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Measuring Access to Nutritious, Affordable Food: A National Assessment

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This research report presents methods used to conduct a national assessment of access to nutritious, affordable food in low-income neighborhoods and communities, an initiative contained in the 2008 Farm Bill. A number of research challenges were addressed in carrying out this directive, including defining what constitutes likely food sources that are nutritious and affordable; identifying low-income neighborhoods and communities; and developing criteria for measuring levels of access to nutritious, affordable food. To address these challenges a national store directory was developed; GIS methods including a projection of Census population data to uniform square-kilometer grids were applied. Cumulative density functions were used to describe the relationship between the share of a given population group, such as urban-low-income, and its distance to the nearest supermarket. Maps of selected areas were used to describe differences in food access in low-income areas.

This research report presents research methods and findings from a national assessment of access to nutritious, affordable food in low-income neighborhoods and communities—an initiative contained in the 2008 Farm Bill (USDA-ERS 2009). In addition to assessing the extent of populations with low food access, the directive requested an analysis of the consequences of food deserts, lessons learned from related Federal programs, and a discussion of policy options for alleviating the effects of food deserts.

Prior studies of limited food access were for the most part confined to geographic areas such as a metro area or rural regions (Apparicio, Cloutier, Shearmur 2007; Gallagher 2007; Morton and Blanchard 2007; Nayga and Weinberg 1999). Research on a national level has been limited due to lack of comprehensive, uniform data on stores and the inability to measure levels of access within relatively small geographic areas (Powell et al. 2007).

Data Sources, Methods, and Measurement Criteria

A number of research challenges were addressed in carrying out this directive, including defining what constitutes likely food sources that are nutritious and affordable, identifying low-income neighborhoods and communities, and developing criteria for measuring levels of access to nutritious,

affordable food that takes into account differences in urbanicity.

Store Criteria

To identify nutritious, affordable food sources we reviewed prior studies of food stores and other retail outlets selling food, such as supercenters and dollar stores, for their price and food variety characteristics. While restaurants, fast-food outlets, and other food-service stores are potential nutritious food sources, they have a larger share of total cost devoted to food preparation and service relative to food stores, and were not considered in this study.

Among food stores, smaller grocery stores, including neighborhood markets, convenience stores, and specialized food stores such as produce markets and meat and seafood markets were considered. While these outlets may offer some nutritious foods, their smaller selling area dictates a limited range of foods are sold. Smaller grocery and specialized stores are less likely to sell store and generic brands or larger, economical package sizes, reducing their affordability. Among retail outlets selling food, supermarkets account for the largest segment of retail food sales nationally, amounting to 57.8 percent of the total in 2008 (USDA-ERS 2010). Due to their larger size they are able to provide all major food departments as well as store and generic brands and larger, economical package sizes. Larger grocery stores are more likely to provide some of these same characteristics, especially in rural areas where food spending in an area is not sufficient to support a supermarket or supercenter.

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We selected supermarkets and supercenters as the most likely source for nutritious, affordable foods. We used the industry criteria of \$2 million or more in annual food sales. This sales minimum can include large grocery stores that are more prevalent in rural locations.

Low-Income Area Criteria

Another challenge was to identify low-income neighborhoods and communities. While the Federal Poverty Level (FPL) identifies poor households, not all poor households live in low-income areas. For a given area, the Census defines low-income areas as those in which at least 20 percent of the total households have incomes below the Federal Poverty threshold, which is adjusted annually and varies by household composition. Because Federal food-assistance programs and other welfare programs allow for eligibility above the FPL, often referred to as the working poor, we used a 200 percent FPL threshold. To determine a low-income neighborhood, we used a larger share of total population criteria equal to 40 percent. Together, the two criteria were used to identify concentrated areas of low-income households.

Geographic Strata and Access Criteria

Because access to sources of nutritious, affordable foods is likely to vary by location, we needed to take into account geographic characteristics that are likely to influence those differences. The concentration of supermarkets, supercenters, and large

grocery stores is likely to be higher in areas of high population density and where a highly developed infrastructure, including retail stores and services, is present. Also, households in those areas may be more dependent on walking and public transit systems. By contrast, households in low-density, less-developed rural areas may have fewer nutritious, affordable food sources and may rely more on owned vehicles for transportation. National measures of access should take account of these differences.

