *φ(·)* is the density function for the standard normal distribution. The log-likelihood for the estimation sample is the sum of the log-likelihoods for the 249 households in the sample.

$$\log \mathrm{L}(\mathrm{B}) = \sum_{i=1}^{249} \log \mathrm{L}_i(\mathrm{B}) \qquad (5)$$

The integral in the formula for L$_i$(B) is calculated using numerical methods. For ease of interpretation, the Rasch scores were inverted to use food security (Y_{ijk}) instead of food insecurity ($\tilde{Y}_{ijk}$) as the outcome variable so that the higher the score the more food secure the household is.

Social capital: We use both an objective and subjective measure of social capital. In this study, the number of Somali refugees rehabilitated in the same location as the participant from 2002 to 2017 is used as an objective measurement of the household's social capital. Data for arrivals, nationalities and placement cities were obtained from the Department of State's Bureau of

Population, Refugees, and Migration. Several studies have used similar measures such as the concentration of ethnic minorities or immigrants in a spatial unit as a measure of social capital in empirical research (Bertrand, Luttmer and Mullainathan 2000; Aizer and Currie 2004; Deri 2005). Another measure of social capital that has been used in the past is the average education level, income, and occupation prestige score of the parents' generation as a measure of ethnic capital for the children (Borjas 1992). As a robustness check, we also used the size and proportion of the Somali community in the county, and the number of Somali stores in the urban centers as measures of objective social capital. Data for the size and proportion of persons of Somali ancestry were calculated from the five-year sample of ACS 2017. All persons who spoke Somali at home, reported their ancestry as Somali, or were born in Somalia were classified as of Somali heritage. These data could not be calculated for two of the data collection sites -- Mankato and Grand Forks -- as it was not publicly available, we instead used the data for persons who speak languages other than English, Spanish, Asian, Pacific Island languages, and other Indo-European languages.

In addition, our survey included questions to measure three types of subjectively perceived levels of social capital. One question was designed to account for the attitude toward the respondents' community and perception of how much the community could be relied on in times of need (perceived community support). This question broadly measures what has been referred to as cognitive social capital, *i.e.*, shared norms, values and attitudes, and

individual expectations of trust and reciprocity (Islam et al. 2006). Modeled after previous studies (Sampson, Raudenbush and Earls 1997; Martin et al. 2004; Walker et al. 2007; Swanson et al. 2008), the items in this question included a series of statements such as whether respondents got together with friends (Swanson et al. 2008), willingness to help neighbors, whether it was a close-knit or tight community where people generally knew each other, the possibility of borrowing $30 from neighbors for an emergency, whether people in the community got along with each other, whether they could rely on neighbors to stop by for groceries if they were sick, and whether the community shared common values (Martin et al. 2004; Walker et al. 2007). These items have also been validated for internal consistency (Sampson et al. 1997).

Based on conversations with community leaders, we learned of the *hisab* (accounts) maintained by Somali grocery stores for their clients. If a shopper cannot pay for the purchases at the time of purchase or prefers to pay a lump sum, the store owner will keep a record of their purchases in a notebook and the buyer can come and make the payments whenever they are ready. Besides, the Somali refugee community is close-knit (Whittaker et al. 2005; Betancourt et al. 2015). Some of the other support they share include borrowing ingredients from neighbors, helping those within the community who do not speak, read or write English to correspond, and having older women from the community help with childcare. We added four items to the question to reflect these informal practices of the community.

The other two questions were designed to measure informal interaction

with friends and family (informal interaction with community) and participation in civic organizations (organized group membership). Both questions were modeled on similar questions in the Civic Engagement Supplement of the CPS. Informal interaction captured bonding social capital or ties among people who share similar personal characteristics that can foster trust or cohesiveness among members (Putnam 2000). This question measured the frequency of connecting with friends and family such as getting in touch via technology, meeting in person for a meal or otherwise, offering rides, helping with childcare, and lending and borrowing money and other household items (U.S. Census Bureau 2014a). Media narratives have highlighted the role of Somali malls, grocery stores, and restaurants as public platforms for community members to gather, connect and interact (Oakes 2006; Sawyer 2017; Shapiro 2018; Natsis 2018). From stakeholders and community leaders, we also learned that community members sometimes help their friends and family pay off bills or borrow or lend money to each other. We added these items to measure the frequency of sending or receiving money and stopping for a cup of tea at the Somali restaurant.

The last type of social capital we assessed was structural social capital or benefits gained from associating with formal organizations (Islam et al. 2006). Participation in civic groups accounted for the number of groups household members participated in such as parent associations or neighborhood, volunteer, sports, and religious organizations (U.S. Census Bureau 2014a). These groups are not often frequented by the Somali

community. The Somali community members are more likely to participate in ESL, job readiness, and citizenship classes, gather with other women for activities such as *henna*, volunteer, frequent or work with Somali youth, women's or community organizations, and visit the mosque. We thus added these more culturally relevant items to the original question.

Each question was developed to include multi-item measures instead of a single item to reduce inconsistencies in individual measurement error (Bernstein and Nunnally 1994). Besides, a single item cannot fully represent complex and multi-dimensional attributes (McIver and Carmines 1981) of a variable such as social capital. The items under each question were first tested for internal consistency using Cronbach's alpha, a coefficient of reliance that examines the reliability of a test by determining the average correlation of items within the test. Typically, a coefficient of 0.7 or greater is considered reliable (Nunnally 1978). The coefficient for perceived community support was 0.90, and for informal interaction was 0.69. Organized group participation had a very low coefficient (alpha) at 0.37 suggesting that not everyone participated in all the diverse organizations, but rather different people participated in different organizations depending on their interests.

Next, the items under each question were analyzed to determine how many factors they could be reduced to and scores for each of those dimensions were calculated. Based on the theory, since all items in a question measure the same underlying attribute, it was hypothesized that every question could be synthesized into one factor. Exploratory factor analysis of the items supported

this hypothesis and the 13, and eight individual items under perceived community support and informal interaction respectively were reduced to one factor each. We also conducted a factor analysis for all the items used to measure perceived community support, and informal interaction together. The optimal number of factors for the combined items was two. While most items in perception and reliance loaded on factor one, most items in informal interaction loaded on factor two. For organized group participation, since Cronbach's alpha was low, we used an item count of the items instead of a factor score.

Socio-economic status: We use measures of income as a proxy for the socio-economic status of households. Accurate measurements of income are difficult to obtain as people are often unwilling or unable to answer it (Moore, Stinson and Welniak 1999; Cantor et al. 1991). For instance, the typical non-response rates for different types of income have been documented to be between 20% and 50% for the CPS (Moore and Loomis 2001). Studies have documented the success of unfolding brackets where respondents are asked a series of close-ended questions about their income range (Ralph 1984; Hippler and Hippler 1986; Ross and Reynolds 1996; Juster and Smith 1997; Kennickell and Woodburn 1997; Moore and Loomis 2001). We thus presented survey respondents with four income categories - $10,000 or less; $10,001 to $22,000; $22,001 to $47,000; and more than $47,000. These ranges were based on the income quartiles for the Somali community in Midwest which could be determined from publicly available data.

In addition to income, other factors such as years of schooling and, age of the household head or the number of years they have lived in the U.S could also influence the socio-economic status of households. However, all these variables are closely related. For instance, car ownership could impact income if an individual can put in more hours at work because they save commute time, and income, in turn, would determine whether a household can afford a car or not. Given the relatively small sample size, instead of using all the above variables in our model, we use only income and then conduct sensitivity analysis using education level, age of the primary income earner and, English proficiency of the primary income earner as proxies for socio-economic status. To control for education level, we use a dummy variable (*no formal schooling*) that equals one if the primary income earner has no formal schooling and zero otherwise. *English proficiency* is the self-rated level of fluency in English on a scale of one to five with one indicating does not speak English well at all and five indicating speaks English extremely well.

Sample weights

Since we used a convenience sample, some households might have had a higher probability of being included in the survey as compared to others resulting in a coverage error (Vaske et al. 2011), *i.e.*, a discrepancy between the overall Somali population and the subset of households included in the sampling frame. In our sample where most of the survey enumerations were conducted at ESL classes, households that had a member attending ESL classes had a higher probability of being included in the sampling frame. Using such a non-probability

sample to draw inferences about the general population can produce biased estimates (Salant and Dillman 1994). Sampling weights can be used to correct for selecting units with unequal probabilities that might lead to bias and other differences between the sample and the reference population (Yansaneh 2003).

We used cell weighting to adjust the sample distribution so that the weighted distribution of households who participated in our study replicates the distribution of the Somali population in the West North Central region of the U.S. in the 2017 ACS data. To calculate the weights, the sample was first stratified using education level, income quartile, and English proficiency as target variables (Sturgis 2004). A weight was then calculated for each stratum to achieve the desired sample distribution using the formula $w_{ig} = {}^{N_g}/_{n_g}$ where w_{ig} is the weight for observation *i* from group *g*, N_g is the population size of group *g*, and n_g is the size of the sample drawn from group *g* (Sharot 1986).

Identification strategy

We used a natural experimental setup to elicit causal effects. Nonetheless, there are some concerns, particularly when interpreting the impact of subjective social capital: reverse causality, unobserved heterogeneity, and measurement error. Reverse causality occurs when the dependent variable impacts the independent variable, or in this case if the household food security determines their subjective social capital level. This occurs if food insecure households tap into community resources out of necessity, participate in more social activities and groups and accumulate more social capital. Because

households were randomly assigned a host city, reverse causality is not a concern for objective social capital. Furthermore, the assigned host city and the subsequent objective social capital were determined before measuring household food insecurity.

Unobserved heterogeneity refers to characteristics distinguishing households with different levels of food security or affecting the dependent variable that cannot be observed or measured. The unobserved characteristics cannot be controlled in the estimated model leading to omitted variable bias. For example, street smart and resourceful individuals are more likely to seek out community resources to tackle food insecurity. It is also possible that a third variable affects both social capital and food security. Accumulating social capital necessitates investing resources such as time to nurture relationships or membership dues to gain access to exclusive clubs. Factors such as income can thus directly influence how much social capital an individual or a household can accumulate. Other variables that can influence both social capital and food security include secondary migration and car ownership.

To overcome the first two threats, we controlled for observable characteristics that can potentially confound or bias our results: socio-economic status, secondary migration, and car ownership. Additionally, PCS captures characteristics such as attitude toward and willingness to seek out community resources that are often not observed and difficult to account for. We are thus able to reduce the bias that might have occurred from omitting a relevant variable. We also conducted an ancillary analysis to establish the association

between socio-economic indicators with social capital to understand the biases in our estimates. Finally, to test the robustness of the model we conducted a falsification test by estimating the model with false food security and objective social capital levels assigned to households. Regardless, we expect the coefficient on objective social capital to be unbiased since our measure of objective social capital is independent and statistically exogenous by definition.

The final concern to our claim of causality is measurement error. Since the study population experienced difficult circumstances before resettling in the U.S., we expect food insecurity to be systematically under-reported in the sample. However, even if the dependent variable is measured with classical error, it does not confound the results. Because social capital is a highly subjective concept prone to reporting biases and recall errors, it is measured using an item response technique that is designed to overcome such biases and measurement errors (Bernstein and Nunnally 1994). Besides, there are no obvious advantages or disadvantages to misreporting social capital, so measurement errors, if any, are not expected to be systematic.

It is also possible that our treatment is not perfect, particularly for individuals granted refuge for family reunification. However, since we conduct our analysis at the household level and not the individual level, even if subsequent household members were granted a certain host city to unify with family, the host city allocated to the first household member immigrating to the U.S. was assigned randomly. Our sample also includes secondary migrant households, *i.e.*, households who relocated to a new city within the U.S. To ensure that

secondary migrant households do not bias the results, we estimated our model without them for a robustness check.

Results

In the following sections, we present an overview of food insecurity and social capital in the study sample and then discuss the estimation results. The analysis is based on a weight-adjusted sample of 249 observations: 30 from Des Moines and Grand Forks, respectively, 50 from Fargo-Moorhead, 26 from Mankato, 32 from Omaha, 37 from Rochester, and 44 from Saint Cloud. About 64% of the respondents were female. Participants were mainly recruited at ESL classes at community colleges (12%), in residential communities (3%), non-profits (20%), public libraries (4%), public schools (22%), and Somali organizations (5%). Other than ESL classes at these locations, participants were also recruited at Somali grocery stores (5%), Mosques (14%), and Somali restaurants (14%). The recruitment cities are presented in Figure 2.1. We also include the statistics for the unweighted (raw) sample (Table A1), and a comparison of our data before and after the weights were applied with the ACS data on three key variables (Tables A2-A4) in the Appendix.

Sample characteristics

Approximately half of the community earned less than $22,000 annually (Table 2.1). While the mean number of working adults per household was 1.56, 18% of the households had no employed adults and relied solely on welfare for their subsistence. The car ownership rate was 89%, yet 20% of the households' grocery shoppers did not have access to a personal vehicle for grocery shopping

- they relied on alternate modes of transportation such as rides from friends and family, public transit, or walking. Sometimes the primary grocery shopper of car-owning households also relied on rides from others if they did not drive or other family members used the car to commute to work.

The homeownership rate was low and reliance on subsidized housing was high, with 9% and 33% of the households residing in owned and Section 8 housing, respectively. On average, households had lived in 1.82 different housing units in the three years preceding the survey, the mean monthly rent was $720.92, and the average size of the residence was 3.55 rooms. The average household size was 5.22 persons. Out-migration from the host city assigned to the incoming refugee family to another city within the U.S. (secondary migration) was high; 72% of the households were secondary migrant households. The primary income earner of 28% of the households had no formal schooling. They scored 2.95 in terms of self-rated English proficiency on a scale of one to five, with one indicating a very low level of fluency and five indicating a very good command of the language. Their mean age was 39 years, and they had lived in the U.S. on average 8 years. Forty-two percent of primary income earners were female.

Food insecurity in the study sample

The food insecurity rate was 22% with 17% of households reporting low food security and 4% reporting very low food security (Table 2.2). The mean Rasch food security score for the sample was 3.05, with the most food-secure households averaging 3.75 and the most food-insecure households averaging

1.32. While 90% of the households responded in the affirmative to having 'enough of the kinds of foods they wanted to eat', 24% agreed that they 'ran short of money to buy food and tried to make food or food money last longer' (Table 2.1).

Fifty-eight percent of the households had received SNAP benefits in at least one month in the year preceding the survey averaging $502.48, while 41% had used SNAP benefits in all 12 months. Sixty-two percent of the households had at least one child who had benefitted from school meals in the 12 months preceding the survey. The usage and awareness of different food assistance programs and community resources are reported in Table 2.3. Almost everyone (94% of study participants) was aware of SNAP, and less than 7% of the households who were eligible had not availed of SNAP benefits. But awareness of other resources was not as high; less than 9% had used senior centers, soup kitchens, or meals-on-wheels, and around 15% had used food pantries in the 12 months preceding the survey. Despite limited English proficiency, only 27% found it difficult to communicate with staff at the grocery stores; 24% said they found it difficult to make time to go to the grocery store and 17% reported the commute to the grocery store being inconvenient (Table 2.1).

Social capital in the study sample

The summary statistics for objective social capital are presented in Table 2.4. Between 2002 and 2017, Mankato (110) and Grand Forks (189) hosted the fewest number of refugees from Somalia while Saint Cloud hosted the highest number at 1,643. According to ACS 2017 though, Mankato (Blue Earth and Nicollet Counties in Minnesota) were home to over thousand (1,407) persons

who speak languages other than English, Spanish, Asian, and Pacific Island languages and other Indo-European languages and Grand Forks (Grand Forks county, ND and Polk county, MN) hosted 997. The size of the Somali community in all the other locations could be determined from ACS 2017 and ranged between 1,500 in Omaha (Douglas County, NE) to over 3000 in Saint Cloud (Sterns County). The number of Somali grocery stores also reflects the size of the community. These variables have a strong positive correlation with each other indicated by correlation coefficients of over 0.8 for each pair.

The measures of subjective social capital we use in this study are perceived community support (PCS), informal interaction with the community (IIC), and participation in organized groups (OGP). The mean first-factor score for PCS was 0.04 while that for informal interaction was -0.03. The mean item count for OGP was 2.86 on a scale of 11 (Table 2.1). The percentage of affirmative responses to all the items used to measure social capital is presented in Table 2.5. Eight of the top ten items with affirmative responses represent PCS suggesting that is the most prevalent form of social capital held in the Somali community. Eighty-eight percent of the sample agreed that people in the community are willing to help each other. This is confirmed by the other items included in the top ten such as in an emergency they could borrow $30 from family (who do not live in the same dwelling as the respondents) or friends and could count on them to shop for groceries or bring meals if they were sick. The responses indicate high levels of trust in the community with a majority affirming that community members can be trusted (84%), generally get along with each

other (75%), know each other (72%), and share the same values (65%). The other two items in the top ten were whether the respondent sees or hears from their family who do not live with them and friends, in person or otherwise, at least once a week (IIC), and regular attendance at mosque or Quran classes (OGM). Since ESL classes were a common recruitment venue, it is not surprising that 83% reported participation in ESL, citizenship, or job readiness classes. Although not among the top 10, almost 48% of the households had an account with a Somali grocery store in the neighborhood to get essentials on credit. At the bottom end, all the items with less than 10% affirmative responses were measures of OGM - attendance of social events with co-workers outside of work, participation in community gardens, hobby classes, and civic organizations.

In Table 2.6 we present how the different types of subjective social capital relate to objective social capital. We hypothesize that the bigger the size of the cultural community the higher would be the likelihood of community members having friends and family from their ethnic background they can rely on. The results support our hypothesis. Objective social capital has a positive and significant impact on both perceived community support and informal interaction with PCS increasing by 1.39 points and IIC increasing by 1.11 points when the size of the Somali community increases by 1000 persons.

To examine reverse causality between social capital and socio-economic status highlighted by past scholars (Durlauf and Fafchamps 2005), we present the results of regressing social capital measures used in the analysis on the socio-economic indicators of households (Table 2.7). In our sample, there was

no statistically significant relationship between the socio-economic indicators like income of the household, English proficiency and schooling of the household head, and car ownership with social capital. Thus, endogeneity of social capital does not appear to be a concern in model estimation. There is a significant relationship between age of the household head and social capital suggesting that older household heads are more engaged with their community, measured by PCS and IIC. The coefficients on secondary migration are also significant when the dependent variable is PCS and IIC, but with different signs. The positive and statistically significant coefficient for PCS suggests that households relocate if they perceive higher levels of social capital in the new host city, while the negative coefficient for IIC suggests that perhaps secondary migrant households have a limited social network in the new host city in reality and thus have fewer opportunities for interaction with the community.

Estimation results

Tables 2.8 to 2.11 report the results of the empirical models in Equation (1) that relate social capital and food security using the weighted sample. Here the outcome variable is the Rasch food security score of the household, and the independent variables are different measures of social capital and socio-economic status of the households. We also include variables to control for car-ownership since it directly impacts the ability of households to access grocery stores and secondary migration to ensure that households that relocate to a new city do not bias the results. We also use location fixed effects and robust standard errors clustered by location. The results show the improvements in food

security that some types of social capital contribute to.

