Published in final edited form as:

J Hunger Environ Nutr. 2016 January 1; 11(1): 29–44. doi:10.1080/19320248.2015.1066735.

Geographic access to food shelves among racial/ethnic minorities and foreign-born residents in the Twin Cities

Caitlin Eicher Caspi, ScD^{1,2}, Amy Maheswaran Lopez, MSW³, and Marilyn S. Nanney, PhD, MPH, RD^{1,2}

Caitlin Eicher Caspi: cecaspi@umn.edu; Amy Maheswaran Lopez: Amy.Lopez@gtcuw.org; Marilyn S. Nanney: msnanney@umn.edu

¹University of Minnesota, Department of Family Medicine and Community Health, 717 Delaware Ave SE, Minneapolis, MN 55414

²Minnesota Population Center, University of Minnesota, 50 Willey Hall, 225 – 19th Avenue South, Minneapolis, MN 55455

³Greater Twin Cities United Way, 404 South Eighth Street, Minneapolis, MN 55404-1084

Abstract

Place-based disparities in access to affordable food sources (e.g., supermarkets) have been well documented, but geographic access to emergency food sources (e.g., food pantries, also known as food shelves) is unknown. This study examined the geography of emergency food in the Twin Cities, MN. U.S. Census and American Community Survey data were used to estimate the average distance to the closest food shelf according to area racial/ethnic composition and foreign-born group composition. In adjusted models, areas with the highest proportion of minority groups had shorter distances to the nearest food shelf (0.13–1.03 log-transformed miles, $p < 0.05$), as did census tracts with more residents born in East Africa and Latin America (0.29–0.31 log-transformed miles, $p < 0.001$). Areas with more racial/ethnic minorities and foreign-born groups may have access to emergency food, but efforts are needed to evaluate the healthfulness and culturally relevance of these offerings.

Keywords

immigrant health; racial/ethnic disparities; food pantries

INTRODUCTION

According to the United States Department of Agriculture, in 2012, one in seven U.S. households experienced food insecurity,¹ defined as uncertainty about having enough food to meet the needs of all household members because of insufficient money or other resources. Food insecurity disproportionately affects low-income, African-American and Hispanic households², as well as a high proportion of Native Americans.³ Adults who are

Correspondence to: Caitlin Eicher Caspi, cecaspi@umn.edu.

Originality statement

This work has not been published elsewhere and has not been submitted simultaneously for publication elsewhere.

older, live in rural areas, or have disabilities or other chronic diseases are also more likely to experience food insecurity.^{4–8} Food insecurity has been associated with poor dietary outcomes, such as low fruit and vegetable intake and overall nutritional quality.^{9–12} These dietary patterns are alarming, as they lead to a higher burden of chronic conditions like obesity and diabetes among food insecure individuals.^{13–15} Among other consequences, diet-related chronic diseases (including obesity, diabetes, and heart disease) take an economic toll on the poor in the form of increased medical expenditures, missed work, and lost wages.^{16,17}

Immigrant and refugee households may also be among those with an increased risk of food insecurity, particularly in the early years of their arrival to the U.S.^{18–20} A recent study of Somali refugee women found a prevalence of food insecurity of 67%, and found that food insecure women demonstrated poorer dietary behaviors.¹⁹ In Minnesota, the population of food insecure immigrants and refugees may be particularly large. An influx of East African, Southeast Asian, and Latino groups between 1990 and 2000 more than doubled the number of immigrants and refugees living in Minnesota,²¹ partly as a result of sponsorship by faith-based groups for displaced persons (e.g., Somali, Hmong, Bosnian, Liberian) in the 1980s and 1990s.^{21,22} Immigration in the region continues to grow at a rate 50% greater than the national rate,²¹ as families are reunified and continue to draw others connected to their community.²³ Data from the U. S. Census and American Community Survey show that the vast majority of Minnesota immigrants are concentrated in the Twin Cities and a few rural agriculture communities.²¹

While national health rankings consistently place Minnesota at the top, disparities between white populations and populations of color exist and are often overlooked.²⁴ In this context, behavioral changes may occur after immigration that shape the trajectory of long-term dietary habits among immigrants. After immigrating, the expense of fresh fruits and vegetables and unfamiliarity of new foods may contribute to food insecurity and inhibit healthy eating.²⁵

A convincing^{26–33} body of research has documented the ways in which poor quality food environments may disproportionately affect communities of color and high-poverty communities. For instance, the relative scarcity of supermarkets in residential areas with a high percentage of low-income and African-American residents has been demonstrated in both multi-city²⁹ and U.S. national studies.²⁶ More recent studies have shown that fast-food restaurants are more common in areas with a high concentration of African-American residents³³ and where residents have lower property values.³⁴ Such poor quality food environment may also contribute to food insecurity experienced by members of the community.³⁵

