# HOW FAR DO LOW-INCOME PARENTS TRAVEL TO SHOP FOR FOOD? EMPIRICAL EVIDENCE FROM TWO URBAN NEIGHBORHOODS[1]

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*Abstract*: Research on the impact of the built environment on obesity and access to healthful foods often fails to incorporate information about how individuals interact with their environment. A sample of 198 low-income WIC recipients from two urban neighborhoods were interviewed about where they do their food shopping and surveys were conducted of food stores in their neighborhoods to assess the availability of healthful foods. Results indicate that participants rarely shop at the closest supermarket, traveling on average 1.58 miles for non-WIC food shopping and 1.07 miles for WIC shopping. Findings suggest that access to healthful foods is not synonymous with geographic proximity.

## INTRODUCTION

As obesity rates have increased beyond what can be explained by genetic and individual-level factors alone, researchers have increasingly looked to the built and social

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environment to explain changes in food consumption and physical activity (Northbridge et al., 2003; Mikkelsen and Chehimi, 2004; Sallis et al., 2005). Studies of neighborhood effects conducted over the past five years have frequently demonstrated modest but statistically significant associations between characteristics of the environment and health behaviors and outcomes (Papas et al., 2007; Sallis and Glanz, 2006). Collectively, these studies provide growing support for an ecological model of obesity, placing emphasis on the role of the environment on individual health outcomes, but they contribute little to our understanding of how individuals interact with their environment and how the environment impacts individual behavior (Northbridge et al., 2003; Papas et al., 2007; Lytle, 2009).

Previous research on obesity and the food environment has not always yielded consistent findings (Holsten, 2008; Feng et al., 2010), but a growing number of studies from the United States have demonstrated a relationship between food access and food consumption and body mass index (BMI). Some of this research has linked greater access to supermarkets to healthier eating (Cheadle et al., 1993; Morland et al., 2002; Laraia et al., 2004; Rose and Richards, 2004; Zenk et al., 2005; Moore et al., 2008) and lower BMI among adolescents (Powell et al., 2007) while other studies have shown an association between the availability of more healthful products in food stores and the reported healthfulness of diets of those living nearby (Cheadle et al., 1991; Bodor et al., 2008). Research by Zick et al (2009) found that the relationship between food outlets and BMI was mediated by the socio-economic status (SES) of the neighborhood. In low-income neighborhoods, the presence of a healthy grocery option was associated with lower BMI while the availability of convenience stores in moderate to high income neighborhoods was associated with lower BMI.

Studies like these are vulnerable to a number of critiques. Most importantly, the methods used tend to be cross-sectional, so it is impossible to discern how individuals interact with their environments or the time order of associations. Many studies also fail to test for and report the psychometric or "ecometric" (Raudenbush and Sampson, 1999) properties of their food environment measures (Lytle, 2009; McKinnon et al., 2009). Others rely on secondary data sources, such as commercial lists of food outlets distributed by Dunn & Bradstreet and InfoUSA, which may be incomplete or outdated and provide little indication of the kinds of foods available (Holsten, 2008; Andreyeva, 2009). Secondary sources of geographically coded data often use administrative areas such as census tracts and block groups, suggesting boundaries that may have little correspondence to how people live and shop (Diez Roux, 2002; Ball et al., 2006; Papas et al., 2007; Feng et al., 2010). Additionally, defining access to healthful foods as Euclidean (straight line) distance to the closest chain supermarkets ignores consumers' travel patterns and selection of shopping destinations (Zenk et al., 2005; Papas et al., 2007; Sarloos et al., 2009). Finally, most existing research on the food environment has done little to incorporate cultural food preferences and characteristics of the social environment or to engage members in the research process, which may be essential to understanding how food access differs across communities with varying racial, ethnic, and socioeconomic composition (Johnson et al., 2009; Odoms-Young et al., 2009).

A limited amount of research has looked at where people actually shop for food, not just what food outlets they live near. Inagami et al (2006) linked data on food store choice from the Los Angeles Family and Neighborhood Study (LAFANS) to U.S. Census data in order to analyze the impact of distance traveled for food shopping and BMI controlling

for individual-level and neighborhood-level characteristics. Results indicated that traveling 1.76 miles or more for food shopping was associated with higher BMI, controlling for education, race/ethnicity, car ownership, and employment status. The SES of the census tract in which individuals shopped was a better predictor of BMI than was the specific choice of food store.