In Table 2.8, objective social capital is associated with an improvement in the household food security score, where an additional 1,000 persons from Somalia rehabilitated in an urban center increases food security among local Somali households by 0.5 to 0.6 points. Contrary to our hypothesis, the impacts of the subjective measures of social capital are not positive; in fact, IIC has a significant negative impact on food security. The measure of socio-economic status in Table 2.8 is a dummy variable equaling one if the household's income is below $22,000. These households were significantly less food secure than households earning more than $22,000 annually, and car ownership increased the household food security score by about 0.2 points, but it was not significant across all models estimated. The relationship observed between income and food security suggests that poverty is one of the key factors responsible for food insecurity, but car ownership also enhances the ability of households to maintain food security. The results also indicate that there was no difference in the food security status of households between those who stayed in their assigned city and those who moved to a different city after arriving in the U.S.

In Table 2.9, we interacted the different measures of subjective social capital with objective social capital to understand the impact of ethnic enclaves when individual exposure to the size of the enclave is accounted for. These results echoed the findings of the previous model that objective social capital improves food security outcomes of households while subjective social capital seemingly does not. However, the interaction terms uncovered additional insight.

In Models 1 and 2, although the coefficients on PCS and IIC are negative indicating that food-secure households are less likely to perceive themselves as having community support or engage the community probably because they can afford formal services, the coefficients on the interaction terms were positive and significant. For every unit increase in the size of the ethnic enclave and perceived community support within the enclave, the household food security increased by 0.14 points, and for informal interaction within the community, household food security increased by 0.30 points.

Sensitivity analysis

To check the sensitivity of the results to different measures of socio-economic indicators, all models were regressed using different indicators in place of income (Table 2.10). The results using different socio-economic indicators were qualitatively similar across all indicators, and in the interest of space, we only present in Table 2.10, the results for Model 5 in Table 2.8 and Model 4 in Table 2.9. Among all the socio-economic indicators used in the model, English proficiency of the primary income earner had a significant impact on household's food security in the expected directions. A one-level improvement in English proficiency increased the food security score by 0.1 points. Car ownership improved the food security score by 0.3 to 0.5 points and consistently had a statistically significant and positive impact on food security when a variable other than income was used as a measure of socio-economic status. Perhaps, omitting income produced biased coefficients on car ownership as the two variables are also closely related. The impact of objective social

capital ranged between 0.4 to 0.8 point increase in the food security score and PCS led to an improvement in the food security score in the range of 0.06 to 0.27. Secondary migration did not affect the food security status of the household. In Table 2.11, we report results using different measurements of objective social capital where the impact of objective social capital remained positive and significant.

The estimation results restricting our sample to households that did not relocate after arriving in the U.S. suggests that secondary migrant households bias our estimates downwards. In the results from the restricted sample (Appendix A5), the magnitude of the coefficients on objective social capital are higher than those reported in Table 2.8, with an increase in the size of the community by 1,000 persons leading to almost a whole unit increase in household food security score.

The results of the placebo (falsification) test also support the reliability of our results (Appendix A6). Households were randomly assigned a new value of food security score in Model 1. In Model 2, households were randomly assigned a different level of objective social capital. The negative and insignificant results on variables in the first column and on objective social capital in the second column indicate that our results are in fact capturing variations arising from the variables in the model we seek to measure.

Discussion

In this paper, we provide empirical support to demonstrate high levels of food insecurity and social capital in the Somali refugee community in the

Midwest. We found food insecurity in the study community stood at almost 22%, compared to the 11% nationally and in the Midwestern states in 2017 (Coleman-Jensen et al. 2018). This is consistent with previous studies reporting high levels of food insecurity among other immigrant communities (Quandt et al. 2006; Hadley et al. 2007; Capps et al. 2009; Vahabi et al. 2011).

We also documented an empirical relationship between social capital and food security in the Somali community in the Midwest. We found that objective social capital measured as the size of the ethnic enclave had a significantly positive impact on the food security outcomes of the respondents, and these estimates we believe are indicative of causal effects.

Our results are consistent with other studies that have found positive impacts of ethnic capital on labor market outcomes such as skills and earnings (Borjas 1995; Edin, Fredriksson and Åslund 2003; Damm 2009; Åslund et al. 2011; Patel and Vella 2013). These studies have also reported tendencies of low-skilled refugees to self-select into ethnic enclaves while benefitting the most from sorting into ethnic enclaves (Edin et al. 2003; Åslund et al. 2011; Damm 2009). We observed a negative, albeit not significant, relationship between secondary migration and food security, suggesting the most food-insecure households tend to migrate. We also observed that the coefficient on informal interaction with the community was estimated to be negative, yet when interacted with the size of the ethnic community was positive and significant. The negative coefficient on informal interaction is possibly a result of endogeneity resulting from food insecure households engaging in more informal

interactions out of necessity and food secure households not needing to rely as much on the social network leading to fewer informal interactions. When we capture the combined exposure of households to the objective social capital through informal interaction, we see that despite engaging with the community out of necessity, households get help from these informal interactions and stave off food insufficiency. Our results thus lend support to findings such as from Aslund et al. (2011) who suggested that boys and children with less educated parents benefitted the most from schooling in ethnic enclaves possibly because other community members made up for the lack of role models at home.

Not surprisingly, the tendency to self-select is responsible for biased coefficient estimates. The literature notes that sorting causes the coefficient on ethnic enclaves to be underestimated, downplaying the importance of ethnic enclaves to low-skilled community members (Edin et al. 2003; Åslund et al. 2011; Damm 2009). The results we report in Appendix Table A9 support this; the magnitude of the coefficient on objective social capital is much greater when secondary migrant households are excluded from the analysis.

This study is also instrumental in demonstrating the shortcomings of how the concept of food security is understood and measured. We documented the monetary and non-monetary resources shared informally among community members to manage food shortages and found a significant reliance on community-based support systems among the Somali communities. The observed coping mechanisms contribute to an emerging strand of literature seeking to uncover the experiential nature of food insecurity, *i.e.*, the diverse set

of experiences related to food insecurity among individuals, households, and communities in addition to the more universal experiences such as insufficient quantity of food, inadequate nutrition, and worry regarding food (Coates et al. 2006).

Such coping mechanisms and other experiential aspects of food insecurity are largely unaccounted in the definition and measurements of food security purported by the USDA. Instead, it focuses narrowly on food sufficiency causing households to be classified as food secure if they have sufficient food to consume, despite the hardships they endure to procure it. The non-monetary barriers we highlighted in this paper suggest that food security is complex, and its measurement should take into account both monetary and other non-monetary resources, such as time, knowledge, and ability to obtain, prepare and consume foods in an acceptable manner. With a more nuanced definition and measurement of food insecurity, such households would more appropriately be classified as food insecure. That is, to be classified as food secure, households should consistently be able to acquire food and access knowledge and resources necessary to prepare adequate foods that meet their food preferences and dietary requirements, without resorting to any coping strategies that entail psychological discomfort, guilt, or shame.

Lastly, another limitation of the current food security measurement is it does not consider the diverse life circumstances that shape our understanding of the concept. During data collection, several questions related to food sufficiency in the instrument were greeted with comments such as *“Here in America there is*

so much food", "Food is so cheap here", and *"Praise the God for plenty of food compared to back home"* causing us to believe several respondents - especially recent immigrants - are likely to under-report food insecurity because of the recent memory of more severe food shortages they confronted before resettling in the U.S. Future research would benefit from contextualizing questions related to food sufficiency and developing a multidimensional and more culturally appropriate scale to measure food security among immigrant communities.

Conclusion

In this paper, we examined the impact of social capital on food security through a case study of Somali communities in the Midwest. Since the state assigns a host city to refugees, they find themselves with varying levels of social capital beyond their control, enabling us to estimate the causal impact of social capital on food security. We found that objective social capital and income have a significant impact on food security across all models, while various dimensions of social capital considered in the analysis had differing effects on food security. This finding suggests that while several different metrics have been used to measure latent concepts such as social capital, social interaction, and social network, not all social connections help to accrue social capital. In this case study, objective social capital had a positive and significant impact on food security scores, the effect of cognitive social capital measured as perceived community support and bonding social capital measured as informal interactions with community were ambiguous, and structural social capital measured as participation in organized groups had no effect on improving food security

outcomes.

Our study has shortcomings. It is based on a convenience sample, allotted limited training to interpreters to improve inter-personal consistency, and used hegemonic food security measurements instead of developing an experiential scale that better represents diverse communities. Finally, the complex dynamic factors that contribute toward enhancing both food security and subjective social capital make it difficult to isolate the causal effects from simple correlations between the two variables.

It remains to be seen if similar effects can be found consistently across other vulnerable populations. Social capital and the other coping mechanisms we highlighted are examples of informal systems historically marginalized communities everywhere use to overcome challenges they face. These findings are relevant to not only refugees but also other low-income immigrant communities that develop informal or unorganized systems in the absence of formal services. These systems including social capital should not be viewed as solutions but rather as temporary arrangements that policy makers need to develop more permanent, inclusive, and reliable substitutes for.

Chapter 3: Impacts of nutrition awareness interventions on food purchases at grocery stores in food deserts - A case study from rural Kansas[4]

Summary

In this Chapter, we estimate the impact of shelf labels that simplify the nutrition information of the product and nutrition education workshops on food purchases at two locally-owned grocery stores in food deserts in rural Kansas using a difference-in-difference model. We found the nutrition labeling intervention to be successful in enhancing the nutritional quality of food purchases primarily in Store A where it was the first intervention to be introduced but the effects faded over time. The impacts of extension education programming were more ambiguous.

Introduction

Food choices influence health outcomes (Nicklas et al. 2001; Prentice and Jebb 2003; Bray, Nielsen and Popkin 2004; Rosenheck 2008; Wolongevicz et al. 2010), and the costs incurred due to negative health outcomes such as diet-related diseases are substantial. For instance, obesity, a common diet-related disease has been attributed to individual choices (Swinburn et al. 2011; Olander et al. 2013; Pulsford et al. 2013) such as reduced intake of fruits and vegetables (Popkin, Adair and Ng 2012), increased intake of fast food (Rosenheck 2008; Anderson et al. 2011), increased consumption of sweetened beverages (Malik et al. 2010) and unhealthy eating habits (Deshmukh-Taskar et al. 2010). The

[4] This chapter was co-authored with Dr. Hikaru Peterson

obesity rate for adults in the United States (U.S) stood at approximately 36% between 2011 and 2014 (Ogden et al. 2015). This entailed a medical cost of $1,901 per individual in 2014 amounting to $149.4 billion at the national level (Kim and Basu 2016). Diet-related diseases are also one of the leading causes of death in the U.S. (Murray et al. 2018).

Promoting healthful food purchases among individuals is crucial to curtail diet-related diseases and ensure a healthy population. In 2010, the quality of food purchased by American households stood at 53 on the 100-point Healthy Eating Index (HEI)[5] proposed by the United States Department of Agriculture (USDA) indicating that the food choices of Americans could be improved substantially (Mancino et al. 2018). Experimental interventions at the store levels such as introduction of different types of shelf tags, reassignment of display spaces, and price subsidies supported by posters, information booklets, and brochures have been explored to improve purchase patterns of households (Curhan 1974; Teisl and Levy 1997; Foster et al. 2014). Some studies have focused mainly on the impact of nutrition awareness on food consumption. These have demonstrated that consumers use the available information to the best of their ability to consume more healthful foods (Weaver and Finke 2003; Roberto et al. 2010; Hellyer, Fraser and Haddock-Fraser 2012; Zhu, Lopez and Liu 2015). Most document a positive relationship between the usage of nutrition labels and healthful food consumption or improved nutrient intake (Kreuter et al. 1997;

[5] A 100-point scale proposed by the USDA measures the food choices of Americans with a score of zero being the worst food choices and 100 being the best (REF).

Neuhouser, Kristal and Patterson 1999; Kim, Nayga Jr. and Capps Jr. 2000; Lin, Lee and Yen 2004; Satia, Galanko and Neuhouser 2005; Nikolova and Inman 2015). A small stream of more recent studies has also demonstrated that some groups of consumers are also willing to pay for customized nutrition information (Balcombe et al. 2016) or pay more for products that are healthier (Hellyer et al. 2012).

Rural residents experience disparities in access to healthy foods. Residents with high school education or less in rural counties in Missouri, Arkansas, and Tennessee reported lower access to a choice of fruits and vegetables, reliance on convenience stores, and preference for buffets and cafeterias (Casey et al. 2008). This is supported by evidence from rural Texas where grocery and convenience stores had less fresh produce than supermarkets (Bustillos et al. 2009; Sharkey, Johnson and Dean 2010). Consequently, their health outcomes are worse relative to the urban population (Meit et al. 2014; Probst, Eberth and Crouch 2019). They experience higher rates of obesity and a lower HEI score. In 2016, the adult obesity rate stood at 34.2% for non-metropolitan counties, compared to 28.7% among adults residing in metropolitan counties (Lundeen et al. 2018). Studies have documented that the mean HEI scores for rural households were below average in their samples (Nanney et al. 2016).

In this paper, we examine the impact of interventions designed to promote healthful food purchase patterns among the patrons of two locally-owned grocery stores in rural food deserts in Kansas. One of the interventions introduced

succinct on-shelf nutrition labels that patrons could use to make informed choices, while the other intervention entailed nutrition education workshops offered to the store patrons. We demonstrate that rural residents are interested in consuming healthier foods. We also document the availability of healthy foods in both the control and treatment stores measured using the metrics recommended by the Nutritional Environment Measures Survey (NEMS)[6] and consumer perceptions and attitudes toward food choices collected through surveys administered to store patrons.

We found that the nutrition labeling intervention was effective at Store A and robust across models, but the impacts of extension education were more ambiguous. Our findings suggest that the first intervention to be introduced was more likely to be successful and that the effects of the interventions wore off over time indicating that it is easier to inspire changes than sustain them among different types of shoppers.

The rest of the paper is organized as follows. The next section presents a contextual overview of the food environment that rural residents maneuver, along with a review of existing literature that examines the link between consumer awareness and food purchase choices. Then we describe the study design and the two interventions, followed by a discussion of the methods and results. We conclude with a discussion of the policy implications.

[6] NEMS provides a standardized metric to measure and compare the availability of nutritional foods across different stores based on quality, assortment and price of products shelved in the stores (Glanz et al. 2007).

Background

In 2015, an estimated 54.4 million Americans (17.7% of the population) lived in low-income census tracts more than 0.5 miles from a supermarket in urban areas and 10 miles in rural areas (Rhone et al. 2017) and 15.8 million (12.7% of the population) were food insecure (Coleman-Jensen et al. 2016). Of these, populations in rural America are particularly vulnerable. Rural counties have higher rates of poverty and unemployment and are home to more aging populations, both of which are associated with higher levels of food insecurity (Coleman-Jensen et al. 2018; Cromartie 2018). Limited access to food and a higher prevalence of food insecurity also affects the quality of the food intake. Below we discuss some of the barriers that affect both food and nutrition security with a focus on rural America.

Barriers to food access

Limited access to foods is likely to perpetuate both food and nutrition security in rural towns as compared to their urban counterparts (Liese et al. 2007). Factors that influence access include the distance traveled to reach a grocery store, transportation challenges, and economic access or availability of affordable foods. Rural residents travel farther to reach a grocery store (Inagami et al. 2006; Liese et al. 2007; Sharkey and Horel 2008) than their urban counterparts. Sharkey et al. (2010) found that increased distance to the store—both objective and perceived—was negatively associated with consumption of fruits and vegetables on a sample of 582 seniors in the Brazos Valley Counties in rural Texas.

Transportation challenges directly influence the ability of households to access grocery stores (Weinberg 1995; Rose and Richards 2004; Kirkup et al. 2004; Lake and Townshend 2006) and affect mainly those without a reliable vehicle or populations like the elderly who may have driving limitations (Glasgow 2000). In rural areas, this could mean walking longer distances, or along non-pedestrian routes (Boehmer et al. 2006; Andress and Fitch 2016). This is evident from the fact that while 92% of food-secure households commute to the grocery store in their car, only 69% of food-insecure households use their own car to shop for groceries. Among other modes of transportation used, 17% of food-insecure households ride with someone else, and 14% used alternative forms of transportation, as compared to 4% of food-secure households using alternative forms of transportation (Ver Ploeg et al. 2015).

Transportation challenges could also explain the higher dependence of rural poor on easily accessible and more expensive store formats like convenience stores (Morris et al. 1990; Kaufman 1999). Convenience stores outnumbered store formats that provided healthier foods at lower price points and the healthier version of the food was typically more expensive than the less healthy version according to a study was based on a survey of all 77 food stores (supermarkets, grocery stores, and convenience stores) in a rural South Carolina county (Liese et al. 2007). Hendrickson et al. (2006) used survey methods and focused group discussions to examine the availability of healthy foods in four communities—one each in North and South Minneapolis and two counties in

rural Minnesota. They found that low-income, rural residents were affected by the high cost of food and transportation problems.

Like perceived distance, perceived higher price points are also associated with greater food insecurity. Garasky et al. (2006) analyzed responses to 793 surveys mailed to residents of two rural Iowa counties using a binomial logit model and found that perceived higher prices were positively related to being food insecure. Smith and Morton (2009) also reported perceived higher prices especially of healthier foods among their study subjects. Their study was based on focused group discussions with 57 participants in two rural counties in Minnesota (3 groups with 21 participants) and Iowa (4 groups with 36 participants). Their participants also highlighted limited economic access and reported buying whatever was on sale to make money last and shopping outside the community if they could to acquire higher quality and diverse foods at more affordable prices. However, out-shopping being more expensive limited what was available to the more impoverished.

Food availability and security

Rural counties have fewer stores per county compared to urban counties (Morris, Neuhauser and Campbell 1992; Powell et al. 2007). In addition, many food outlets contained poorly stocked shelves, lacked healthy and nutritious foods (Morris et al. 1990), and offered foods unsafe to consume such as expired products or overripe fruits and vegetables (Smith and Morton 2009). Rural poor also have a higher dependence on convenience stores (Morris et al. 1990; Kaufman 1999). Typically, convenience stores are poorly stocked as compared

to supermarkets and supercenters. The average NEMS score for convenience stores, corner stores, and small grocers stands at 10.60 as compared to chain supermarkets at 32.90 and non-chain supermarkets at 30.50 on a scale from zero to 50 (Ulrich, Hillier and DiSantis 2015).

Evidence supports positive food environments are associated with a higher intake of fruits and vegetables (Moore et al. 2008; Ver Ploeg 2010). Morland et al. (2002) examined the association between the local food environment and self-reported dietary intake among 10,623 Atherosclerosis Risk in Communities (ARIC) residents. Their sample included observations from 221 census tracts located in Maryland, North Carolina, Mississippi, and Minnesota. Random-effects log-linear models for each census tract demonstrated that black Americans' fruit and vegetable intake increased by 32% for each additional supermarket in the census tract, while white Americans' fruit and vegetable intake increased by 11%. Hanson et al. (2005) estimated Spearman's correlation between parent report of fruit, vegetable, dairy foods and soft drink availability in household and adolescent intake of these foods among 4,746 participants of Project EAT (Eating among Teens) who were adolescents from public middle schools and high schools in urban Minnesota. They concluded that median intake increased among adolescents as their parents reported these foods were more frequently available at home. Bodor et al. (2008) found that greater fresh vegetable availability within 100 meters of residence was positively associated with vegetable intake and each meter of additional shelf space in grocery stores was associated with 0.35 servings per day of increased intake. They used a

linear regression model and controlled for household demographic factors to obtain their estimates for a random sample of 102 households in four contiguous census tracts in New Orleans.