To help fill the gap in food access that results from poor nutritional environments and constrained financial resources, many families rely on emergency assistance programs such as food shelves (also known as food pantries). It is estimated that, among food insecure families, approximately 5% of meals are obtained through emergency sources.³⁶ One recent nation-wide geographic analysis found that over 40% of census tracts without a supermarket in high-poverty areas had a food pantry supplying emergency food to area residents.³⁷ In

this study, areas with a greater percentage of non-white residents and households receiving Supplemental Nutrition Assistance Program (SNAP) benefits were the most likely areas to have a food pantry, but *not* have access to a supermarket. This supports the notion that food pantries are likely a common and accessible source of food among these segments of the population. However, such venues may not currently have the capacity to keep up with the growing need for emergency food – a need driven by the increase in supplemental food usage that is increasingly *chronic* and not only used in emergencies, as well as the rise of food insecurity rates from 10% to 14.5% following the 2007 economic downturn.^{1,2} Among researchers conducting community-based studies on the food environment, emergency food sources have remained notably overlooked in comparison with mainstream food retailers. This is the case even though researchers have already begun to pay increased attention to “non-traditional” sources of food that may contribute substantially to residents’ diets, including fruit and vegetable stands,³⁸ mobile food vendors,³⁹ dollar stores, and mass merchandisers^{40,41}

The aim of this study was to examine how the location of emergency food shelves might be patterned by area socio-demographic factors, particularly the concentration of racial/ethnic minorities and foreign-born groups in the largest metropolitan area of Minnesota (the Twin Cities). This work served two main purposes: 1) to assess the geographic accessibility of emergency food services among groups at risk for poor health, and 2) to contribute to a more comprehensive depiction of the food landscape in the Twin Cities.

METHODS

Census tract data

Census tract data were obtained for 718 census tracts in the 9-county Twin Cities area (Anoka, Carver, Chisago, Dakota, Hennepin, Isanti, Ramsey, Scott, Washington). This area includes the greater metropolitan areas of Minneapolis and St. Paul – geographically proximate cities in Minnesota separated by the Mississippi River. This area is the 14th largest metropolitan area in the country,⁴² with approximately 3.1 million residents in 2013.⁴³ Racial/ethnic composition, based on 2010 Census data, included the percent of white, African American, American Indian/Alaska Native, Asian, and Hispanic residents in each census tract; mixed-race groups were not included in this analysis because the practical implications for any findings for this group would have been limited. The number of foreign-born residents for each census tract was obtained from the 2010 American Community Survey. This included an estimate of the number of residents from each country. These countries were categorized into four distinct groups from countries commonly immigrating to the Twin Cities:²¹ 1) East African (including Somalia, Sudan, Ethiopia, and Eritrea), 2) Southeast Asian (including Vietnam, Laos, Thailand, Cambodia), 3) Latin American (which included Mexico and all Central and South America), and 4) Eastern European (former Soviet Union/Yugoslavian, including 21 countries). Data on the number of residents from each country were aggregated within the four immigrant groups and then divided by the total population of each census tract. This provided an estimate of the percent of the population each group represented in each census tract. Variables obtained from the 2010 Census also included poverty status for each census tract (the percent reporting poverty

in the last 12 months, as defined by 2010 census poverty thresholds accounting for the size of household), and population density (excluding water) of each census tract in the study area.

Food shelf data

A listing of food shelves was obtained from Hunger Solutions Minnesota,⁴⁴ a comprehensive hunger relief advocacy organization that works to end hunger statewide. Data on the number of pounds of food distributed in 2010 was also provided by Hunger Solutions, and served as an indicator of food shelf size and reach. The existence and address of each food shelf was verified first by comparing the list against another independent list of food shelves from the Greater Twin Cities United Way, and second by checking each listing against online listings (since many food shelves are not open all the time, they often provide data online about the hours they are open) or calls to the main food shelf contact number. Because names and addresses were obtained from two different sources, the lists served as cross-references for each other. Food shelves were omitted from the analysis if their address could not be verified, or if data on food shelf size during all four quarters of 2010 was not listed. A total of 132 food shelves were identified in the 9-county metro area.

Geographic analysis

Using Business Analyst Desktop⁴⁵ version 10.1, the location of food shelves was geocoded and mapped, as well as the food shelf size, the percent of each racial/ethnic and foreign born group, and poverty. The population density variable obtained from U.S. Census data represented the population-weighted centroid of each census tract, and this was added to the map. We then calculated the street network distance in miles from the population-weighted centroid of each census tract to the closest food shelf using the “closest facility” function. All variables were then exported to a data set for the univariate and regression analyses performed in SAS version 9.3 (Gary, NC).

Variables

Racial/ethnic composition – a continuous variable representing the percent of each racial/ethnic group in each census tract – was recoded into quartiles; for example, the 25% of census tracts with the highest percent of African American residents represented the top (4th) quartile for African Americans, while the 25% of census tracts with the lowest percent of African American residents represented the bottom (1st) quartile for African Americans. The bottom quartile was the reference group in all analyses. Foreign-born groups were less common than racial/ethnic minority groups, and tended to concentrate in certain metropolitan areas. Therefore, foreign-born composition for each group was divided into only two categories: census tracts in the highest quartile of each foreign-born group compared with census tracts in the bottom 3 quartiles. Food shelf size, area poverty and population density were included in adjusted models as continuous variables.

