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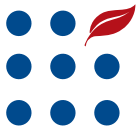

A Report from the Economic Research Service

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Access to Affordable and Nutritious Food: Updated Estimates of Distance to Supermarkets Using 2010 Data

Michele Ver Ploeg, Vince Breneman, Paula Dutko, Ryan Williams, Samantha Snyder, Chris Dicken, Phil Kaufman

Abstract

Efforts to encourage Americans to improve their diets and to eat more nutritious foods presume that a wide variety of these foods are accessible to everyone. But for some Americans and in some communities, access to healthy foods may be limited. This report updates population estimates of indicators of spatial access to healthy and affordable foods in the United States using population data from the 2010 Census, income and vehicle availability data from the 2006-2010 American Community Survey, and a 2010 directory of supermarkets. Spatial access to healthy and affordable food is proxied by measuring the distance to the nearest supermarket for the overall U.S. population and for subpopulations including households without vehicles, populations with low incomes, and populations that live in low-income areas. These updated data reflect recent changes in population characteristics, the economy, and the location of supermarkets. An estimated 9.7 percent of the total population, or 29.7 million people, live in low-income areas more than 1 mile from a supermarket. However, most households that are far from a supermarket have vehicles: only 1.8 percent of all households (2.1 million households) live more than 1 mile from a supermarket and do not have a vehicle. Estimated distance to the nearest three supermarkets is an indicator of the choices available to consumers and the level of competition among stores. Estimates show that half of the U.S. population lives within 2 miles of three supermarkets.

Keywords: food access, food deserts, supermarkets, food assistance, low-income, diet and health

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Summary

What Is the Issue?

Efforts to encourage Americans to improve their diets and to eat more nutritious foods presume that a wide variety of these foods are accessible to everyone. But, for some Americans and in some communities, access to healthy foods may be limited. In the 2009 report to Congress, *Access to Affordable and Nutritious Food: Measuring and Understanding Food Deserts and Their Consequences*, the U.S. Department of Agriculture estimated several indicators of access to healthy food sources, based on population data from the 2000 Census and supermarket location data from 2006. This report uses data from 2010 to provide updated population estimates of spatial access to affordable and nutritious food. These estimates reflect openings and closings of supermarkets, changes in the distribution of the population in relation to supermarkets, and the effects of the 2007-09 recession, which include the expansion of the number of low-income people and areas. Estimates by income, vehicle availability, and other characteristics of the population are provided in addition to estimates for those who live in low-income neighborhoods. These estimates are based on data from 2010 and, therefore, precede Federal policy initiatives to reduce barriers to food access, which began in 2011.

What Did the Study Find?

Updated estimates from 2010 data present a mixed picture of the extent of food access challenges in the United States. First, there was very little change in the distance to the nearest supermarket between 2006 and 2010 overall, both in terms of the median distance to the nearest supermarket and throughout the distribution.

Second, vehicle availability for households more than 1 mile from a supermarket has improved. In 2010, 1.8 percent of all U.S. households (2.1 million households) did not have a vehicle and were more than 1 mile from a supermarket. This is a decrease relative to 2006, when an estimated 2.3 percent (2.4 million households) were more than 1 mile from a supermarket and without a vehicle. The number and percentage of households without a vehicle between one-half to 1 mile from a supermarket also decreased in 2010.

In contrast, the number of people in low-income areas who are more than 1 mile from a supermarket increased. In 2010, 29.7 million people, or 9.7 percent of the population, lived in low-income areas (½ kilometer-square grids where more than 40 percent of the population has income at or below 200 percent of Federal poverty thresholds for family size) more than 1 mile from a supermarket, up from 23.5 million, or 8.4 percent, in 2006. However, given the stability in the distribution of the population relative to the nearest supermarket and in the number of supermarkets overall, growth in the share of population in low-income areas more than 1 mile from a store is likely due more to the greater number of low-income areas in 2010 than in 2006, not to substantial changes in store openings and closings.

Distance to the nearest supermarket by individual income level and area income level differs from rural areas to urban areas. In urban areas, low-income people (those with income at or below 200 percent of Federal poverty thresholds for family size) and people in low-income areas are closer to supermarkets than moderate- and high-income people and areas. But in rural areas, low-income people and people in low-income areas are farther from supermarkets than moderate- and high-income areas.

Examining the distance to only one supermarket does not provide information on whether that supermarket is competitive as it may be the one and only store in the area. Distance to the three nearest supermarkets was estimated for the U.S. population and for subpopulations as an additional indicator of the level of consumer choice and competition among supermarkets. Estimates show that half of the U.S. population lived within 2 miles of three supermarkets in 2010, while 80 percent lived within 5 miles.

How Was the Study Conducted?

This study estimates several distance-based measures of supermarket access. These measures proxy access to healthy and affordable food for the overall U.S. population and for subpopulations, including households without vehicles, populations with low incomes, and populations that live in low-income areas. Data on the total population—along with data on age, race, and ethnicity—come from the 2010 Decennial Census. Data on income and vehicle availability come from the 2006-2010 American Community Survey. These population data were downcast, or allocated aerially, to ½-kilometer-square grids that cover the entire U.S. land area. Two 2010 lists of supermarkets, supercenters, and large grocery stores (food stores selling all major categories of food and having annual sales of at least $2 million) were combined to produce a comprehensive list of stores that represent sources of affordable and nutritious food. Distances from the center of each ½-kilometer-square grid containing population data to the center of the grid containing the nearest store were estimated for the entire population and for population subgroups. In addition to updating the previous analysis, a new analysis of supermarket access in Alaska Native, American Indian, and Native Hawaiian tribal areas is presented, as well as estimates of the distance to the three nearest stores as an indicator of the amount of competition and consumer choice available.

Introduction and Background

Efforts to encourage Americans to improve their diets and to eat more nutritious foods presume that a wide variety of these foods are accessible to everyone. But, for some Americans and in some communities, access to affordable healthy foods may be limited. If healthy foods can be obtained only with great effort, those affected by poor access may have poorer diets and higher rates of diet-related disease, such as obesity and diabetes. The cost and effort required to access healthful food may also contribute to food insecurity if a household has to spend scarce budget and time resources traveling to a store that sells healthful food. The lack of full-service stores in some neighborhoods may also make participation in the USDA Supplemental Nutrition Assistance Program (SNAP) less attractive if it is more difficult to redeem benefits.

Policies to improve access to healthful foods have been implemented at all levels of government. One national effort, the First Lady Michelle Obama's *Let's Move!* campaign, considers access to healthy food one of five pillars in the effort to address childhood obesity. A plan, the Healthy Food Financing Initiative (HFFI), has been proposed in Congress to bring affordable, nutritious food to areas of low access and low income. A working group comprising staff from the U.S. Departments of Treasury, Health and Human Services, and Agriculture is charged with coordinating and sharing information about strategies to expand the availability of nutritious food in areas of limited access. (Information about this combined Federal effort can be found at http://apps.ams.usda.gov/fooddeserts/.)

This tri-agency effort made its first awards in the fall of 2011 and builds upon State and local programs already in existence. For example, the Pennsylvania Fresh Food Financing Initiative uses State funds, combined with funds from private organizations, to provide grants and loans to develop grocery stores in areas of limited access throughout Pennsylvania. This program has been underway since 2004 and served as a model for other programs in New York City, New Orleans, and California. Many other communities have private and publicly sponsored programs to improve healthy food access, as well.

Upon request from Congress in 2009, USDA's Economic Research Service published a report that estimated the extent of food access limitations in the United States, reviewed literature and conducted analyses on the effects of food access on food choices and health, studied the causes and consequences of food deserts, and outlined policy options and future research (USDA, 2009; http://www.ers.usda.gov/Publications/AP/AP036/). The report presented population estimates of several indicators of access to healthy food. Estimated distances to the nearest supermarket were provided for the entire population and by characteristics such as income, age, and vehicle availability. The report also compared distances to the nearest supermarket in low-income areas versus higher income areas. Self-reported estimates of whether store accessibility affected a household's ability to provide food for household members were included, as well as estimates of the amount of time spent traveling to a grocery store. The 2009 report also analyzed price differences in products across store type and summarized literature on how prices paid for groceries differ across income levels.

The 2009 report used population data from the 2000 Decennial Census and supermarket location data from 2006, both the most current data available at the time. This report updates and expands that analysis with data from the 2010 Census, the 2006-2010 American Community Survey (ACS), and an updated list of stores from 2010. The analysis in this report is important because the past decade has seen substantial changes in population characteristics such as an aging population, migration and immigration, and wide swings in the economic well-being of families amid a 3-year recession. The development and placement of food retail stores of all types have responded to market, population, and economic conditions. Our analysis estimates supermarket access for the overall population and for those without vehicles, both in low-income and moderate/high-income areas.

Previous National-Level Estimates of Food Access

The concept of food deserts and how food access limitations are measured continues to evolve. USDA (2009) reviews some of the ways that the concept of limited food access has been measured. Bitler and Haider (2010) give a general critique of the barriers to measurement. Defining which foods are "healthy" is not straightforward, and measuring which retailers carry healthy food is difficult, especially when detailed data on many smaller retailers are not available at a national level. Some of the focus has been on whether or not people lack access to healthy food—and whether healthy food options are not accessible because they are too far away and hard to get to without a vehicle. A separate focus that involves more of a behavioral component to food choice is on the relative access of healthful food options compared to less healthful options; while healthful options are accessible, those may be "swamped" by the overabundance of less healthful options. Much of the research on measuring food access has focused on neighborhood-level access, specifically access in low-income neighborhoods. Individual-level estimates of healthy food access, regardless of whether those individuals live in high- or low-income neighborhoods, have received less attention.

USDA (2009) was the first effort to measure healthy food access on a national level. That report included both individual and area-based measures of access. For example, one key area-level measure from the report estimated that 23.5 million people, or 8.4 percent of the U.S. population, lived in low-income neighborhoods, 1-kilometer-square grids where more than 40 percent of the population has income at or below 200 percent of Federal poverty thresholds for family size, that were more than 1 mile from a supermarket or large grocery store.[2] As is typical in the food access literature, this area-based measure focuses on low-income neighborhoods because they contain higher concentrations of residents who may have difficulty accessing stores. Neighborhoods are, however, heterogeneous—not all low-income people live in low-income neighborhoods, and not all people who live in low-income neighborhoods have low incomes. Further, most households that are far from a supermarket have access to vehicles for personal use, which is a reasonable proxy for individuals' access to supermarkets and other food stores. USDA (2009) estimated that 2.3 million households, or 2.2 percent of all households, were more than 1 mile from a supermarket and did not have access to a vehicle.[3] An additional 3.4 million households (3.2 percent) were between one-half to 1 mile from a supermarket and without a vehicle.

USDA (2009) also estimated self-reported barriers to food access from direct questions in the 2001 Current Population Survey. Responses showed that nearly 6 percent of U.S. households did not always have the food they wanted or needed because of access-related problems. The 2009 USDA report also matched data from the American Time Use Survey (ATUS) to census tract-level information on supermarket distance in order to investigate differences in time use and travel modes for grocery shopping trips. People living in low-income areas more than a mile from the nearest supermarket spent slightly more time traveling to a grocery store (19.5 minutes) than the national average (15 minutes).[4] Most of the people surveyed drove to the supermarket. This is true even for those who lived in low-income neighborhoods over a

[2]For this estimate, the 1-mile marker was used for the entire Nation, both urban and rural areas, and does not account for vehicle availability.

[3]*Quasi-individual* may be a better term for these estimates because although they are based on individual population or household characteristics like vehicle availability, distance to the store is estimated at the ½-kilometer-square grid level, not at the individual level.

[4]Hamrick et al. (2011) extend some of the analysis of the ATUS data to measure food access by examining trip chaining (combining trip purposes) and characteristics of grocery shopping trips in more detail.

mile from a supermarket—over 93 percent traveled to shop for groceries in a vehicle that they or another household member drove.

Finally, the 2009 USDA report also summarized research on store choices, shopping behaviors, and prices paid for food among low-income consumers and participants in SNAP. For example, almost half of all SNAP benefits are redeemed at supercenters—large stores usually 100,000 square feet or more of floor space, with a separate grocery area and general merchandise area under a single roof (USDA, 2011), which often offer lower prices than traditional supermarkets and grocery stores (Leibtag, 2006). Further, Broda et al. (2009) find that low- and middle-income households are more likely to purchase foods at supercenters than higher income households and that most low-income consumers pay less for the same grocery items than do higher income consumers.

Based on these different estimates, USDA (2009) concluded that between 2 and 5 percent of U.S. households and about 4 to 8 percent of the population experienced some difficulty in accessing healthy food.

Recently, both public and private institutions have made advancements in measuring food access on a national level. In order to begin understanding the scope of food deserts, and the characteristics of limited healthy food access, ERS estimated food desert locations using census tracts as the geographical unit of analysis. Under this definition, food deserts are low income census tracts where a substantial number or share of residents has low access to a supermarket or large grocery store. This effort resulted in the development of the Food Desert Locator (http://www.ers.usda.gov/Data/FoodDesert/index.htm), an online mapping tool that indicates the location of food desert census tracts and selected characteristics of the population in food desert tracts (USDA/ERS, 2012a). Data in the Food Desert Locator are used by the interagency group as a starting point to assess need and as one way to help guide the targeting of funds to develop healthy retail food options. ERS has plans to update this census tract-level measure of food access, which will be made available in the Food Desert Locator, along with additional indicators of vehicle availability and alternative measures of distance to the nearest supermarket.[1]

Others have also estimated area-based measures of food access. For example, The Reinvestment Fund (TRF)—a Philadelphia, PA-area community development organization that finances neighborhood revitalization—developed a national-level measure of low-access areas (LAAs) and a tool to map these areas (http://www.trfund.com/). LAAs are clusters of census block groups where residents are farther from supermarkets than high-income block groups that are otherwise similar in terms of population density and car ownership rates (TRF, 2011). The census tract unit of measurement is also used for the Centers for Disease Control and Prevention's (CDC) Healthy Tracts measure, published in the 2009 State Indicator Report on Fruit and Vegetables (CDC, 2009). The Healthy Tracts measure considers a census tract healthy if a healthy food retailer is within the census tract or within one-half mile of the tract boundary. Esri—a private company that provides geographic information systems (GIS) software and consulting services—has also developed area-based measures of food access that use network distance measures to consider supermarket walking and driving scores (Richardson, 2010). Finally, the Food Research Action Center (FRAC) sponsored a question on the 2011

[1]ERS' Food Environment Atlas offers additional data about factors that may contribute to healthy food access challenges at the county level: www.ers.usda.gov/data-products/food-environment-atlas.aspx.