The 1997 National Food Stamp Program Survey (NFSPS) also collected information from participants about the type of store where they shopped and how far it was from their home (Ohls et al., 1999). Results indicated that 90 percent of respondents shopped primarily at supermarkets but also shopped at smaller neighborhood grocery stores, convenience stores, warehouse or discount stores, and produce stands. Many respondents did not shop at the store closest to their home. One-third of respondents shopped for food within a mile and another third patronized stores between one and four miles away. Most reported traveling by car, either in their own car (45%) or by getting a ride from a friend or relative (31%).

Little research exists about the travel patterns of low-income households, in general, much less specifically about food shopping. Some recent research has explored the application of new spatial methodologies, including GPS (Ong, 2009) and geo-ethnograpy (Matthews et al., 2005), which combines geographic information systems (GIS) and ethnographic research, to map and analyze travel patterns of low-income households. Semi-structured interviews with people in low-income households in Austin, Texas highlighted the frequency of travel by car even for households that did not own one (Clifton, 2004). Research conducted in Knoxville, Tennessee using ethnography, travel diaries, and GIS highlighted how women create "communities of spatial necessity" and barter to overcome lack of automobile access (Rogalsky, 2010).

Similarly, in-depth interviews with people living in South Australia who did not own cars suggested that personal social welfare networks, including relatives and friends willing to provide rides, were more central to understanding food access than distance to food stores (Coveney and O'Dwyer, 2008). This limited amount of research on low-income travel patterns has focused exclusively on physical distance rather than social distance. Traditionally, the concept of "social distance" has referred to the extent of "intimacy and understanding" within personal relations rather than anything referring to geography (Park, 1924; Bogardus, 1925). In this paper, the term "social distance" is used to refer to the combination of environmental challenges a person faces in efforts to acquire the foods she/he hopes to purchase. In essence, the social distance between a person and desired food may incorporate consideration of transportation options, financial resources, and the racial/ethnic and the socioeconomic profile of the shopper and composition of the neighborhood where she/he shops.

This article analyzes self-reported food shopping patterns of low-income Hispanic and African American parents in two urban neighborhoods using a cross-sectional design and GIS, descriptive statistics, and multivariate regression. It addresses some of the limitations relating to food environment and food store accessibility measures described above by relying upon address-level data of where parents live and shop and observations of the food environment based on a validated field measure. This study seeks to answer four research questions: (1) How far do low-income families travel to do their food shopping? (2) Does the distance traveled differ based on the type of shopping, including the use of Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) benefits? (3) Do participants cross neighborhood racial/ethnic boundaries to do their shopping, reflecting

not only physical distance but social distance traveled? (4) What individual-level and neighborhood-level characteristics help explain the distance traveled?

## METHODS

### *Neighborhoods and Sample*

This study focused on two ZIP codes in North Philadelphia that were chosen because they are contiguous, have a high percentage of families living below the poverty line (32.8% and 50.8%, respectively, in the 2000 U.S. Census) relative to the city-wide average (23.3%), and represent distinct racial/ethnic areas. One ZIP code area is predominantly African American (97.0%) and the other is predominantly Hispanic/Puerto Rican (56.7%). Trained research assistants (RAs) conducted interviews in English and Spanish with WIC recipients who visited one of three WIC offices in or near the study area between February and June 2009. WIC recipients receive monthly paper vouchers listing specific foods that they can redeem at participating food stores. They receive separate coupons during summer months to redeem at participating farmers' markets for fresh, locally grown fruits, vegetables, and herbs. To be eligible for WIC, households must include a pregnant or breastfeeding mother or one or more children ages five years and under, be certified by a physician as being "nutritionally at risk" (which can include medical risks such as anemia, underweight, overweight, history of pregnancy complications or poor pregnancy outcomes, or dietary risks such as failure to meet the dietary guidelines or inappropriate nutrition practices) and have a household income below 180% of the federal poverty line (USDA, 2009b).

The RAs approached WIC participants, invited them to participate in the study, sought informed consent, and conducted interviews in a WIC waiting room. They administered a 125-item survey about food shopping, perception of the food environment, food insecurity, and specific food products purchased. Approximately 60 percent of WIC participants who were approached chose to participate. Only WIC participants who were 18 years or older and reported doing the food shopping for their family were eligible to participate. Upon completion of the interview, participants chose either a $10 gift certificate to a local supermarket or 10 bus/subway tokens (value of $14.50) as compensation. The RAs used HP iPAQ 110 PDAs programmed with Pendragon software to record the interview data. Survey results were downloaded at the end of each day into Microsoft Excel. This study protocol was approved by the University of Pennsylvania Institutional Review Board.

### *Measure of Food Store Shopping Locations*

Participants were asked for the name of the store or stores where they do most of their grocery shopping, the name of the store or stores where they do their WIC shopping, and the street intersections where those stores are located. They were also asked where they purchase fresh fruits and vegetables.