Analysis

Linear regression models estimated the association between the average street-network distance from the population-weighted centroid of each housing site to the closest food shelf

and the racial/ethnic composition and foreign-born group composition of each census tract. Census tract poverty level, population density, and food shelf size were included in the models as covariates, as all of these factors were considered to be possible confounders in the relationship between census tract race/ethnicity and foreign-born composition and food shelf distance. Preliminary analyses revealed that distance data were right skewed, and distance to the nearest food shelf was, therefore, log-transformed in regression models for a better fit. A Bonferroni correction was applied to reduce the risk of Type I error and account for multiple testing of the 4-category race/ethnicity quartile variables.

RESULTS

Table 1 presents the average distance to the closest food shelf, food shelf size, and the demographic characteristics of each census tract. The raw distance to the closest food shelf averaged 2.6 miles, and the average food shelf distributed over 407,000 lbs of food. Census tracts averaged 77.9% white, 9.1% African American, 6.2% Asian, 0.8% American Indian/Alaska Native, and 6.2% Hispanic residents. Latin American immigrants were the most populous, averaging 2.8% of each census tract population, followed by Southeast Asians at 2.0%, East Africans at 1.2%, and Eastern Europeans at 0.6%. On average, the percent of residents living in poverty was 11.1%.

In Table 2, correlation coefficients show the raw relationship between poverty, population density, and the population of each demographic group. African American, American Indian/Alaska Native, Asian, and Hispanic residents were more likely to live in census tracts with higher poverty rates, as were East African, Latin American, and Southeast Asian residents. By contrast, white residents and Eastern European residents were less likely to live in high-poverty census tracts. These findings suggest an interplay between poverty and demographic factors, and support the inclusion of both sets of variables in subsequent analysis examining census tract characteristics with food shelf locations.

Regression model estimates of the association between census tract racial/ethnic composition and distance to the nearest food shelf are presented in Table 3. Census tracts with a highest proportion of African American, American Indian/Alaska Native, Asian, and Hispanic residents (but not white residents) all had shorter distances to food shelves, on average. Controlling for census tract poverty rates, population density and food shelf size, census tracts with the highest quartile of African American residents had a distance to the nearest food shelf 1.03 log-transformed miles less than in census tracts with the lowest quartile of African American residents ($p < 0.05$ after Bonferroni correction). Differences in distances between the highest and lowest quartiles for American Indian/Alaska Native, Asian, and Hispanic groups were -0.77 , -0.13 and -0.77 log-transformed miles, respectively ($p < 0.05$ after Bonferroni correction). Differences in distances between the third quartiles and the lowest quartiles were observed in the same direction, and were statistically significant for all minority groups except Asians ($p < 0.05$ after Bonferroni correction). Poverty was significant in all models (estimates not shown) indicating that higher poverty areas had shorter distances to food shelves.

Table 4 presents the regression model estimates of the association between census tract foreign-born composition and distance to the nearest food shelf. In unadjusted models, census tracts with the highest proportion of East African, Latin American, and Southeast Asian residents (but not Eastern European residents) all had shorter distances to food shelves, on average. In adjusted models, only associations for East Africans and Latin Americans remained significant. Census tracts with the highest proportion of East African residents had a food shelf distance 0.31 log-transformed miles less than census tracts with a lower proportion of these residents ($p < 0.0001$); the difference among census tracts with the highest proportion of Latin American residents was 0.29 log-transformed miles less than census tracts with a lower proportion of these residents ($p < 0.0001$). Notably, the magnitude of food shelf access differences between the highest and lowest quartile was larger in racial/ethnic minority analyses than among foreign-born groups.

DISCUSSION

In the Twin Cities, census tracts with the highest proportion of minority residents and some foreign-born groups had shorter distances to food shelves. This is in contrast to previous findings suggesting that other types of services – supermarkets and produce stores, retail areas, and recreational facilities – are less common in areas with a high proportion of minority residents.⁴⁶ Our results suggest that there is a relative abundance of food shelves in areas with higher proportion of minority residents, while at the same time, other studies have suggested a relative dearth of other health-related services in similar areas.

It is notably difficult to categorize food shelves as inherently “healthy” or “unhealthy” sources of food. Previous research has suggested that the quality of the food provided is not optimal – for example, food shelves may provide inadequate amounts of energy, micro- and macro-nutrients and relatively little fruit and milk,^{47,48} even while they provide necessary sustenance for food insecure families. Indeed, this demonstrates how problematic it can be to classify any single food source as purely “healthy” or “unhealthy” – a common practice in the food environment literature.⁴⁹ Supermarkets are rife with low-nutrient, energy dense foods and corner stores may sell a variety of fresh produce. As is the case for most food sources, the role of emergency food in the community nutrition environment depends on the quality of the inventory it provides, and very little research has so far investigated these indicators. The quality of inventory may be especially important considering recent local efforts on the part of food shelves to partner with farmers and community gardens to receive fresh produce. Overall, these results contribute to the discourse on the “geography of opportunity,”⁵⁰ by acknowledging that food shelves may contribute substantially to the balance of services offered within different neighborhoods.