We used the Census Urbanized Area designations to assign populations to one of three geographic locations: Urban Areas (central city and suburbs), Urban Clusters (small cities and towns), and Rural Areas (defined as all remaining areas). In the analysis, separate measures of access were applied to each geographic stratum.

Relative Measures of Food Access

To measure differences in access across urbanicity types, we developed a time-based measure of distance that allows for walking or driving means of transportation. We used three levels of access to measure time-equivalent distance to the nearest supermarket, supercenter, or large grocery store. Table 1 describes the access level, travel time, and walking- and driving-equivalent distance measures.

Different distance criteria were used, depending on the urbanicity type. We applied walking-distance measures for urban areas and urban clusters. Driving-distance measures were applied to rural areas.

Table 1. Access Time and Distance Criteria.

Level of access	Travel time	Distance-equivalent measure	
		Walking	Driving
High	< 15 min.	< 1/2 mile	< 10 miles
Medium	15–30 min.	1/2–1 mile	10–20 miles
Low	> 30 min.	> 1 mile	> 20 miles

Walking speed = 2 mph. Driving speed = 40 mph.
Source: USDA-ERS (2009).

Data and Sources

Comprehensive data at the national level were required for this study. A primary data source was the 2000 Census of Population, the most recent available. In addition to population by urbanicity, demographic characteristics of persons and households were also used to compare food access between population groups, including low-income, non-white, elderly, and households without vehicle.

Two separate national-level directories of food stores from the year 2006 were combined to develop a comprehensive list of supermarkets, supercenters, and large grocery stores in the U.S. The first directory was a list of authorized stores that accept Supplemental Nutrition Assistance Program (SNAP) benefits (formerly the Food Stamp Program). More than 166,000 outlets were authorized in 2006, but only approximately 34,000 met the supermarket/supercenter definition criteria. The SNAP data were augmented with additional supermarket data from Trade Dimensions TDLinX (a Nielsen company), a proprietary source of individual supermarket store listings, also for the year 2006.

Spatial Analysis

We used ArcView GIS to measure distance to nearest store. First, all stores classified as supermarkets/large grocery stores or supercenters were geo-coded to obtain mapping coordinates. Next we created a geographic overlay of one-square-kilometer grids covering the continental U.S. To obtain population data for each grid area we used the Socioeconomic Data and Applications Center (SEDAC) grid data, which is based on 2000 Census of Population at the block-group level (SEDAC 2009). SEDAC provides grid-level estimates of Census population characteristics. The one-square-kilometer grids provide population and demographic data in greater detail than is possible with larger Census-based areas, such as a tract or block group. The centroid of each grid (the physical center) was used to measure the level of access to the nearest store location, using the Euclidean (straight-line) distance.

The one-square-kilometer grids were also used to identify the population located in low-income areas. Because the geographic areas consisted of uniform one-square-kilometer grids, a systematic search criterion was used, where for each grid the

population of adjacent grids extending three km in all directions was used to test whether at least 40 percent of the total population within the search area met the poverty threshold requirement. This procedure is a type of kernel density function. Its primary purpose here is to test each grid within the context of adjacent grids for meeting the low-income area criteria.

National Access Measures

Individual distance measures for each grid area were aggregated in various ways to provide summary statistics for the national assessment. Data were summarized nationally by urbanicity type, by income, and by income area. Within each Census urbanicity type we provided access measures for each of four vulnerable populations: low-income populations, non-white populations, households without vehicle, and elderly (age 65 or more) populations. Within each vulnerable population we distinguished between persons living in low-income areas or in higher-income areas. For each vulnerable group and income area we calculated the total number of persons and the share of total persons for each of three measures of food access: high access, medium access, and low access.