### *Analysis of Participant Home Locations and Food Store Proximity*

The home address of study participants and the intersections of the stores where they reported shopping were geocoded using ArcView GIS 9.3 software and a 2008 street

centerline file from the City of Philadelphia. The distance between a participant's home address and the store(s) where they shop was calculated using PointDistance version 9 script for ArcMap (City of Scottsdale, 2009). Driving and walking distances were also calculated using Google Maps. Home and store locations were linked to small area-level (i.e., block group) 2000 U.S. Census data to identify the majority racial/ethnic composition of those areas. Areas where no one racial/ethnic group constituted more than 50% of residents was coded "no majority."

Survey results were analyzed using SPSS 10.0. Distances traveled from home for non-WIC and WIC food shopping were compared using paired *t*-tests to determine whether there was a significant difference. Distances for regular and WIC food shopping were also compared to the distance to the closest chain supermarket (regular food shopping) and WIC-approved food store (WIC shopping) using paired *t*-tests to determine if participants were choosing to travel significantly further than if they chose the closest store. Finally, the distance traveled for non-WIC shopping was analyzed relative to individual-level characteristics and neighborhood characteristics using OLS regression in order to determine which characteristics help explain the distance traveled. Table 1 provides a complete description of variables included.

*Measure of Healthful Food Availability in Stores*

In order to assess the availability of healthful foods to study participants, all food stores located within the study area were surveyed between February and June 2009 using a modified version of the Nutrition Environment Measure Survey for Stores (NEMS-S) developed by Glanz et al. (2007). The NEMS-S instrument is used to identify food items available in retail establishments, including both regular items (such as whole milk or ground beef) and more healthful alternatives (such as reduced fat milk and lean beef or turkey). NEMS-S also measures the quality of fresh fruits and vegetables (acceptable/unacceptable) and price. It has been shown to be associated with diet (Franca et al., 2009) and to have high inter-rater and test-retest reliability (Glanz et al., 2007).

The standard NEMS-S instrument was modified for this study by adding several items to reflect changes to the WIC food package, including canned and dried beans, canned fish, whole grain tortillas, and brown rice. Additionally, the instrument was adapted to incorporate foods traditionally associated with African American and Puerto Rican diets. Specifically, mango, avocado, plantains, greens (collard, mustard, turnip, kale), green beans, and hot peppers were added. Some foods, including frozen dinners, baked goods, chips, and soda, were eliminated from the adapted NEMS-S because they were not related to the WIC food package.

All stores in the catchment area that participated in the SNAP program[3] were identified through data from the U.S. Department of Agriculture and then maps were generated showing all food store locations using ArcView GIS 9.2 software. Through field work, trained student and community RAs confirmed the location and operation of the SNAP stores and identified any additional stores, existing stores that had closed, and the type of store: chain supermarket (full-service chain stores of at least 10,000 square feet, $75,000 in

[3]Supplemental Nutrition Assistant Program (SNAP), formerly called the Food Stamp Program.

**Table 1.** Independent Variables included in OLS Regression Models

| Variable | Measure |
|---|---|
| **Individual-level** | |
| Age | Years |
| Education level | Less than high school diploma, high school diploma, some college/vocational training, college graduate, professional/ graduate education |
| Work status | Number of hours employed per week outside the home |
| Income level | Income per month, less than $500, $500–$999, $1,0000–$1,499, $1,500–$1,999, $2,000 or more |
| Receives SNAP benefits | Yes/no |
| Receives cash assistance (TANF) | Yes/no |
| Born in Philadelphia | Yes/no |
| Hispanic/Latino | Yes/no |
| Children living in home | Total number under 18 |
| Fresh fruit purchased | Number of varieties in last month |
| Fresh vegetables purchased | Number of varieties in last month |
| Food insecurity | Sometimes or often worries about running out of food before the end of the month |
| **Neighborhood-level** | |
| Distance to closest chain supermarket | Euclidean distance in miles |
| Perception of food store quality in neighborhood | Agree or strongly agree that food stores in neighborhood are of good quality |
| Poverty rate | 2000 U.S. Census, block group |
| Percent black residents | 2000 U.S. Census, block group |

weekly sales, and 10 employees based on information from TradeDimension's Retail Site Database); grocery store (smaller than supermarket but larger than convenience or corner store, more than one register); chain convenience store; or corner store (non-chain store with only one register in a building the size of a typical 14-foot rowhouse). Butcher/fish shops, dollar stores, and chain pharmacies were excluded, consistent with the NEMS-S protocol, because they could not be expected to carry a full line of foods. Through the food store enumeration, 140 stores were identified to survey. RAs working in pairs completed NEMS-S surveys of all enumerated food stores between March and June 2010.