Correlation analysis indicated that areas with the highest concentration of East Africans, Southeast Asians, and Latin Americans and all minority groups also tended to be high poverty areas. Yet, in fully adjusted models, the results showed that the geographic location of food shelves was patterned by demographic factors even when controlling for poverty levels. Results are consistent with other findings suggesting that, unlike for-profit retail services, food shelves are more likely to locate in areas with high levels of poverty and a known need for emergency food.^{37,51} Our study additionally found that these areas include a

high proportion of minority and immigrant/refugee residents. In this cross sectional study, our results might be interpreted to suggest that food insecure families make choices about where to live based on access to emergency food suppliers, but given the known choice constraints on housing among the poor,⁵² this explanation is unlikely. More likely is the idea that food shelf sites locate strategically in neighborhoods where there are high concentrations of communities in need. Eastern Europeans, by contrast, were the only immigrant group more likely to settle in areas with less poverty, even while there is no indication that they rely less on food shelves.

While geographic measures of the food environment can only capture certain dimensions of access,⁵³ they may be even more relevant to food shelves than other food retail outlets like supermarkets and grocery stores, where food price and affordability may also influence purchases.⁵⁴ A recent study of factors related to community food security highlighted the importance of transportation (i.e., geographic access) in improving community food security.⁵¹ In another study, over 40% of food shelf clients achieved physical access to food pantries by walking, using public transportation, and sharing rides with friends,⁵⁵ indicating that the distance to food shelves is likely a key consideration for families who rely on this service. Few previous studies have considered the contributions of emergency food suppliers in local food environments, perhaps due to limitations in accessing reliable geographic data on these establishments, or perhaps because of more concern about criticizing charitable establishments than businesses. While food shelves cannot be considered mainstream retailers because they often require evidence of low income in order to use their services, results of the current study nonetheless suggest that food shelves are common and accessible sources of food in urban areas. Food shelves might be particularly relevant in the context of studying immigrant families, who might face cultural or legal barriers in receiving other kinds of food assistance like SNAP.⁵⁶ Adding emergency food sources to the discourse of the neighborhood food environment ultimately provides a more accurate depiction of local food landscapes that can be used to gauge the impact of food environments on individual dietary behaviors and weight outcomes. This is particularly important given the general emphasis on disparities in food environments and the quality of food in areas with high poverty and a high proportion of minority residents. This study is one of the first to examine the geography of food shelves, which may be a key understudied source of the urban food landscape. Also, while much of the food access disparities work has focused on racial/ethnic minorities,^{26–33} very little research has examined foreign-born residents. However, there are several limitations to acknowledge when interpreting the findings. First, data on foreign-born residents from the American Community Survey relies on sampling, rather than census data. Data on country of origin must therefore be interpreted with caution, as it represents only an estimate of the proportion of residents from each group, rather than an exact number. A second limitation of this study is that we examined only geographic access to food shelves. Other challenges beyond geographic access almost certainly exist for those who rely on food shelves,³⁷ including challenges that may be unique to food shelves, as compared with other mainstream food retailers. These challenges have been well documented among Minnesota emergency food suppliers.⁵⁷ For example, emergency food shelves often operate on an appointment system and usually limit the number of visits and amount of food obtained in a month. Also unlike grocery stores, food shelves may only open limited hours

during the week. Obtaining food may require planning, waiting in line, communication with food shelf staff, and paperwork which make cultural barriers like language present a challenge.

Because we relied on publicly available listings of food sources, there is the possibility that our data do not represent a complete list of food shelves in the Twin Cities. These data were sourced from two local hunger-relief organizations who regularly correspond with and gather data on food shelves, and the two lists were cross-checked (from the Greater Twin Cities United Way and Hunger Solutions). Yet, the smallest food shelves, often operated through faith-based institutions, may be unlisted. Additionally, the emergency food system is comprised of a wide range of services, including mobile food pantries, hot meal programs, and senior delivery programs, while this analysis is limited only to non-mobile food shelves.

Conclusions

Results suggest that food shelves are common and geographically-accessible sources of food in many areas of the city with a high proportion of low-income, minority, and immigrant residents. Results from the current study encourage a focus on the quality and cultural appropriateness of food in the emergency food supply in future studies. Much in the way that the food environment research has increasingly focused efforts on conducting store audits evaluating the healthfulness of its products,⁵⁸ emergency food suppliers may be ripe for such evaluations. Where possible, evaluations should assess the quality of the emergency food supply, perhaps using measures like the Healthy Eating Index,⁵⁹ which allow for targeted improvements in inventory. Beyond improving the availability of healthy foods, food shelves may also support efforts to improve dietary outcomes among their clients by offering opportunities to improve nutrition education and meal preparation skills.

Based on the findings from the current study, food shelves must consider the degree to which they are able to offer culturally-specific foods to demographic groups that use their services, as well as their ability to attend more broadly to the provision of culturally appropriate services (e.g., SNAP-Ed programming). Evaluation of these metrics of cultural competency is warranted. The emergency food supply may not meet the needs of immigrants, particularly when they do not use choice-based food distribution models but instead rely on pre-assembled packages of food. Efforts should be focused on evaluating the cultural appropriateness of these models of distribution, along with increasing the purchase and donations of culturally-specific food items.