Gallup-Healthways Well-Being Index project that asked respondents if it was easy to get affordable fresh fruits and vegetables (FRAC, 2011).

The Importance of Updated Population Estimates

USDA (2009) was unique in its broad approach to food access measurement—including both individual and area-based measures of food access and estimates of the distribution of food access for vulnerable subpopulations. Area-based measures can imply that everyone in the same area has the same access to healthy food, when, in reality, access varies for individuals within an area. Individuals have different resources available to them (income, vehicle ownership, social and family networks, and time), which are likely to translate into differences in access within areas. Focusing only on low-income areas—instead of low-income or vehicle-less individuals—may overestimate the access problem in these areas while underestimating the access problems in higher income areas. For example, of the estimated 2.3 million households that did not own vehicles and were more than 1 mile from a supermarket in 2006, 1.4 million lived in moderate- and high-income areas, while 900,000 lived in low-income areas (USDA, 2009).

Individual measures are also important because areas can change in ways that suggest improved access when, in fact, access for vulnerable populations has not changed or has worsened. For example, if enough higher income people move into a low-income area, the area may no longer be designated as low income. However, if there is still no nearby source of healthy food, then access has not improved for the low-income or vehicle-less people in the area. Alternatively, an area may become a low-income area because the overall incomes of people in the area falls—a point that is especially relevant for the current analysis because it uses income data from during and after the Great Recession. The locations of supermarkets in and around such areas may not have changed at all, but the area may now be a concern simply because the overall income level changed enough to make it a "low-income" neighborhood.

Thus far, most food access policy has focused on area-based estimates for potential interventions—specifically low-income areas. This focus on areas may have resulted in a narrow view of which policy instruments could be used to improve access. If individuals who lack access are concentrated in neighborhoods, then policy strategies that bring healthy food retailers to those neighborhoods may be appropriate. If, on the other hand, individuals with access barriers are dispersed, then other policies—like a voucher to offset transportation costs of getting to a store or providing stores with funds to deliver groceries to those with access problems—might make more sense.

This report updates many of the food access measures in USDA (2009) using new population and store location data and expands access estimates by including measures for Alaska and Hawaii, and separate estimates of food access for Alaska Native, American Indian, and Native Hawaiian tribal areas. We also expand upon the 2009 report by including an estimate of the distance to the three nearest supermarkets, which indicates both consumer choice and price competition (Apparicio et al., 2007; Sparks et al., 2009). This report uses a grid-based method similar to USDA (2009) that allocates more recent population data to the ½-kilometer-square grid level, enabling greater precision in measuring supermarket distances.

Data, Definitions, and Methods

The data and methods used to estimate food store access for this update are quite similar to those used in USDA (2009). However, some enhancements were implemented. In this section, we describe the methods used to estimate food store access using 2010 data and indicate where current methods diverge from those used in USDA (2009).

Development of the 2010 Supermarket Directory

The methods used to develop a 2010 directory of stores are similar to those used in USDA (2009). Two lists of stores were combined: a list of stores authorized to accept SNAP benefits and a list of stores from Trade Dimensions TDLinx®, a proprietary store directory. The combined directory includes only retail food stores that offer a full range of food products—including fresh meat and poultry, produce, dairy, dry and packaged foods, and frozen foods—and that have at least $2 million or more in annual sales.[5] Stores meeting these criteria include one of three store types: (1) supercenters—large stores usually 100,000 square feet or more of floor space, with a separate grocery area and general merchandise area under a single roof; (2) supermarkets—stores that are typically smaller than a supercenter and that primarily sell food and nonfood grocery products; and (3) large grocery stores—stores that sell a full range of foods and have at least $2 million in annual sales, but are not as large as supermarkets.[6] Throughout the rest of this report, we use the general term "supermarket" to refer to this combined list of all three types of stores, except in tables where the types of stores are broken out separately (tables 4 and B-2).

This combined list of stores is intended to serve as an estimate of access to healthy and affordable food. It is only a proxy, however, because there are other retailers that offer healthy and affordable food. Some convenience stores, drugstores, and dollar stores, for example, carry healthy foods as well. Farmers' markets also provide a source of healthy food and fill in gaps in healthy food in some neighborhoods. Many community and public policy efforts to improve the food retail environment have started with improving the offerings at smaller stores (see, for example, a review of these efforts in Gittelsohn et al., 2012). While more of these smaller retailers may be carrying a greater selection of healthy foods, the offerings and their prices can still vary greatly from store to store. Detailed information on what products and prices are offered in each of these stores is not available on a national level. Without such information, we cannot reliably classify these stores as offering healthy and affordable foods, so they are not included in our directory. Further, we exclude military commissaries—whose size and product offerings are comparable to supermarkets—because they are only available to active-duty military personnel. Warehouse club stores—such as Costco, BJ's, and Sam's Club—are also excluded because a membership fee is required. The exclusion of these types of food retailers from our analysis is likely to result in an overestimate of the number and percentage of the population that lacks access to healthy food sources, because some people who would otherwise lack access to supermarkets may obtain healthy foods through these retailers.

[5]The sales and product offering criteria follow established retail food industry standards used to define a supermarket.

[6]The combined directory used in USDA (2009) also included these three types of stores. However, separate estimates of store numbers and types were not presented in that report.

Each supermarket directory provided the store name and address from which geo-coded location coordinates (latitude and longitude) were derived to measure distance from the center of each grid cell to the center of the grid cell containing the nearest supermarket. In total, there were 39,877 supermarkets in the 2010 merged directory. The majority of supermarkets in the merged list—28,693—were in both data sources. Of the remaining ones, 7,195 were found only in the TDLinx list, and 3,989 were found only in the SNAP list. Details on the merging are in Appendix A.

Population Data

Population data from the 2010 Census and the 2006-10 ACS are used in this analysis. We draw total population, age, race, and ethnicity data at the Census block level from the 2010 Census.[7] We use block group-level data on income-to-poverty ratios and vehicle availability from the 2006-2010 ACS.[8]

The ACS is an ongoing survey that replaced the census long form after 2000 and asks similar questions, relying on monthly, independent samples to collect data for small areas (i.e. census tracts and block groups) in the United States and separately for Puerto Rico. By producing 1-year, 3-year, and 5-year estimates, the ACS provides more continuous measurement than the decennial census. Five-year estimates are intended to replace the long form of the decennial census and thus include data for all statistical, legal, and administrative geographies for the most recent 5 years of data collection; 3-year estimates are released for geographies of 20,000 residents or more; and 1-year estimates are provided only for entities with a population of 65,000 or greater. For each survey year, approximately 3 million housing units and 2.5 percent of the expected residents of group quarters are sampled, with a slightly higher sampling rate for group quarters in 16 States with particularly small group quarters populations.[9] Data collection via mail, phone, and personal interview lasts for 3 months for each sample. The process operates in continuous cycles so that, at any given time, multiple samples are in different phases of data collection (U.S. Census Bureau, 2009).

The 2006-10 data are the most recent data available at the smaller levels of geography required for this report's detailed analysis (i.e., population characteristic estimates at the block, block group, and census tract levels). In 2010, the ACS covered 99.1 percent of all housing units and 81 percent of all group quarters populations, to reflect approximately 94.6 percent of the U.S. population. The response rates from 2006 through 2010 were 97.5 percent or higher. For our analysis, all data are taken at the smallest geographic area that is available to minimize error involved in downcasting the data to ½-kilometer-square grid cells (that is, allocating the population estimates at the census geography level down to ½-kilometer square grids). Table 1 shows the data source of each population characteristic used in the analysis, as well as the geographic level at which the estimates are drawn.

Downcasting Population Data to Half-Kilometer-Square Grids

USDA (2009) used 1-kilometer-square grid estimates of population characteristics to measure distance to supermarkets for population subgroups.

[7]Census blocks are statistical areas bounded by visible features, such as streets, roads, streams, and railroad tracks, and by nonvisible boundaries, such as selected property lines; city, township, school district, and county limits; and short line-of-sight extensions of streets and roads. They are the smallest geographic unit used by Census and are contained within block groups.

[8]The ACS records income on a rolling 12-month basis, which is different than the calendar-year measurement used for the income measure based on the 2000 Census. We are not sure whether or how much this may affect comparisons between measures of income and poverty levels between 2000 and 2010, but changes in income over a 10-year period are likely to be substantial enough to outweigh discrepancies due to different income measurements.

[9]Group quarters include such places as college residence halls, residential treatment centers, skilled nursing facilities, group homes, military barracks, correctional facilities, and workers' dormitories.

Table 1
Sources for demographic and economic data

Data	Data source	Source geographic level
Total population	Census 2010	Block
Age	Census 2010	Block
Race	Census 2010	Block
Hispanic ethnicity	Census 2010	Block
Sex	Census 2010	Block
Household type	Census 2010	Block
Housing units	ACS 2006-2010	Block group
Vehicle access	ACS 2006-2010	Block group
Income	ACS 2006-2010	Block group

ACS = American Community Survey.
Source: USDA, Economic Research Service.

These population grid estimates came from the Socioeconomic Data and Applications Center (SEDAC), 2000 Census of Population (SEDAC, 2006). This report uses a similar process to allocate more recent population data to the ½-kilometer-square grid level, which allows for even greater precision in measuring distance. The process of allocating population estimates to grid cells can introduce error in estimates of population numbers and characteristics for each grid cell. However, we expect that the improvement in estimating distance relative to other methods that rely on larger and irregular geographies outweighs the potential for error in the allocation process. Further details of this downcasting method can be found in Appendix A.

Measuring Distance and Other Indicators of Food Store Access

In measuring access to affordable, nutritious food, we consider distance measures in addition to socioeconomic characteristics that are likely to play a role in food access. Distance to the nearest supermarket is the primary measure of access. For each ½-kilometer-square grid cell, we calculate the Euclidean distance from the geographic center of the cell to the geographic center of the cell with the nearest supermarket. Using this calculation, we estimate median distances to the nearest supermarket for the population and population subgroups, as well as distance at the 20th and 80th percentiles.

We also calculate the percentage of the population that lives within different distances to at least one supermarket: within half a mile, between one-half to 1 mile, and more than 1 mile. In estimates that separately consider urban and rural areas (tables 10-14 and tables 17-18), a separate categorization of access is used for rural areas: within 10 miles of a supermarket, between 10 and 20 miles from a supermarket, and more than 20 miles from a supermarket. For some population characteristics, we also present figures showing cumulative density functions of the distance to the nearest supermarket. These figures show the distance to the supermarket on the horizontal axis and the cumulative share of the population on the vertical axis. These figures can be used to

measure the share of the population that is within a specific distance to the nearest grocery store.

We estimate distance-based measures of access on a national level and across subgroups of the population—by income level, race and ethnicity, age, and household vehicle availability. Income, which is defined and collected for families, is reported on an individual basis (where everyone in a family is assigned the family income level). We also consider the income on the grid cell level, comparing supermarket access in low-income grids to access in moderate/high-income grids. Individuals are considered low-income if their family income is at or below 200 percent of Federal poverty thresholds for family size, and grids are considered low-income if more than 40 percent of the grid population has income at or below 200 percent of the poverty level.

The ACS measures vehicle "availability" for occupied households as the number of passenger cars, vans, and trucks with a capacity of 1 ton or less, kept at the home and available for use by household members. This number includes vehicles that have been rented or leased for at least 1 month. It also counts police, government, and company vehicles, provided the vehicle is kept at home and is used for non-business purposes. We use the responses to the question as an indicator of whether a household has at least one vehicle available. The income and vehicle availability data both come from the 2006-2010 ACS, which includes data from both the pre- and post-recession period. Data from the most recent year only, if it were available, would likely show greater economic hardship—lower incomes and perhaps lower vehicle availability.

For some measures, we separately estimate supermarket access for rural and urban areas due to differences in population density and development. Urban areas are the most densely developed of urban geographies, with 50,000 or more people. The Census defines urban clusters as densely developed geographies with at least 2,500 people but fewer than 50,000. Areas not meeting the urban cluster or urban area definition are considered rural.

Changes in Population Characteristics Between 2000 and 2010

Changes in the total U.S. population and in the macroeconomy may affect estimates of food access. The U.S. population grew by 9.7 percent between 2000 and 2010, from 281.4 million to 308.7 million (Mackun and Wilson, 2011). In 2000, the economy was very strong, and real household income levels were at all-time high levels (DeNavas-Walt et al., 2011). The decade following 2000 saw one modest recession that began in late 2001 and one severe recession that began in late 2007 and continued through most of 2009. Over this period, real median household income was largely stagnant from 2000 to 2007, fell substantially as the 2007 recession hit, and has continued to fall from the peak in 2000 (DeNavas-Walt et al., 2011). Falling incomes mean that more people are poor and more neighborhoods are poor. The weak economy could also mean fewer grocery stores as some stores are forced to close. Both overall real food expenditures and real at-home food expenditures fell between 2008 and 2009.

Macroeconomic trends have altered the income distribution of the population since 2000. Comparing data from the 2000 census and the 2006-2010 ACS,

the share of the population classified as low-income has increased from 28.8 percent to 31.9 percent (table 2).[10] Nearly all of the increase has taken place in urban areas, where the share of low-income people rose from 28.5 percent in 2000 to 32.7 percent. (The share of low-income people in rural areas remained constant at 29.6 percent.)

We are also interested in the income characteristics of neighborhoods. The share of the population residing in low-income areas increased from 25.5 percent in 2000 to 31.4 percent in 2010. Low-income individuals represented a larger share of the population of low-income areas—overall and in both rural and urban areas—in 2010 when compared to 2000, which is not surprising given the recession of 2007-09. Moderate- and high-income neighborhoods, on the other hand, tend to be more homogenous in terms of resident income level relative to low-income neighborhoods. In both 2000 and 2010, moderate- or high-income households comprised over three-quarters of the residents in moderate- and high-income neighborhoods.

Table 2
Changes in income of the population and of low-income areas for 2000 and 2010

	Overall			
Population characteristics	2000		2010	
	Million	*%*	*Million*	*%*
Total low-income population	79.3	28.8	97.9	31.9
Total moderate/high-income population	196.1	71.2	208.8	68.1
Total population	275.5		306.7	
Total population in low-income areas	71.3	25.5	96.4	31.4
Total population in moderate/high-income areas	208.3	74.5	210.3	68.6
Total population	279.6		306.7	
Low-income population in low-income areas	36.0	50.5	51.2	53.1
Moderate/high-income population in low-income areas	35.3	49.5	45.2	46.9
Total population	71.3		96.4	
Low-income population in moderate/high-income areas	43.3	21.2	46.7	22.2
Moderate/high-income population in moderate/high income areas	160.8	78.8	163.6	77.8
Total population	204.1		210.3	

Note: 2000 data from Census of the Population. 2010 data from 2006-2010 American Community Survey.
Income data are missing for about 4.1 million people in 2000.
Estimates do not include Alaska and Hawaii. See appendix table B-1 for national estimates for the entire United States in 2010.