*Analysis of Healthful Food Availability in Stores*

Completed surveys were scanned using TELEform software to create an ACCESS database. Scores for each store were calculated based on the availability, quality, and price of food items consistent with the original NEMS-S scoring system, with possible scores ranging from –7 to 63.

## RESULTS

### *Study Participant Characteristics*

One hundred ninety-eight (198) WIC recipients chose to participate and completed surveys. Nearly all study participants were women (193 women; 5 men). More than half (55.8%) of participants identified themselves as black or African American, 37.6% as Hispanic, 2.0% as white or Caucasian, and 4.5% as multi-racial or other. Nearly two-thirds (65.8%) were born in Philadelphia and 10.1% were born in Puerto Rico. The average age was 27 years old and median was 25, with a range from 18 to 77 years old. Only 4.5% of participants had no children (pregnant only), 24.2% had one child, 27.8% had two children, 20.1% had three children, and 22.7% had four or more children. Fifty-nine participants (30.0%) reported living within the study area; an additional 75 (37.9%) reported living within a mile.

More than half (55.5%) of participants reported monthly household incomes of less than $1,000. Less than one-third (31.2%) of participants reported working for pay at the time of the interview, and those employed reported working an average of 30 hours per week. More than three quarters (76.3%) of participants reported receiving SNAP benefits and 41.2% reported receiving cash public assistance benefits. Nearly two-thirds of participants reported that in the previous two months, they worried sometimes (47.9%) or often (17.0%) that their food would run out before they received money to buy more. Participants reported purchasing an average of 7.1 (median 7.0) varieties of fresh fruits and 6.7 (median 7.0) varieties of fresh vegetables within the previous month. Two-thirds of participants (54.6%) agreed or strongly agreed (12.2%) that the quality of food stores in their neighborhood was good.

African American participants were more likely than Hispanic participants to live in block groups where they were in the racial/ethnic majority. Nearly two-thirds (62.6%) of African American study participants lived in block groups where more than 50% of residents were also African American, while 23.2% lived in predominantly Hispanic areas. Only 29.4% of Hispanic study participants lived in block groups where more than 50% of residents were also Hispanic, while 39.7% lived in majority–African American areas. These statistics reflect the overall racial/ethnic composition of Philadelphia, which was 47.5% white, 44.8% black/African American, and 11.3% Hispanic in 2000 (U.S. Census).

### *Food Store Characteristics*

NEMS-S surveys were completed for 135 of the 140 food stores in the study area; staff at the remaining five stores did not permit research assistants to conduct the research in their stores. The surveyed stores included five chain supermarkets, seven medium-sizes grocery stores, and 117 small convenience stores. One of the supermarkets was a national discount chain and one was a local chain. Three of the convenience stores were chain stores with gas stations and the rest were “mom and pop” corner stores. Nearly all of the food stores were participating in SNAP at the time of the survey and 52 stores (38.0%) were participating in the WIC program.

NEMS-S scores ranged from 2 to 44. On average, supermarkets scored the highest (36.8), followed by grocery stores (23.9) and corner stores (13.8). There were few fresh

fruits and vegetables in stores other than supermarkets and grocery stores; 79% of stores had no fresh fruit at all and 46% of stores had no fresh vegetables at all. On average, supermarkets had 9 varieties of fresh fruit and 12 varieties of fresh vegetables available while grocery stores carried an average of four varieties of fresh fruits and four varieties of fresh vegetables. The availability of frozen vegetables was similar: supermarkets had an average of nine varieties while grocery stores carried an average of four varieties.

The availability of whole grains followed a similar pattern. 60% of supermarkets, 57% of grocery stores, and only 22% of convenience stores carried brown rice. All supermarkets surveyed carried at least one variety of 100% whole wheat bread but only 43% of grocery stores and only 29% of convenience stores had at least one variety of whole wheat bread; 40% of supermarkets carried 100% whole wheat tortillas but none of the grocery stores or convenience stores did. Similarly, 40% of supermarkets carried lean beef and 80% carried lean turkey but none of the grocery stores or corner stores carried either. Finally, all supermarkets carried 2% milk, while 72% of grocery stores and 46% of convenience stores did.