In addition to descriptive statistics of the access measures, we developed cumulative density functions (CDFs) and maps of selected areas. The CDFs plot a continuous curve of the relationship between the cumulative share of a specific population (urban low-income persons, for example) and their distance to the nearest supermarket. Cumulative density functions were used to compare differences in food access between urbanicity types and between vulnerable population groups. Maps were used to depict low-income areas and to provide examples of levels of access in urban and rural areas.

Findings

The share of population located in low-income neighborhoods with low access to nutritious, affordable food is relatively small—about 8.4 percent of the national population, equaling 23.5 million persons (excludes Alaska and Hawaii). Of the low-income area population experiencing low access, about half—11.5 million—are low-income, equaling 4.1 percent of the total population (Table 2).

We also gauged low access among the four vulnerable populations nationally (Table 3). Low-income persons had the largest number with low-access (30.2 million), followed by non-white persons (14.8 million), and the elderly (6.9 million). Low-income persons also had the largest share experiencing low access, 38.1 percent of the total, while households without vehicle had the smallest share experiencing low access, 12.0 percent. Of the three urbanicity types, Urban Clusters had the largest share of low access in each vulnerable group, ranging from 22.2 to 35.0 percent of the Urban Cluster total number.

Conclusions

The analysis found that while some low-income neighborhoods experienced low levels of access to supermarkets, large grocery stores, and supercenters, the problem was not widespread. While access to transportation is critical to populations facing low access, most households owned vehicles. A relatively small number of households experiencing low access did not own a vehicle. Especially

in rural areas, these households may rely more on small grocery stores and other retail food outlets that are less affordable and offer a reduced variety of foods.

Because this study was conducted at the national level, potential sources of affordable and nutritious food sources may have been overlooked. Produce markets, farmers markets, and other food marketers may provide additional sources at the local level. Community advocacy groups and local governments may be better suited to collect and assess this additional information.

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Table 2. Supermarket Access for People in Low-Income and Higher-Income Areas (Walking Distances).*

Access Level (walking)	All People in low-income areas			All low-income people in low-income areas		
	Total number (millions)	Share of people in low-income areas (%)	Share of U.S. population (%)	Total number (millions)	Share of low-income people (%)	Share of total U.S. population (%)
High	22.9	32.1	8.2	12.1	33.5	4.3
Medium	24.9	34.9	8.9	12.5	34.7	4.5
Low	23.5	33.0	8.4	11.5	31.8	4.1
Subtotal in low-income areas	71.3	100.0	25.5	36.0	100.0	12.9
Total U.S. Population	279.6			79.3		

* Low-income and higher-income areas defined according to ERS criteria. Source: USDA-ERS (2009).

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Table 3. Low-Access Populations/Households by Vulnerable Group (All Income Levels).

Vulnerable group	Vulnerable population/ households		Vulnerable population/households with low access ¹	
	Number (millions)	Share of total (percent)	Number (millions)	Share of urbanicity type (percent)
Low-income persons				
Urban areas	50.6	63.8	10.2	20.2
Urban Clusters	8.8	11.1	2.8	31.8
Rural areas	19.9	25.1	0.3	1.5
Total	79.3	100.0	30.2	38.1
Non-white persons				
Urban areas	69.8	81.4	12.5	17.9
Urban Clusters	6.0	7.0	2.1	35.0
Rural areas	9.9	11.6	0.2	2.0
Total	85.7	100.0	14.8	17.3
Elderly (age 65 and above)				
Urban areas	22.2	63.8	5.5	24.8
Urban Clusters	3.9	11.2	1.3	33.3
Rural areas	8.7	25.0	0.1	1.1
Total	34.8	100	6.9	19.8
Households without vehicle ²				
Urban areas	8.5	78.7	1.1	12.9
Urban Clusters	0.9	8.3	0.2	22.2
Rural areas	1.4	13.0	(z)	(x)
Total	10.8	100.0	1.3	12.0

¹ More than one mile from the nearest supermarket (urban/urban clusters). More than 20 miles from the nearest supermarket (rural).

² Data are for number of households only.

(x) = Less than 0.1 percent of households.

(z) = Less than 100,000 households.

Source: USDA-ERS (2009).