Information utilization and food choices

Availability of healthier purchase options alone is not sufficient to improve diet quality. A recent analysis of the Nielson Homescan data from 2004-2016 using a structural demand model found that exposing low-income households to the same products and prices available to high-income households reduces nutritional inequality by only nine percent, while the remaining 91 percent is driven by differences in demand (Allcott et al. 2019).

Emerging evidence indicates that making appropriate information available is just as important as access to and availability of healthy foods to facilitate healthy food choices. Recent studies have illustrated that consumers use available resources to make informed choices. Balcombe et al. (2016) found that people were willing to pay to use technology to customize food shopping and that people were willing to pay more for specific information such as scanner applications designed to give shoppers a tally of the overall nutritional value of their shopping baskets versus for generic nutritional information. In their discrete choice experiment, 791 British citizens completed an online survey administered by a polling company. Their findings complemented an earlier experiment by Hellyer et al. (2012) based on 183 individuals recruited at the University of Kent. Using Vickrey second price auctions for a variety of bread products, they found

that the provision of a health claim along with nutrition information influenced the participants' willingness to pay.

In the case of nutrition labels, studies have consistently observed an association between increased use of the food label and improved nutrient intake or healthier dietary patterns among study participants (Kreuter et al. 1997; Neuhouser, Kristal, and Patterson 1999; Kim, Nayga Jr., and Capps Jr. 2000; Lin, Lee, and Yen 2004; Satia, Galanko, and Neuhouser 2005). For instance, Kim et al. (2000) used endogenous switching regression techniques and found that nutrition label use changed dietary intake in favor of dietary fiber and reduced the intake of cholesterol, sodium, and saturated fat. Their findings were based on 5,203 complete observations from the Diet and Health Knowledge Survey. Ollberding et al. (2010) used 4,454 responses from the 2005-06 National Health and Nutrition Examination Survey (NHANES) and found that the use of specific nutrient information found on the nutrition facts panel was associated with the largest difference in mean nutrient intake between label users and non-users for energy, total fat, cholesterol, and sodium. Sato et al. (2013) also demonstrated a positive relationship between nutrient labeling and sales of healthy foods in the cafeteria of Kaiser Permanente San Francisco Medical Center based on 131 anonymous surveys and sales data. The cafeteria served about 100 customers a day 70% of whom were employees at the Center. Thorndike et al. (2012) found that color-coded labels improved sales of healthy items in five cafeterias in the Massachusetts General Hospital. The two-phased intervention based on a sample size of over 100,000 for beverages and over

900,000 for all items, was analyzed using logistic regressions and difference-in-difference models for all items sold and for changes within the group for beverages (diet soda, regular soda, and bottled water).

Other recent studies have investigated the environments in which nutrition labels are likely to be most effective. Visschers et al. (2013) investigated the kind of consumers who were likely to benefit from nutrition labels. They concluded that different strategies worked to promote healthy eating among different groups of people and hence nutrition awareness was not a substitute but a complement to improving food environments. Their findings were based on the Swiss Food Panel Questionnaire that had a sample size of 6,061. Zhu et al. (2015) extended consumer search theory to include healthfulness and examined whether decreasing the cost of nutrition information increased the probability of healthful consumption for ready-to-eat breakfast cereals. Their study spanned 5,844 households from Nielsen Homescan Panel over 152 weeks. They found that simplifying nutrition labeling did indeed increase the healthfulness of consumer choices. More detailed investigation revealed that less educated and smaller households with frequent purchases benefitted the most from reduction in information cost.

The studies discussed above examined the impact of traditional nutrition panels at the back of the package (Kreuter et al. 1997; Neuhouser et al. 1999; Kim et al. 2000; Lin et al. 2004; Satia et al. 2005; Ollberding, Wolf and Contento 2010), were conducted in small experimental settings in schools, colleges, hospitals or cafeterias (Roberto et al. 2012; Thorndike et al. 2012; Sato et al.

2013; Christoph, Ellison and Meador 2016; Reilly et al. 2018), were based on urban samples (Schucker et al. 1992; Teisl and Levy 1997; Foster et al. 2014) or examined the sales of healthier products at the store level rather than purchases among shoppers (Schucker et al. 1992; Teisl and Levy 1997; Thorndike et al. 2012; Sato et al. 2013; Foster et al. 2014; Reilly et al. 2018). Studies that examined the impact of front-of-package or shelf labels can be classified into two groups – those that use health claim phrases such as low-sodium, low-cholesterol high fiber (Berning, Chouinard and Mccluskey 2011; Roberto et al. 2012; Hamlin, McNeill and Moore 2015) and those that use simplified nutrition information such as traffic lights, guiding stars or numerical scores (Sutherland, Kaley and Fischer 2010; Cawley et al. 2015; Nikolova and Inman 2015; Epstein et al. 2016; Hobin et al. 2017; Finkelstein et al. 2018). This study is most closely related to the second group. Except Epstein et al. (2016) which is based on an online experiment, all the other studies examine the impacts on both rural and urban shoppers combined. Additionally, Sutherland et al. (2010), Cawley et al. (2014), and Nikolova and Inman (2015) use a natural experimental model as they do not have any control stores to compare to the intervention stores. Finklelstein et al. (2018) analyzed the impact of simplified shelf labels only on the yogurt category.

This study contributes to the literature by focusing on rural residents in food deserts. Our study takes place at grocery stores, which are the primary outlet of food purchases for at-home consumption (Volpe, Kuhns and Jaenicke 2017; Chrisinger et al. 2018). We use evaluation methods to analyze the impact of the

interventions on the overall shopping choices of buyers rather than sales of specific products.

Study design

The study interventions were implemented in 2015 at two locally-owned grocery stores in communities with a population of less than 2,500 in rural Kansas. Four stores located in similar rural communities were selected as control stores. Two of the control stores (C1 and C4) were in Iowa and the other two (C2 and C3) were in Missouri. The participating stores had to fulfill three requirements: the stores had to be located within or service an area designated as a food desert by the USDA, the store owners had to be willing to participate in the project, and the stores had to be serviced by Affiliated Foods Midwest (AFM)[7], a wholesale grocery distributor of over 800 rural grocery stores throughout the Midwest and over 70% of the rural grocery stores in Kansas at the time of the study. The treatment stores received $2,000 for participating in the study at the end of the project, which they could use to support the community. The control stores were required to have a card-based, customer loyalty program in place. A similar program was introduced in the treatment stores as part of the study to collect data from shoppers.

The county-level characteristics of each of the control and treatment stores and how they compare with the rural Midwest are presented in Table 3.1. According to the 2015 American Community Survey (5-year sample), both the

7 In July 2016 AFM and Associated Wholesale Grocers (AWG) announced they had reached an agreement to combine the two businesses and this merger was completed in October 2016, with AWG retaining the business name.

treatment stores were located in counties where 94% of the total population was white and the average household size was just over 2.5 persons, which were representative of the rural Midwest. Store A was located in a relatively affluent county with a median income of about $60,000 and an unemployment rate of 3.7%. Approximately 6% of the households received Supplemental Nutrition Assistance Program (SNAP) benefits. The county with Store B had a median income near $50,000, an unemployment rate of 7%, and 11% of households receiving SNAP benefits. For the control stores, the median income ranged from $38,289 to $55,203; the unemployment rate ranged from 5.5% to 7.8%, and the number of households receiving SNAP benefits ranged from 8% to 14%. The median income for rural Midwest was $57,000, the unemployment rate was 5.2%, and the number of households receiving food stamps was 12.3%. The control and treatment stores had similar proportions of working-age populations (around 45%) as compared to 58% for the rural Midwest and, labor force participation rates (around 63%) as compared to 60% for the rural Midwest.

The two interventions were implemented in the treatment stores in different sequences to estimate their joint as well as the independent impact. The timeline of the interventions is summarized in Table 3.2. One intervention was the introduction of on-shelf nutrition labels. The labels simplified nutrition information for consumers by assigning a succinct score to each food item as a single number from 1 to 100. Consumers could see the nutrition scores of the food items relative to other comparable items shelved around as they shopped. The scores were displayed on the left-hand side of the shelf tag that lists the

price and barcode of the item on the shelf (Figure 1). This intervention was introduced in Store A in February 2015 and Store B in June 2015. The intervention was publicized widely in the treatment stores with posters educating store patrons on how to read and interpret the scores displayed prominently.

The other intervention, an Extension outreach program, was designed in conjunction with the overall nutritional quality index (ONQI) system to complement SNAP and nutrition education materials that were already in use.[8] A one-hour workshop was designed accounting for shopping patterns, technology limitations, and other practical considerations of customers at each of the treatment stores. The workshops, advertised extensively via in-store flyers and notices on Kansas State University's website, covered components of a balanced meal based on *My Plate*, a healthy eating guide proposed by the USDA's Center for Nutrition Policy and Promotion, followed by a review of how to read and use nutrition labels on food packages. The first part of the workshop ended with a discussion of different approaches to planning and preparing easy family meals. The workshops at Stores A and B were attended by 24 and 40 participants, respectively. The second part of the program consisted of a field trip to the grocery store to work through interactive smart shopping worksheets and exercises. At Store A, where the nutrition labels had been introduced a few months ago, the educator also gave participants an overview of the newly

[8] The ONQI is a nutrient profiling algorithm that incorporates over 30 dietary components and aims to rank foods by relative healthfulness (Katz et al. 2010).

introduced nutrition labels. The nutrition education program was hosted in Store B in February-March 2015 and Store A in July-August 2015.

Although attendance at the workshops was limited, store patrons were aware of healthy eating campaigns and programs introduced in their stores, because they were asked to enroll in the customer loyalty program and use the card when shopping at the store. The workshops were advertised extensively via in-store flyers which also helped to increase awareness. Based on previous studies that have documented relatively high levels of customer awareness of in-store interventions (Levy et al. 1985; Kristal et al. 1997) and because the grocery stores are located in small towns, we expect that although not everyone participated in the workshops, a significant portion of store clients were aware of the Extension campaign to make healthier purchase choices.

Data

Data from several different sources were gathered to evaluate the impact of the interventions. The data collected included transaction data from all the six stores and customer intercept surveys and measures of the food environment from the study stores. We also used Food Scores published by the Environmental Working Group (EWG) to measure the nutritional value of the consumer food purchases.[9]

[9] The Environmental Working Group (EWG) is a nonprofit dedicated to drive consumer choice and civic action through research and education. The nutrition scores used in the intervention were discontinued by the publishers and were not available for data analysis, so we used the EWG Food Scores to analyze the data.

To collect consumer purchase data, a customer loyalty program, in use by the control stores, was introduced at the treatment stores. During the 4-week enrollment period, shoppers were asked to complete an application form to receive their loyalty card. They were informed that at the end of the study period, the store would receive funds for participating in the study ($2,000) on behalf of the community. In our analysis, we use transaction data from November 2014 to February 2016 from the treatment and control stores. This data included the time stamp, transaction id, frequent shopper number of the purchasing household, price, product description, discount availed if any, and the universal product code (UPC) of all items purchased. The transaction data included a total number of 2,422,493 transaction items, which were both purchase and non-purchase transactions such as refunds and discounts. All non-purchase transactions and non-food purchases were excluded from the analysis. Alcohol and pharmacy products were not included in the analysis either because nutrition scores for these products were not introduced as a part of the intervention. The dataset was also stripped of error entries, return transactions, discounts, and transactions that exceeded $600. The purchase data were aggregated by week for each household. The final dataset included 1,769,761 item sales from 341,181 unique transactions by 11,245 households for 70 weeks (Table 3.3).

Customer intercept surveys were conducted in the treatment stores to gather the patrons' demographic data and measure their awareness, attitude, and preferences related to food and diet. Store patrons' demographic information was obtained from surveys administered when they signed up for the loyalty

program cards. This survey was administered in October 2014 at the time of enrollment and documents their age, occupation, income, gender, and race. Follow-up surveys to measure changes in their perception of food intake and nutrition awareness were administered by intercepting shoppers in February-March, May-June, and October-November of 2015.

NEMS was administered in the study stores in January 2015 and a follow-up was done in March 2016. During the follow-up round, the NEMS evaluation was independently conducted by two evaluators in each store and an average of their scores was obtained. NEMS provides a standardized metric to measure and compare the availability of nutritional foods across different stores. The score for stores can range from zero to 50. The method can be used to assign scores to grocery stores based on the quality and price of products shelved in the stores. While stores are given points based on the assortment and availability of different products depending on their nutritional value, they are also penalized for higher prices on healthier alternatives (Glanz et al. 2007).

The nutritional value of each purchase was calculated using Food Scores published by the EWG. The EWG Food Scores are based on a model developed at Oxford University called Ofcom (Rayner, Scarborough and Lobstein 2009) that has been validated (Azaïs-Braesco, Goffi and Labouze 2006; Garsetti et al. 2007; Rayner et al. 2009) and used in the United Kingdom since 2007. They took into consideration more than 80,000 foods, 5,000 ingredients, and 1,500 brands and rated each food item based on nutrients, ingredient concerns, and processing (EWG food scores 2014). Nutrition was weighted the highest,

followed by ingredient concerns and then processing. Ingredient concerns controlled for the presence of contaminants, pesticides, hormones, antibiotics, and health implications of certain food additives. The processing score reflected an estimate of the extent to which a particular food had been processed, modification of individual ingredients from whole foods, the number of artificial ingredients used, and other factors. We used only the nutrition component of the EWG scores, which accounted for calories, saturated fat, trans-unsaturated fat, sugar, sodium, protein, fiber and fruit, vegetable, and nut content to analyze the data so that the scores were more comparable to the nutrition scores used in the intervention.

In the EWG Food Score database, each food item was assigned a single overall product score on a scale of 1 to 10 such that the best (healthiest) foods scored 1 and the worst (least healthy) foods scored 10. For instance, fresh fruits and vegetables had the lowest scores typically between one and two, while scores for candy ranged from five to ten with dark chocolate and fruit bars at the lower end of the spectrum. Scores for breakfast cold cereal ranged from one for steel-cut oats to ten for frosted and sweetened cereal. Similarly, yogurt scores ranged from one to nine, with organic Greek yogurts at the lower end followed by non-organic, flavored, and frozen yogurts.

To construct the outcome variable, the four and 11-digit UPCs were first converted into a 12 digit number using the algorithm defined to calculate the last check digit of the UPC (Kirtland 2001). The complete 12-digit UPC was then used to match observations in the sales dataset with their nutrition score from the

EWG food score database. The EWG Food Score database assigned a nutrition score to about 49% of the total unique UPCs in our sample. Scores of products missing a score were calculated based on the scores assigned to similar products in the EWG database. If the range of scores was less than two for a group of similar food items classified within a product category, the group mode was assigned as the score for all products with missing scores in that group. Examples of such groups include low-calorie soft drinks, ground coffee, fresh potatoes, and cooking oils. For product groups with a range of scores exceeding two, such as yogurt, cereal, and peanut butter, the keywords in the product description were used to assign the scores. For instance, products with words such as *lite*, *low-fat*, *lf*, *reduced-fat, no added sugar,* and *low sodium* were assigned scores based on products in the same product group with similar keywords in their product description. After this process, 1,769,761 of the food items purchased had an assigned score, representing 86% of the unique UPCs and 89% of the purchase transactions in our dataset. Finally, to facilitate interpretation, the scale of the scores was inverted such that higher values implied healthier options.

Methods

The difference-in-difference approach is used to determine the extent to which the interventions modified the food purchase patterns of the shoppers. We constructed two nutrition scores of the food purchases to use as outcome variables. The first one, score per item, was computed as the aggregate score of all food items purchased by household *h* at store *s* in week *t* divided by the

number of food items purchased by the household at the store during the week. The second, the score per dollar spent, was calculated as the aggregate score of all food items purchased by household *h* at store *s* in week *t* multiplied by the item price divided by the household's food expenditure at the store for the given week.

The independent variables include the two treatments, week and calendar month fixed effects, and household-level fixed effects. Two model equations are specified to explore the individual and joint impact of the two interventions and determine whether the sequence in which they are implemented matters. In equation (1) we measure the treatment effects of the two interventions, while in equation (2) we measure the independent effects of the first treatment that was introduced in each of the stores and the joint impact of the second treatment. We also estimate equation (2) using only a subsample of observations from Store A and the control stores, and then using the subsample from Store B and the control stores to estimate the individual impact of the two interventions. The estimated model equations are presented below:

(1) $y_{hsw} = \alpha + \delta_{post1}\, post1_{hsw} + \delta_{post2}\, post2_{hsw} + \Upsilon_h h + \Upsilon_{tm} cm + \Upsilon_{tw} week + \epsilon_{hsw}$

(2) $y_{hsw} = \alpha + \delta_{label}\, label_{hsw} + \delta_{educ}\, educ_{hsw} + \delta_{post2}\, post2_{hsw} + \Upsilon_h h + \Upsilon_{tm} cm + \Upsilon_{tw} week + \epsilon_{hsw}$

In both equations, y_{hsw} is the nutrition score of foods purchased by household *h* at store *s* during week *w.* In equation (1), $post1_{hsw}$ takes the value 1 for all observations after the first intervention was put in place in the treatment

stores, and $post2_{hsw}$ takes the value 1 for all observations after the second intervention was put in place in the treatment stores. The coefficient on $post1_{hsw}$ represents the marginal impact of the first intervention, the coefficient on $post2_{hsw}$ represents the conditional impact of the second intervention given the first intervention, and the sum of the coefficients represents the joint impact. The variable $label_{hsw}$ is a dummy variable that takes the value 1 for all transactions from the treatment stores after the nutrition labels were put in place; *i.e.*, $label_{hsw}$ is equal to one for all observations from week 18 onward at Store A and week 32 onward at Store B. The variable $educ_{hsw}$ is also binary and takes the value 1 for all transactions from the treatment stores after the extension education programming was completed; *i.e.*, $educ_{hsw}$ is one for all observations from week 43 onward at Store A and week 23 onward at Store B. Parameters δ_{label} and δ_{educ} capture the marginal impact of the two interventions. Variables *h*, and *week* represent household, and time (week) fixed effects, respectively. *week* includes a dummy variable for each week with the first week omitted as the base week to capture any week-specific idiosyncrasies during the study period that might confound the coefficients. *cm* is a series of dummy variables flagging every calendar month with January omitted as the reference period to capture any seasonal factors that may confound the effects of the intervention.

We also estimate the impact of the interventions on different types of shoppers - the subsamples of shoppers who frequented the stores regularly (regular patrons) and those who rarely shopped at the stores (occasional shoppers). We define regular patrons as shoppers who shopped at the study

stores for at least 10 out of the 70 weeks during the study period which is the median number of weeks households are observed in our panel. Occasional shoppers are shoppers who made purchases at the study stores less than the median number of weeks households were observed in the panel *i.e.,* less than 10 weeks. We hypothesized that regular shoppers would benefit more from both the interventions as they would be exposed to the awareness campaigns more often than the occasional shoppers.