*Participant Reports of Food Shopping Locations*

Most study participants (98.5%) named only one store where they did most of their non-WIC food shopping and most participants (96.5%) named only one store where they did their WIC shopping, so the results presented here are based solely on the first store named by participants. Nearly all participants (98.0%) reported doing most of their non-WIC food shopping at a chain supermarket. More than half (54.2%) reported doing most of their food shopping at a discount chain supermarket or local chain supermarket rather than a national chain. All together, participants reported shopping at 36 different stores for most of their non-WIC food shopping, only 5 of which (13.9%) were located within the study area.

Just over half (55.7%) of the participants reported doing their WIC shopping at the same store where they do most of their non-WIC food shopping. A smaller proportion reported shopping at a different chain supermarket (14.5%), while 25.3% of participants reported doing their WIC shopping at a corner store or medium-sized grocery store. All together, participants reported shopping at 53 different stores for their WIC food shopping, 16 of which (30.2%) were located within the study area.

Because not all stores where participants reported shopping were located within the study area, NEMS-S surveys were not conducted in all of the stores where they reported shopping. For several supermarket chains, NEMS-S scores were obtained for a different store within the same chain where participants reported shopping. NEMS-S scores indicate that the three non-discount chain supermarkets and the local chain supermarket had similar inventories, while the national chain discount store scored considerably lower because it had fewer varieties of fresh fruit and vegetables and no brown rice, whole-wheat tortillas, or canned salmon.

When shopping for fruits and vegetables, specifically, the overwhelming majority of study participants reported going to chain supermarkets (90.0% for fruits and 80.0% for vegetables), but participants also reported shopping at farmers' markets (30% for fruits and 28% for vegetables). A small proportion of study participants reported shopping for fresh fruit (13%) and fresh vegetables (10%) at fruit and vegetable trucks, while a slightly lower

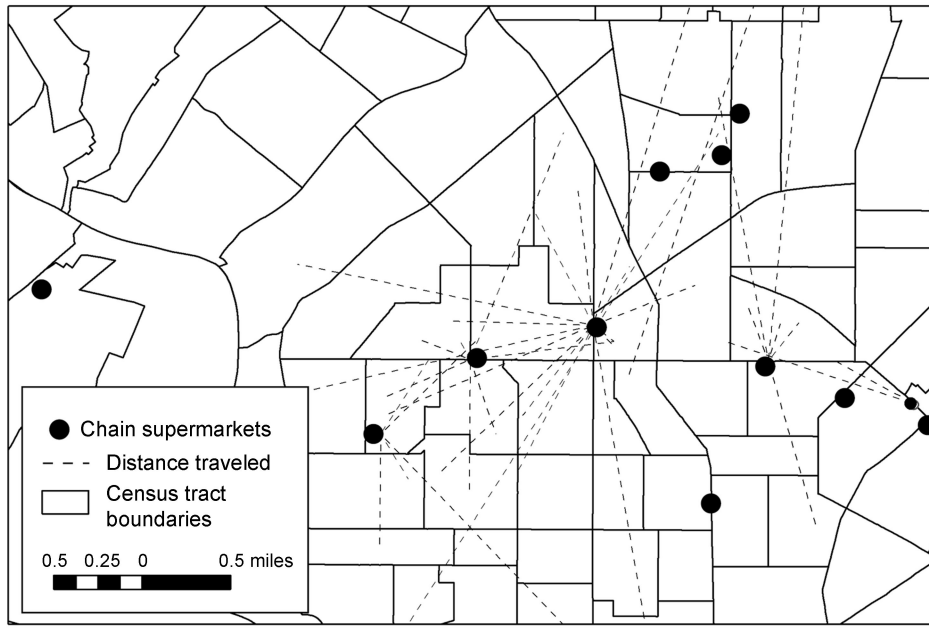


**Fig. 1.** Euclidean distance between home and food stores relative to census tract boundaries. The lines connect participant home addresses to the stores where they do their non-WIC food shopping (lines do not represent the actual paths they take). They are intended to show that most participants shop for food outside the census tracts in which they live.

proportion reported purchasing fresh fruit (12%) and fresh vegetables (10%) at corner stores.

*Travel Distance to Food Stores*

The distance participants reported traveling to food stores varied by the type of shopping, with participants tending to travel shorter distances for their WIC shopping. On average, participants reported traveling 1.58 miles (1.26 median) to do their non-WIC food shopping and just 1.07 miles (0.65 median) to do their WIC shopping (significant at $p < .001$). Differences between driving and walking distances (calculated with Google Earth) and the Euclidean distance (calculated with ArcGIS) for the two types of food shopping were very similar.