In moving forward, future research should also examine more fully how the location of emergency food sources compares with the location of other sources of food in the area (e.g. supermarkets), given the lack of research in this area. Finally, researchers should consider examining patterns of access to food shelves in rural areas, which may have more white residents, but comparable food insecurity levels.

Acknowledgments

Funding for the lead author (CC) was provided by the NIH/NCI Cancer Related Health Disparities Education and Career Development Program (R25 CA163184). We would also acknowledge the contributions of Jerry Shannon

and Hunger Solutions in providing data on area food shelves, as well as Molly Wynia at U-Spatial and the Minnesota Population Center (grant R24HD041023) for their assistance on the geographic analysis.

References

1. USDA Economic Research Service – Key Statistics & Graphics. <http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx#insecure>. Accessed April 27, 2015
2. Coleman-Jensen, A.; Nord, M.; Carlson, S. Household Food Security in the United States in 2010. U.S. Department of Agriculture; 2011.
3. Jernigan VBB, Salvatore AL, Styne DM, Winkleby M. Addressing food insecurity in a Native American reservation using community-based participatory research. *Health Educ Res.* 2012; 27(4): 645–655.10.1093/her/cyr089 [PubMed: 21994709]
4. Seligman HK, Laraia BA, Kushel MB. Food insecurity is associated with chronic disease among low-income NHANES participants. *J Nutr.* 2010; 140(2):304–310.10.3945/jn.109.112573 [PubMed: 20032485]
5. Seligman HK, Bindman AB, Vittinghoff E, Kanaya AM, Kushel MB. Food insecurity is associated with diabetes mellitus: results from the National Health Examination and Nutrition Examination Survey (NHANES) 1999–2002. *J Gen Intern Med.* 2007; 22(7):1018–1023.10.1007/s11606-007-0192-6 [PubMed: 17436030]
6. Tarasuk V, Mitchell A, McLaren L, McIntyre L. Chronic Physical and Mental Health Conditions among Adults May Increase Vulnerability to Household Food Insecurity. *J Nutr.* 2013; 143(11): 1785–1793.10.3945/jn.113.178483 [PubMed: 23986364]
7. Lee JS, Frongillo EA. Nutritional and health consequences are associated with food insecurity among US elderly persons. *J Nutr.* 2001; 131(5):1503–1509. [PubMed: 11340107]
8. Ramadurai V, Sharf BF, Sharkey JR. Rural Food Insecurity in the United States as an Overlooked Site of Struggle in Health Communication. *Health Commun.* 2012; 27(8):794–805.10.1080/10410236.2011.647620 [PubMed: 22329342]
9. Dixon LB, Winkleby MA, Radimer KL. Dietary intakes and serum nutrients differ between adults from food-insufficient and food-sufficient families: Third National Health and Nutrition Examination Survey, 1988–1994. *J Nutr.* 2001; 131(4):1232–1246. [PubMed: 11285332]
10. Duffy P, Zizza C, Jacoby J, Tayie FA. Diet quality is low among female food pantry clients in Eastern Alabama. *J Nutr Educ Behav.* 2009; 41(6):414–419.10.1016/j.jneb.2008.09.002 [PubMed: 19879497]
11. Robaina KA, Martin KS. Food insecurity, poor diet quality, and obesity among food pantry participants in Hartford, CT. *J Nutr Educ Behav.* 2013; 45(2):159–164.10.1016/j.jneb.2012.07.001 [PubMed: 23219294]
12. Rose D. Economic determinants and dietary consequences of food insecurity in the United States. *J Nutr.* 1999; 129(2S Suppl):517S–520S. [PubMed: 10064321]
13. Leung CW, Williams DR, Villamor E. Very low food security predicts obesity predominantly in California Hispanic men and women. *Public Health Nutr.* 2012; 15(12):2228–2236.10.1017/S1368980012000857 [PubMed: 22463949]
14. Wilde PE, Peterman JN. Individual weight change is associated with household food security status. *J Nutr.* 2006; 136(5):1395–1400. [PubMed: 16614436]
15. Yaemsiri S, Olson EC, He K, Kerker BD. Food concern and its associations with obesity and diabetes among lower-income New Yorkers. *Public Health Nutr.* 2012; 15(1):39–47.10.1017/S1368980011001674 [PubMed: 21810285]
16. Goetzel RZ, Long SR, Ozminkowski RJ, Hawkins K, Wang S, Lynch W. Health, Absence, Disability, and Presenteeism Cost Estimates of Certain Physical and Mental Health Conditions Affecting U.S. Employers. *J Occup Environ Med.* 2004; 46(4):398–412.10.1097/01.jom.0000121151.40413.bd [PubMed: 15076658]
17. Finkelstein, EA.; Ruhm, CJ.; Kosa, KM. Annual Review of Public Health. Vol. 26. Palo Alto: Annual Reviews; 2005. Economic causes and consequences of obesity; p. 239-257.