We investigate the short-run and the long-run impact of the interventions. To estimate the short-run impact of the interventions, we restrict the sample to observations before the second intervention was introduced *i.e.,* from November 2014 to June 2015. To estimate the long-run impact of the interventions, we restrict the sample to observations before the first intervention was introduced *i.e.,* from November 2014 to February 2015, and observations a year later from November 2015 to February 2016 when both the interventions had been implemented. We also interact each month post-treatment with the treatment dummy variable to see how the effects change over time. Finally, we also conduct a falsification test by reassigning observations to check the robustness of our results.

Results

In this section, we first describe the changes at the treatment stores as a result of the interventions, the demographic profile of the shoppers at the treatment store, and the descriptive statistics and trends observed in the data in general followed by the estimation results. The NEMS score for both the

treatment stores was 26 in the follow-up surveys done in March 2016. This was comparable to mean scores at limited assortment /deep discount stores (25) and big box stores (26) in 2013 (Ulrich et al. 2015). For Store A the NEMS score was down from 27 in the baseline survey conducted in January 2015 and for Store B it was a substantial increase from the pre-intervention score of 14.

Household characteristics of shoppers who frequented the treatment stores are reported in Table 3.4. The mean household size was 2.9 persons out of which 0.91 were children. Thirty-eight percent of the households had at least one child below 18 years of age and 25% of the households had a senior above 65 years of age. Five percent of the households were home to a person of color. Thirty-one percent of households had no adult with any college education *i.e.,* the person with the highest level of education in the household had completed 12 years of schooling or less or had a high school diploma or equivalent. Seventy-five percent of households had at least one employed adult, while the rest were home to only housemakers, students, retired, unemployed, or permanently disabled adults. Forty-seven percent of the households had at least one adult whose workplace was outside their community. Thirty-two percent of households had a person who had a diet-related condition such as diabetes or heart disease. Around 56% reported that they consider maintaining a healthy weight and choosing nutritive foods very important. On average respondents answered just one out of the four questions they were asked to measure their knowledge of saturated fats correctly (Table 3.4).

The descriptive statistics for the whole sample and treatment and control groups are presented in Table 3.3. The mean weekly household expenditure on food items is $25.12 and they purchase 9 food items per week on average. The mean number of weeks each household made purchases during the 70-week sample period was almost 17 weeks. The weekly food expenditure per household at the treatment and control stores averaged $29.26 and $24.89, respectively. Shoppers at the treatment stores purchased 11 food items on average per week compared to 9 food items per week at the control stores.

Time series for the two outcome variables during the sample period is illustrated in Figure 3.2. We present monthly rather than weekly averages to represent the trends more clearly and without random fluctuations that might occur in some weeks. The monthly mean nutrition scores of household food purchases for the control and treatment groups experience very similar trends during the pre-intervention period (November 2014 to January 2015) and begin to diverge in February- the month when the first interventions were introduced. We also observe that in both the treatment and control groups there is an uptake in the purchase of healthier foods in January after the December holiday season, but there is a noticeable spike in the nutrition scores for the treatment stores in the months following the first interventions in late February.

The mean score per item for the control group decreased from 6.888 in the pre-treatment period to 6.868 after at least one of the interventions was introduced in the treatment stores (Table 3.3). For the treatment group, it increased from 6.875 during the pre-intervention period to 6.932 after at least

one of the interventions was introduced. Similarly, the mean score per dollar for the treatment and the control group is 6.774 and 6.799 before the first intervention and 6.835 and 6.795 after the first intervention respectively.

Estimation results

Equations (1) and (2) were estimated using ordinary least squares, and the results are presented in Tables 3.5 through 3.9. Table 3.5 presents the results for all shoppers, Table 3.6 and Table 3.7 represent the results for regular patrons and occasional shoppers respectively, and Tables 3.8 and 3.9 present the short-run and the long-run effects of the interventions. The results from interacting the months post-treatment to illustrate how the effects wear off over time, and results from the falsification test are found in Appendix B. In all tables, columns present estimations for different samples defined by stores included, *i.e.,* observations from all stores, observations from Store A and the control stores, or observations from store B and the control stores. In all the tables the outcome variable in columns (1) through (4) is the nutrition score per item of the food purchases and the outcome variable in columns (5) through (8) is the nutrition score per dollar of the food purchases. Robust standard errors clustered by stores are included in the parenthesis.

All shoppers: The results in Table 3.5 illustrate the impact of the interventions on the treated households. The score per item of purchases increased by 0.111 points (Column 1) after the first intervention, with the marginal impacts of nutrition labels and extension education being 0.153 points and 0.052 points respectively (Column 2). However, on disaggregating the two

treatment stores, it is evident that the effects for the nutrition labels were driven by the observations from Store A while the effects for extension education were driven by observations from Store B (Columns 3 and 4). The findings presented suggest that the intervention to be introduced first had a more significant impact on the shoppers. At store A where nutrition labeling was the first intervention to be introduced, it achieved a 0.167 point increase in the score per item (Column 3). At Store B, the Extension education workshops preceded the introduction of the nutrition labels. Here the nutrition labels did not have the desired effect on the food purchase choices of shoppers, but Extension education promoted healthier purchases. It resulted in a 0.049 point increase in the outcome (Column 4).

The impact of nutrition labels is consistent when the outcome examined is the score per dollar. The intervention had a positive and significant impact on the score per dollar which increased by 0.137 and the impact of Extension education on the other hand was not significant (Column 6). It is evident the positive impact of nutrition labeling was driven by observations from Store A, an increase in the score by 0.152 points (Column 7).

Regular patrons and occasional shoppers: Table 3.6 illustrates the impact of the interventions on regular patrons. The impacts of nutrition labels and Extension education were 0.149 and 0.035 points increase respectively (Column 2) on the score per item of regular shoppers. The impact of the nutrition labels and Extension education on score per dollar was 0.134 and 0.011 points increase respectively (Column 6), but the impact of Extension education was not statistically significant. It is once again evident that the nutrition labeling

intervention at Store A was more successful and drove the results. The results in Table 3.7 present the impact of the interventions on occasional shoppers. The interventions not only have a positive impact on the occasional shoppers suggesting that they did benefit from the interventions, but their magnitudes are also higher, contradicting our hypothesis that regular store customers would benefit more than those who shop at the stores occasionally. For instance, at Store A the impact of nutrition labels on occasional shoppers is 0.168 (Table 3.6, Column 3) point increase in the score per item while that among occasional shoppers was 0.173 (Table 3.7, Column 3).

Short-term and long-term effects: Tables 3.8 and 3.9 depict the short-run and the long-run impact of the interventions. The sample in Table 3.8 was restricted to observations before the second intervention was introduced. While the sample in Table 3.9 was restricted to observations before the first intervention was introduced *i.e.,* November 2014 to January 2015 and observations from the corresponding months a year later *i.e.,* observations from November 2015 to January 2016. In the months immediately following the first intervention represented in Table 3.8, the increase in the score per item ranges between 0.060 points at Store B (Column 3) to 0.163 points at Store A (Column 2) and an increase in score per dollar from 0.035 at Store B to 0.148 at store A (Columns 5-6). However, from Table 3.9 it is evident that these effects do not last, with improvement in scores a year after the baseline data reduced to an increase in score per item in Store A to 0.023 and in Store B 0.043 points (Columns 2 and 3). The impact on score per dollar is reduced to 0.062 and 0.009

points respectively at Store A and Store B (Columns 5 and 6). The coefficients are also not significant consistently across different samples. Appendix B1 illustrates how these effects fade over time.

Finally, to test the robustness of the model we conducted a falsification test by estimating the models with false values of the outcome and treatment variables. In the first table in Appendix B2, two of the control stores were flagged as treatment stores, while in the second table households were randomly assigned a different level of the outcome variable. The results of the placebo (falsification) test also support the reliability of our results and indicate that our results are not capturing other correlations or events instead of the effects of the interventions.

Discussion

Our study contributes to the literature related to store interventions to promote healthy dietary habits among shoppers and the evaluations of these interventions. Broadly, these studies have classified store interventions into five categories: point-of-purchase nutrition labels, cash incentives, nutrition education programs, modifications to store environments, and advertising and promotional campaigns, or a combination of two or more of these strategies (Langellier et al. 2013; Escaron et al. 2013; Gittelsohn, Rowan and Gadhoke 2012; Hartmann-Boyce et al. 2018). The interventions evaluated in this paper can be classified primarily as point-of-purchase interventions. Our results are consistent with other studies that have evaluated the impact of point-of-purchase nutrition labels on sales of promoted, healthier products in supermarkets and demonstrated their

effectiveness in modifying consumer behavior in favor of purchases of healthier food items (Sutherland et al. 2010; Nikolova and Inman 2015; Finkelstein et al. 2018; Surkan et al. 2016). Evaluations of some interventions in smaller store environments have also demonstrated positive impacts on sales as well as other outcomes measured such as knowledge attitude and intention to consume healthier foods (Gittelsohn et al. 2007; Gittelsohn et al. 2008; Gittelsohn et al. 2010; Ho et al. 2008; Escaron et al. 2013; Song et al. 2009; Foster et al. 2014).

Our intervention included a nutrition education component. While in our analysis we were unable to identify patrons in the sample who attended the extension workshops, the interventions were widely advertised in the stores and the surrounding communities and shoppers tended to be aware of ongoing store interventions. Thus, awareness campaigns rather than nutrition education is a more apt secondary classification of our interventions (Kristal et al. 1997; Martínez-Donate et al. 2015; Levy et al. 1985). Previous studies have documented the effectiveness of mass media campaigns on population-level purchase decisions for some food groups and the relative ineffectiveness of interventions consisting of just consumer education (Hartmann-Boyce et al. 2018; Escaron et al. 2013; Beckelman et al. 2020). This could explain the ambiguous impacts of extension education we observed. It is also possible that for observations in store A, Extension education captured the impact of enhanced awareness of the nutrition labels because Extension educators also discussed with program participants how the nutrition labels could be used to inform their purchase decisions. Another possibility is that rather than the impact of extension

education workshops, the coefficient on extension education captured the impact of the nutrition intervention campaigns at the community level if store patrons inspired by the campaigns chose healthier foods within their capacity.

Our results also suggest that it is easier to inspire changes than sustain them. The interventions were found to be more effective on occasional shoppers rather than regular patrons. Since occasional shoppers were observed on less than four occasions in the panel on average, the treatment effects on occasional shoppers may have captured the willingness among patrons to form new habits and eat healthier foods. These findings highlight the need for a more continuous community engagement process. Policies would be more effective in improving diet-related health outcomes if directed at both changing and then sustaining healthy dietary patterns. Continuous outreach and engagement activities such as inspection and monitoring visits by program staff and promotion activities to maintain customer demand are important to ensure that stores maintain the changes and to also reinforce new consumer trends (Gittelsohn et al. 2014). For rural America, this highlights the role that institutions such as the Cooperative Extension System and other established and resourceful institutions can play, along with local food pantries, community centers, and non-profit organizations. Such establishments have agents at the grassroots levels and institutional support to develop long-term engagement programs to help buyers to maintain new dietary habits.

The effectiveness of our interventions across different shopper types suggests that rural residents are interested in consuming healthier foods and are

willing to use the available resources and information to modify choices to the best of their ability. This is consistent with other recent findings based on non-rural samples that indicate consumers are not only willing to change their behaviors but are also willing to pay to make more informed choices (Balcombe et al. 2016; Hellyer et al. 2012). While some store owners are willing to offer a choice of healthier foods (D'Angelo et al. 2017), others are hesitant to do so due to lack of customer interest (Pinard et al. 2016). The effectiveness of our study interventions demonstrates to rural storeowners the demand for nutritious foods and nutrition information among their patrons.

Studies, particularly those that measure diet quality as an outcome, have found little or no impact of store interventions (Martínez-Donate et al. 2015; Lawman et al. 2015; Laska et al. 2019; Gittelsohn et al. 2014). It is possible that the overall diet quality of the shoppers in our study has also not increased significantly – as changes have occurred only in purchases made in the treatment stores, that these healthier purchases could be event-induced behavioral changes. It is possible that shoppers maintain their old food preferences and shopping habits when shopping in other grocery stores. If households' total food purchases are studied, the changes in food purchase patterns may not be statistically significant.

Finally, this study is one of the few intervention evaluations that was conducted with a robust evaluation design that included both a treatment and control group of stores. Reviews of store intervention evaluations have pointed out the dearth of good quality evaluation studies (Liberato, Bailie and

Brimblecombe 2014). Lack of solid evaluation designs such as small sample sizes or not having a control arm could explain the inability of previous evaluations to detect any treatment effects.

Concluding Remarks

In this paper, we evaluated the impact of two interventions designed to promote healthier food purchase patterns among the shoppers of locally-owned grocery stores in small rural communities that are designated as food deserts. One of the interventions was extension programming designed to provide nutrition education while the other was the introduction of succinct on-shelf nutrition scores that shoppers could use to make more informed choices.

We found that while the nutrition labeling intervention was effective at Store A and robust across models, the impacts of extension education were more ambiguous. Our analysis also suggested that the first intervention to be introduced was more likely to be successful and that the effects of the interventions wore off over time. It is thus easy to inspire changes, but long-term programs and continuous engagement are necessary to sustain changes. We also estimated the effects of the treatments on different types of shoppers and observed that all types of shoppers benefitted leading us to conclude that rural residents are interested in adopting healthier food consumption habits.

Although our study is one of the few studies to use an experimental design with both a treatment and control group, there are a few limitations to our study. First, the number of clusters in this study is relatively small and the significance

of the estimates is not robust to bootstrap tests for clustered standard errors. Secondly, we are unable to control for socioeconomic status and other demographic variables. It is possible that not everyone benefits equally from the treatment, but certain demographics are likely to use the labels more than others causing a selection bias. We also do not have data on exposure to the treatments as well as to what extent shoppers rely on the labels to make choices. Future studies would benefit from more holistic evaluations that can measure impact on sales at store levels but also, impact on different outcome variables such as household purchases and diet quality at an individual level.

Chapter 4: How is a SNAP dollar spent? Analysis of SNAP redemptions over the benefit month[10]

Summary

In this chapter, we first describe the time-variant nature of the Supplementary Nutrition Assistance Program (SNAP) redemptions at different store formats over the benefit month in the Minneapolis-Saint Paul metro area using a SNAP administrative dataset. Then, we study how increased benefits received due to an exogenous policy change were allocated across different store formats and over the benefit cycle. We confirm that the dollar amounts redeemed at different store formats fell over the benefit month. We also find that after the American Recovery and Reinvestment Act (ARRA), a disproportionately higher amount of additional benefits were redeemed at grocery stores. A small and steady amount of redemptions were made at convenience stores throughout the benefit month both before and after the ARRA.

Introduction

The Supplemental Nutrition Assistance Program (SNAP) formerly known as the Food Stamp Program is the largest federal nutrition assistance program in the United States (U.S.). The program supported 44 million people every month on average, increasing their cumulative annual food-at-home budget by 85 billion dollars in 2020 (Cunnyngham 2019; Kim 2016). The program has been credited with success in reducing food insecurity and poverty (Nord and Prell 2011; Van Hook and Balistreri 2006; Gundersen, Kreider and Pepper 2017; Gundersen

[10] This chapter was co-authored with Dr. Joel Cuffey and Dr. Hikaru Peterson.

2015). However, it has also evoked some debates. Firstly, the SNAP cycle, *i.e.*, the fall in food expenditures among SNAP recipients as the month progresses, has been well-documented (Wilde and Ranney 2000; Castner and Henke 2011; Hamrick and Andrews 2016; Tiehen, Newman and Kirlin 2017; Dorfman et al. 2019; Beatty et al. 2019), which has questioned the sufficiency of the benefits disbursed to participants. Secondly, high rates of obesity among SNAP participants have raised concerns about the quality of food purchased using SNAP benefits and caused people to question whether SNAP benefits in fact subsidize calorie-dense foods such as sugar-sweetened beverages (Gundersen 2015).

Understanding the store formats that recipients shop at over the benefit cycle could offer some explanation of the SNAP cycle as well as the diet quality of SNAP recipients. SNAP recipients are more likely to shop at easily accessible, alternate store formats such as convenience stores than the general population (Castner and Henke 2011). Typically, convenience stores offer limited product varieties especially of fresh produce and other healthy foods, and tend to be more expensive than grocery stores (Caspi et al. 2017; Sallis et al. 1986; Jetter and Cassady 2006; Blanchard and Matthews 2007; Alviola, Nayga and Thomsen 2013). Combined, we postulate one contributing mechanism to the SNAP cycle - when households shop more at convenience stores toward the end of the benefit month, higher prices and limited produce offerings would limit the quality and quantity of their food purchases.

Insights into where and how SNAP recipients shop also have policy

implications to promote consumption of sufficient and healthy foods throughout the SNAP benefit month. If inadequate food budgets drive the SNAP cycle and cause people to shop for food at alternate store formats such as convenience stores, then expanding the food budget could help to smooth consumption and direct SNAP redemptions from convenience stores that are more accessible but have fewer healthier varieties of foods, toward full-service grocery stores that offer a wider and cost-effective selection of healthier foods.

With this in mind, we first describe the redemption patterns of SNAP recipient households over the benefit month across different store formats using SNAP administrative data from the Minneapolis-Saint Paul Metro area in Minnesota from October 2007 to September 2010. The American Recovery and Reinvestment Act (ARRA) implemented during our study period increased the benefits disbursed to program participants and gives us an opportunity to tease out the impact of increased SNAP benefits that might otherwise be confounded with changes in the circumstances of households. Using this exogenous policy change, we then study how additional SNAP benefits are allocated across store formats and over the benefit month by estimating SNAP redemptions each week of the benefit month at four different store formats: full-service grocery stores, convenience stores, ethnic stores, and other stores. Our hypothesis is that the additional SNAP benefits will help to smooth consumption over the benefit month as well as direct dollars from convenience stores to full-service grocery stores.

Previous studies used randomized cash-out experiments from the early 1990s to examine the marginal propensity to consume SNAP-eligible foods

(MPCF) as an increase in food expenditure from food stamp and SNAP benefits versus cash pay-outs, but their findings were inconsistent (Fraker 1990; Fraker, Martini and Ohls 1995; Wilde, Troy and Rogers 2009; Moffitt 1989; Hoynes and Schanzenbach 2009). Besides, the SNAP program has evolved since then and the characteristics of participants also changed substantially (Kim 2016). More recently, after the ARRA was implemented, studies unanimously established the increase in food expenditure of SNAP-recipient households due to the increase in benefits allocated to participants (Nord and Prell 2011; Beatty and Tuttle 2015; Hastings and Shapiro 2018). Kim (2016) extended this literature further in one direction by examining the change in expenditure across different consumption baskets as a result of the ARRA-induced increase in benefits. We extend this literature in another direction by examining how the additional benefits were distributed over the benefit month and to different store formats.