[10]The 2010 estimates in table 2 do not include Alaska and Hawaii, as they were not included in USDA (2009). Appendix table B-1 provides estimates including these two States.

In 2010, about 36 percent of the U.S. population was minority, versus 30.7 percent in 2000 (table 3). Minorities were overrepresented in low-income areas in both 2000 and 2010 (about 55.5 percent of the population in low-income areas in 2010). In moderate- and high-income areas, the large majority of residents are non-minority, comprising nearly 73 percent of the population in these neighborhoods in 2010 (compared with nearly 78 percent in 2000).

The elderly population (age 65 and older) as a share of the total population increased from 12.4 percent in 2000 to 13.0 percent in 2010. In moderate- and high-income areas, the elderly share increased from 12.9 percent to 13.8 percent (versus 11.2 to 11.4 percent in low-income areas).

Vehicle availability is measured and released at the census geographies for households, not individuals. In 2000, just over one-tenth of U.S. households did not have a vehicle available for use. By 2010 that percentage had fallen to 8.8 percent, almost a 15-percent drop. However, as expected, vehicle availability rates are lower in low-income areas. In 2010, over 15 percent of households in low-income neighborhoods did not have a vehicle, compared with 6 percent in moderate- and high-income areas.

Changes in the Number of Food Stores Between 2006 and 2010

The total number of supercenters, supermarkets, and large grocery stores decreased slightly between 2006 and 2010 (table 4).[11] The number of supercenters and large grocery stores increased, while the number of supermarkets declined. The observed increase in large grocery stores may be due, in part, to our use of better individual store sales data in 2010 for some large grocery stores in the SNAP directory, which were not available in 2006.

[11]Data on supermarkets used in USDA (2009) came from a 2006 directory. The estimates in table 4 do not include Alaska and Hawaii, which were not part of the 2006 estimation. Appendix table B-2 shows 2010 estimates that include these two States.

Table 3
Changes in selected population characteristics: Overall and by income of area of residence for 2000 and 2010

Population characteristics	Overall				Low-income areas				Moderate/high-income areas			
	2000		2010		2000		2010		2000		2010	
	Million	*%*	*Million*	*%*	*Million*	*%*	*Million*	*%*	*Million*	*%*	*Million*	*%*
Race/ethnicity:												
Minority	85.7	30.7	110.6	36.1	39.7	55.7	53.5	55.5	46.0	22.1	57.2	27.2
Non-minority	193.9	69.3	196.1	63.9	31.6	44.3	42.9	44.5	162.3	77.9	153.1	72.8
Age:												
Elderly (65 or older)	34.8	12.4	40.0	13.0	8.0	11.2	11.0	11.4	26.8	12.9	29.0	13.8
Under age 65	244.8	87.6	266.7	87.0	63.3	88.8	85.4	88.6	181.5	87.1	181.3	86.2
Total population	279.6	100.0	306.7	100.0	71.3	100.0	96.4	100.0	208.3	100	210.3	100.0
Occupied housing units without vehicles	10.8	10.3	10.2	8.8	4.5	17.9	5.3	15.2	6.3	7.9	4.9	6.0
Total occupied housing units	104.9	100.0	116.0	100.0	25.1	100.0	34.9	100.0	79.8	100	81.1	100

Note: 2000 data from Census of the Population. 2010 data from 2006-2010 American Community Survey. Estimates do not include Alaska and Hawaii.

Over the past 20 years, there has been large growth in the share of grocery shopping at nontraditional grocery stores—supercenters, warehouse clubs, and other stores (Leibtag, 2005) and an increase in the share of SNAP benefits redeemed at what the SNAP program calls "superstores"— stores that sell a wide variety of nonfood goods in addition to groceries, the equivalent of our supercenters (USDA, Food and Nutrition Service, 2012). Nonetheless, supermarkets still outnumber other types of stores and account for more than three-quarters of the total number of food retailers in our 2010 directory. In 2006, supermarkets accounted for almost four-fifths of food retailers. Large grocery stores were the second most common store type in 2010.

In low-income areas, the largest proportional increase between 2006 and 2010 was in the number of supercenters, which increased 49.1 percent from 719 supercenters in 2006 to 1,072 in 2010. The number of food stores in moderate- and high-income areas decreased from 2006 to 2010 for each store type. However, comparisons over time of store numbers in low-income and moderate/high-income areas are tenuous because the number of low-income areas has increased. Thus, the differences in store numbers for each of these areas may be attributed more to the income status of an area than to the opening or closing of stores.

Table 4
Changes in the number of stores by store type and by income level of area, 2006 and 2010

	Continental U.S.				Low-income areas				Moderate/high-income areas			
	2006		2010		2006		2010		2006		2010	
	Num.	*%*	*Num.*	*%*	*Num.*	*%*	*Num.*	*%*	*Num.*	*%*	*Num.*	*%*
Store type:												
Supercenter	3,089	7.8	3,432	8.7	719	6.6	1,072	7.3	2,370	8.2	2,360	9.4
Supermarket	31,652	79.5	30,519	77.1	8,179	74.9	10,767	73.7	23,473	81.3	19,752	79.1
Large grocery store	5,050	12.7	5,627	14.2	2,026	18.5	2,765	18.9	3,024	10.5	2,862	11.5
Total (excludes Alaska and Hawaii)	39,791	100.0	39,578	100.0	10,924	100.0	14,604	100.0	28,867	100.0	24,974	100.0

Note: Store data for both 2006 and 2010 are combined from TDLinx and SNAP-authorized lists of stores.
2000 income data from Census of the Population. 2010 income data from 2006-2010 American Community Survey.
Estimates do not include Alaska and Hawaii. See appendix table B-2 for national estimates for the entire United States in 2010.

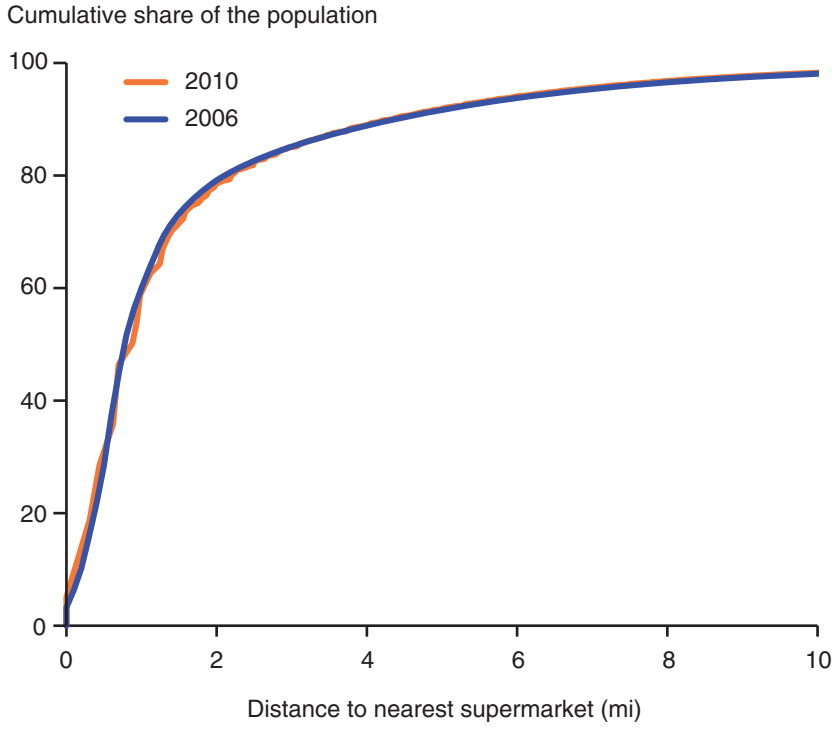
Results

We first examine distance-based measures of food access for the entire population comparing estimates from USDA (2009) (which used 2000 census data and 2006 store data) with 2010 data-based estimates. The proportion of the total population living within a specific distance of the nearest supermarket in 2010 barely changed from 2006 to 2010 (fig. 1). In both years, about 85 percent of the population lived within 3 miles of the nearest supermarket, and nearly the entire population lived within 10 miles. It is possible, however, that the overall picture masks shifts in the location of individuals and population subgroups with respect to supermarkets.

Household Vehicle Availability and Distance to the Nearest Supermarket

Vehicle availability is a key indicator of how easily a household can access a supermarket. The number of U.S. households without a vehicle for private use dropped between 2000 and 2010 (table 3), and supermarket access for households without vehicles improved (table 5). In 2010, 2.1 million housing units, or 1.8 percent of all households, were more than 1 mile from a supermarket and without a vehicle, down from 2.4 million households (2.3 percent) in 2006. Further, the number of households without a vehicle and living between a half-mile to 1 mile from a supermarket also dropped from 3.4

Figure 1
Distance to the nearest supermarket for the continental United States, 2006 and 2010



Source: USDA, Economic Research Service.

Table 5
Supermarket access for households without vehicles: Overall and by income level of area, 2006 and 2010

	2006			2010		
	# house-holds	% of HH without vehicles	% of all HH in U.S.	# house-holds	% of HH without vehicles	% of all HH in U.S.
All areas:						
HH without vehicle and > 1 mile	2,400,000	22.2	2.3	2,056,174	20.1	1.8
HH without vehicle and ½ mile to 1 mile	3,400,000	31.5	3.2	2,741,044	26.8	2.4
HH without vehicle and < ½ mile	5,000,000	46.3	4.8	5,412,449	53.0	4.7
Total HH without vehicles	10,800,000	100.0	10.3	10,209,670	100.0	8.8
Low-income areas:						
HH without vehicle and > 1 mile	936,700	20.9	0.9	903,568	17.0	0.8
HH without vehicle and ½ mile to 1 mile	1,596,846	35.7	1.5	1,482,819	27.9	1.3
HH without vehicle and < ½ mile	1,941,814	43.4	1.9	2,928,067	55.1	2.5
Total HH without vehicles	4,475,360	100.0	4.3	5,314,457	100.0	4.6
Moderate/high-income areas:						
HH without vehicle and > 1 mile	1,449,144	22.9	1.4	1,152,606	23.5	1.0
HH without vehicle and ½ mile to 1 mile	1,821,953	28.8	1.7	1,258,225	25.7	1.1
HH without vehicle and < ½ mile	3,045,857	48.2	2.9	2,484,382	50.8	2.1
Total HH without vehicles	6,316,954	100.0	6.0	4,895,213	100.0	4.2
Total number of occupied households	104,900,000			116,002,896		

HH = households. Estimates do not include Alaska and Hawaii. See appendix table B-3 for national estimates for the entire United States in 2010.

million (3.2 percent of all households) in 2006 to 2.7 million (2.4 percent) in 2010.[12]

The number of households without vehicles in low-income areas increased from 2006 to 2010, but all of the increase was among those living within a half mile of a supermarket (table 5). Moderate- and high-income areas, like low-income areas, showed a decrease in the number and share of households without a vehicle that were more than a half mile from a supermarket.

These estimates highlight a problem in focusing only on supermarket access in low-income areas. Specifically, in 2010 there were just over 900,000 households in low-income areas without a vehicle that were more than 1 mile from a supermarket. However, there were 1.4 million such households in moderate-/high-income areas. According to this indicator, moderate- and high-income areas may contain more people with supermarket access limitations than low-income areas.[13]

Households without vehicles are closer to the nearest supermarket than households with a vehicle at the 20th, 40th, 50th (median), 60th, and 80th percentiles of the total population of households (table 6). This pattern holds for low-income and moderate- and high-income areas. The distance to the nearest supermarket at the 20th percentile of all households without vehicles was 0.03 mile, compared to 0.34 mile at the 20th percentile of households with vehicles. For households without vehicles, the distance to the nearest supermarket at the 80th percentile was 0.99 mile, compared with 2.26 miles

[12]This table excludes 2010 estimates for Alaska and Hawaii to make the 2010 estimates comparable to the 2006 estimates, which only covered the continental United States. Appendix table B-3 contains 2010 estimates for Alaska and Hawaii.

[13]We do not have data to determine if a household is both low income and without a vehicle. It is possible that some of the households without vehicles have sufficient incomes to pay for other ways to obtain their groceries (e.g., delivery services), whether they live in low-income or moderate- and high-income areas.

Table 6
Quintile and median distance to the nearest supermarket by household vehicle availability, 2010

	Distance at 20th percentile	Distance at 40th percentile	Distance at Median	Distance at 60th percentile	Distance at 80th percentile
			Miles		
All households:	0.32	0.64	0.83	1.00	2.19
Households without vehicles	0.03	0.29	0.41	0.61	0.99
Households with vehicles	0.34	0.66	0.90	1.07	2.26
All households in low-income areas:	0.22	0.50	0.65	0.84	1.57
Households without vehicles	0.04	0.28	0.39	0.55	0.94
Households with vehicles	0.26	0.57	0.67	0.91	1.81
All households in moderate/high-income areas:	0.35	0.67	0.93	1.15	2.34
Households without vehicles	0.03	0.31	0.43	0.64	1.22
Households with vehicles	0.38	0.68	0.94	1.24	2.46

for households with vehicles. The bottom two panels of the table show the distribution of distance to the nearest supermarket for households by area-level income. Households without vehicles are closer to supermarkets in both low-income areas and in moderate- and high-income areas. Further, households in low-income areas are closer to supermarkets than households in moderate- and high-income areas, regardless of whether they have vehicles.

Estimates of access to supermarkets by vehicle availability reflect the general increase in vehicle availability since the last census. It is also consistent with other studies that have shown a marked increase in vehicle ownership among low-income populations over the past two decades, as asset tests for public assistance programs have been reduced or eliminated and as the Earned Income Tax Credit has expanded (Baum and Owens, 2010; Goodman-Bacon and McGranahan, 2008; Hurst and Ziliak, 2006; and Sullivan, 2006). The 2006-10 ACS data may not fully reflect the economic downturn, which may stall this upward trend.

Area Income and Supermarket Access

We compare indicators of supermarket access for people in low-income areas with people in moderate- and high-income areas first for the entire Nation, and then separately for urban and rural areas. For the overall and urban estimates, we use the one-half-mile and 1-mile cutoffs to demarcate categories of distance to the nearest supermarket. For rural areas, we use the distance categories of less than 10 miles, between 10 and 20 miles, and more than 20 miles from a supermarket. It is important to reemphasize that the number of people who live in low-income areas increased substantially between 2006 and 2010.