Only 58 participants (29.3%) did most of their food shopping within the ZIP code where they live and only 3 participants (1.5%) did most of their food shopping within the census tract in which they live. On average, participants traveled more than 10 census tracts away, with a median of four census tracts. Less than half of the participants (46.0%) conducted their WIC shopping within the ZIP code in which they live or the adjacent ZIP code, and only 29 participants (14.6%) did their WIC shopping within the census tract in which they live or the adjacent census tract. Figure 1 is intended for illustrative rather than analytical purpose and shows lines connecting where a non-random sample of participants live to where they shop relative to census tract boundaries.

**Table 2.** Predominant Race/Ethnicity of Areas where Participants Live and Shop[a]

| Participant race/ethnicity | Block group composition | | Non-WIC shopping | | WIC shopping | |
|---|---|---|---|---|---|---|
| | Where live | Where shop | Pct. of all participants | Pct. within participant racial/ethnic group | Pct. of all participants | Pct. within participant racial/ethnic group |
| African American | African American | African American | 27.4 | 52.0 | 32.6 | 62.5 |
| African American | African American | Hispanic | 15.3 | 29.0 | 10.9 | 20.8 |
| Hispanic | Hispanic | Hispanic | 14.2 | 56.3 | 20.1 | 80.4 |
| Hispanic | Hispanic | African American | 2.6 | 10.4 | 1.1 | 4.3 |

[a]This table does not include data about the participants who live in block groups where the majority of residents are of a different race/ethnicity (33.0%) or those participants who identify as white or multi-racial (7.5%).

Participants consistently reported traveling further than the closest food store for both types of shopping. On average, participants traveled 0.65 miles beyond the closest chain supermarket for their non-WIC shopping (significant at $p < .001$) and 0.95 miles beyond the closest WIC store for their WIC shopping (significant at $p < .001$).

*Racial Composition of Areas of Residence and Food Stores*

More than half of participants reported doing most of their grocery shopping within areas of the same predominant race/ethnicity as where they live: 52.0% of participants living in predominantly African American block groups shop in predominantly African American block groups and 56.3% of participants living in predominantly Hispanic block groups shop in predominantly Hispanic block groups (Table 2). The most common exception was for participants in African American block groups to shop in predominantly Hispanic block groups. This phenomenon seemed to be driven mostly by African American participants who crossed a north-south racial/ethnic boundary to shop at a local chain supermarket.

Fewer participants reported crossing racial/ethnic boundaries to do their WIC shopping than their non-WIC shopping: 62.5% of participants living in African American areas shop in African American areas and 80.4% of participants in Hispanic areas shop in Hispanic areas.

*Multivariate Correlates of Distance Traveled for Shopping*

The dependent variable (distance traveled for shopping) had a normal distribution. None of the individual-level participant characteristics were significant predictors of the distance traveled to do non-WIC shopping (Table 3) with the exception of a small association with the number of hours participants reported working ($p < 0.001$). This independent

**Table 3.** Association between Individual Characteristics and Distance Traveled to Conduct Non-WIC Food Shopping: Results of Stepwise OLS Regression[a]

| | Unstandardized coefficients | | Standardized coefficients | *t* | Sig. |
|---|---|---|---|---|---|
| | *B* | Std. Error | Beta | | |
| (Constant) | .603 | .375 | | 1.611 | .109 |
| Worry that food will run out | .369 | .193 | .137 | 1.914 | .057 |
| Distance to chain supermarket | .420 | .144 | .213 | 2.911 | .004 |
| Hours worked/week | .020 | .006 | .235 | 3.271 | .001 |
| Poverty rate (block group) | –.064 | .037 | –.124 | –1.732 | .085 |
| Fresh fruit varieties purchased | .058 | .033 | .128 | 1.776 | .077 |

[a]Adjusted $R^2 = 0.119$.

variable had the largest standardized beta coefficient, but a one-hour increase in the number of hours worked per week was associated with just a 0.02-mile increase in the distance traveled. The relationship with participants who said that they worry that they will run out of food before they have money to buy more was positive and marginally significant ($p = 0.057$), meaning that people who were food insecure traveled farther, on average, to conduct their shopping. Distance traveled was also positively associated with the variety of fresh fruits purchased within the previous month ($p = 0.077$). The distance to the closest chain supermarket was significantly associated with distance traveled ($p = 0.004$), while the poverty rate of the block group in which a participant lived was marginally significant ($p = 0.085$) and negative, meaning that participants living in areas with higher poverty rates traveled shorter distances for food shopping, on average.