The contributions of this paper to the existing literature can be summed as follows. Firstly, we use a unique dataset to describe the time-variant nature of redemption patterns across different store formats for all SNAP recipient households in the Minneapolis-Saint Paul Metro area in Minnesota. Secondly, we use an exogenous policy change to identify how households distributed the additional SNAP benefits received. We break down this increase in redemptions resulting from ARRA into store formats and over the benefit month with the goal of understanding whether their store format choices or temporal redemption patterns changed because of the increased food-at-home budget.

Our findings confirm that the dollar amounts redeemed at different store formats declined as the benefit month progressed both in the pre and post-ARRA period. We also found that a disproportionately higher amount of additional benefits were redeemed at grocery stores; out of each additional dollar of weekly amounts redeemed, about 70 cents were redeemed at grocery stores. A small and steady amount of redemptions were made at convenience stores throughout the benefit month both before and after the ARRA.

The rest of the paper is organized as follows. The next section presents an overview of the SNAP cycle and food shopping behavior of low-income households. We then describe the unique SNAP administrative dataset and the empirical methods used. We end with a discussion of the results and concluding remarks.

Background

SNAP is administered by the USDA in collaboration with state and local social service agencies to alleviate hunger and malnutrition (Yaktine and Caswell 2013). To be eligible to receive SNAP benefits, a household's gross monthly income should be less than 130% of the Federal Poverty Guideline (FPG) and net income 100% less than the FPG. Some states unlike Minnesota also have asset limits. Benefit levels are determined in accordance with the Thrifty Food Plan (TFP) such that benefits roughly equal the difference between the cost of food according to the TFP (which is the same as the maximum benefits a household can receive) and 30% of the household's income net of exemptions

such as dependent care costs and child support (Tuttle 2016)[11]. It is assumed that households will allocate 30% of their income to food, and SNAP benefits will cover the remaining cost of food for the households. The benefits are disbursed at the same time each month, via an Electronic Benefits Transfer (EBT) card, which functions like a debit card. The EBT card can be used at SNAP authorized retailers to purchase food items. Each state decides the monthly distribution schedule. Some states disburse benefits to all households simultaneously at the beginning of the month, while other states stagger disbursal of benefits through the month. In Minnesota, SNAP benefits during our study period were distributed between the 4th and the 13th day of the calendar month (Castner and Henke 2011). After receiving the disbursed benefits, each household has one month until the next payment allowing us to observe the monthly SNAP cycle, *i.e.*, the fall in food expenditures among SNAP recipients as the month progresses.

The SNAP cycle

The SNAP cycle is directly associated with an increase in food insufficiency, *i.e.*, increased levels of food insecurity and a fall in diet quality. Food insecurity among SNAP recipient families is not constant throughout the month but increases in the last two weeks of the benefit month with both food insufficiency and stress related to food being higher in the second half of the month (Gassman-Pines and Schenck-Fontaine 2019). SNAP participants were increasingly more likely to report an entire day of not eating over the benefit

[11] Benefits received by household of size *n* = Maximum benefit level for household of size n based on estimates of the TFP – 0.3*Net household income.

month cycle with the odds of SNAP recipients not eating on an average day being 1.56 more than non-recipients (Hamrick and Andrews 2016). This is also reflected in the official measures of food security. The probability of being classified as food insecure increased by 11 percentage points for SNAP households that completed the 30-day food security module near the end or at the beginning of the benefit month (Gregory and Smith 2019).

The related decrease in diet quality as measured by the Healthy Eating Index (HEI) has also been documented (Kharmats et al. 2014; Kuhn 2018; Whiteman, Chrisinger and Hillier 2018). After controlling for covariates, the total HEI scores of households in the final 10 days of the benefit cycle were 2.95 points lower than all other SNAP households (Whiteman et al. 2018). Although expenditure fell across almost all food groups including fruits, vegetables, sugar-sweetened beverages, poultry, red meat, and convenience foods (Franckle et al. 2019), the deterioration in diet quality was mainly attributed to a reduced intake of fruits and vegetables (Kharmats et al. 2014; Whiteman et al. 2018; Sanjeevi and Freeland-Graves 2019).

Households rely on several different strategies to cope with the ‘end of the month’ period. Reliance on school meals is a popular coping mechanism among households with school-age children (Laurito and Schwartz 2019), which in part is credited for reducing the effects among school-age children (Kuhn 2018). Other coping mechanisms include emotional resilience and relying on social support, modifying food shopping behaviors, and modifying eating patterns, *i.e.*, skipping meals and relying on energy-dense foods (Kinsey et al. 2019).

Food shopping practices of low-income households

Research that examines the food shopping practices of low-income households has highlighted shopping patterns. Full-service grocery stores account for most of the food purchases. Eighty-nine percent of SNAP-recipient households in National Household Food Acquisition and Purchase Survey (FoodAPS), a nationally representative survey of American households to collect data about household food purchases and acquisitions conducted in 2012-13, did their primary grocery shopping at supermarkets or supercenters. Their preferred grocery store in urban areas was 3.26 miles away from their residence on average, although the closest SNAP-authorized grocery store was 1.88 miles away (Ver Ploeg et al. 2015). Analysis of the SNAP Food Security Survey (SNAPFS 2011-12) found similar results; in urban areas, the median commute time to grocery stores was 10 minutes and the median distance commuted was three miles (Mabli 2014). A third of SNAP-recipient households in the FoodAPS could not commute to the grocery store in their own car (Mabli 2014; Ver Ploeg et al. 2015). They relied on courtesy rides, borrowed vehicles, public transportation, walking, or biking to visit grocery stores (Castner and Henke 2011; Mabli 2014).

Given the transportation challenges they face (Clifton 2004; Burns et al. 2011; Marshall and Pires 2017), factors such as store location, time and distance traveled to go to the store, and ease of access are important determinants of store preferences (Chenarides and Jaenicke 2018; Mabli 2014; Gustafson et al. 2013; Marshall and Pires 2017; Taylor and Villas-Boas 2016; Solgaard and Hansen 2003; Bonfrer and Gustafsson-Wright 2017). Gustafson (2017)

demonstrated that SNAP-recipient households who had a supercenter (or a supermarket) within a one-mile radius of their residence were more likely to shop at supercenters (or supermarkets) relative to those who did not have a supercenter (or supermarket) within a one-mile radius. Marshall and Pires (2017) demonstrated that convenience of location or travel costs drove store choice, rather than prices or product variety. Taylor and Villas-Boas (2016) found that households represented in the FoodAPS were willing to pay $2.50 per week to have a superstore one mile closer to their home, and $2 per week for a fast food outlet to be one mile closer to home.

Limited access to grocery stores reinforces the reliance of SNAP recipient households on neighborhood and convenience stores making them an important and integral part of retail food establishments that low-income households rely on. Small grocery and convenience stores help to mitigate adult food insecurity (Bonanno and Li 2015). Nationally, 15.1% of total SNAP redemptions took place at convenience stores and another 11.2% of the redemptions were recorded at grocery stores other than supermarkets and supercenters in 2009 (Castner and Henke 2011). Ease of access was also one of the main reasons for the popularity of small food retailers such as corner stores, gas-marts, dollar stores, and pharmacies in a study conducted in Minneapolis and Saint Paul, Minnesota, with 29% of the participants shopping at such stores at least once a day and an additional 44% at least once per week (Caspi et al. 2017). Feather (2003) hypothesized that larger stores do not exist in the inner city, deterring food stamp recipients from shopping there. He found that if redemptions of food stamps were

restricted to superstores and other grocery stores, the losses in welfare would range from $4.16 to $8.78. Restricting redemptions to supermarkets and supercenters and excluding other grocery stores such as neighborhood stores would result in an even more significant loss ranging from $9.78 to $20.32 per month. In all scenarios, female-headed households and persons not owning automobiles would be the most severely affected.

Few scholars have explored how food shopping behaviors change over the benefit month or what transpires at the end of the month. These studies suggest that shopping trips of SNAP recipients differ depending upon the timing within the SNAP cycle. According to Damon et al. (2013), low-income households in early SNAP distribution areas decreased their big grocery store expenditures at the end of the calendar month and supplemented it with increased food expenditures in convenience stores and food away from home. The authors suggested that households shopped at grocery stores earlier in the benefit cycle to stock up for the month and then did convenience store runs for fewer food items later in the month. Results of another qualitative study supported their findings. Study participants in focus groups indicated that the first shopping trip after receiving benefits was reserved for stocking up essentials and the following trips were made for items such as sauces, condiments, and treats for children to meat marts and corner stores. Their participants also reported buying inexpensive, calorie-dense foods to fill them up toward the end of the month when they were running out of money (Kinsey et al. 2019).

The ARRA

The American Recovery and Reinvestment Act (ARRA) was signed into law in 2009 to give a boost to the economy during the Great Recession (Kim 2016). Commonly known as the Stimulus Act, it allocated nearly $20 billion to SNAP and enabled the program to increase administrative funding, eliminate time limits on participation, expand eligibility for jobless adults, and increase the maximum monthly benefits that participants could receive (Tuttle 2016). Implemented on April 1, 2009, monthly SNAP benefits received by program participants increased by 13.6% so that a family of four received an additional $80 per month increasing their maximum monthly benefits to $668 (Kim 2016; Tuttle 2016). This was the largest benefit increase since the program was initiated (Kim 2016).

The ARRA gave researchers a unique opportunity to measure how participants respond to changes in benefit levels. The increase in benefit levels reduced the SNAP cycle in daily dietary intake and also helped to smooth consumption (Todd 2015; Todd and Gregory 2018). This is illustrated by the fact that caloric intake declined as much as 25% at the end of the month before ARRA, but not after implementation (Todd 2015). Scholars also used this policy change to establish that SNAP benefits are not fungible even for infra-marginal households, *i.e.,* households that spend an amount greater than their SNAP allotment on household food purchases. Thus the food-at-home expenditure of SNAP recipient households increased disproportionately more when given additional SNAP benefits instead of cash pay-outs (Beatty and Tuttle 2015;

Hastings and Shapiro 2018; Tuttle 2016). Tuttle (2016) found that SNAP households increased food expenditure after the increase in benefits spending 53 cents of each additional dollar of SNAP benefits on food and that households with the lowest income, single-parents, unemployed, or children exhibited higher MPCF out of SNAP benefits. Other studies also confirmed the increase in MPCF resulting from ARRA-inspired increase in benefits and placed the MPCF around 0.5 (Beatty and Tuttle 2015; Hastings and Shapiro 2018). They confirmed that MPCF out of SNAP benefits was much higher compared to the MPCF out of cash pay-outs. Kim (2016) found that non-food consumption of households also increased in response to the ARRA-induced increase in SNAP benefits suggesting the spill-over effects also increased the overall welfare.

In this paper, we bring together these different strands of literature by describing the redemption patterns over the benefit month and investigating how SNAP participants allocate additional benefits across store-formats and over the SNAP benefit month. We expand on Damon et al. (2013) by confirming a relationship between store-format choice and the SNAP cycle among SNAP recipient households and then extend the literature on the effects of additional benefits on SNAP redemptions. Determining how low-income households redeem their benefits over the benefit month will help to understand the role that different store formats play in the retail food system low-income households operate in.

Data

We used three SNAP administrative datasets: household enrollment and verification, SNAP disbursements, and SNAP redemptions for the Minneapolis-Saint Paul Metropolitan region from October 2007 to September 2010. The enrollment and verification data including the age and racial composition, car ownership, and mailing address of households were updated routinely during the recertification process to confirm the client's eligibility to continue receiving benefits. We matched these with the date and amount of SNAP benefits disbursed every month and the redemptions data that included the dollar amount, store name and address, and timestamp of all SNAP redemptions.

We define each household's benefit month to begin on the day SNAP benefits are issued to the household (day 0) and end on the day before next month's benefits are issued. Redemptions occurring between these days are assigned to that benefit month. We match each benefit month's redemption data with the household benefit disbursement date allowing us to observe how quickly and at what stores households redeem their benefits throughout the benefit month until the next issuance of benefits.

Using the benefit issuance date and each redemption date, we calculated the number of days since issuance each redemption occurred. For each household, week 1 contains all the redemptions between days 0, *i.e.*, the day SNAP benefits were issued and day 6, week 2 contains all the redemptions from day 7 to 13, week 3 contains all redemptions occurring between days 14 and 20, and week 4 contains all redemptions occurring on day 21 and later. For each

week, we calculate the total amount of benefits that the household redeemed at each store format.

We used the store names in the redemptions data and other publicly available information about the store to classify food purchases of households into four different store formats: grocery stores, convenience stores, ethnic stores, and other stores. We defined grocery stores to include full-service grocery stores such as mass merchandisers, supermarkets, supercenters, small and large grocery stores, and discount stores. Convenience stores include pharmacies, gas marts, and dollar stores. Asian, Hispanic, and East African stores were classified as ethnic stores. Other stores include specialty stores, meat marts, fruit and vegetable markets, cooperatives, butchers, bakeries, farmers markets, stores outside Minnesota, and everything else that was not included in the first three categories.

To quantify access to store formats, we geocoded all the store and household addresses and created a series of indicators for whether the household had a convenience and grocery store within a half, one, and 1.5-mile radius of their mailing address. We were able to geocode 97% of the household addresses and all the stores in our study area. Stores that could not be geocoded included some out-of-state stores and stores on reservations. In urban areas, straight-line distance may not be an appropriate measure of how difficult it is to get to a store. To investigate this, we used ArcGIS Network Analyst to calculate the driving time between the household and store address for a random selection of 1,000 household-store pairs from the data. The correlation coefficient

between driving time and straight-line distance was 0.98. Given the close correlation between the two, we use straight-line distance to measure store access. It is also possible that shoppers do grocery stops en route to or from places other than their homes, suggesting distance between the residence and retail establishment is not an accurate measure of store access. However, a vast majority of SNAP recipients (94%in a nationally representative dataset of SNAP-recipient households) went grocery shopping directly from home (Mabli 2014).

Finally, we calculate the additional benefits that each household received as a result of the ARRA increasing their food-at-home budget. Using household size and net income, we estimated the benefits households would have received under the pre-ARRA policy regime and subtract this amount from the benefits they received post-ARRA. The increase in benefits thus calculated were received due to an exogenous policy change and not due to changes in the household's circumstances such as income or household size.

We restricted our sample to households residing in urban census tracts. Due to uncertainty in the household's location relative to stores, we excluded households that updated their mailing addresses, ever had a homeless person or did not have a geocodable address. We also dropped households that reported a change in income after benefits were issued in a month and were thus issued benefits a second time in the same calendar month. Finally, we also dropped households who added or lost family members or reported a change in address during the study period from the analysis. The final dataset contained 486,101 household-month-week observations from 53,833 unique households during a

31-month period (Cuffey 2018). These administrative data are discussed in detail in Cuffey (2018).

Empirical methods

In this section, we detail our empirical strategy. We first model households' weekly redemptions at different store formats as a function of the week of the benefit month relative to week 1, an indicator for the post ARRA period, and an interaction between week of benefit month and the new policy regime. Next, we model households' weekly redemptions at different store formats as a function of increase in benefits received due to the ARRA (*ARRAbenefits*) and other control variables during each week of the benefit month. These models are presented in the equations below.

$$y_{hitf} = \alpha + \sum_{i=2}^{4}(\delta_{wki} weeki_{ht}) + \delta_A postARRA_t + \sum_{i=2}^{4} \delta_{wkipA} * weeki_{ht} * postARRA_t + \mathbf{X\beta} + \Upsilon_t t + \Upsilon_h h + \epsilon_{hit} \quad \text{for } f = G, C, E, O \quad (1)$$

$$y_{hitf} = \alpha + \delta_{Abi} ARRAbenefits_{ht} + \mathbf{X\beta} + \Upsilon_t t + \Upsilon_h h + \epsilon_{ht} \quad \text{for } f = G, C, E, O \text{ and for } i = 1 \text{ to } 4 \quad (2)$$

$$w_{hitf} = \alpha + \delta_{Abi} ARRAbenefits_{ht} + \mathbf{X\beta} + \Upsilon_t t + \Upsilon_h h + \epsilon_{ht} \quad \text{for } f = G, C, E, O \text{ and for } i = 1 \text{ to } 4 \quad (3)$$

We use regression models with household and time fixed effects to estimate the models presented in the above equations. The outcome variable in Equations (1) and (2) is the dollar amount redeemed by household *h* at store format *f* in *week i* of the benefit month in calendar month-year *t* (y_{hitf}). In Equation

(3), the outcome variable is the percentage of dollars redeemed at the given store format during the week of the benefit month, *i.e.*, y_{hitf} divided by the total SNAP dollars redeemed by household *h* in week *i* of the benefit month multiplied by 100. The four store formats we estimate the equations for are grocery stores (*G*), convenience stores (*C*), ethnic stores (*E*), and other stores (*O*). We estimate the models presented in Equation (1) separately for each store format and Equations (2) and (3) separately for each store format and for each week of the benefit month. In Equation (1), our variable of interest is $weeki_{ht.}$, which takes the value 1 for all observations during *week i*, with the first week of the benefit month (days 0-6) omitted as a reference week; *postARRA*, which is a dummy variable equal to one for all observations after the ARRA was implemented; and an interaction between *weeki* and *postARRA.* In Equations (2) and (3), our variable of interest is *ARRAbenefits*, which is the additional SNAP benefits that program participants received due to the ARRA.

X is a vector of control variables. It controls for the presence of grocery and convenience stores within half, one and 1.5 miles around the household's residence. It also includes household income net of SNAP exemptions (i.e., income used to determine eligible benefits), dummy variables for zero-income households, whether a household owns one car or more than one car, size of the household, presence of household members who are white, black, below the age of 18 and above the age of 65, and households with single parents. In addition to time-invariant and time-variant household controls in **X**, we also control for a

linear time trend with month-year fixed effects (*t*). The parameters to be estimated are *α, β, δ,* and *γ*.

The parameters of interest in this study are *δ*. In Equation 1, δ_{wki} captures differences in weekly SNAP redemptions, relative to the first week of the benefit month, δ_A captures the additional redemptions in the first week of the post ARRA period relative to the first week of the benefit month in the pre ARRA period, and δ_{wkpAi} captures the redemptions in *week i* at store format *f* in the post ARRA period relative to the first week of the benefit month in the post ARRA period. In Equations (2) and (3), δ_{Abi} captures the amount or percentage of SNAP dollars redeemed at store format *f* during week *i*, after controlling for observable household differences, from the exogenous increase in SNAP benefits received by the household.

Results

We first describe the demographic characteristics of the households and descriptive statistics for the key variables used in the estimations in Table 4.1. The mean size of SNAP-recipient households was 2.04 persons. Single-parent households comprised 21% of the sample. On average, 38% of households had children below the age of 18. In contrast, 11% of households had seniors above the age of 65. Fifty percent of households had at least one white person and 35% had at least one black resident. Car ownership stood at 36% with households owning on average 0.45 cars. Twenty-three percent of the households had a grocery store within half-mile of their house, 62% had a grocery store within a mile, and 89% within 1.5 miles of their house. In contrast, the percentages for

convenience stores in half, one and 1.5 miles around their homes were 64%, 86%, and 93%. The mean monthly income net of SNAP exemptions was $396.47, the income distribution was skewed with 27% zero-income households or households having no other source of income. The mean income of households that had another source of income (non-zero-income households) was $542.83.