18. Chilton M, Black MM, Berkowitz C, et al. Food Insecurity and Risk of Poor Health Among US-Born Children of Immigrants. *Am J Public Health*. 2009; 99(3):556–562.10.2105/AJPH.2008.144394 [PubMed: 19106417]
19. Dharod JM, Croom JE, Sady CG. Food Insecurity: Its Relationship to Dietary Intake and Body Weight among Somali Refugee Women in the United States. *J Nutr Educ Behav*. 201210.1016/j.jneb.2012.03.006
20. Hadley C, Zothiaties A, Sellen DW. Acculturation, economics and food insecurity among refugees resettled in the USA: a case study of West African refugees. *Public Health Nutr*. 2007; 10(4):405–412.10.1017/S1368980007222943 [PubMed: 17362537]
21. Wilder Research. A New Age of Immigrants: Making Immigration Work for Minnesota. The Minneapolis Foundation; 2010. <http://www.minneapolisfoundation.org/uploads/CuteEditor/Publications/ANewAgeofImmigrants.pdf>. Accessed April 27, 2015
22. Kaplan DH. The Creation of an Ethnic Economy: Indochinese Business Expansion in Saint Paul. *Econ Geogr*. 1997; 73(2):214–233.10.2307/144448
23. Pavlish CL, Noor S, Brandt J. Somali immigrant women and the American health care system: Discordant beliefs, divergent expectations, and silent worries. *Soc Sci Med*. 2010; 71(2):353–361.10.1016/j.socscimed.2010.04.010 [PubMed: 20494500]
24. Eliminating Health Disparities Initiative. 2013. Minnesota Department of Health: Report to the Minnesota Legislature <http://www.health.state.mn.us/ommh/publications/legislative rpt2013.pdf>. Accessed April 27, 2015
25. Patil CL, Hadley C, Nahayo PD. Unpacking dietary acculturation among new Americans: results from formative research with African refugees. *J Immigr Minor Health Cent Minor Public Health*. 2009; 11(5):342–358.10.1007/s10903-008-9120-z
26. Powell L, Slater S, Mirtcheva D, Bao Y, Chaloupka F. Food store availability and neighborhood characteristics in the United States. *Prev Med*. 2007; 44(3):189–195. [PubMed: 16997358]
27. Walker RE, Keane CR, Burke JG. Disparities and access to healthy food in the United States: A review of food deserts literature. *Health Place*. 2010; 16(5):876–884.10.1016/j.healthplace.2010.04.013 [PubMed: 20462784]
28. Larson N, Story M, Nelson M. Neighborhood Environments Disparities in Access to Healthy Foods in the US. *Am J Prev Med*. 2009; 36(1):74–81. [PubMed: 18977112]
29. Morland K, Wing S, Roux A, Poole C. Neighborhood characteristics associated with the location of food stores and food service places. *Am J Prev Med*. 2002; 22(1):23–29. [PubMed: 11777675]
30. Zenk SN, Schulz AJ, Israel BA, James SA, Bao S, Wilson ML. Fruit and vegetable access differs by community racial composition and socioeconomic position in Detroit, Michigan. *Ethn Dis*. 2006; 16(1):275–280. [PubMed: 16599383]
31. Morland K, Filomena S. Disparities in the availability of fruits and vegetables between racially segregated urban neighbourhoods. *Public Health Nutr*. 2007; 10(12):1481–1489.10.1017/S1368980007000079 [PubMed: 17582241]
32. Moore LV, Roux AVD. Associations of neighborhood characteristics with the location and type of food stores. *Am J Public Health*. 2006; 96(2):325–331.10.2105/AJPH.2004.058040 [PubMed: 16380567]
33. James P, Arcaya MC, Parker DM, Tucker-Seeley RD, Subramanian SV. Do minority and poor neighborhoods have higher access to fast-food restaurants in the United States? *Health Place*. 2014; 29:10–17.10.1016/j.healthplace.2014.05.011 [PubMed: 24945103]
34. Drewnowski A, Aggarwal A, Rehm CD, Cohen-Cline H, Hurvitz PM, Moudon AV. Environments Perceived as Obesogenic Have Lower Residential Property Values. *Am J Prev Med*. 2014; 47(3):260–274.10.1016/j.amepre.2014.05.006 [PubMed: 25049218]
35. Mayer VL, Hillier A, Bachhuber MA, Long JA. Food Insecurity, Neighborhood Food Access, and Food Assistance in Philadelphia. *J Urban Health-Bull N Y Acad Med*. 2014; 91(6):1087–1097.10.1007/s11524-014-9887-2
36. The Missing Meals Unmet Food Needs Study. Hunger-Free Minnesota; 2009. <http://hungerfreemn.org/media-coverage/publications/original-missing-meals-study-2009/>. Accessed April 27, 2015