## DISCUSSION

Among a sample of low-income parents living within two Philadelphia neighborhoods, there are significant differences in food shopping patterns when comparing non-WIC to WIC shopping. Participants reported traveling farther, on average, to do their non-WIC food shopping. This may reflect the fact that WIC benefits work differently from cash or SNAP benefits. In the case of WIC benefits, each voucher is redeemable for specific food items, rendering sticker prices irrelevant. In other words, WIC participants do not save money by traveling farther to redeem their WIC vouchers at stores with cheaper prices. A substantial proportion of participants also indicated shopping for fruits and vegetables at farmers' markets. The number and size of farmers' markets in Philadelphia have expanded because of the work of The Food Trust to make them more accessible to low-income households by accepting Food Stamps/Electronic Benefit Transfer (EBT).

Differences across neighborhood racial/ethnic composition accounted for little of the variability we found in food store choices. African American and Hispanic participants reported shopping at the same types of food stores, even when that meant crossing racial boundaries. Hispanic participants were more likely to live in majority–African American

areas than African American participants were to live in majority-Hispanic areas, a reflection of the strong historical pattern of black-white residential segregation in Philadelphia as well as the fact that African Americans outnumber Hispanics by five to one in the city. But African American participants were more likely to shop in majority-Hispanic areas than Hispanic participants were to shop in majority–African American areas, possibly suggesting a racial/ethnic difference in the experience of neighborhood boundaries as described by Odoms-Young et al. (2009) or in the types of food stores available in neighborhoods of different racial/ethnic composition.

The relatively low adjusted $R^2$ value for the OLS regression model (0.119) suggests that even all together, the individual and neighborhood-level characteristics considered explain little of the variability in travel distance. The fact that the number of hours worked was significant may reflect time spent outside participants' neighborhoods rather than income, inasmuch as income was also included in the initial model. The positive association between food insecurity and distance traveled could reflect the lack of affordable foods near where participants live and some association with food insecurity and physical access. The fact that distance to the closest chain supermarket was positively associated with distance traveled for non-WIC food shopping suggests that, even though food access is not synonymous with distance to the closest chain supermarket, they are related. While participants rarely reported doing their non-WIC food shopping at the closest supermarket, most still shopped within two miles of their home.

## CONCLUSIONS AND FUTURE RESEARCH NEEDS

This article responds to calls for both field-based research on the food environment (Oakes et al., 2009) and detailed data about the local environment in which individuals make choices (Sarloos et al., 2009) by presenting empirical results from a survey about where low-income parents do their food shopping. Only by addressing the "individual space-time behavior that underlies the interaction between the built environment and health" (Sarloos et al., 2009, p. 1726) can we expect to develop interventions that modify the relationship between individuals and their environment. The concept of "activity space"—the geographic area within which individuals spend time and make decisions—was developed by geographers and transportation planners (Brown and Moore, 1970; Horton and Reynolds, 1971; Buttimer, 1980; Newsome et al., 1998; Dijst et al., 2002), but has potential value to public health researchers trying to better understand neighborhood landscapes and dynamics and their attendant health effects.

Given that participants generally traveled more than a mile to do their non-WIC food shopping, mode and cost of transportation must be considered in future studies along with distance to a chain grocery store (Rose and Richards, 2004). Brief follow-up telephone interviews with 64 of the study participants between November 2009 and February 2010 were conducted in order to ask participants how they travel to the store. Of those 64 participants, 56 were still receiving WIC. Fewer than half (44.6%) owned a car, but 75.0 percent either drove or received a ride to do their non-WIC food shopping either to and from the store or only on the way home. Only 17.9 percent walked either to or from the store for non-WIC shopping while 53.6 percent walked either both ways or to the store for their WIC shopping. These results are consistent with our findings that low-income parents travel farther for their non-WIC shopping than their WIC shopping. Walking was

likely a more popular option for WIC shopping (at least before the 2009 food package changes; see below) because of the shorter distance and because the contents of the WIC package were often something parents could carry home. Most participants (82.1%) also reported that they take their children shopping with them, which could further complicate transportation.

Our results showing the reliance of low-income households on automobiles are consistent with previous studies (Clark and Wang, 2010). The 2003–2007 American Time Use Survey found that the mode of transportation varies by the level of income and supermarket access in an area, but even in low-income areas with high supermarket access, 65.3% of households drove or were driven to do their food shopping (USDA, 2009a). The relatively high proportion of our study participants who walk to do their WIC shopping may change with the changes to the WIC food package implemented nationwide in October 2009,[4] because the increase in the number of jars of baby food for families with infants could make it more difficult for them to walk home with heavy WIC groceries.