Low-income areas tend to be closer to supermarkets than moderate- and high-income areas (table 7). This is consistent with previous estimates in USDA (2009). The distance in miles to the nearest supermarket for people in low-income areas is 0.21 at the 20th percentile, 0.69 at the median, and 1.56 at the 80th percentile; these numbers are 0.37, 0.88, and 2.44 for households in

Table 7
Supermarket access for low-income areas compared with moderate/high-income areas, 2006 and 2010

Area characteristic	Distance to Nearest Supermarket			< ½ mIle			
	20th Percentile	Median	80th Percentile	2006		2010	
	2010 miles			*Million*	*Percent (of row)*	*Million*	*Percent (of row)*
All areas							
Income of area							
Low-income area	0.21	0.69	1.56	22.9	32.1	36.1	37.5
Moderate/high-income area	0.37	0.88	2.44	47.6	22.8	51.3	24.4
Total	0.33	0.83	2.19	70.5	25.2	87.4	28.5
Urban areas							
Income of area							
Low-income area	0.15	0.59	0.95	22.0	40.0	34.6	45.6
Moderate/high-income area	0.29	0.72	1.28	45.9	29.3	48.3	32.3
Total	0.23	0.68	1.19	67.9	32.1	82.9	36.8
Rural areas				*< 10 miles*			
Income of area							
Low-income area	1.14	4.1	7.57	13.8	85.7	18.3	89.6
Moderate/high-income area	1.30	3.4	5.94	49.0	94.2	57.6	94.8
Total	1.28	3.5	6.35	62.8	92.2	75.9	93.5

--continued

Table 7
Supermarket access for low-income areas compared with moderate/high-income areas, 2006 and 2010—continued

Area characteristic	½ mile to 1 mile				> 1 mile				2000 total population	2010 total population
	2006		2010		2006		2010			
	Mil.	*Percent (of row)*	*Mil.*	*Percent (of row)*	*Mil.*	*Percent (of row)*	*Mil.*	*Percent (of row)*	*Million*	*Million*
All areas										
Income of area										
Low-income area	24.9	34.9	30.7	31.9	23.5	33.0	29.7	30.8	71.3	96.4
Moderate/high-income area	68.0	32.6	62.4	29.7	92.8	44.5	96.6	45.9	208.3	210.3
Total	92.9	33.2	93.1	30.4	116.3	41.6	126.3	41.2	279.6	306.7
Urban areas										
Income of area										
Low-income area	23.1	42.0	28.5	37.5	9.9	18.0	12.9	17.0	55.0	76.0
Moderate/high-income area	63.9	40.9	56.6	37.9	46.6	29.8	44.6	29.8	156.4	149.6
Total	87.0	41.2	85.1	37.7	56.5	26.7	57.5	25.5	211.4	225.5
Rural areas	*10 to 20 miles*				*> 20 miles*					
Income of area										
Low-income area	1.9	11.8	1.8	9.0	0.4	2.5	0.3	1.4	16.1	20.4
Moderate/high-income area	2.7	5.2	2.9	4.7	0.3	0.6	0.3	0.5	52	60.7
Total	4.6	6.8	4.7	5.8	0.7	1.0	0.6	0.7	68.1	81.2

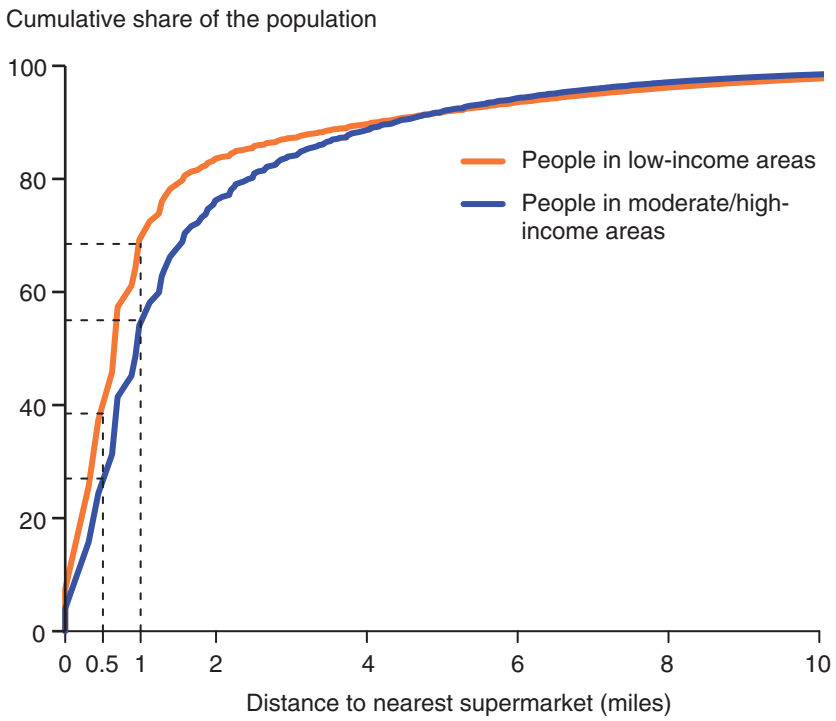
Note: Population reported in millions.
Data do not include Alaska and Hawaii. See appendix table B-4 for national estimates that include Alaska and Hawaii.

moderate- to high-income areas. Figure 2 shows the share of the population in low-income areas (indicated by the orange line) and moderate/high-income areas (depicted by the blue line) living a specific distance from the nearest supermarket in 2010. Up to a distance of 5 miles, low-income areas are closer to a supermarket than moderate-/high-income areas—a greater proportion of people in low-income areas are within 5 miles of a supermarket. For example, close to 70 percent of all people in low-income areas are within 1 mile of a supermarket compared with about 55 percent of people in moderate-/high-income areas. However, for distances of more than 5 miles, people in low-income areas tend to be farther from a supermarket than those in moderate/high-income areas, although differences are small since so few people are that far from a supermarket.

While the number of people living in low-income areas and more than 1 mile from a supermarket increased between 2006 and 2010, there was a much larger increase in the number of people living in low-income areas within ½ mile of the nearest supermarket (table 7).[14] Specifically, the number of people living in low-income areas that are more than 1 mile from a supermarket increased from 23.5 million, or 8.4 percent of the total population in 2006, to 29.7 million, or 9.7 percent of the total population in 2010. The increase in the number of people in low-income areas living within ½ mile of a supermarket was much greater, however—from 22.9 million to 36.1 million.

[14]This table excludes 2010 estimates for Alaska and Hawaii to make the 2010 estimates comparable to the 2006 estimates. Appendix Table B-4 contains 2010 estimates for Alaska and Hawaii.

Figure 2
Distance to the nearest supermarket for people in low-income areas compared with people in moderate/high-income areas, 2010



Source: USDA, Economic Research Service.

Together, these indicators present a mixed picture of changes in access over time. Indeed, more people lived in low-income areas far from a supermarket in 2010 than in 2006. However, as a percentage of all people in low-income areas, a greater share is within a half mile of a supermarket in 2010 than in 2006 (37.5 percent in 2010 compared with 32.1 percent in 2006). A smaller share of people in low-income areas is more than 1 mile from a supermarket (down to 30.8 percent in 2010 from 33.0 percent in 2006). Further, the median distance to the nearest supermarket in low-income areas in 2010 was essentially unchanged compared with 2006 (0.83 mile compared with 0.84 mile (USDA, 2009)). Given the stability in median distance and the increased number of stores in low-income areas (table 4), growth in the share of the population in low-income areas more than 1 mile from a store is likely due more to the greater number of low-income areas in 2010, not to substantial changes in store openings and closings.

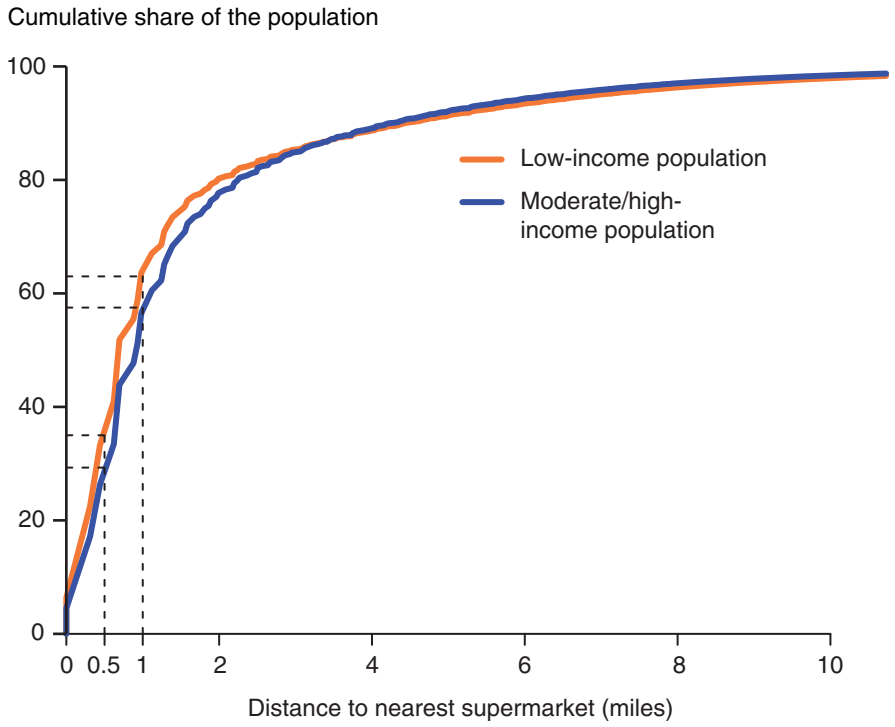
Changes in urban areas follow the same trend as overall changes. For rural areas, though, the number of people living in low-income areas that are more than 20 miles from a supermarket dropped from 400,000 people in 2006 to about 288,000 people in 2010. There was also a slight decline in the number of people in low-income areas between 10 and 20 miles from a supermarket (table 7). Residents of moderate-/high-income areas saw less change in access from 2006 to 2010. The share of people living in moderate-/high-income urban areas more than 1 mile from a supermarket remained stable at 29.8 percent, while the share in moderate/high-income rural areas fell from 0.6 percent to 0.5 percent.

Individual Income and Supermarket Access

The income levels of neighborhoods are a general indicator of the resources available, but neighborhoods are not homogeneous. Low-income neighborhoods may contain residents who are not poor and higher income neighborhoods may contain residents who are poor. Focusing solely on low-income neighborhoods misses some households that may experience barriers accessing healthy foods. We compare indicators of supermarket access for low-income people to indicators of access for moderate and high-income people, regardless of the income levels of the neighborhoods in which they live.

The cumulative distribution of distance to the nearest supermarket for low-income individuals compared with moderate/high-income individuals (fig. 3) shows only small differences for these two populations. Roughly parallel to the distribution for low-income areas compared with moderate/high-income areas (fig. 2), people with low incomes are closer to supermarkets than those with moderate/high incomes for most of the distribution. At distances greater than 4 miles (the right tail of the distribution), those with low incomes tend to be farther from supermarkets than those with moderate and high incomes. These results likely reflect that low-income people in urban areas tend to be closer to supermarkets than moderate- and high-income people, but in rural areas, low-income people tend to be farther from supermarkets than moderate- and high-income people. We explore urban and rural differences below.

Figure 3
Distance to the nearest supermarket for low-income people compared with moderate/high-income people, 2010



Source: USDA, Economic Research Service.

In 2006, 11 percent of the entire population, and 38.1 percent of the low-income population, lived more than 1 mile from a supermarket (table 8). By 2010, the number of low-income people living more than a mile from a supermarket increased to 35.6 million, which represents an increase from 2006 to 11.6 percent of the total U.S. population. However, a smaller share (36.4 percent) of all low-income people was more than 1 mile from a supermarket. There was a greater increase in the number of low-income people within ½ mile of a supermarket, which was up by nearly 10 million from 22.6 million in 2006 to 32.5 million in 2010.

The number of low-income people in low-income areas more than a mile from the nearest supermarket increased from 11.5 million in 2006 to 15.4 million in 2010 (table 8), although the share of such people (in low-income areas) dropped nearly 2 percentage points. Further, in 2010, a greater proportion of the low-income population in low-income areas lived within ½ mile of the nearest supermarket than in 2006. In moderate/high-income areas, the proportion of the overall population and of the low-income population living within ½ mile of a supermarket increased between 2006 and 2010.

The number of low-income people living more than 1 mile from a supermarket is greater in moderate/high-income areas than in low-income areas—20.1 million or 6.6 percent of the total population compared with 15.4 million or 5.0 percent of the total population (table 8). Low-income areas have a greater number of low-income people between ½ and 1 mile from a

Table 8
Supermarket access for low-income populations: Overall and by income level of area, 2006 and 2010

	2006			2010		
	# of low-income people	% of low-income population	% of total population	# of low-income people	% of low-income population	% of total population
	Million			*Million*		
All areas						
> 1 mile	30.2	38.1	11.0	35.6	36.4	11.6
½ mile to 1 mile	26.4	33.3	9.6	29.8	30.4	9.7
< ½ mile	22.6	28.5	8.2	32.5	33.2	10.6
Total number of low income people	79.3	100.0	28.8	97.9	100.0	31.9
Low-income areas						
> 1 mile	11.5	31.9	4.2	15.4	30.1	5.0
½ mile to 1 mile	12.5	34.7	4.5	16.2	31.6	5.3
< ½ mile	12.1	33.6	4.4	19.6	38.2	6.4
Total low-income people in low-income areas	36.0	100.0	13.1	51.2	100.0	16.7
Moderate/high-income areas						
> 1 mile	18.7	43.2	6.8	20.1	43.1	6.6
½ mile to 1 mile	13.9	32.1	5.0	13.6	29.2	4.4
< ½ mile	10.5	24.2	3.8	12.9	27.7	4.2
Total low-income people in moderate/high-income areas	43.3	100.0	15.7	46.7	100.0	15.2
Total number of people	275.5			306.6		

Estimates do not include Alaska and Hawaii.

supermarket than moderate- and high-income areas. But when combined with those more than 1 mile from a supermarket, moderate- and high-income areas have a larger number of low-income people more than ½ mile from a supermarket (33.7 million compared with 31.6 million, or 11 percent of the total population compared with 10.3 percent).