The mean benefits received and redeemed per month were $219.57 and $219.26, respectively. The amount and percentage of household redemptions at the different store formats by week are presented in Table 4.2. The mean redemption in the first week of the benefit month was $127.34 and by the end of the month (week 4) dropped to $18.20. The mean redemptions at grocery stores fell from $95.95 in week 1 to $13.64 in week 4. The weekly redemptions at convenience stores fell from $7.66 to $1.19 over the benefit month. The difference in mean redemptions before and after the ARRA at different store formats over the benefit month is also presented in Table 4.2. After the ARRA was implemented, households received an additional $67.54 per month and redeemed on average $59.95 additional benefits per month. After the ARRA was implemented, the dollars redeemed over the benefit month at all store formats increased significantly with the increase being highest at grocery stores in week one at $20.90. The difference in mean redemptions in the four weeks of the benefit month was $27.80, $14.01, $10.20, and $7.94.

In the first week of the benefit month, 75% of the benefits redeemed are at grocery stores, 7% at convenience stores, 13% at ethnic stores, and 3% at other

stores. The distribution of benefits redeemed at different store formats changes in the second week of the benefit month with the benefits redeemed at grocery stores decreasing to 71% and redemptions at convenience stores increasing to 12%. This distribution remains relatively stable throughout the rest of the benefit month.

In Table 4.3, we present the estimation results for Equation (1). Each column represents the estimates of the equation for a different store format. The outcome variable in Table 4.3 is the amount in dollars redeemed each week at different store formats. Robust standard errors clustered by household are reported in parenthesis. While the total redemptions fall by $74.08 in week two relative to week one, the redemptions at grocery stores reduce by $56.71 and that of convenience stores and ethnic stores reduced by $3.96 and $10.80 respectively. In week 3 and week 4 the total redemptions were $91.33 and $98.74 less than week one respectively. At grocery stores, the fall was $69.05 and $74.44 in weeks 3 and 4. At convenience stores, the fall was around $5 each of the two weeks. The redemptions at ethnic stores dropped by about $10.82 in week 2 and by around $14 in both week 3 and 4 relative to week 1, while at other store formats the redemptions dropped by about $3 relative to week one in all the consequent weeks.

In the post ARRA period, redemptions at all store formats increased significantly with households redeeming $20.88 more in the first week of the benefit cycle after the ARRA was implemented than the pre-ARRA period. We also observe that benefits redeemed increased significantly at all store formats

after the ARRA was implemented. We also observe that the SNAP cycle continues to persist with redemptions in the following weeks declining compared to the first week of the benefit month in the post-ARRA period, but the decline is less steep indicating that households attempt to smooth their consumption by allocating additional dollars to all consequent weeks of the benefit month. So, for instance, in the second week of the benefit month in the post ARRA period, households redeem $13.46 less than the additional amount redeemed in the first week of the benefit month in the post ARRA period which is $20.88, *i.e.,* households redeem an additional $7.42 ($20.88 - $13.46) in the second week of the benefit month in the post ARRA period.

In Table 4.4, we present the estimation results (point estimates and standard errors) for Equations (2) and (3). Each coefficient is obtained from a different model specific to the week and store format. We observe that the additional benefits redeemed at all store formats over the benefit month due to the new policy regime were significantly different from zero. Out of every additional dollar received in benefits received, 35 cents were redeemed in week one with 24 cents going toward purchases at grocery stores, around 3 cents each towards convenience, ethnic, and other store formats. We observe that in week two out of the 15 cents that were redeemed per additional dollar, 10 cents went to grocery stores, and an additional one to two cents were redeemed at other store formats. Out of the additional benefits received, an additional 13 and 11 cents were redeemed in weeks three and four with nine and seven cents of these being redeemed at grocery stores respectively. The additional dollars that

went toward other store formats in the third and fourth week of the benefit month ranged from less than one to two cents. Since on average, households in our sample received an additional $67.54 and redeemed 35 cents out of every additional dollar in week one, they redeemed about $23.64 (67.54 * 0.35) more in the first week of the benefit month post ARRA.

The additional dollars were not evenly distributed across different store formats. The percentage of benefits redeemed at grocery stores increased while the percentage of benefits redeemed at ethnic stores decreased every week of the benefit month as result of the increase in benefits received. The percentage of benefits redeemed at convenience stores remained unchanged. In the first week of the benefit month, for every dollar increase in benefits received due ARRA, the percentage of benefits redeemed at grocery stores increased by 0.0085 percentage points. This means that on average, the increase in benefits due to ARRA cause the percentage of benefits redeemed at grocery stores in week one to increase by 0.57 percentage points (67.54 * 0.0085). The increase in the subsequent weeks was 0.0048, 0.0069, and 0.0049 points in weeks two, three, and four for every additional dollar received respectively. The redemptions at other stores increased in weeks two and three respectively but remained unchanged (were not significantly different from zero) in the last two weeks of the benefit month. The percentage of benefits redeemed at ethnic stores decreased by 0.01 percentage points in the first week, and by 0.0071, 0.0060, and 0.0067, respectively, in the consequent weeks.

Concluding discussion

In this paper, we measured the extent to which the store formats where SNAP recipient households redeem benefits changed over the benefit month. We first described the redemption patterns of SNAP recipient households over the benefit month across different store formats, and then studied how additional SNAP benefits were allocated across store formats and over the benefit month at four different store formats – full-service grocery stores, convenience stores, ethnic stores, and other stores – using an exogenous policy change (ARRA) that increased SNAP benefits distributed to households.

Our results highlight a few facts about the food shopping behavior of the study population. We found benefits redeemed in dollars progressively decreased at all store-formats over the benefit month. After the ARRA was implemented, additional benefits received as a result of exogenous policy changes increased redemptions statistically significantly across store formats and throughout the benefit month. Our results suggest increasing the benefits disbursed to SNAP recipient families not only will increase the food budgets of households but will more importantly increase their redemptions at full-service grocery stores where they can access healthier varieties of foods.

We also observed that a small but significant portion of the additional benefits received by participants were redeemed at convenience stores. Nationally about 10% of SNAP redemptions in 2009 took place at convenience stores, and small and large grocery stores excluding supermarkets and supercenters each. Other studies that have demonstrated reliance on small and

neighborhood food retailers among low-income households include Feather (2003), Caspi et al. (2017), and Marshall and Pires (2017). These findings taken together suggest that policymakers would increase overall welfare among SNAP recipients and other low-income households by not only increasing their food budgets but also by decreasing their food procurement costs. One way to achieve this goal would be to reimagine the role of neighborhood stores to serve the communities they are located in. This could include programs such as the Pennsylvania Fresh Foods Initiative that incentivize new and existing grocery stores to offer healthier foods such as produce and dairy, invest in low-income neighborhoods, and create jobs locally. Such programs will not only improve access to nutritious foods and enhance food security but also promote investment and build community in low-income neighborhoods.

Finally, the study has some limitations. We were unable to observe the quality of food purchased by recipients. Data also were limited, so we could not take into consideration the other sources of income of SNAP recipient households and the food expenditures of households incurred using income or benefits other than SNAP benefits. Future research could be directed to study the composition of foods purchased with the additional benefits.

Chapter 5: Conclusion

This research highlighted the non-monetary challenges low-income households face when they navigate retail food establishments as well as the informal mechanisms and behaviors adopted to overcome these challenges.

In the first essay, I assessed food insecurity and social capital in the Somali community in the Midwest and then examined the relationship between social capital and food security in the community. I confirmed that food insecurity was high in the study population and that objective social capital measured as the size of the ethnic community mitigated food insecurity. The impacts of cognitive social capital measured as perceived community support and bonding social capital measured as informal interaction with community members were ambiguous. Structural capital measured as membership in organized groups did not mitigate food insecurity in the community.

While collecting data for the first essay I observed the camaraderie, food, and other resources shared in the Somali community, as well as the challenges they face. For instance, a mother who came grocery shopping with her three toddlers ran in the mall and found someone to wait in the car with the children so she would not have to manage them in the store and buckle them back in the car seats for the ride home. I also noticed the role Somali malls, restaurants, and grocery stores play in the community. For some women, going to the grocery store, mall, or ESL classes was not just an errand but an opportunity to get together and catch up with their friends. Since new immigrant communities such as the Somali community tend to be close-knit, understanding the extent to which social

capital can help mitigate food insecurity can provide some evidence necessary to encourage policy geared toward addressing food insecurity at a community level instead of individual or household levels.

In the second essay, I evaluated the impact of interventions designed to increase the nutrition awareness of grocery shoppers in two locally-owned grocery stores in rural Kansas. The study focused on the impact of succinct nutrition labels displayed on the shelf and nutrition education workshops conducted by university extension educators on the food purchase patterns of shoppers. We found the nutrition labeling intervention to be successful in enhancing the nutritional quality of food purchases primarily in Store A where it was the first intervention to be introduced but the effects faded over time. The impacts of extension education programming were more ambiguous. Our findings suggest that rural households are interested in consuming healthier foods and respond to information made available to do so, but uninterrupted community engagement is necessary to sustain the behavior modifications in the long run.

In the third essay, I studied how the redemptions of SNAP recipient households changed across different store formats over the SNAP benefit month. We confirmed that both before and after the ARRA, the dollar amounts redeemed at different store formats fell over the benefit month and although a large percentage of benefits were redeemed at grocery stores, a small amount of redemptions were made at convenience stores. We also found that after the ARRA, a disproportionately higher amount of the additional benefits were

redeemed at grocery stores. Our findings suggest that SNAP recipient households prefer to (and redeem) most SNAP dollars at grocery stores but they also rely on convenience stores. Different store formats are important to low-income households for different reasons at different times. Rather than focusing policies to promote grocery store usage by restricting food establishments permitted to accept SNAP benefits or disbursing payments multiple times a month to smooth consumption, it would be beneficial to incentivize neighborhood and convenience stores to make healthier foods more accessible to low-income households. This project reinforced the importance of neighborhood food stores.

My doctoral research reminded me that societies are built and sustained around food, and community-owned and local grocery stores are not just food access points but can be harnessed to play a much larger role in general. Rural grocery stores are crucial to revitalize small towns and keep them from dying. Ethnic grocery stores serve as a space for community members to get together. Neighborhood stores serve as crucial food access points to SNAP recipient households when they cannot go to a supermarket or supercenter. Additionally, these alternate food stores (retail food channels other than supermarkets and supercenters) boost local economic activity, cultivate social ties, and can also instill a sense of community pride and identity.

The non-monetary challenges highlighted in my dissertation also suggest that cash transfer programs such as SNAP are indispensable, but other creative community responses also contribute toward enhancing food security and resiliency of communities. Some current programs such as SNAP education

programs that equip SNAP recipients with tools to get the best value for SNAP dollars or the Pennsylvania Fresh Foods Initiative that was designed to attract grocery stores to underserved communities help to address the non-monetary challenges to some extent.

This dissertation paves the way for two research themes to address in future work. First, future research can investigate the complementarity of community responses to retail food systems and their success in addressing food insecurity. Second, future research can explore broader definitions and measurements of concepts such as food security. For instance, a more holistic measurement of food insecurity would encompass both food and nutrition sufficiency and account for insecurity stemming from the non-monetary barriers low-income households face and the hidden costs they impose.

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Table 2.1: Sample characteristics

Variable	Mean	Std. dev.	Sample size
Household			
Household income below $22,000 (Y/N)	0.47	0.50	225
Number of employed adults (persons)	1.56	1.36	239
Households with no employed adult (Y/N)	0.18	0.38	239
Car ownership (Y/N)	0.89	0.32	245
Alternate mode of transportation used (Y/N)	0.20	0.40	245
Number of cars owned	1.74	1.06	245
Home ownership (Y/N)	0.09	0.29	244
Section 8 housing (Y/N)	0.33	0.47	237
Number of residences in the last 3 years	1.82	0.87	240
Rent ($/month)	720.92	290.87	211
Number of rooms in residence	3.55	1.58	240
Household size (persons)	5.22	2.47	245
Secondary migrant household (Y/N)	0.72	0.45	244
Primary income earner			
No formal schooling (Y/N)	0.28	0.45	245
English proficiency (1-5 scale: 1 least proficient)	2.95	1.12	245
Age when enumerated (years)	39.34	12.67	240
Number of years in the U.S.	8.59	5.91	239
Female (Y/N)	0.42	0.49	233
Food security			
Sufficient and satisfactory food* (Y/N)	0.90	0.30	241
Stretched food or food money** (Y/N)	0.24	0.43	235
Used SNAP at least once in past year (Y/N)	0.58	0.49	245
SNAP benefit received ($/month)	502.48	258.79	169
Used SNAP throughout past year (Y/N)	0.41	0.49	245
Children received school meals (Y/N)	0.62	0.49	242
Difficult to talk to staff at the grocery store (Y/N)	0.27	0.44	245
Difficult to find time to go to the grocery store (Y/N)	0.24	0.43	246
Inconvenient to travel to the grocery store (Y/N)	0.17	0.37	245
Social capital			
Objective social capital (OSC)	0.70	0.44	245
Perceived community support (PCS) factor score	0.04	0.88	245
Informal interaction in community (IIC) factor score	-0.03	0.88	229
Organized group membership (OGM) item count	2.86	1.42	245

* Households that affirmed they had 'enough of the kinds of foods they wanted to eat'

** Households that agreed that they ‘ran short of money to buy food and tried to make food or food money last longer’

Table 2.2: Food security score distribution

Food insecurity Index	Weighted sample (%)	Mean (Rasch food security score)	Std. dev.	Sample size
Food Secure (0)	40.3	3.75	0.00	101
Marginally food secure (1-2)	37.3	2.98	0.20	78
Low food security (3-5)	17.6	2.07	0.23	51
Very low food security (6-10)	4.7	1.32	0.18	15
Total	100	3.05	0.74	245

Table 2.3: Awareness and usage of food resources

	SNAP	WIC	Food pantries	Other*
	------Percentage of households------			
Don't know this program/resource	6.00	15.50	44.30	46.06
Eligible or aware but not used	6.10	9.80	40.10	45.55
Used in the last 12 months	62.80	36.60	15.70	8.39
Know the program but don't know if we are eligible	1.50	3.40		
Know the program but not eligible	23.60	34.60		
Total	100	100	100	100

*Other includes meals-on wheels, soup kitchens and senior homes

Table 2.4: Objective social capital

Location	County	**Refugees from Somalia rehabilitated from 2002 -2017	**Persons of Somali ancestry and persons who speak Somali in county	Proportion of persons of Somali ancestry and persons who speak Somali in county	Number of Somali grocery stores
Mankato*	Blue earth and Nicollet, MN	0.11	1.41	1.53	7
Grand Forks*	Grand Forks, ND and Polk, MN	0.19	1.00	1.11	2
Des Moines	Polk, IA	0.52	1.50	0.70	6
Omaha	Douglas, NE	0.59	1.08	0.23	4
Fargo-Moorhead	Cass, ND	0.74	1.34	0.84	5
Rochester	Olmstead, MN	0.96	2.27	2.01	5
Saint Cloud	Sterns, MN	1.64	3.39	5.06	13

*Population of Somali ancestry could not be obtained, so the number of persons speaking language other than English, Spanish, other Indo-European and Asian used as a proxy.

** Divided by 1000

Table 2.5: Subjective social capital

Item (Y/N)	Mean	Std.dev.
Perceived community support (PCS)		
People in our community are willing to help each other.	0.88	0.33
I could borrow $30.00 in an emergency from a friend or family.	0.85	0.36
People in our community can be trusted.	0.84	0.37
People in our community generally get along well with each other.	0.75	0.43
If I were sick, I could count on my friends and family to buy groceries for me.	0.74	0.44
If I were sick, I can count on friends and family to bring us meals.	0.74	0.44
Our community is close-knit, and people generally know one another.	0.72	0.45
People in our community share the same values.	0.65	0.48
Our community leaders talk to us about adapting to life in the United States.	0.57	0.50
I can sometimes get ingredients such as milk and spices from our neighbor if I run out.	0.56	0.50
I can usually get forms filled / paper work done from teachers at the ESL class, community navigators or friends or children who can read and write.	0.52	0.50
We have a credit account with a grocery store to get essentials on credit.	0.48	0.50
I know older Somali women who don't work and watch my children when necessary.	0.33	0.47
Informal interaction with community at least once a week (IIC)		
See or hear from them whether in-person or otherwise	0.63	0.48
Stop for a cup of tea or coffee at the Somali / halal store or restaurant	0.49	0.50
Give each other a ride to the grocery store	0.42	0.49
Get together for a meal	0.31	0.46
House sit for each other	0.22	0.42
Watch each other's children	0.21	0.41
Lend each other things such as garden or house tools, clothes, jewelry, utensils	0.18	0.39
Send or receive money or pay bills for each other	0.14	0.34
Organized group membership (OGM)		
ESL, citizenship or job readiness classes	0.83	0.37
Regular attendance at the mosque or Quran classes	0.65	0.48
Cultural organization such as Somali student / youth or women's organization	0.27	0.45
A school group such as PTA/PTO	0.20	0.40
A church, synagogue, mosque, or other religious institution or organization, not counting your attendance at regular religious services at the mosque	0.20	0.40
A sports or recreation organization such as a soccer club or tennis club	0.16	0.36
A neighborhood, or community association like neighborhood watch group	0.14	0.35
Social events with coworkers outside of work or events organized by the employer.	0.11	0.31
Community gardens	0.09	0.29
Hobby class, such as sewing and crafts	0.07	0.26
A service or civic organization such as American Legion or Lions Club	0.04	0.21

Table 2.6: Relationship between different types of social capital

	(1) PCS	(2) IIC	(3) OGM
Perceived community support (PCS)		-0.041	0.168
		(0.114)	(0.271)
Informal interaction with community(IIC)	-0.030		0.321
	(0.075)		(0.250)
Organized group membership (OGM)	0.053	0.137	
	(0.080)	(0.124)	
Objective social capital	1.398**	1.117**	-1.203
	(0.097)	(0.220)	(0.527)
R^2	0.47	0.28	0.33
N	229	229	229
Community Fixed Effects	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by urban center in parentheses.

Table 2.7: Socioeconomic indicators and social capital

Outcome: Social capital	(1) OSC	(2) PCS	(3) IIC	(4) OGM
Household income below $22,000	-0.120	-0.175	0.136	-0.027
	(0.074)	(0.137)	(0.111)	(0.282)
English proficiency of household head	-0.116	0.041	0.066	-0.069
	(0.064)	(0.086)	(0.099)	(0.115)
Household head has no schooling	0.194	-0.064	0.151	0.090
	(0.123)	(0.114)	(0.299)	(0.236)
Household owns car	-0.072	-0.078	-0.055	0.141
	(0.051)	(0.102)	(0.162)	(0.229)
Age of the household head	-0.001	0.011*	0.010**	-0.013
	(0.002)	(0.004)	(0.002)	(0.009)
Secondary migrant household	0.075	0.411**	-0.178*	0.163
	(0.120)	(0.058)	(0.056)	(0.161)
R2	0.43	0.60	0.27	0.36
N	220	220	204	220
Community Fixed Effects	No	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by urban center in parentheses.