37. Mabli J, Jones D, Kaufman P. Characterizing Food Access in America: Considering the Role of Emergency Food Pantries in Areas without Supermarkets. *J Hunger Environ Nutr*. 2013; 8(3):310–323.10.1080/19320248.2013.786663
38. Lucan SC, Maroko A, Shanker R, Jordan WB. Green Carts (mobile produce vendors) in the Bronx—optimally positioned to meet neighborhood fruit-and-vegetable needs? *J Urban Health Bull N Y Acad Med*. 2011; 88(5):977–981.10.1007/s11524-011-9593-2
39. Lucan SC, Varona M, Maroko AR, Bumol J, Torrens L, Wylie-Rosett J. Assessing mobile food vendors (a.k.a. street food vendors)—methods, challenges, and lessons learned for future food-environment research. *Public Health*. 2013; 127(8):766–776.10.1016/j.puhe.2013.05.006 [PubMed: 23891280]
40. Bustillos B, Sharkey JR, Anding J, McIntosh A. Availability of More Healthful Food Alternatives in Traditional, Convenience, and Nontraditional Types of Food Stores in Two Rural Texas Counties. *J Am Diet Assoc*. 2009; 109(5):883–889.10.1016/j.jada.2009.02.011 [PubMed: 19394475]
41. Sharkey JR. Measuring potential access to food stores and food-service places in rural areas in the U.S. *Am J Prev Med*. 2009; 36(4 Suppl):S151–S155.10.1016/j.amepre.2009.01.004 [PubMed: 19285206]
42. Department of Employment and Economic Development. Economic Overview and Industry Strengths of Minneapolis/St Paul. 2010. http://mn.gov/deed/images/Economic_Overview_Mpls-St_Paul.pdf. Accessed May 4, 2015
43. United States Census Bureau State & County QuickFacts. <http://quickfacts.census.gov/qfd/states/>. Accessed May 4, 2015
44. Hunger Solutions. <http://www.hungersolutions.org/>. Accessed April 27, 2015
45. ESRI Business Analyst. <http://www.esri.com/software/arcgis/extensions/businessanalyst>. Accessed April 27, 2015
46. Smiley MJ, Roux AVD, Brines SJ, Brown DG, Evenson KR, Rodriguez DA. A spatial analysis of health-related resources in three diverse metropolitan areas. *Health Place*. 2010; 16(5):885–892.10.1016/j.healthplace.2010.04.014 [PubMed: 20478737]
47. Hoisington A, Manore MM, Raab C. Nutritional quality of emergency foods. *J Am Diet Assoc*. 2011; 111(4):573–576.10.1016/j.jada.2011.01.007 [PubMed: 21443991]
48. Verpy H, Smith C, Reicks M. Attitudes and behaviors of food donors and perceived needs and wants of food shelf clients. *J Nutr Educ Behav*. 2003; 35(1):6–15. [PubMed: 12588675]
49. Lucan SC, Chambers EC. Better Measurement Needed to Move Food-Environment Research Forward. *Obesity*. 2013; 21(1):2–3.10.1002/oby.20015 [PubMed: 23401317]
50. de S Briggs, X. THE GEOGRAPHY OF OPPORTUNITY Race and Housing Choice in Metropolitan America Introduction. DeSouzaBriggs, X., editor. Washington: Brookings Inst; 2005.
51. Bletzacker KM, Holben DH, Holcomb JP. Poverty and Proximity to Food Assistance Programs are Inversely Related to Community Food Security in an Appalachian Ohio Region. *J Hunger Environ Nutr*. 2009; 4(2):172–184.10.1080/19320240902915276
52. Rosenblatt P, DeLuca S. “We Don’t Live Outside, We Live in Here”: Neighborhood and Residential Mobility Decisions Among Low-Income Families. *City Community*. 2012; 11(3):254–284.10.1111/j.1540-6040.2012.01413.x
53. Caspi CE, Sorensen G, Subramanian SV, Kawachi I. The local food environment and diet: A systematic review. *Health Place*. 2012; 18(5):1172–1187.10.1016/j.healthplace.2012.05.006 [PubMed: 22717379]
54. Caspi CE, Kawachi I, Subramanian SV, Adamkiewicz G, Sorensen G. The relationship between diet and perceived and objective access to supermarkets among low-income housing residents. *Soc Sci Med* 1982. 2012; 75(7):1254–1262.10.1016/j.socscimed.2012.05.014
55. Daponte BO, Lewis GH, Sanders S, Taylor L. Food pantry use among low-income households in Allegheny County, Pennsylvania. *J Nutr Educ*. 1998; 30(1):50–57.10.1016/S0022-3182(98)70275-4
56. Chaufan C, Davis M, Constantino S. The Twin Epidemics of Poverty and Diabetes: Understanding Diabetes Disparities in a Low-Income Latino and Immigrant Neighborhood. *J Community Health*. 2011; 36(6):1032–1043.10.1007/s10900-011-9406-2 [PubMed: 21533887]

57. Rochester JS, Nanney MS, Story M. Assessing Foodshelves' Ability to Distribute Healthy Foods to Foodshelf Clients. *J Hunger Amp Environ Nutr.* 2011; 6(1):10–26.10.1080/19320248.2011.549363
58. Gustafson A, Hankins S, Jilcott S. Measures of the consumer food store environment: a systematic review of the evidence 2000–2011. *J Community Health.* 2012; 37(4):897–911.10.1007/s10900-011-9524-x [PubMed: 22160660]
59. Reedy J, Krebs-Smith SM, Bosire C. Evaluating the food environment: application of the Healthy Eating Index-2005. *Am J Prev Med.* 2010; 38(5):465–471.10.1016/j.amepre.2010.01.015 [PubMed: 20171823]