Distance to Supermarkets by Subpopulation Characteristics

People with low income are closer to supermarkets than those with moderate and high incomes at the median (0.79 mile vs. 0.94 mile) and at the 20th and 80th percentiles of distance (table 9). Overall, 41.2 percent of the U.S. population lived more than 1 mile from a supermarket in 2010. A smaller share of low-income (36.3 percent) than moderate/high-income individuals (43.4 percent) were more than 1 mile from a supermarket. These general trends by income group are similar to what was found in USDA (2009).

The median distance estimates show that most racial and ethnic minorities are closer to supermarkets than Whites. A notable exception is for American Indian/Alaska Native populations—a result we explore in more detail later. These results are similar to findings in USDA (2009) and are true not only for

Table 9
Supermarket access for selected population characteristics, 2010

Population characteristics	20th percentile distance to nearest supermarket	Median distance to nearest supermarket	80th percentile distance to nearest supermarket	< ½ mile to nearest supermarket		½ mile to 1 mile to nearest supermarket		> 1 mile to nearest supermarket		Total
	Miles	*Miles*	*Miles*	*Million*	*%*	*Million*	*%*	*Million*	*%*	*Million*
All individuals	0.33	0.90	2.19	88.0	28.5	93.7	30.3	127.1	41.2	308.7
Income										
Low-income people	0.26	0.79	1.98	32.7	33.2	29.9	30.4	35.8	36.4	98.4
Moderate/high-income people	0.35	0.94	2.24	55.3	26.3	63.7	30.3	91.4	43.4	210.3
Expanded race										
White	0.37	0.97	2.66	55.1	24.6	65.3	29.2	103.2	46.2	223.6
Black	0.24	0.69	1.35	13.7	35.3	13.4	34.5	11.8	30.2	38.9
Asian	0.16	0.64	1.10	6.3	42.8	5.0	34.0	3.4	23.2	14.7
Native Hawaiian/ Pacific Islander	0.23	0.69	1.42	0.2		0.2		0.2		
American Indian/ Alaska Native	0.36	1.06	5.09	0.7		0.7		1.5		
Other and multiple races	0.17	0.64	1.26	11.9	42.4	9.0	32.2	7.1	25.4	28.1
Hispanic ethnicity										
Hispanic	0.17	0.64	1.25	21.5	42.5	16.5	32.7	12.5	24.8	50.5
Non-hispanic	0.36	0.95	2.49	66.5	25.7	77.2	29.9	114.6	44.4	258.3
Age										
Children (age 17 or less)	0.33	0.91	2.18	20.3	27.5	22.5	30.6	30.9	41.9	73.7
Working age (18 to 64)	0.32	0.90	2.19	56.2	29.1	58.6	30.4	78.2	40.5	193.0
Elderly (65 or older)	0.34	0.93	2.42	10.9	27.2	12.0	30.0	17.1	42.8	40.0

median distances, but at the 20th and 80th percentiles of distance also. These results likely reflect differences in the racial composition in rural, urban, and suburban areas. Differences in access levels across age groups are small. The elderly are slightly more likely to be more than 1 mile from a supermarket than other age groups, and slightly less likely to be within ½ mile.

Urban Food Store Access

The median distance to the nearest supermarkets for urban populations was about 0.68 mile in 2010 (table 10). Median distances were shorter for low-income individuals, most non-Whites, and Hispanics. As was true in USDA (2009), the share of White urban residents living more than a mile from the nearest supermarket was greater than for other racial groups. Hispanics also tend to live within ½ mile of a supermarket in greater proportion than

Table 10

Urban supermarket access: Overall and by selected population characteristics, 2010

Population characteristics	20th percentile distance to nearest supermarket	Median distance to nearest supermarket	80th percentile distance to nearest supermarket	< ½ mile to nearest supermaket		½ mile to 1 mile to nearest supermaket		> 1 mile to nearest supermaket		Total urban	
	Miles	*Miles*	*Miles*	*Million*	*%*	*Million*	*%*	*Million*	*%*	*Million*	*%*
All individuals	0.23	0.68	1.19	83.5	36.8	85.6	37.7	58.0	25.5	227.1	100.0
Income											
Low-income people	0.18	0.64	1.01	31.2	42.1	27.6	37.2	15.4	20.8	74.2	32.7
Moderate/high-income people	0.26	0.69	1.26	52.3	34.2	58.0	37.9	42.6	27.9	152.8	67.3
Race											
White	0.28	0.71	1.26	51.5	33.4	58.9	38.2	43.8	28.4	154.2	67.9
Black	0.19	0.65	1.04	13.4	40.2	12.7	38.2	7.2	21.6	33.3	14.6
Asian	0.13	0.60	0.96	6.1	46.5	4.7	35.4	2.4	18.1	13.2	5.8
Native Hawaiian/ Pacific Islander	0.19	0.64	1.07	0.2	41.7	0.2	36.1	0.1	22.2	0.5	0.2
American Indian/ Alaska Native	0.20	0.66	1.11	0.7	39.7	0.6	36.6	0.4	23.7	1.7	0.8
Other and multiple races	0.13	0.58	0.95	11.6	48.0	8.5	35.1	4.1	16.9	24.2	10.7
Hispanic ethnicity											
Hispanic	0.14	0.58	0.95	21.0	47.6	15.6	35.4	7.5	17.0	44.0	19.4
Non-hispanic	0.27	0.69	1.25	62.5	34.2	70.0	38.2	50.5	27.6	183.0	80.6
Age											
Children (age 17 or less)	0.25	0.68	1.24	19.3	35.6	20.6	37.9	14.4	26.4	54.3	23.9
Working age (18 to 64)	0.22	0.67	1.17	53.9	37.4	54.0	37.5	36.1	25.1	144.0	63.4
Elderly (65 or older)	0.25	0.68	1.22	10.3	35.7	11.0	38.2	7.5	26.1	28.8	12.7
Family type (single-person households are excluded)											
All households	0.22	0.67	1.15	32.4	37.7	32.3	37.6	21.3	24.8	86.1	100.0
Married couple	0.29	0.73	1.27	12.5	32.3	14.7	38.1	11.4	29.5	38.6	44.8
Female householder (no husband present)	0.19	0.65	1.04	5.0	40.5	4.7	37.9	2.7	21.6	12.3	14.3
Male householder (no wife present)	0.20	0.65	1.06	1.8	40.4	1.6	37.4	1.0	22.2	4.4	5.1

[1]Estimates include Alaska and Hawaii.

non-Hispanics: 47.6 percent of the urban Hispanic population lived ½ mile or closer to the nearest supermarket in 2010, versus 34.2 percent of urban non-Hispanic individuals.

Compared with female- and male-headed households with no spouse present, a greater share of urban married households lived more than a mile from a supermarket (29.5 percent compared with almost 22 percent for both female- and male-headed single households) in 2010.

When the urban population is broken down by neighborhood income level (table 11), those who live in low-income areas tend to live closer to the nearest supermarket than others. In moderate/high-income areas, 29.8 percent of all individuals lived more than 1 mile from the nearest supermarket or large grocery in 2010 versus 17 percent in low-income urban areas. Further, moderate- and high-income urban areas had 1.6 million more low-income people living more than 1 mile from a supermarket than did low-income urban areas. Again, this demonstrates a problem in focusing only on low-income areas.

In low-income urban areas, 17.4 percent of both children and the elderly lived more than 1 mile from the nearest supermarket in 2010 (table 11). In moderate/high-income areas, however, children were more likely to live more than 1 mile from the supermarket than the elderly, with 31.6 percent of those under the age of 18 living a mile or more from the nearest supermarket or grocery store in 2010, compared to 29.5 percent of seniors.

Figure 4 uses the St. Louis, Missouri, area to illustrate supermarket access by population density and for low-income areas. One-mile radius circles are drawn around each supermarket in the area, and population density for the ½-kilometer-square grids are shown by shading, with lighter areas being less dense and darker areas being more dense. Low-income ½-kilometer-square grids are represented by cross-hatching. Middle sections of St. Louis and portions of the northern and northwest parts of the city have densely populated low-income areas outside of 1 mile from a supermarket. The East St. Louis, Illinois, area on the east side of the Mississippi River, although less densely populated, also has very large swaths of areas that are low-income and outside of 1 mile from a supermarket.

Rural Food Store Access

Approximately 26.5 percent of the U.S. population is located in rural census tracts, as defined by the U.S. Census Bureau. Of this population, over 93 percent lived within 10 miles of a supermarket in 2010 (table 12). Nearly 6 percent lived in areas between 10 and 20 miles to the nearest supermarket, and almost 1 percent were more than 20 miles away.

A smaller share of low-income individuals (91.6 percent) than higher income individuals (94.2 percent) lived within 10 miles of a supermarket. Larger shares of low-income individuals live in rural areas between 10 and 20 miles from the nearest supermarket (7.3 percent) or farther than 20 miles (1.1 percent) compared with higher income individuals (5.2 and 0.6 percent, respectively). These results differ from urban areas where low-income

Table 11

Urban supermarket access by income level of area and by selected population characteristics, 2010

Population characteristics	20th percentile distance to nearest supermarket	Median distance to nearest supermarket	80th percentile distance to nearest supermarket	< ½ mile to nearest supermaket		½ mile to 1 mile to nearest supermaket		> 1 mile to nearest supermaket		Total urban	
	Miles	*Miles*	*Miles*	*Million*	*%*	*Million*	*%*	*Million*	*%*	*Million*	*%*
Low-income areas											
All individuals	0.15	0.61	0.96	34.6	45.5	28.5	37.5	12.9	17.0	76.0	100.0
Income											
Low-income people	0.15	0.60	0.95	18.9	46.1	15.1	36.9	6.9	17.0	40.9	53.8
moderate/high-income people	0.16	0.62	0.96	15.8	44.9	13.4	38.1	6.0	17.1	35.2	46.2
Race											
White	0.18	0.63	0.97	17.4	42.9	15.7	38.7	7.5	18.5	40.6	53.3
Black	0.16	0.63	0.97	8.2	43.3	7.4	38.7	3.4	18.0	19.0	24.9
Asian	0.04	0.42	0.69	1.7	60.0	0.9	31.0	0.3	9.0	2.9	3.8
Native Hawaiian/ Pacific Islander	0.17	0.61	0.95	0.1	45.5	0.1	38.4	0.0	16.1	0.1	0.2
American Indian/ Alaska Native	0.16	0.63	0.98	0.4	44.5	0.3	35.6	0.2	19.9	0.9	1.1
Other and multiple races	0.09	0.49	0.88	6.9	54.2	4.2	33.3	1.6	12.5	12.6	16.6
Hispanic ethnicity											
Hispanic	0.10	0.51	0.90	12.8	52.9	8.1	33.5	3.3	13.6	24.2	31.8
Non-hispanic	0.18	0.64	0.97	21.8	42.1	20.4	39.3	9.6	18.6	51.9	68.2
Age											
Children (age 17 or less)	0.16	0.62	0.96	8.9	45.2	7.3	37.4	3.4	17.4	19.6	25.8
Working age (18 to 64)	0.15	0.61	0.95	22.2	45.8	18.1	37.4	8.1	16.8	48.4	63.6
Elderly (65 or older)	0.16	0.62	0.96	3.6	44.4	3.1	38.1	1.4	17.4	8.0	10.6
Family type (single-person households are excluded)											
All households	0.15	0.61	0.95								
Married couple	0.17	0.63	0.97	4.1	43.4	3.5	38.0	1.7	18.6	9.3	34.2
Female householder (no husband present)	0.14	0.61	0.95	2.5	45.8	2.1	37.6	0.9	16.6	5.6	20.3
Male householder (no wife present)	0.14	0.59	0.94	0.8	47.3	0.7	36.8	0.3	15.9	1.8	6.6

--continued

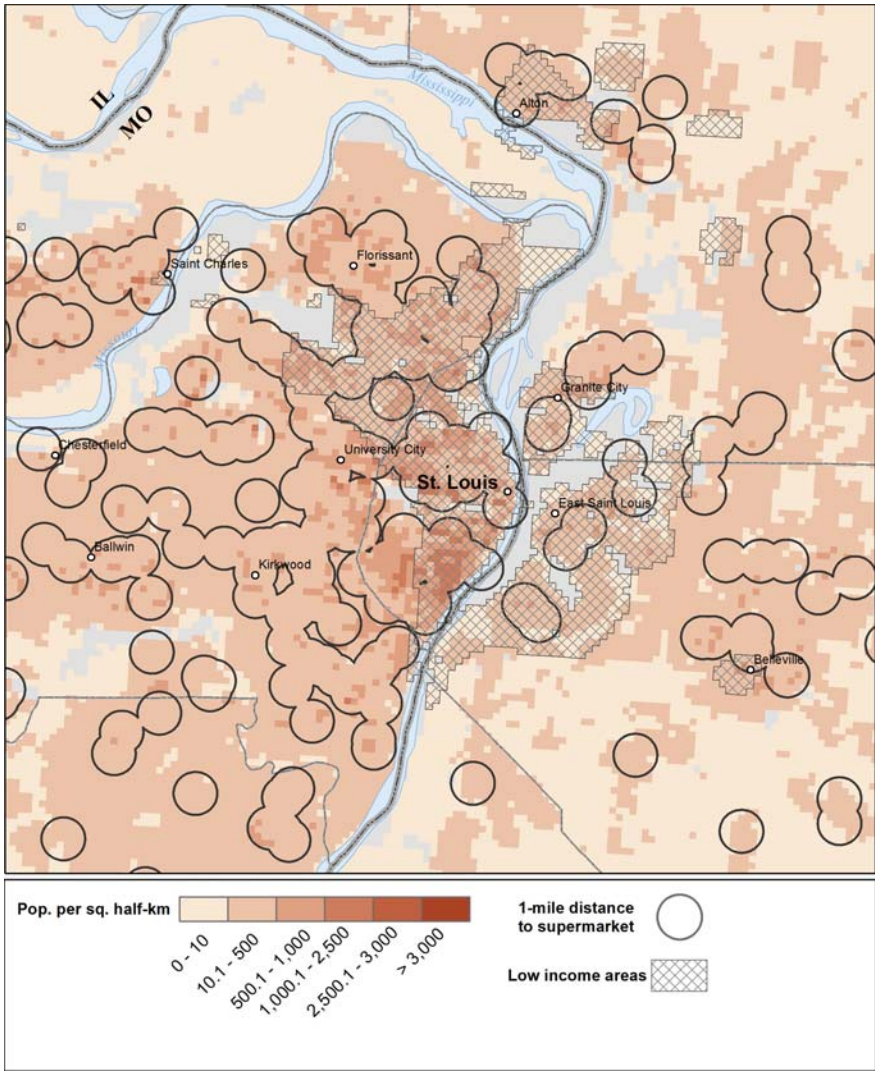
Table 11

Urban supermarket access by income level of area and by selected population characteristics, 2010—continued