This study raises new sets of questions about what access to healthful foods means in low-income communities. Why do participants travel beyond the closest chain supermarket for their non-WIC food shopping? Is it primarily to save money or to find culturally appropriate foods? Are participants who travel farther more likely to purchase healthful foods? What meaning, if any, do low-income parents assign to crossing neighborhood and racial/ethnic boundaries? Do they move across such invisible lines unconsciously or with trepidation? Beyond the racial/ethnic composition of the area in which food stores are located, how does the race/ethnicity of the store staff and owners influence their decision about where to shop or their experience of shopping? Photo-voice work conducted in Philadelphia indicated that relationships between residents in predominantly African American neighborhoods and Asian store proprietors are often hostile (Cannuscio et al., 2009). These issues are relevant to food access because social distance could contribute to choices distinct from physical distance. This study only explores one element of social distance—the match between the race/ethnicity of the shopper and the area in which they shop—but this constitutes a rich area of future inquiry.

Answers to these questions have clear policy implications. What is the best strategy, or combination of strategies, to improve access to healthful foods in low-income communities? Philadelphia and Pennsylvania have led the way in investing in new supermarkets, reflecting the leadership of The Food Trust, The Reinvestment Fund, and the Pennsylvania State Legislature in supporting the model Fresh Food Finance Initiative (Giang et al., 2008). But what role do the many new chain supermarkets play in the lives of low-income shoppers? If the price of food is as much an issue as physical access to foods, do low-income families need subsidies such as WIC and the Fresh Fund Demonstration program in San Diego, where SNAP recipients receive up to $10 for purchasing fresh fruits and vegetables in order to shop at non-discount supermarkets (French, 2003)?

[4]In response to concern regarding the prevalence and consequences of childhood and adult obesity, the U.S. Department of Agriculture made changes in October 2009 to the food items that WIC participants receive. These changes included the addition of fruits and vegetables and whole grains and a switch from whole milk to 2 percent milk for children over two years of age. The food package changes included the addition of jars of vegetables, fruits, and meats for babies—the total number varies by the age of the child and whether the mother is breast-feeding or not, but can easily number several dozen.

In-depth qualitative research, using interview-based, ethnographic, geographic, and visual methods, among others, can begin to answer some of these questions. For example, study participants might document the experience of food shopping with a digital camera, video camera, and/or digital voice recorder, explaining typical decisions such as bringing children along, mode of transportation and route, choosing a food store, and choosing food items. Use of online mapping systems, such as Google's MyMaps, during in-depth interviews would allow low-income parents to record annotations about local food stores, explaining when and why they shop there as well as their mode and route of transportation. Surveys like the American Time Use Survey are needed to provide comparisons across different cities and urban and rural areas, but to be most effective, they need to include more specific questions about the type and location of stores where low-income families shop, similar to the research conducted by Zenk et al (2005). Together, these qualitative studies and detailed surveys can expand our knowledge of how people interact with their environment to access food. Identifying the specific causal mechanisms linking environment and obesity and other nutrition-related health issues is critical to designing appropriate interventions.

Beyond raising new questions, this study further develops the concept of healthful food access, moving beyond the conception of environment as being only the immediate area surrounding one's residence. The fact that block group and census tract boundaries or even a one-mile radius around one's residence held no meaning for food shopping behavior in this study provides additional evidence for the need for more fluid and sophisticated ways of measuring environment (Ball et al., 2006; Boschmann and Kwan, 2010; Neutens et al., 2010). This finding is relevant to the epidemiologic study of neighborhoods, which too often relies on administrative geographic boundaries in analyses of environmental conditions, behavior, and health. Food access must be understood spatially, but that involves much more than simply mapping home addresses and supermarket locations. With the exception of the small proportion of people who order groceries online or over the phone and have them delivered, purchasing food requires a physical trip to a store. Detailed spatial data are needed to understand the activity space in which low-income families are making their food decisions. Only by conducting similar studies in diverse settings can the generalizability of these findings be determined, but it is likely that research on the shopping patterns of low-income households beyond North Philadelphia will generate similar empirical findings if it adopts the conceptualization that access to food is not synonymous with the Euclidean distance to the closest supermarket.

Finally, by asking low-income families where they shop, we acknowledge their agency in navigating the resources and constraints of their environments. All of us make choices that have implications for our health. The choices low-income families make are often more constrained than their higher-income counterparts, but they are still able to make choices about where to shop and what they purchase. Taken to its extreme, ecological theory can lead to environmental determinism, implying that neighborhood is destiny. There is too much variability within food shopping behavior among low-income households to accept that. Only by understanding the interaction between individual and household-level characteristics and a broad conception of access can we hope to understand and improve access to healthful foods in low-income communities (Zenk et al., 2005; Lytle, 2009).

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