Table 2.8: Impact of social capital on food security

Outcome: Rasch food security	(1)	(2)	(3)	(4)	(5)
Objective social capital (OSC)	0.647*	0.667*	0.560**	0.591*	0.546**
	(0.219)	(0.226)	(0.072)	(0.222)	(0.068)
Perceived community support (PCS)		-0.064			-0.016
		(0.059)			(0.033)
Informal interaction with community (IIC)			-0.213*		-0.210*
			(0.067)		(0.068)
Organized group membership (OGM)				-0.062	-0.044
				(0.044)	(0.041)
Household income below $22,000	-0.426*	-0.433*	-0.413*	-0.430*	-0.416*
	(0.122)	(0.124)	(0.114)	(0.135)	(0.119)
Household owns car	0.221*	0.211*	0.253	0.218*	0.272
	(0.066)	(0.069)	(0.118)	(0.081)	(0.122)
Secondary migrant household	-0.150	-0.127	-0.214	-0.139	-0.202
	(0.184)	(0.190)	(0.163)	(0.175)	(0.163)
R2	0.26	0.26	0.33	0.27	0.34
N	224	224	208	224	208
Community Fixed Effects	Yes	Yes	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by urban center in parentheses.

Table 2.9: Impact of social capital on food security - exposure to objective social capital

Outcome: Rasch food security	(1)	(2)	(3)	(4)
Objective social capital (OSC)	0.613*	0.407**	0.574	0.607*
	(0.220)	(0.085)	(0.400)	(0.182)
Perceived community support (PCS)	-0.154*			0.055
	(0.055)			(0.028)
PCS * OSC	0.140*			-0.078
	(0.041)			(0.042)
Informal interaction w/ community (IIC)		-0.433**		-0.424**
		(0.064)		(0.060)
IIC * OSC		0.304**		0.278**
		(0.053)		(0.047)
Organized group membership (OGM)			-0.067	0.012
			(0.103)	(0.048)
OGM * OSC			0.007	-0.077
			(0.100)	(0.074)
Household income above $22,000	-0.437*	-0.388*	-0.431*	-0.386*
	(0.126)	(0.113)	(0.134)	(0.114)
Household owns car	0.210*	0.271	0.217*	0.306
	(0.067)	(0.129)	(0.084)	(0.139)
Secondary migrant household	-0.125	-0.220	-0.139	-0.217
	(0.191)	(0.168)	(0.176)	(0.163)
R^2	0.27	0.35	0.27	0.36
N	224	208	224	208
Community Fixed Effects	Yes	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by urban center in parentheses.

Table 2.10: Impact of social capital on food security - sensitivity to different socioeconomic indicators

Outcome: Rasch food security score	(1)	(2)	(3)	(4)	(5)	(6)
Socioeconomic indicator:	English proficiency		Age		No formal schooling	
Objective social capital (OSC)	0.877**	0.719**	0.636**	0.418*	0.670**	0.409*
	(0.096)	(0.081)	(0.080)	(0.133)	(0.098)	(0.145)
Perceived community support (PCS)	0.056*	0.152*	0.095*	0.269**	0.066	0.201**
	(0.023)	(0.059)	(0.027)	(0.072)	(0.028)	(0.053)
PCS * OSC		-0.085		-0.197		-0.139
		(0.073)		(0.097)		(0.069)
Informal interaction w/ community (IIC)	-0.185	-0.605**	-0.168	-0.584**	-0.161	-0.599**
	(0.124)	(0.098)	(0.127)	(0.101)	(0.135)	(0.093)
IIC * OSC		0.547**		0.532**		0.572**
		(0.106)		(0.127)		(0.121)
Organized group membership (OGM)	-0.030	0.001	-0.047	-0.042	-0.037	-0.036
	(0.030)	(0.026)	(0.034)	(0.056)	(0.029)	(0.052)
OGM * OSC		-0.032		0.007		0.011
		(0.025)		(0.059)		(0.051)
Socioeconomic indicator	0.154*	0.168*	-0.006	-0.006	-0.307	-0.361*
	(0.062)	(0.046)	(0.004)	(0.004)	(0.178)	(0.139)
Household owns car	0.380*	0.401*	0.433**	0.434*	0.488*	0.515*
	(0.125)	(0.138)	(0.113)	(0.123)	(0.142)	(0.161)
Secondary migrant household	-0.212	-0.265	-0.198	-0.248	-0.174	-0.233
	(0.144)	(0.133)	(0.143)	(0.136)	(0.141)	(0.145)
R^2	0.31	0.37	0.26	0.32	0.29	0.36
N	228	228	223	223	228	228
Community Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by urban center in parentheses.

Table 2.11: Impact of social capital on food security - sensitivity to different measurements of objective social capital

Outcome: Rasch food security score	(1)	(2)	(3)	(4)	(5)	(6)
Objective social capital:	Number of Somali stores		Size of Somali community		Proportion of Somali community	
Objective social capital (OSC)	0.088**	0.097*	0.324**	0.360*	0.141**	0.156*
	(0.011)	(0.029)	(0.041)	(0.108)	(0.018)	(0.047)
Perceived community support	-0.016	0.055	-0.016	0.055	-0.016	0.055
	(0.033)	(0.028)	(0.033)	(0.028)	(0.033)	(0.028)
PCS * OSC		-0.078		-0.078		-0.078
		(0.042)		(0.042)		(0.042)
Informal interaction w/ community (IIC)	-0.210*	-0.424**	-0.210*	-0.424**	-0.210*	-0.424**
	(0.068)	(0.060)	(0.068)	(0.060)	(0.068)	(0.060)
IIC * OSC		0.278**		0.278**		0.278**
		(0.047)		(0.047)		(0.047)
Organized group membership (OGM)	-0.044	0.012	-0.044	0.012	-0.044	0.012
	(0.041)	(0.048)	(0.041)	(0.048)	(0.041)	(0.048)
OGP * OSC		-0.077		-0.077		-0.077
		(0.074)		(0.074)		(0.074)
Household income below $22,000	-0.416*	-0.386*	-0.416*	-0.386*	-0.416*	-0.386*
	(0.119)	(0.114)	(0.119)	(0.114)	(0.119)	(0.114)
Household owns car	0.272	0.306	0.272	0.306	0.272	0.306
	(0.122)	(0.139)	(0.122)	(0.139)	(0.122)	(0.139)
Secondary migrant household	-0.202	-0.217	-0.202	-0.217	-0.202	-0.217
	(0.163)	(0.163)	(0.163)	(0.163)	(0.163)	(0.163)
R^2	0.34	0.36	0.34	0.36	0.34	0.36
N	208	208	208	208	208	208
Community Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by urban center in parentheses.

Table 3.1: County characteristics of the treatment and control stores

Store	Store A	Store B	Store C1	Store C2	Store C3	Store C4	Non-metro West North-Central U.S.
County	Pottawatomie	Sumner	Marshall	Shelby	Knox	Tama	
State	Kansas	Kansas	Iowa	Missouri	Missouri	Iowa	
Community size (N households)	312	474	539	696	545	715	
County population	22,625	23,638	40,962	6,179	4,035	17,479	
Number of households in county	8,192	9,091	15,297	2,499	1,689	6,790	
White population (%)	94.09	94.38	84.41	97.93	96.60	88.68	93.19
Married-couple households (%)	62.61	55.02	55.08	53.18	54.65	56.57	
Household size (N persons)	2.72	2.55	2.72	2.37	2.34	2.51	3.02
Working age adults* (%)	48.19	44.94	46.37	46.48	41.69	46.58	58.11
Labor force participation rate	68.70	62.70	65.10	63.20	58.10	63.60	59.55
Unemployed working age adults (%)	3.70	7.00	6.30	5.80	7.40	5.60	5.23
Car ownership (%)	99.00	98.80	97.50	99.10	98.50	98.50	96.62
Median household income ($)	60,216	50,141	53,351	39,087	38,289	55,203	57,000
SNAP participant households (%)	6.58	11.71	14.13	11.80	13.38	8.35	12.49
Rural urban continuum code (RUCC**) 2013	3	2	4	9	9	6	2 to 9
Household with seniors age 65+ (%)	13.9	18.1	17.8	21	21.7	19.5	24.65

Source: American Community Survey 2015 (5 year sample)

*Adults 16 years of age and older are classified as working age population

**Definition of RUCC (USDA, 2013)

2: Counties in metro areas of 250,000 to 1 million population

3: Counties in metro areas of fewer than 250,000 population

4: Urban population of 20,000 or more, adjacent to a metro area

6: Urban population of 2,500 to 19,999, adjacent to a metro area

9: Completely rural or less than 2,500 urban population, not adjacent to a metro area

Table 3.2: Intervention timeline

Begin Date	End Date	Intervention
1-Oct-14		Frequent shopper enrollments began in the treatment stores
16-Jan-15	27-Jan-15	Baseline NEMS survey at the two treatment stores.
14-Feb-15	13-Mar-15	First customer intercept survey
23-Feb-15	27-Feb-15	Introduction of on-shelf nutrition scores in Store A (First Intervention)
25-Feb-15	30-Mar-15	Provision of nutritional education training in Store B (First Intervention)
16-May-15	12-Jun-15	Second customer intercept survey
4-Jun-15	5-Jun-15	Introduction of on-shelf nutrition scores in Store B (Second Intervention)
24-Jul-15	20-Aug-15	Provision of nutritional education training in Store A (Second Intervention)
30-Oct-15	14-Nov-15	Third customer intercept survey
10-Mar-16	24-Mar-16	Follow up NEMS survey at the two treatment stores.

Table 3.3: Descriptive statistics

	Treatment	Control	Total
Total count			
Number of stores	2	4	6
Number of households	486	10,759	11,245
Number of food items sold	109,309	1,660,452	1,769,761
Number of food purchase transactions	17,006	324,175	341,181
Number of household-week observations	9,878	180,373	190,251
Average per household			
Dollars spent at the store per week	$ 29.26	$ 24.89	$ 25.12
# food items purchased at the store per week	11.07	9.21	9.30
# weeks household shopped at the store	20.33	16.76	16.92
Average per household-week			
Score per item before the first intervention	6.875	6.888	6.888
Score per item after the first intervention	6.932	6.868	6.871
Score per $$ before the first intervention	6.774	6.799	6.798
Score per $$ after the first intervention	6.835	6.795	6.797

Table 3.4: Sample characteristics - treatment stores

Variable	Mean	SD	N
Household size (number of persons)	2.94	1.88	435
Number of children in household	0.91	1.48	411
Children below 18 years of age (Y/N)	0.38	0.49	411
Seniors above 65 years of age (Y/N)	0.25	0.43	411
Person of color in household (Y/N)	0.05	0.22	407
No adult with college education or above (Y/N)	0.31	0.46	404
Employed adult in household (Y/N)	0.75	0.43	411
Workplace outside community (Y/N)	0.47	0.50	411
Diet-related conditions (Y/N)	0.32	0.47	107
Considers healthy weight very important (Y/N)	0.56	0.50	109
Considers nutrition very important (Y/N)	0.57	0.50	109
Nutrition knowledge (0 - 4 points)	1.03	0.78	107

Table 3.5: Impact of the interventions

	----------Outcome score per item----------				----------Outcome score per $$----------			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All stores	All stores	Store A + control stores	Store B + control stores	All stores	All stores	Store A + control stores	Store B + control stores
After 1st intervention	0.111*				0.093			
	(0.043)				(0.046)			
Nutrition labels		0.153**	0.167**	-0.067**		0.137**	0.152**	-0.044*
		(0.011)	(0.012)	(0.005)		(0.013)	(0.012)	(0.015)
Extension education		0.052**	-0.141**	0.049*		0.028	-0.125**	0.025
		(0.012)	(0.003)	(0.011)		(0.011)	(0.005)	(0.011)
After 2nd intervention	-0.121*	-0.217**			-0.102*	-0.177**		
	(0.032)	(0.011)			(0.036)	(0.013)		
Adjusted R-squared	0.0041	0.0041	0.0041	0.0040	0.0031	0.0031	0.0031	0.0030
N	190,251	190,251	183,065	187,559	190,251	190,251	183,065	187,559
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by store in parenthesis

Table 3.6: Impact of the interventions on regular store shoppers

	----------Outcome score per item----------				----------Outcome score per $$----------			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All stores	All stores	Store A + control stores	Store B + control stores	All stores	All stores	Store A + control stores	Store B + control stores
After 1st intervention	0.102				0.084			
	(0.049)				(0.052)			
Nutrition labels		0.149**	0.168**	-0.048**		0.134**	0.154**	-0.027
		(0.012)	(0.011)	(0.006)		(0.013)	(0.012)	(0.014)
Extension education		0.035*	-0.129**	0.031		0.011	-0.115**	0.007
		(0.012)	(0.001)	(0.011)		(0.012)	(0.006)	(0.011)
After 2nd intervention	-0.109*	-0.193**			-0.092	-0.156**		
	(0.036)	(0.010)			(0.040)	(0.012)		
Adjusted R-squared	0.0040	0.0040	0.0041	0.0039	0.0030	0.0030	0.0031	0.0029
N	172,568	172,568	165,756	170,209	172,568	172,568	165,756	170,209
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by store in parenthesis

Store patrons are households shopping at the study stores in 10+ weeks

Table 3.7: Impact of the interventions on occasional shoppers

	----------Outcome score per item----------				----------Outcome score per $$----------			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All stores	All stores	Store A + control stores	Store B + control stores	All stores	All stores	Store A + control stores	Store B + control stores
After 1st intervention	0.230**				0.197*			
	(0.054)				(0.063)			
Nutrition labels		0.186**	0.173**	-0.383**		0.147**	0.130**	-0.290**
		(0.014)	(0.012)	(0.052)		(0.022)	(0.020)	(0.058)
Extension education		0.309**	-0.319**	0.316**		0.288**	-0.242**	0.297**
		(0.035)	(0.016)	(0.032)		(0.045)	(0.013)	(0.041)
After 2nd intervention	-0.323**	-0.579**			-0.225**	-0.452**		
	(0.042)	(0.048)			(0.041)	(0.055)		
Adjusted R-squared	0.0063	0.0063	0.0065	0.0063	0.0055	0.0054	0.0058	0.0056
N	20,153	20,153	19,729	19,760	20,153	20,153	19,729	19,760
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by store in parenthesis

Occasional shoppers are those who shopped at the study stores less than 10 weeks

Table 3.8: Short term impact of the interventions

	----------Outcome score per item----------			----------Outcome score per $$----------		
	(1)	(2)	(3)	(4)	(5)	(6)
	All stores	Store A + control stores	Store B + control stores	All stores	Store A + control stores	Store B + control stores
After 1st intervention	0.116*	0.163**	0.060**	0.096	0.148**	0.035*
	(0.041)	(0.011)	(0.010)	(0.044)	(0.012)	(0.009)
Adjusted R-squared	0.0039	0.0038	0.0037	0.0030	0.0030	0.0029
N	136,225	132,713	134,080	136,225	132,713	134,080
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by store in parenthesis

Table 3.9: Long-term impact of the interventions

	----------Outcome score per item----------			----------Outcome score per $$----------		
	(1)	(2)	(3)	(4)	(5)	(6)
	All stores	Store A + control stores	Store B + control stores	All stores	Store A + control stores	Store B + control stores
Long term effects	0.039*	0.023	0.043*	0.021	0.062*	0.009
	(0.014)	(0.014)	(0.013)	(0.021)	(0.015)	(0.016)
Adjusted R-squared	0.0061	0.0061	0.0060	0.0046	0.0046	0.0045
N	88,568	84,702	87,191	88,568	84,702	87,191
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by store in parenthesis

Table 4.1: Descriptive statistics - household characteristics

N= 1,103,276	Mean	Std. dev
Demographic characteristics		
Household size (number of persons)	2.04	1.62
Single parent household (Y/N)	0.21	0.41
Children below 18 years of age (Y/N)	0.38	0.48
Seniors above 65 years of age (Y/N)	0.11	0.31
White person in household (Y/N)	0.50	0.50
Black person in household (Y/N)	0.35	0.48
Household has at least one car (Y/N)	0.36	0.48
Number of cars owned	0.45	0.71
Retail store establishment access		
Grocery store in half mile (Y/N)	0.23	0.42
Grocery store in one mile (Y/N)	0.62	0.48
Grocery store in 1.5 mile (Y/N)	0.89	0.31
Convenience store in half mile (Y/N)	0.64	0.48
Convenience store in one mile (Y/N)	0.86	0.35
Convenience store in 1.5 mile (Y/N)	0.93	0.26
Income and SNAP benefits		
Income per month - all households ($)	396.47	435.97
Income per month - non-zero income households ($)	542.83	425.19
Zero income households (Y/N)	0.27	0.44
Benefits disbursed per month ($)	219.57	196.91

Table 4.2: Descriptive statistics - SNAP redemptions over benefit month by store format

	Dollar amount			Percentage of weekly redemptions		
	Mean	Std. dev	ARRA Difference	Mean	Std. dev	ARRA Difference
Benefits redeemed / month	219.26	200.15	59.95***			
Additional benefits	39.55	49.62	67.54***			
Week 1						
Total	127.34	130.33	27.80***			
Grocery stores	95.95	110.71	20.90***	75.29	36.43	1.04***
Convenience stores	7.66	29.73	1.80***	7.88	21.43	-0.69***
Ethnic stores	18.57	58.03	3.21***	13.13	29.11	-0.87***
Other stores	5.16	28.06	1.88***	3.70	15.61	0.53***
Week 2						
Total	46.70	71.00	14.01***			
Grocery stores	33.98	56.35	10.17***	71.79	39.26	0.70***
Convenience stores	3.36	15.02	1.02***	12.01	28.00	-0.51***
Ethnic stores	7.33	31.03	1.93***	12.41	28.98	-0.78***
Other stores	2.02	14.94	0.87***	3.79	16.54	0.59***
Week 3						
Total	27.02	52.79	10.20***			
Grocery stores	20.00	42.18	7.62***	71.87	39.98	0.86***
Convenience stores	1.86	10.26	0.68***	12.65	29.46	-0.51***
Ethnic stores	4.06	21.24	1.36***	11.86	28.74	-0.83***
Other stores	1.10	10.37	0.52***	3.63	16.56	0.48***
Week 4						
Total	18.20	48.39	7.94***			
Grocery stores	13.64	38.68	6.03***	71.79	40.53	1.02***
Convenience stores	1.19	8.43	0.49***	12.96	30.33	-0.69***
Ethnic stores	2.64	17.86	1.00***	11.66	28.83	-0.94***
Other stores	0.72	8.44	0.41***	3.60	16.56	0.61***