Population characteristics	20th percentile distance to nearest supermarket	Median distance to nearest supermarket	80th percentile distance to nearest supermarket	< ½ mile to nearest supermarket		½ mile to 1 mile to nearest supermaket		> 1 mile to nearest supermaket		Total urban	
	Miles	*Miles*	*Miles*	*Million*	*%*	*Million*	*%*	*Million*	*%*	*Million*	*%*
Moderate/high- income areas											
All individuals	0.29	0.74	1.28	48.9	32.4	57.1	37.8	45.1	29.8	151.0	100.0
Income											
Low-income poeple	0.23	0.68	1.19	12.4	37.1	12.5	37.5	8.5	25.4	33.3	22.1
Moderate/high-income people	0.31	0.77	1.29	36.5	31.0	44.6	37.9	36.6	31.1	117.7	77.9
Race											
White	0.32	0.79	1.31	34.1	30.0	43.2	38.0	36.3	31.9	113.7	75.3
Black	0.24	0.68	1.24	5.2	36.1	5.4	37.5	3.8	26.5	14.3	9.5
Asian	0.17	0.64	1.00	4.4	42.7	3.8	36.7	2.1	20.6	10.3	6.8
Native Hawaiian/ Pacific Islander	0.20	0.66	1.20	0.1	40.0	0.1	35.2	0.1	24.7	0.3	0.2
American Indian/ Alaska Native	0.26	0.69	1.26	0.3	34.8	0.3	37.7	0.2	27.5	0.9	0.6
Other and multiple races	0.19	0.65	1.04	4.8	41.1	4.3	37.2	2.5	21.7	11.6	7.7
Hispanic ethnicity											
Hispanic	0.20	0.65	1.02	8.2	41.1	7.5	37.7	4.2	21.2	19.9	13.2
Non-hispanic	0.31	0.77	1.30	40.7	31.0	49.6	37.8	40.8	31.1	131.2	86.8
Age											
Children (age 17 or less)	0.32	0.78	1.30	10.5	30.2	13.2	38.2	10.9	31.6	34.7	22.9
Working age (18 to 64)	0.28	0.72	1.27	31.7	33.2	35.9	37.6	28.0	29.3	95.6	63.3
Elderly (65 or older)	0.29	0.74	1.27	6.7	32.3	7.9	38.2	6.1	29.5	20.7	13.7
Family type (single-person households are excluded)											
All households	0.26	0.71	1.26	20.0	34.0	22.0	37.5	16.8	28.5	58.8	100.0
Married couple	0.33	0.82	1.33	8.4	28.8	11.2	38.2	9.6	33.0	29.2	49.7
Female householder (no husband present)	0.24	0.68	1.20	2.4	36.1	2.6	38.1	1.7	25.8	6.7	11.5
Male householder (no wife present)	0.25	0.68	1.25	0.9	35.6	1.0	37.8	0.7	26.6	2.6	4.4

[1]Estimates include Alaska and Hawaii.

Figure 4
Supermarket access in St. Louis, Missouri



Source: USDA, Economic Research Service.

individuals are, in general, closer to supermarkets than individuals with higher incomes.

Grouping the rural population by race reveals some striking differences. Each group follows the same general pattern illustrated in the national numbers—i.e., the largest portion of the population lives within 10 miles of the nearest supermarket, followed by those living between 10 and 20 miles, and those beyond 20 miles. However, for the American Indian/Alaska Native population, the percentages are dramatically different. While this category makes up just 1.5 percent of the total rural population, more than 1 in 10 American Indians/Alaskan Natives live more than 20 miles from the nearest supermarket. Moreover, American Indians and Alaskan Natives are the only minority population living farther from the nearest supermarket than Whites. The difference in distance to the nearest supermarket between this population and all other racial and ethnic groups is particularly pronounced in rural areas: distance to the nearest supermarket at the 80th percentile is 12.2 miles for American Indians and Alaskan Natives, compared to 6.4 miles for Whites

Table 12

Rural supermarket access: Overall and by selected population characteristics, 2010

Population characteristics	20th percentile distance to nearest supermarket	Median distance to nearest supermarket	80th percentile distance to nearest supermarket	< 10 miles to nearest supermarket		10-20 miles to nearest supermaket		> 20 miles to nearest supermarket		Total
	Miles	*Miles*	*Miles*	*Million*	*%*	*Million*	*%*	*Million*	*%*	*Million*
All individuals	1.3	3.2	6.4	76.3	93.4	4.7	5.8	0.6	0.8	81.7
Income										
Low-income people	1.3	3.5	7.0	22.2	91.6	1.8	7.3	0.3	1.1	24.2
Moderate/high-income people	1.3	3.1	6.1	54.2	94.2	3.0	5.2	0.4	0.6	57.5
Race										
White	1.3	3.3	6.4	64.9	93.5	4.0	5.8	0.5	0.7	69.3
Black	1.0	2.6	6.0	5.3	94.3	0.3	5.7	0.0	0.1	5.7
Asian	0.7	1.6	2.9	1.5	98.6	0.0	1.2	0.0	0.2	1.5
Native Hawaiian/Pacific Islander	0.9	2.2	5.3	0.1	94.9	0.0	4.4	0.0	0.7	0.1
American Indian/Alaska Native	1.6	4.7	12.2	0.9	75.1	0.2	14.5	0.1	10.4	1.2
Other and multiple races	1.0	2.5	5.7	3.6	93.8	0.2	5.3	0.0	0.9	3.9
Hispanic ethnicity										
Hispanic	1.0	2.4	5.5	6.1	93.9	0.3	5.1	0.1	1.0	6.4
Non-hispanic	1.3	3.2	6.4	70.3	93.4	4.4	5.9	0.6	0.7	75.2
Age										
Children (age 17 or less)	1.3	3.1	6.2	18.7	93.8	1.1	5.5	0.1	0.7	19.9
Working age (18 to 64)	1.3	3.2	6.3	47.1	93.6	2.9	5.7	0.4	0.7	50.3
Elderly (65 or older)	1.3	3.3	6.7	10.6	92.1	0.8	6.9	0.1	1.0	11.5
Family type (single-person households are excluded)										
All households	1.3	3.19	6.5	28.5	93.1	1.9	6.1	0.2	0.8	30.6
Married couple	1.4	3.3	6.4	16.8	93.5	1.0	5.8	0.1	0.7	17.9
Female householder (no husband present)	1.0	2.9	6.2	2.8	93.6	0.2	5.7	0.0	0.7	3.0
Male householder (no wife present)	1.3	3.4	6.6	1.3	92.8	0.1	6.4	0.0	0.9	1.4

[1]Estimates include Alaska and Hawaii.

(table 12). Measures of access to supermarkets for residents of tribal areas are examined in greater detail in the next section.

The rural elderly also appear to be slightly farther from the nearest supermarket than other age groups. Approximately 94 percent of both rural

children and working-age adults lived within 10 miles of the nearest supermarket in 2010, while only 92 percent of those aged 65 and older lived within the same distance. A slightly higher proportion of the elderly population lived farther than 20 miles from the nearest supermarket as well, but those more than 20 miles away represent only 1 percent of all elderly in rural areas.

Separate estimates for low-income areas versus moderate/high-income areas show that those living in low-income rural areas tend to be farther from a supermarket than those in moderate- and high-income rural areas (table 13). The median distance that individuals in low-income rural areas must travel to the nearest supermarket is 3.6 miles, compared with 3.1 miles for individuals in moderate/high-income rural areas. Just under 90 percent of individuals in low-income rural areas live within 10 miles of the nearest supermarket versus nearly 95 percent of individuals in moderate/high-income rural areas. Similarly, 1.5 percent of individuals in low-income rural areas lived more than 20 miles from the nearest supermarket in 2010 versus 0.5 percent in moderate/high-income areas.

For several demographic subgroups, those in low-income areas are farther from supermarkets. In every case, a larger percentage of the subgroup population living in low-income rural areas is at least 20 miles from the nearest supermarket than for the same subgroup living in moderate/high-income rural areas. For example, while the problem of access for American Indian/Alaska Native individuals is apparent overall, it is even more striking when area income is considered. Over 15 percent of American Indian/Alaska Native individuals in low-income rural areas lived farther than 20 miles from a supermarket in 2010 (table 13) versus 2.8 percent in moderate/high-income areas.

Figure 5 shows supermarket access in South Dakota, again using shading to indicate more densely populated areas and cross-hatches to indicate low-income areas. In contrast to the St. Louis map, this map uses 10- and 20-mile radii around supermarkets to indicate access levels. The map shows that significant portions of the State, including many low-income areas, are beyond 20 miles from a supermarket. These parts of South Dakota are sparsely populated, but there are still areas with sizable numbers of people far from supermarkets, including some tribal areas.

Food Access in Tribal Areas

We now describe access to healthful food for populations living in federally designated tribal areas, including American Indian Tribal Areas, Alaska Native Village Areas, and Native Hawaiian Homelands. As in the rest of this report, access is measured as the distance to the nearest supermarket—regardless of whether this supermarket is located within tribal lands or not. The analysis is conducted separately for rural and urban tribal areas. Due to data limitations, Oklahoma Tribal Statistical Areas (OTSAs) were excluded from the analysis.[15]

More than 1.3 million individuals reside in tribal areas in the United States, representing American Indian (AI), Alaska Native (AN), and Native Hawaiian (NH) homelands. Of the total tribal area population, 71.5 percent live in rural areas while the remaining live in urban areas.

[15]OTSAs are areas in Oklahoma that have high concentrations of American Indian (AI) populations, but include considerable non-AI populations. Only a small portion of OTSAs are federally designated tribal lands.

Table 13

Rural supermarket access by income level of area and by selected population characteristics, 2010

Population characteristics	20th percentile distance to nearest supermarket	Median distance to nearest supermarket	80th percentile distance to nearest supermarket	< 10 miles to nearest supermarket		10-20 miles to nearest supermarket		> 20 miles to nearest supermarket		Total
	Miles	*Miles*	*Miles*	*Million*	*%*	*Million*	*%*	*Million*	*%*	*Million*
Low-income areas										
All individuals	1.1	3.6	7.6	18.4	89.4	1.9	9.0	0.3	1.5	20.5
Income										
Low-income people	1.2	3.7	7.7	9.3	89.0	1.0	9.3	0.2	1.7	10.4
Moderate/high-income people	1.1	3.6	7.5	9.1	89.8	0.9	8.8	0.1	1.4	10.1
Race										
White	1.2	3.8	7.6	14.3	90.1	1.4	8.8	0.2	1.1	15.8
Black	1.0	3.0	7.2	2.3	91.0	0.2	8.9	0.0	0.1	2.5
Asian	0.7	1.7	4.9	0.1	94.4	0.0	4.5	0.0	1.1	0.1
Native Hawaiian/ Pacific Islander	0.9	2.7	6.5	0.0	90.3	0.0	8.6	0.0	1.1	0.0
American Indian/ Alaska Native	1.6	5.8	16.4	0.5	66.4	0.1	18.4	0.1	15.2	0.7
Other and multiple races	0.9	2.9	6.8	1.2	90.9	0.1	7.6	0.0	1.5	1.3
Hispanic ethnicity										
Hispanic	0.9	2.8	6.4	2.2	91.4	0.2	6.9	0.0	1.7	2.4
Non-hispanic	1.2	3.8	7.7	16.2	89.2	1.7	9.3	0.3	1.5	18.2
Age										
Children (age 17 or less)	1.1	3.6	7.5	4.5	89.6	0.4	8.8	0.1	1.6	5.0
Working age (18 to 64)	1.2	3.6	7.5	11.2	89.7	1.1	8.9	0.2	1.5	12.5
Elderly (65 or older)	1.0	3.7	7.9	2.6	88.2	0.3	10.1	0.1	1.8	3.0
Family type (single-person households are excluded)										
All households	1.1	3.7	7.7							
Married couple	1.3	4.0	7.8	3.5	89.1	0.4	9.4	0.1	1.5	3.9
Female householder (no husband present)	0.9	3.1	7.2	0.9	90.3	0.1	8.3	0.0	1.4	1.0
Male householder (no wife present)	1.1	3.7	7.7	0.4	89.1	0.0	9.2	0.0	1.7	0.4

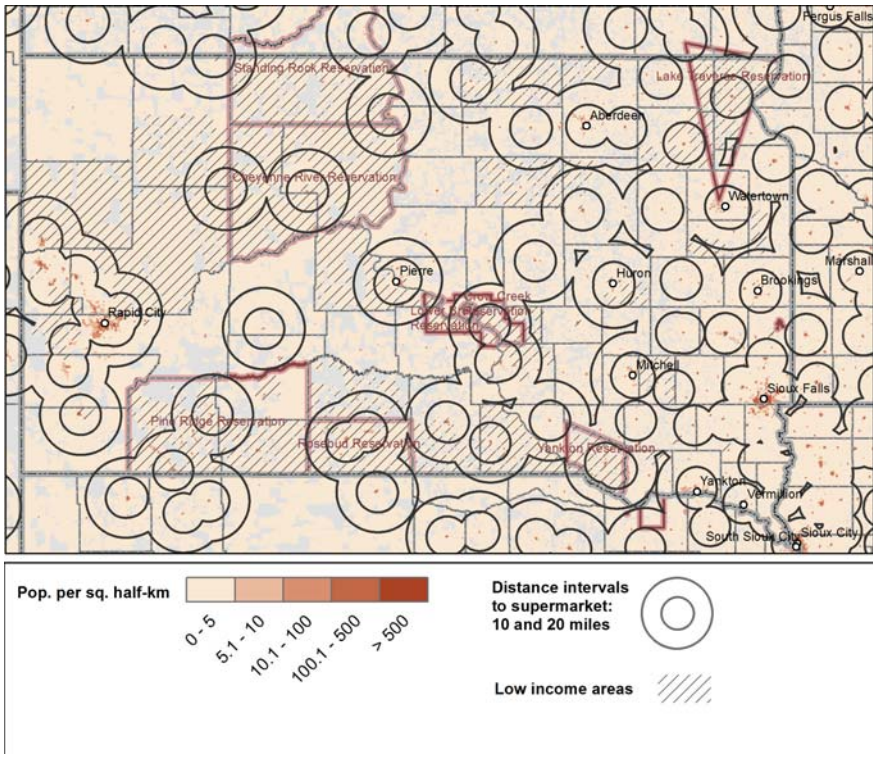
--continued

Table 13
Rural supermarket access by income level of area and by selected population characteristics, 2010—continued