Table 1

Census tract characteristics in 9-county Twin Cities metro area (n = 718)

	Mean	Std Dev	Minimum	Maximum
Distance to nearest food shelf (miles)	2.6	2.2	0.0	14.7
Closest food shelf size (lbs of food produced in 2010)	407,246	463,243	762	2,146,788
Percent (%) of residents in each census tract				
White	77.9	19.0	2.9	98.0
African American	9.1	11.5	0.1	72.5
Asian	6.2	6.6	0.3	43.2
American Indian/Alaska Native	0.8	1.2	0.0	22.0
Hispanic	6.2	6.6	0.7	44.9
East African	1.2	3.1	0.0	29.7
Southeast Asian	2.0	3.9	0.0	47.4
Latin American	2.8	4.4	0.0	33.9
Eastern European	0.6	1.1	0.0	8.2
Living in poverty	11.1	11.9	0.0	97.0
Population	4,093	1,731	1,032	14,633
Population density (per sq km minus water)	2,084	52,867	0	1,416,700

Table 2

a: Pearson correlation coefficients for census tract characteristics and race/ethnicity, n = 718

	Poverty	Population Density	White	African American	American Indian/Alaska Native	Asian	Hispanic
Poverty	1.00	-0.02	-0.73***	0.70***	0.39***	0.45***	0.41***
Population Density		1.00	0.03	-0.02	-0.02	-0.03	-0.03
White			1.00	-0.92***	-0.46***	-0.68***	-0.61***
African American				1.00	0.37***	0.44***	0.41***
American Indian/Alaska Native					1.00	0.08*	0.56***
Asian						1.00	0.20***
Hispanic							1.00

b: Pearson correlation coefficients for census tract characteristics and foreign-born groups, n = 718

	Poverty	Population Density	East African	Southeast Asian	Latin American	Eastern European
Poverty	1.00	-0.02	0.33***	0.32***	0.30***	-0.14**
Population Density		1.00	-0.01	-0.02	-0.02	-0.01
East African			1.00	0.07	0.24***	0.04
Southeast Asian				1.00	0.21***	-0.06
Latin American					1.00	0.05
Eastern European						1.00

*

p<0.5,

**

p<0.001,

p<0.0001

Table 3Distance to the nearest food shelf^a by population level of each racial group^b (n = 718)

		Adjusted for food shelf size, census tract percent poverty and census tract population density			
		Unadjusted		Estimate	
		Estimate	Standard Error		Standard Error
African American	Highest quartile	-1.44 *	(0.08)	-1.03	(0.10)
	Third quartile	-0.64 *	(0.08)	-0.53	(0.08)
	Second quartile	-0.48 *	(0.08)	-0.47	(0.08)
	First quartile	ref		ref	
American Indian/Alaska Native	Highest quartile	-1.20 *	(0.08)	-0.77	(0.09)
	Third quartile	-0.50 *	(0.09)	-0.33	(0.09)
	Second quartile	-0.10	(0.08)	-0.07	(0.08)
	First quartile	ref		ref	
Asian	Highest quartile	-0.53 *	(0.10)	-0.13	(0.09)
	Third quartile	-0.24	(0.10)	-0.21	(0.09)
	Second quartile	-0.29 *	(0.10)	-0.29	(0.09)
	First quartile	ref		ref	
Hispanic	Highest quartile	-1.24 *	(0.09)	-0.77	(0.09)
	Third quartile	-0.87 *	(0.09)	-0.71	(0.08)
	Second quartile	-0.58 *	(0.09)	-0.50	(0.08)
	First quartile	ref		ref	
White	Highest quartile	1.33 *	(0.09)	0.84	(0.10)
	Third quartile	0.92 *	(0.09)	0.43	(0.10)
	Second quartile	0.74 *	(0.09)	0.35	(0.10)
	First quartile	ref		ref	

^aLog in miles, from the population-weighted centroid of each census tract

Author Manuscript Author Manuscript

Census tracts in each quartile are compared with the lowest quartile for each racial group

$p < 0.05$ after Bonferroni correction

*

Author Manuscript

Author Manuscript

Table 4

Distance to the nearest food shelf^a for census tracts with a high population of high foreign born groups^b (n = 718)

		Adjusted for food shelf size, census tract percent poverty and census tract population density			
		Unadjusted		Estimate	
		Estimate	Standard Error		Standard Error
East African	Highest quartile	-0.62	*** (0.08)	-0.31	*** (0.07)
	Lower quartiles	ref		ref	
Latin American	Highest quartile	-0.62	*** (0.08)	-0.29	*** (0.07)
	Lower quartiles ^b	ref		ref	
Southeast Asian	Highest quartile	-0.45	*** (0.08)	-0.12	(0.07)
	Lower quartiles	ref		ref	
Eastern European	Highest quartile	0.07	(0.08)	-0.06	(0.07)
	Lower quartiles	ref		ref	

^aLog in miles, from the population-weighted centroid of each census tract

^bCensus tracts with the highest quartile population for foreign-born each group are compared with all other census tracts

* p<0.05,

** p<0.001,

*** p<0.0001