*** p<0.001

Table 4.3: Store format usage over benefit month

Outcome: Benefits redeemed (in $) at store formats	Total	Grocery store	Convenience store	Ethnic store	Other
	(1)	(2)	(3)	(4)	(5)
week=2	-74.08***	-56.71***	-3.96***	-10.82***	-2.59***
	(0.450)	(0.387)	(0.0922)	(0.187)	(0.063)
week=3	-91.33***	-69.05***	-5.25***	-13.74***	-3.30***
	(0.498)	(0.426)	(0.103)	(0.212)	(0.068)
week=4	-98.74***	-74.44***	-5.80***	-14.90***	-3.60***
	(0.525)	(0.446)	(0.108)	(0.224)	(0.070)
PostARRA	20.88***	15.40***	1.44***	2.44***	1.60***
	(0.392)	(0.334)	(0.103)	(0.182)	(0.100)
week2*postARRA	-13.46***	-10.58***	-0.75***	-1.13***	-1.00***
	(0.390)	(0.333)	(0.086)	(0.165)	(0.082)
week3*postARRA	-17.15***	-13.10***	-1.07***	-1.63***	-1.35***
	(0.411)	(0.351)	(0.094)	(0.177)	(0.087)
week4*postARRA	-19.32***	-14.64***	-1.24***	-1.99***	-1.45***
	(0.429)	(0.367)	(0.097)	(0.185)	(0.088)
Household fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	4,003,928	4,003,928	4,003,928	4,003,928	4,003,928

Standard errors in parentheses

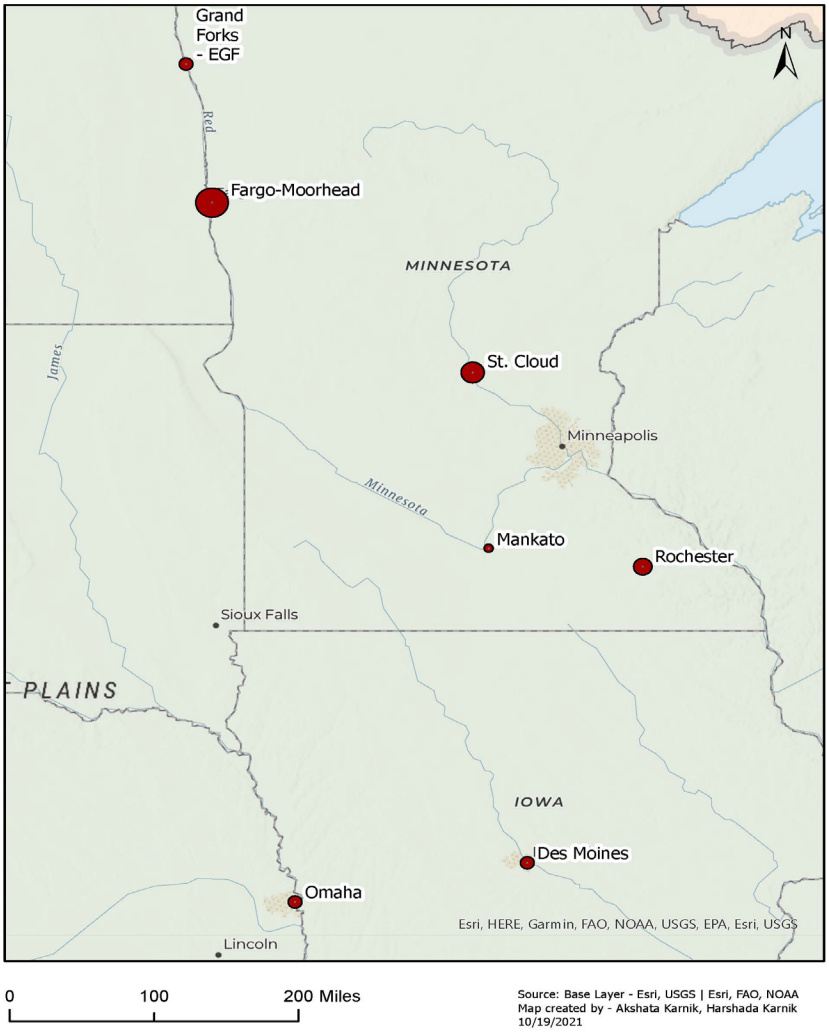
*p < 0.1 **p < 0.05 ***p < 0.01

Table 4.4: SNAP redemptions over benefit month by store format

	Dollar amount (Eq. 2)		Percentage of weekly redemptions (Eq.3)	
	Coefficients	SE	Coefficients	SE
Week 1				
Total	0.35***	(0.0080)		
Grocery stores	0.25***	(0.0065)	0.0085***	(0.0015)
Convenience stores	0.03***	(0.0039)	0.0007	(0.0013)
Ethnic stores	0.03***	(0.0064)	-0.0108***	(0.0014)
Other stores	0.03***	(0.0049)	0.0017*	(0.0010)
Week 2				
Total	0.15***	(0.0048)		
Grocery stores	0.10***	(0.0036)	0.0048**	(0.0019)
Convenience stores	0.01***	(0.0018)	0.0004	(0.0015)
Ethnic stores	0.02***	(0.0034)	-0.0071***	(0.0015)
Other stores	0.01***	(0.0017)	0.0019**	(0.0010)
Week 3				
Total	0.13***	(0.0039)		
Grocery stores	0.09***	(0.0030)	0.0069***	(0.0023)
Convenience stores	0.01***	(0.0012)	-0.0009	(0.0017)
Ethnic stores	0.02***	(0.0025)	-0.0060***	(0.0018)
Other stores	0.01***	(0.0011)	-0.000000047	(0.0011)
Week 4				
Total	0.11***	(0.0046)		
Grocery stores	0.08***	(0.0031)	0.0049*	(0.0027)
Convenience stores	0.01***	(0.0012)	0.0024	(0.0022)
Ethnic stores	0.02***	(0.0024)	-0.0067***	(0.0022)
Other stores	0.00***	(0.0009)	-0.0006	(0.0012)

*p < 0.1 **p < 0.05 ***p < 0.01 N= 1,103,276

Figure 2.1: Data collection sites



Source: Base Layer - Esri, USGS | Esri, FAO, NOAA
Map created by - Akshata Karnik, Harshada Karnik
10/19/2021

Figure 3.1: Illustration of in-store nutrition labels

Source: healthylaps.com

Figure 3.2: Average nutrition scores over the study period

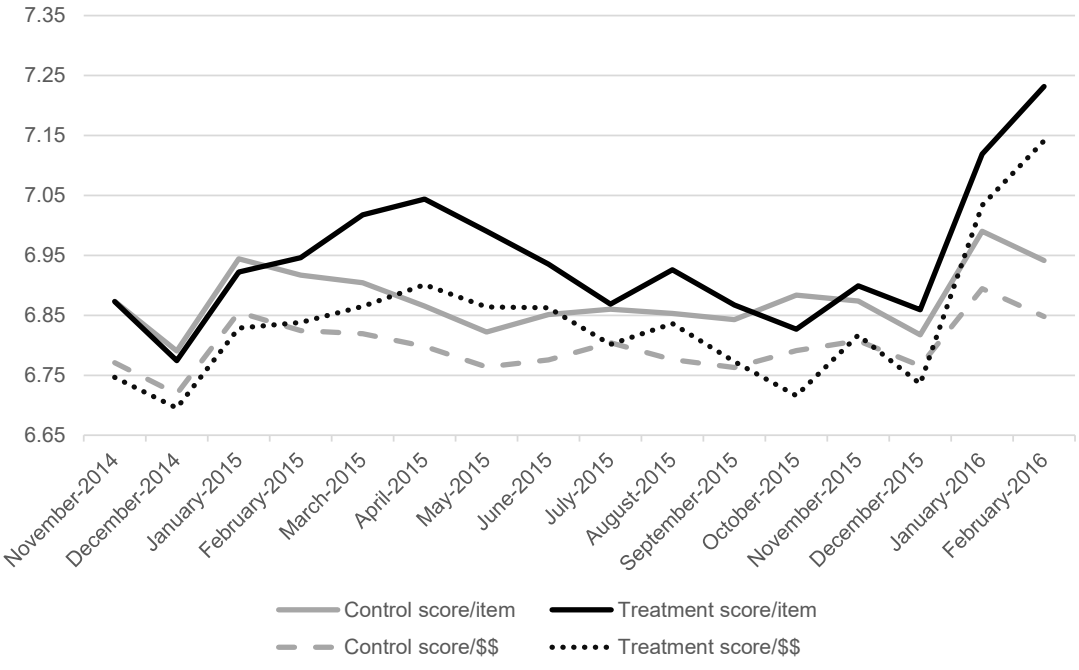


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Table A1: Survey responses - unweighted statistics

Variable	Mean	Std. dev.	Sample size
Household			
Household income below $22,000 (Y/N)	0.64	0.48	226
Number of employed adults (persons)	1.32	1.11	240
Households with no employed adult (Y/N)	0.21	0.41	240
Car ownership (Y/N)	0.85	0.36	249
Number of cars owned	1.43	0.93	249
Alternate mode of transportation used (Y/N)	0.24	0.43	249
Home ownership (Y/N)	0.03	0.17	245
Section 8 housing (Y/N)	0.36	0.48	238
Rent ($/month)	702.06	295.62	212
Number of residences in the last 3 years	1.83	0.80	241
Number of rooms in residence	3.36	1.46	241
Household size (persons)	5.04	2.38	246
Secondary migrant household (Y/N)	0.64	0.48	245
Primary income earner			
No formal schooling (Y/N)	0.38	0.49	246
English proficiency (1-5 scale: 1 least proficient)	2.63	1.27	246
Age when enumerated (years)	40.23	12.91	241
Number of years in the U.S.	7.43	5.90	243
Female (Y/N)	0.49	0.50	233
Food security			
Sufficient and satisfactory food* (Y/N)	0.89	0.32	242
Stretched food or food money** (Y/N)	0.24	0.43	236
Used SNAP benefits at least once in past year (Y/N)	0.71	0.46	249
SNAP benefit received ($/month)	497.19	272.25	170
Used SNAP benefits throughout past year (Y/N)	0.51	0.50	249
Children received school meals (Y/N)	0.65	0.48	243
Social capital			
Objective social capital (OSC)	0.75	0.49	249
Perceived community support (PCS) factor score	0.00	0.96	249
Informal interaction in community (IIC) factor score	0.65	0.48	243
Organized group participation (OGP) item count	0.39	0.49	245

* Households that affirmed they had 'enough of the kinds of foods they wanted to eat'

** Households that agreed that they 'ran short of money to buy food and tried to make food or food money last longer'

Table A2: Income distribution

Income	Households of Somali ancestry*	Weighted sample	Unweighted sample
$10,000 or less	26.40	26.30	27.40
$10,001-$22,000	23.70	21.00	36.30
$22,001-$47,000	27.60	31.30	30.10
More than $47,000	22.30	21.40	6.20
Total	100.00	100.00	100.00

* From the 2017 ACS 5-year sample for the West North Central region

Table A3: Level of educational

Educational attainment	Households of Somali ancestry*	Weighted sample	Unweighted sample
No formal schooling	16.90	27.60	37.30
Some formal schooling (up to grade 11)	20.50	14.30	25.30
Grade 12, GED or associates degree	50.80	51.20	31.70
Bachelors degree or above	11.80	7.00	5.60
Total	100.00	100.00	100.00

* From the 2017 ACS 5-year sample for the West North Central region

Table A4: English proficiency

English proficiency	Households of Somali ancestry*	Weighted sample	Unweighted sample
Not well at all (1)	11.40	13.90	24.40
Slightly well (2)	18.30	19.80	24.40
Moderately well (3)	30.30	27.90	24.00
Very well (4)	37.00	34.30	18.70
Extremely well (5)	2.90	4.10	8.50
Total	100.00	100.00	100.00

* From the 2017 ACS 5-year sample for the West North Central region

Table A5: Impact of social capital on food security among non-secondary migrant households

Outcome: Rasch food security	(1)	(2)	(3)	(4)	(5)
Objective social capital (OSC)	1.188**	1.222**	1.226*	1.812**	1.660*
	(0.072)	(0.163)	(0.453)	(0.301)	(0.579)
Perceived community support (PCS)		0.033			-0.160
		(0.281)			(0.290)
PCS * OSC		0.040			0.133
		(0.215)			(0.204)
Informal interaction w/ community (IIC)			-0.309		-0.265
			(0.339)		(0.316)
IIC * OSC			0.211		0.143
			(0.329)		(0.304)
Organized group membership (OGM)				0.308	0.290
				(0.166)	(0.215)
OGM * OSC				-0.236	-0.203
				(0.141)	(0.135)
Household income below $22,000	-0.371*	-0.377*	-0.363*	-0.306**	-0.291*
	(0.140)	(0.131)	(0.109)	(0.050)	(0.111)
Household owns car	0.275*	0.304*	0.492	0.228	0.333
	(0.105)	(0.120)	(0.476)	(0.128)	(0.594)
R^2	0.48	0.48	0.55	0.51	0.58
N	85	85	79	85	79
Community Fixed Effects	Yes	Yes	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by urban center in parentheses.

Table A6: Placebo / falsification test

Outcome: Rasch food security score (RFSS)	(1)	(2)
Placebo (falsified) variable:	RFSS	OSC
Objective social capital (OSC)	0.231	0.031
	(0.209)	(0.127)
Perceived community support	-0.042	-0.014
	(0.161)	(0.031)
Informal interaction	-0.041	-0.216*
	(0.079)	(0.078)
Organized group participation	0.013	-0.043
	(0.107)	(0.043)
Household income below median	-0.098	0.417*
	(0.143)	(0.117)
Car ownership	0.081	0.263
	(0.170)	(0.132)
Secondary migrants	-0.036	-0.207
	(0.063)	(0.166)
R^2	0.12	0.34
N	208	208
Community Fixed Effects	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by urban center in parentheses.

Table B1: Impact of the interventions over time

	----------Outcome score per item----------				----------Outcome score per $$----------			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All stores	All stores	Store A + control stores	Store B + control stores	All stores	All stores	Store A + control stores	Store B + control stores
After 1st intervention	0.248**				0.234*			
	(0.048)				(0.072)			
Nutrition labels		0.309**	0.150**	-0.005		0.298**	0.143**	0.039
		(0.003)	(0.013)	(0.014)		(0.025)	(0.016)	(0.025)
Extension education		0.158**	-0.070	0.137**		0.140**	-0.152**	0.091**
		(0.006)	(0.028)	(0.010)		(0.018)	(0.020)	(0.017)
After 2nd intervention	-0.122	-0.341**			-0.101	-0.305**		
	(0.055)	(0.009)			(0.067)	(0.037)		
One month post interventions	-0.182**	-0.218**	-0.050		-0.194*	-0.232**	-0.064**	
	(0.035)	(0.021)	(0.023)		(0.053)	(0.029)	(0.013)	
Two months post intervention	-0.161*	-0.166*	-0.048*	0.001	-0.170	-0.175	-0.070**	0.060
	(0.056)	(0.059)	(0.011)	(0.027)	(0.091)	(0.095)	(0.011)	(0.039)
Three months post intervention	-0.098	-0.074	0.131**	-0.091**	-0.122**	-0.097**	0.114**	-0.093**
	(0.043)	(0.034)	(0.008)	(0.014)	(0.030)	(0.021)	(0.012)	(0.017)
Four months post intervention	-0.122**	-0.115**	0.060*	-0.117**	-0.106**	-0.098**	0.065**	-0.085*
	(0.023)	(0.023)	(0.013)	(0.023)	(0.019)	(0.019)	(0.009)	(0.019)
Five months post intervention	-0.181**	-0.192**		-0.206**	-0.180**	-0.192**		-0.197**
	(0.024)	(0.020)		(0.015)	(0.018)	(0.016)		(0.017)
Six months post intervention	-0.113**	-0.121**	0.056**	-0.139**	-0.116**	-0.125**	0.096**	-0.138**
	(0.028)	(0.024)	(0.009)	(0.015)	(0.022)	(0.019)	(0.008)	(0.014)
Seven months post intervention	-0.143**	-0.142**	-0.051*	-0.158**	-0.146**	-0.146**	0.059	-0.156**
	(0.027)	(0.028)	(0.017)	(0.021)	(0.023)	(0.023)	(0.021)	(0.020)
Eight months post intervention	-0.178**	-0.179**	-0.028	-0.204**	-0.194**	-0.195**	0.008	-0.203**
	(0.035)	(0.034)	(0.023)	(0.013)	(0.018)	(0.017)	(0.025)	(0.015)
Nine months post intervention	-0.119**	-0.119**	-0.101	-0.116**	-0.142**	-0.142**	0.014	-0.140**
	(0.020)	(0.020)	(0.051)	(0.020)	(0.019)	(0.019)	(0.049)	(0.020)
Ten months post intervention	-0.159**	-0.157**	-0.072	-0.174**	-0.210**	-0.207**	0.012	-0.229**
	(0.029)	(0.030)	(0.035)	(0.022)	(0.026)	(0.027)	(0.025)	(0.008)
Eleven months post intervention	-0.049	-0.046	-0.065	-0.020	-0.037	-0.034	0.073	-0.009
	(0.029)	(0.029)	(0.031)	(0.010)	(0.034)	(0.034)	(0.040)	(0.023)
Adjusted R-squared	0.0041	0.0041	0.0041	0.0040	0.0031	0.0031	0.0031	0.0030
N	190,251	190,251	183,065	187,559	190,251	190,251	183,065	187,559
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by store in parenthesis

Table B2: Placebo test - false treatment

	----------Outcome score per item----------				----------Outcome score per $$----------			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All stores	All stores	Store A + control stores	Store B + control stores	All stores	All stores	Store A + control stores	Store B + control stores
False 1st intervention	-0.037**				-0.024*			
	(0.007)				(0.007)			
False nutrition labels		-0.033*	-0.006	-0.006		-0.028*	-0.010	-0.010
		(0.010)	(0.013)	(0.011)		(0.010)	(0.016)	(0.014)
False extension education		-0.039**	-0.025	-0.021		-0.022*	-0.014	-0.010
		(0.006)	(0.015)	(0.013)		(0.007)	(0.010)	(0.010)
False 2nd intervention	0.009	0.044*			0.004	0.030		
	(0.005)	(0.012)			(0.011)	(0.012)		
Adjusted R-squared	0.0041	0.0041	0.0041	0.0040	0.0031	0.0031	0.0031	0.0030
N	190,251	190,251	183,065	187,559	190,251	190,251	183,065	187,559
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by store in parenthesis

Table B2: Placebo test - false outcome

	----------Outcome: False score per item----------				----------Outcome: False score per $$----------			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All stores	All stores	Store A + control stores	Store B + control stores	All stores	All stores	Store A + control stores	Store B + control stores
After 1st intervention	0.016				0.004			
	(0.025)				(0.029)			
Nutrition labels		0.038**	0.049**	0.016		-0.030**	-0.022*	-0.082**
		(0.004)	(0.003)	(0.011)		(0.006)	(0.006)	(0.007)
Extension education		-0.017	-0.023*	-0.021		0.052**	0.013	0.051**
		(0.009)	(0.006)	(0.008)		(0.006)	(0.006)	(0.006)
After 2nd intervention	-0.015	-0.021			-0.033	-0.050**		
	(0.019)	(0.013)			(0.034)	(0.004)		
Adjusted R-squared	0.0002	0.0002	0.0002	0.0002	0.0000	0.0000	0.0000	0.0000
N	190,251	190,251	183,065	187,559	190,251	190,251	183,065	187,559
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.05; ** p<0.01

Robust standard errors clustered by store in parenthesis