Population characteristics	20th percentile distance to nearest supermarket	Median distance to nearest supermarket	80th percentile distance to nearest supermarket	< 10 miles to nearest supermarket		10-20 miles to nearest supermarket		> 20 miles to nearest supermarket		Total
	Miles	*Miles*	*Miles*	*Million*	*%*	*Million*	*%*	*Million*	*%*	*Million*
Moderate/high-income areas										
All individuals	1.3	3.1	5.9	57.9	94.8	2.9	4.7	0.3	0.5	61.1
Income										
Low-income people	1.3	3.3	6.5	12.9	93.5	0.8	5.9	0.1	0.7	13.8
Moderate/high-income people	1.3	3.0	5.8	45.1	95.1	2.1	4.4	0.2	0.5	47.4
Race										
White	1.4	3.2	6.1	50.6	94.6	2.6	4.9	0.3	0.5	53.5
Black	1.1	2.4	5.0	3.1	96.8	0.1	3.2	0.0	0.1	3.2
Asian	0.7	1.5	2.8	1.3	99.1	0.0	0.8	0.0	0.1	1.4
Native Hawaiian/ Pacific Islander	0.9	2.1	4.8	0.1	96.4	0.0	3.0	0.0	0.6	0.1
American Indian/ Alaska Native	1.5	3.7	7.3	0.4	88.7	0.0	8.5	0.0	2.8	0.5
Other and multiple races	1.0	2.4	5.3	2.4	95.3	0.1	4.2	0.0	0.5	2.6
Hispanic ethnicity										
Hispanic	1.0	2.2	4.9	3.9	95.4	0.2	4.1	0.0	0.6	4.1
Non-hispanic	1.3	3.1	6.0	54.1	94.7	2.7	4.8	0.3	0.5	57.1
Age										
Children (age 17 or less)	1.3	2.9	5.8	14.2	95.2	0.6	4.3	0.1	0.4	14.9
Working age (18 to 64)	1.3	3.1	5.9	35.8	94.9	1.8	4.6	0.2	0.5	37.8
Elderly (65 or older)	1.3	3.2	6.3	8.0	93.5	0.5	5.8	0.1	0.7	8.5
Family type (single-person households are excluded)										
All households	1.3	3.11	6.0							
Married couple	1.4	3.1	6.0	13.3	94.7	0.7	4.8	0.1	0.5	14.0
Female householder (no husband present)	1.1	2.9	5.8	1.9	95.3	0.1	4.3	0.0	0.4	1.9
Male householder (no wife present)	1.3	3.3	6.2	0.9	94.3	0.1	5.2	0.0	0.5	1.0

[1]Estimates include Alaska and Hawaii.

Figure 5
Supermarket access in South Dakota



Source: USDA, Economic Research Service.

Urban Tribal Areas

Of the total urban population, 47.9 percent lived more than 1 mile from the nearest supermarket in 2010, while 23.4 percent were within ½ mile (table 14). Levels of supermarket access vary across population subgroups. The share of low-income population living more than 1 mile from a supermarket (43.6 percent) was lower than the share of moderate/high-income individuals (50.7 percent). As in all urban areas, those households without vehicles in urban tribal areas were closer to the nearest supermarket than those with vehicles.

Rural Tribal Areas

Among the total population in rural tribal areas, 14.0 percent lived more than 20 miles from a supermarket in 2010 (table 15). Another 18.2 percent live between 10 and 20 miles from the nearest supermarket. The median distance to a supermarket was 5.3 miles in 2010.

Disadvantaged populations in rural tribal areas tend to be farther from supermarkets than those with higher incomes and with vehicles: 18.4 percent of low-income people were more than 20 miles from a supermarket, compared with 10 percent of those with higher incomes. Though only about 10 percent of all households in rural tribal areas lack vehicles, those households were located much farther from the nearest supermarket (9.9 miles, median distance) than those with vehicles (4.9 miles). Among rural tribal households

Table 14
Supermarket access in urban Tribal Areas of the United States: Overall and selected population characteristics, 2010

Urban population characteristics	20th percentile distance to nearest super-market	Median distance to nearest super-market	80th percentile distance to nearest supermar-ket	< ½ mile to nearest supermarket		½ mile to 1 mile to nearest supermarket		> 1 mile to nearest supermarket		Total urban tribal areas
	Miles	*Miles*	*Miles*	*Number*	*%*	*Number*	*%*	*Number*	*%*	*Number*
All individuals	0.39	1.0	2.1	87,884	23.4	108,006	28.7	180,249	47.9	376,139
Income										
Low-income people	0.35	1.0	2.0	38,548	26.0	44,938	30.4	64,492	43.6	147,977
Moderate/high-income people	0.41	1.1	2.1	49,336	21.6	63,068	27.6	115,757	50.7	228,161
Age										
Children (age 17 or less)	0.40	1.0	2.2	22,762	22.5	28,856	28.5	49,518	49.0	101,136
Working age (18 to 64)	0.39	1.0	2.1	52,882	23.3	64,479	28.4	109,733	48.3	227,094
Elderly (65 or older)	0.36	1.0	1.9	12,240	25.5	14,671	30.6	20,998	43.8	47,909
Household vehicle availability										
All households	0.37	1.0	2.0	33,484	24.6	39,823	29.2	62,969	46.2	136,276
With vehicle available	0.38	1.0	2.0	29,911	23.9	36,273	29.0	58,970	47.1	125,153
Without vehicle available	0.29	0.8	1.6	3,574	32.1	3,550	31.9	4,000	36.0	11,123

Note: Oklahoma Tribal Statistical Areas are excluded.

without a vehicle, 31.3 percent were more than 20 miles from the nearest supermarket in 2010.

By age group, the share of individuals more than 20 miles from a supermarket ranged from 12.5 percent for the elderly (65 and older) to 15.4 percent among children (age 17 or younger). The share of rural tribal households without a vehicle (10.6 percent) was slightly higher than the share for urban tribal areas (8.2 percent).

This analysis does not include distribution sites served by the USDA Food Distribution Program on Indian Reservations (FDPIR). Including these distribution sites in the store directory would likely reduce the distance to the nearest source of healthful food, particularly in rural areas.[16] Future ERS research will measure tribal area population access to FDPIR sites in greater detail.

[16]Tribal areas designated as urban are largely excluded from participation in FDPIR.

Table 15

Supermarket access in rural Tribal Areas of the United States: Overall and selected population characteristics, 2010

Rural population characteristics	20th percentile distance to nearest super-market	Median distance to nearest super-market	80th percentile distance to nearest supermar-ket	< 10 miles to nearest supermarket		10-20 miles to nearest supermarket		> 20 miles to nearest supermarket		Total rural tribal areas
	Miles	*Miles*	*Miles*	*Number*	*%*	*Number*	*%*	*Number*	*%*	*Number*
All individuals	1.8	5.3	15.6	639,100	67.8	171,698	18.2	131,926	14.0	942,724
Income										
Low-income people	1.9	6.5	18.9	274,602	61.1	92,023	20.5	82,826	18.4	449,450
Moderate/high-income people	1.7	4.7	12.5	364,498	73.9	79,675	16.2	49,100	10.0	493,274
Age										
Children (age 17 or less)	1.8	5.6	16.6	187,534	65.9	53,282	18.7	43,716	15.4	284,532
Working age (18 to 64)	1.8	5.3	15.2	379,831	68.6	98,773	17.8	75,189	13.6	553,793
Elderly (65 or older)	1.6	5.3	14.7	71,735	68.7	19,643	18.8	13,021	12.5	104,400
Household vehicle availability										
All households	1.7	5.1	14.6	218,015	69.6	55,725	17.8	39,406	12.6	313,146
With vehicle available	1.6	4.9	13.4	201,303	71.9	49,575	17.7	29,006	10.4	279,885
Without vehicle available	1.9	9.9	30.3	16,711	50.2	6,150	18.5	10,399	31.3	33,261

Note: Oklahoma Tribal Statistical Areas are excluded.

Distance to Three Supermarkets

Estimated distance to the nearest supermarket indicates the ease of access to one source of healthy food, but the nearest store may not offer the best prices or quality. Distance to the nearest store does not indicate whether other sources of healthful food are just beyond the nearest store or if that store is the only store for miles. If a number of food stores are relatively close by, competition on price, quality, and other store attributes is likely to be greater, and consumers are likely to benefit. If a store is the only one nearby, there is likely to be less competition on these attributes. Previous studies have used measures of the distance to three stores selling healthy foods in order to capture this concept of competition (Apparicio et al., 2007; Sparks et al., 2009). We estimate the median distance to the third nearest supermarket, along with the distances at the 20th and 80th percentiles by population characteristics, first for the whole country and then, separately, for urban and rural areas in order to provide additional insight into the extent of access challenges across the United States (tables 16-18).

Half the U.S. population is within 2 miles of three supermarkets. Further, 80 percent of the population is within 5 miles of three supermarkets. These results indicate that overall, Americans have several choices of supermarkets within a few miles of their homes.

The same general patterns across subpopulations hold for measures of distance to the three nearest supermarkets as they do for the nearest supermarket (table 5). At the median, households without vehicles are closer to three supermarkets than households with vehicles (1.3 miles compared with 2.0 miles). Further, 80 percent of households without vehicles are within 2.2 miles of three supermarkets (table 16). Low-income people and areas are also closer to three supermarkets than moderate/high-income people and areas at the median. Distance to the nearest (single) supermarket has been criticized as a poor indicator of supermarket quality and affordability, especially for low-income individuals, given the presumed lack of competition on price and quality. To the extent that the distance to the third nearest supermarket is an indicator of competition, differences across income levels are small overall.

In urban areas, the median distance to the third nearest supermarket is 1.6 miles (table 17), and in rural areas, the median is 6.2 miles (table 18). Differences across subpopulations in urban areas are small, but the general patterns of distance to the nearest three supermarkets for the 20th, 50th and 80th percentiles are similar to the overall distribution. This is not the case for subpopulations in rural areas. Rural low-income people and low-income areas are farther from three supermarkets than moderate/high-income people and areas at the 20th, 50th, and 80th percentiles. Rural American Indians/Alaska Natives are much farther from three supermarkets than other racial groups at the 20th, median, and 80th percentiles of distance.

Table 16
Distance to nearest three supermarkets: Overall and by population characteristics, 2010

Population characteristics	Overall		
	20th percentile distance to 3rd nearest supermarket	Median distance to 3rd nearest supermarket	80th percentile distance to 3rd nearest supermarket
	Miles		
All people	1.0	1.9	4.8
Income			
Low-income people	0.9	1.8	5.0
Moderate/high-income people	1.0	2.0	4.7
Race			
White	1.1	2.2	5.7
Black	0.9	1.6	2.6
Asian	0.7	1.4	2.1
Native Hawaiian/Pacific Islander	0.8	1.6	3.1
American Indian/Alaska Native	1.1	2.8	12.8
Other and multiple races	0.7	1.5	2.5
Hispanic ethnicity			
Hispanic	0.7	1.4	2.5
Non-hispanic	1.1	2.1	5.3
Age			
Children (age 17 or less)	1.0	2.0	4.8
Working age (18 to 64)	1.0	1.9	4.6
Elderly (65 or older)	1.0	2.0	5.5
All households	1.0	1.9	4.8
Household vehicle ownership			
Own vehicle	1.0	2.0	5.0
Do not own vehicle	0.4	1.3	2.2
Low-income areas	0.8	1.6	4.5
Moderate/high-income areas	1.1	2.1	4.8

Estimates include Alaska and Hawaii.

Table 17

Urban areas' distance to nearest three supermarkets: Overall and by population characteristics, 2010

Population characteristics	Urban areas		
	20th percentile distance to 3rd nearest supermarket	Median distance to 3rd nearest supermarket	80th percentile distance to 3rd nearest supermarket
		Miles	
All individuals	0.8	1.6	2.3
Income			
Low-income people	0.8	1.5	2.2
Moderate/high-income people	0.9	1.6	2.4
Race			
White	0.9	1.7	2.5
Black	0.8	1.5	2.0
Asian	0.7	1.3	1.8
Native Hawaiian/Pacific Islander	0.8	1.5	2.3
American Indian/Alaska Native	0.8	1.6	2.6
Other and multiple races	0.7	1.3	1.9
Hispanic ethnicity			
Hispanic	0.7	1.3	1.9
Non-hispanic	0.9	1.6	2.4
Age			
Children (age 17 or less)	0.9	1.6	2.4
Working age (18 to 64)	0.8	1.6	2.3
Elderly (65 or older)	0.9	1.6	2.4
All households	0.8	1.6	2.3
Household vehicle ownership			
Own vehicle	0.9	1.6	2.4
Do not own vehicle	0.4	1.2	1.7
Low-income areas	0.7	1.4	2.0
Moderate/high-income areas	0.9	1.7	2.5

Estimates include Alaska and Hawaii.

Table 18
Rural areas' distance to nearest three supermarkets: Overall and by population characteristics, 2010

Population characteristics	Rural areas		
	20th percentile distance to 3rd nearest supermarket	Median distance to 3rd nearest supermarket	80th percentile distance to 3rd nearest supermarket
		Miles	
All individuals	3.1	6.2	10.7
Income			
Low-income people	3.4	7.1	11.9
Moderate/high-income people	3.0	5.9	10.2
Race			
White	3.2	6.4	10.7
Black	2.6	5.5	10.7
Asian	1.7	2.9	5.0
Native Hawaiian/Pacific Islander	2.2	4.8	9.9
American Indian/Alaska Native	4.8	10.4	26.3
Other and multiple races	2.5	5.3	10.3
Hispanic ethnicity			
Hispanic	2.4	5.0	10.1
Non-hispanic	3.1	6.3	10.8
Age			
Children (age 17 or less)	3.0	6.1	10.5
Working age (18 to 64)	3.1	6.2	10.6
Elderly (65 or older)	3.3	6.7	11.6
All households	3.1	6.3	10.9
Household vehicle ownership			
Own vehicle	3.1	6.3	10.8
Do not own vehicle	2.8	6.8	10.8
Low-income areas	3.7	8.1	13.3
Moderate/high-income areas	3.0	5.8	9.8

Estimates include Alaska and Hawaii.

Study Limitations and Future Research

Our analysis updates estimates of food access across the United States, and provides the impetus for further research on food access measures and on the effects of economic and demographic changes on retail food markets. Future research could address the issue of store type and its connection to healthy food access. In this report, we use the location of supermarkets as a proxy for access to healthy foods. Some smaller stores, however, may also offer healthier items. Further, many community efforts and some Federal and publicly sponsored interventions have focused on improving the retail environment through non-supermarket interventions (like the opening of farmers' markets or improvements in supply distribution chains for smaller vendors in areas of low access). Consistent data on the availability of healthy foods by smaller vendors were unavailable, so this study excluded smaller stores from analysis.

Another limiting factor of our study is that the industry definition of a supermarket as having $2 million or more in annual sales has not been updated to reflect inflation over many years. As a result, some retailers categorized as "small grocery stores" in our store directory may meet this definition without the typical offerings of a large, full-service grocery store. Future analysis could examine how sensitive our results are to different definitions of large grocery stores (e.g., excluding stores with sales between $2 million and $4 million annually).

Whereas straight-line distance measures are used in our study to measure access to food retailers, existing roadways, natural and manmade barriers, and other factors may extend the distance that consumers actually have to walk or drive. Computing these distances on a national level, however, would require substantial computational resources. This potential problem is likely to be a greater in less densely populated areas where there are likely to be more man-made and natural barriers and less dense street networks. One study showed that differences in distance measurement methods matter more in less dense urban areas than in dense areas, but do not differ greatly for overall food access patterns (Sparks et al., 2011). Performing related sensitivity analyses using our measurements could provide guidance for future efforts to measure food access.

The measures of food access in this report are meant to proxy access to supermarkets by measuring distance to supermarkets and the resources available to consumers, such as vehicles and income, that may help or hinder their ability to get to those stores. As a complement to these measures, it would be useful to directly ask individuals whether they perceive or experience barriers to access supermarkets and other sources of healthy foods. As noted above, there are some precedents of asking such questions on a nationally representative survey. Adding questions of this type to already existing national-level surveys may be worth considering.

These limitations and potential extensions notwithstanding, estimates presented in this report show a mixed picture of changes in supermarket access over the past decade. Perhaps the best indicator of supermarket access shows improvement. In 2010, 1.8 percent of all households did not

have a vehicle and were more than 1 mile from a supermarket, down from 2.3 percent in 2006. Further, the share of households without a vehicle and between ½ and 1 mile from a supermarket is also down from 2006 (2.4 percent compared with 3.2 percent).

There has, however, been growth in the number and percentage of people who live in low-income areas who are at least 1 mile from the nearest supermarket (up to 9.7 percent of the population in 2010 from 8.4 percent in 2006). The distribution of distance to the nearest supermarket for the overall population has remained essentially unchanged since 2006. And although the number of supermarkets has declined slightly since 2006, this decline occurred in moderate/high-income areas while the number of supermarkets in low-income areas increased. As a result, it is likely that changes in this indicator of access between the USDA (2009) analysis and this report are due more to increases in the number of low-income areas than to changes in store location.

While there are many low-income areas with supermarket access limitations, our results show that for some indicators, access limitations may be greater outside of low-income areas. For example, moderate/high-income areas contain a greater number and share of households without vehicles that are far from food stores than do low-income areas. Moderate- and high-income areas also contain a greater number and share of low-income people who are far from stores. Results from this study show that focusing only on low-income areas will miss access limitations of those who do not have a vehicle or are poor but do not live in low-income areas.

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Appendix A: Data and Methodological Details

Methods for Developing and Geo-coding a National List of Stores

Methods to develop and assign geographic coordinates—or geo-code—a 2010 list of stores (consisting of large grocery stores, supermarkets, and supercenters) are largely consistent with the method used in USDA (2009). We note below where methods for the 2010 analysis diverged from USDA (2009) and explain the methods in more detail.

USDA's Food and Nutrition Service changed the method used to assign store types for SNAP-authorized stores in 2008. Where prior store types were assigned primarily using retailer self-classification, SNAP now uses confidential methods and more complete information obtained from a new application form for store authorization. To ensure that SNAP stores were comparable to those included in the TDLinx store directory, ERS requested a special tabulation of all SNAP stores meeting minimum annual sales (food and nonfood items) and offering four major food groups: milk, meat, fruits and vegetables, and bread, in any form (canned, fresh, frozen). Almost 35,000 of 204,705 total stores met these criteria and were included in the 2010 ERS store directory.

The Trade Dimensions TDLinx® store directory consisted of 39,502 retail food stores with at least $2 million or more in sales (food and nonfood). Additional information included annual sales volume range and store format, allowing for the identification of supercenters, supermarkets, and large grocery stores.

In addition to descriptive information, both SNAP and TDLinx provided the store name, address, and geo-coded location coordinates (latitude and longitude) to allow for measurement of distance from each grid area to the nearest store.

Matching the TDLinx and SNAP Store Lists

TDLinx and SNAP stores were merged and stores common to each were counted as the same store to avoid duplication. Both the geographic coordinates of each store's location and the use of automated scripting in ArcGIS software to compare store names and addresses among potential matches were employed in combining the two store lists. First, a proximity analysis using a $1/3$-mile buffer to identify a subset of potential store matches from the two store lists was performed. Next, the resultant potential matches were analyzed through an automated script to compare the store name and address from each of the store lists and denote exact matches.

Both automated and manual review methods were used for the remaining unmatched stores. Any partial matches—such as having the same store name but a different street address, or vice versa—were manually reviewed. The Trade Dimensions *Marketing Guidebook* (2012) was used to verify

current store names and addresses. Online sources, such as company Web sites and Google maps, were used to verify store name and location data. Any remaining unmatched stores in the same ZIP Code area were manually checked for potential matches using the store name and street address. Once all store matches were identified, the store lists were combined into one data set encompassing the matched stores, TDLinx-only stores, and SNAP-only stores.

When a SNAP store matched to a TDLinx store, the TDLinx store classification was used. We did this because many SNAP "superstores" were found to include larger traditional supermarkets, mass-merchandise stores selling some food varieties, and supercenters. They were reclassified according to the TDLinx store definitions. For SNAP stores that did not match the TDLinx store directory, all large mass-merchandise stores that sell some food varieties but typically do not offer fresh meat and produce—such as Target, Wal-Mart, and Kmart—were eliminated (3,078 SNAP-only mass merchandise stores eliminated). SNAP-only large grocery stores that did not meet the minimum annual sales and food category requirement were also eliminated (1,620 SNAP-only stores eliminated). SNAP-only superstores were reclassified as supercenters if stores with the same name (but a different location) had been classified as a supercenter by TDLinx.

Assignment of Store Locations for 2006 and 2010

Because store location is critical to measures of access, it is important to have the greatest possible consistency when comparing change in food access and food deserts between 2006 and 2010. Those stores common to both 2006 and 2010 directories had up to four different geographic coordinates assigned, depending on its source. When applying geo-codes to the 2010 stores, a protocol was developed to address potential inconsistencies of store location due to differences in geo-code precision. First, all 2010 stores that were also in the 2006 directory and had an address that was geo-coded to an exact street address in 2006 were assigned the 2006 geo-code to fix the location of those stores and to eliminate artificial change in store location between the two years. Second, the selection of location coordinates for the remaining stores (those 2010 stores not present in 2006) was based on the method used to obtain the geo-code. Stores that had been geo-coded to an exact street address were deemed to have the greatest accuracy, while stores that had been geo-coded to a ZIP Code centroid were deemed to have more potential inaccuracy. For example, if the store was newly opened and was geo-coded to an exact street address, then the 2010 coordinates were selected as the location of the store. Third, any remaining stores were either manually reviewed with geographic coordinates assigned based upon the manual inspection, or taken from stores that had been geo-coded to a census block group centroid or the centroid of a ZIP Code + 4 polygon. Store locations that could not be determined manually were assigned lat/long coordinates from population-weighted ZIP Code centroids since store locations are most likely to be located in population centers.

Taken together, these methods ensure that the best available store location coordinates were applied, and that among stores common to both years, locations are consistent when used to compare change in access measures over time.

Methods for Developing ½-km Square Grids and Downcasting Population Data

To link supermarket distance with census population, housing, and urban characteristics, a grid-based approach was used. The grid-based approach provides a common unit for which all data inputs can be linked and efficiently aggregated and summarized at many levels of geography. It also provides a method for gaining greater spatial detail to population characteristics that are only available at more aggregate spatial resolutions. A grid composed of 500-meter cells, with a unique value for each grid cell, was developed so that every half-kilometer region in the entire land area of the 50 States is represented by its own distinct value. Based on this common grid cell identifier, we developed supermarket distance and grid population characteristics (e.g., low income or urban) to the same common grid.

To allocate census population data, the unique value grid was overlaid with the census block geographies to get the combined set of block–grid cell pieces. The area of each of these pieces is used to calculate the area-weighted average of block-level people or household counts at the grid-cell level. First, for each of the block–grid cell pieces, we calculated the share of each block's area. For each of these block–grid cell pieces we multiplied this share by the population of the block and then aggregated the populations to the grid-cell level.

While most of our data were population counts from the 2010 census, income and vehicle access data came from the 2006-2010 American Community Survey (ACS) and were only available at the more aggregate block-group level. These were apportioned to grid cells through a population and area weighting technique. First, the share of the block-group population that was low income was calculated. The share was then multiplied by the population for all the blocks that made up that block-group. The area weighting downcasting method discussed above was then used to allocate low-income populations to the grid-cell level.

Our downcasting approach is consistent with a simple aerial allocation method, which allocates population counts from census geographies (e.g., the number of people at the block, block-group, or tract level) evenly across that census geography.[17] It is important to note that there may be error in the process of allocating populations and their characteristics to ½-kilometer grid cells (e.g., some people who actually live in one grid cell may be allocated to neighboring grid cells). We are not able to estimate the extent of this error. However, the grid-cell method that we use is likely to result in better estimates of distance to supermarkets by population characteristics than other methods, such as a centroid approach, in which the entire population of that census geography is assigned to the centroid of that geography (either geographic or population weighted). This is because the centroid method assigns distance from the centroid for the entire geography, which will likely result in even greater error. For example, using the centroid approach, the distance to the nearest supermarket at the tract centroid is the distance to the nearest supermarket for everyone in that tract. The grid-cell approach is likely to be most advantageous compared with a centroid approach in rural and less densely populated census geographies, which are larger in land area.

[17]For variables not available at the block level (income, vehicle availability, and poverty rates), we use the more detailed block-level population distribution to allocate these larger aggregations to the grid level.

Appendix B: Additional Tables With Estimates That Include Alaska and Hawaii

Table B1
National individual and area measures of income, including Alaska and Hawaii, 2010

	Overall		Urban		Rural	
	Million	*Percent*	*Million*	*Percent*	*Million*	*Percent*
Total low-income population	98.4	31.9	74.2	32.7	24.2	29.6
Total moderate/high-income population	210.3	68.1	152.8	67.3	57.5	70.4
Total population in low-income areas	96.6	31.3	76.0	33.5	20.5	25.1
Total population in moderate/high-income areas	212.2	68.7	151.0	66.5	61.1	74.9
Low-income population in low-income areas	51.3	16.6	40.9	18.0	10.4	12.7
Low-income population in moderate/high-income areas	47.1	15.3	33.3	14.7	13.8	16.9
Total population	308.7	100.0	227.1	100.0	81.7	100

Table B2
Change in total number of stores by type, including Alaska and Hawaii by area income level, 2006 and 2010

	Total U.S.				Low-income areas		Moderate/high-income areas	
	2006		2010		2010		2010	
	Million	*Percent*	*Million*	*Percent*	*Millions*	*Percent*	*Million*	*Percent*
Store type								
Supercenter	3,099	7.5	3,432	8.6	1,072	7.3	2,360	9.4
Supermarket	31,894	79.8	30,762	77.1	10,789	73.7	19,973	79.2
Large grocery store	5,094	12.7	5,683	14.3	2,784	19.0	2,899	11.5
Total	40,087	100.0	39,877	100.0	14,645	100.0	25,232	100.0

Table B3

Supermarket access for housing units without vehicles, including Alaska and Hawaii: Overall and by area income level, 2010

Area characteristics	Total number of households	Households without access to a vehicle (distance to supermarket)					
		< ½ mile		½ mile to 1 mile		> 1 mile	
All areas							
Low-income area	5.3	2.9	55.0	1.5	27.9	0.9	17.1
Moderate/high-income area	4.9	2.5	50.8	1.3	25.6	1.2	23.5
Urban areas							
Low-income area	4.8	2.9	60.0	1.4	29.5	0.5	10.5
Moderate/high-income area	4.2	2.4	57.8	1.2	28.1	0.6	14.1
Rural areas							
Low-income area	0.6	0.5	88.8	0.0	8.6	0.0	2.6
Moderate/high-income area	0.7	0.7	94.2	0.0	5.2	0.0	0.7

[a]High access = less than 0.5 mile; medium access = between 0.5 to 1.0 miles; low access = more than 1.0 mile.
[b]High access = less than 10 miles; medium access = between 10 to 20 miles; low access = more than 20 miles.

Table B4

Supermarket access for low-income areas compared with moderate/high-income areas, including Alaska and Hawaii, 2010

Area characteristics	20th percentile distance to nearest supermarket	Median distance to nearest supermarket	80th percentile distance to nearest supermarket	< ½ mile to nearest supermarket		½ mile to 1 mile to nearest supermarket		> 1 mile to nearest supermarket		Total # of people	% of total population
	Miles	*Miles*	*Miles*	*Million*	*% (of row)*	*Million*	*% (of row)*	*Million*	*% (of row)*	*Million*	*% (of row)*
All areas[a]	0.33		2.19								
Low-income area	0.22	0.69	1.56	36.1	37.4	30.7	31.8	29.8	30.8	96.6	31.3
Moderate/high-income area	0.37	0.98	2.43	51.9	24.5	62.9	29.7	97.3	45.9	212.2	68.7
Urban areas[a]										308.7	
Low-income area	0.15	0.62	0.96	34.6	45.5	28.5	37.5	12.9	17.0	76.0	24.6
Moderate/high-income area	0.29	0.69	1.28	48.9	32.4	57.1	37.8	45.1	29.8	151.0	48.9
Rural areas[b]	1.28		6.36								
Low-income area	1.14	3.64	7.60	18.4	89.4	1.9	9.0	0.3	1.5	20.5	6.7
Moderate/high-income area	1.30	3.08	5.95	57.9	94.8	2.9	4.7	0.3	0.5	61.1	19.8

[a]High access = less than 0.5 mile; medium access = between 0.5 to 1.0 miles; low access = more than 1.0 mile.
[b]High access = less than 10 miles; medium access = between 10 to 20 miles; low access = more than 20 miles.