

Designed for Disease

The Link Between Local Food Environments and Obesity and Diabetes

SUMMARY

Healthy eating can help reduce the incidence of obesity and diabetes—increasingly common conditions that result in shortened lives, lowered productivity, and enormous economic costs. Although healthy eating habits are ultimately a matter of individual choice, local food environments influence the options available to individuals and families.

Designed for Disease: The Link Between Local Food Environments and Obesity and Diabetes examines the relationships between retail food environments, obesity and diabetes, and community income. The study demonstrates that people who live near an abundance of fast-food restaurants and convenience stores compared to grocery stores and fresh produce vendors, have a significantly higher prevalence of obesity and diabetes.

The highest rates of obesity and diabetes are among people who live in lower-income communities and have worse food environments. However, for people living in lower-income and higher-income communities alike, the higher the ratio of fast-food restaurants and convenience stores to grocery stores and produce vendors near home, the higher the prevalence of obesity and diabetes.

To help reduce the prevalence of obesity and diabetes, the authors urge state and local lawmakers to enact public policies to make healthy foods more readily available. These policies include providing retail incentives, promoting smaller-scale markets that sell healthy foods, maximizing the opportunities that come with the new WIC food package, using zoning to limit the number of fast-food restaurants in overburdened communities, and requiring nutritional information on restaurant menus.

STUDY OVERVIEW

Increasingly, research suggests that the foods available in communities influence dietary behaviors and related health outcomes.¹ According to a 2007 study by the California Center for Public Health Advocacy, California has more than four times as many fast-food restaurants and convenience stores as grocery stores and produce vendors—suggesting that Californians have greater access to foods with lower nutritional values than to healthier foods.²

This policy brief, produced collaboratively by the California Center for Public Health Advocacy, PolicyLink, and the UCLA Center for Health Policy Research, builds on the 2007 study as well as on related research by all three organizations. It investigates whether there is an association between the retail food environment and the prevalence of obesity and diabetes in California and explores the effect of community income on that relationship.

BACKGROUND

Obesity and Diabetes Rates Are Increasing

According to the 2005 California Health Interview Survey (CHIS 2005), 21 percent of California adults are obese and another 35 percent are overweight. The consequences of obesity are severe; they include increased risk for chronic conditions such as diabetes, heart disease, cancer, arthritis, stroke, and hypertension.³⁻⁵ Each year in California, obesity is responsible for thousands of deaths⁶ and costs families, employers, the health-care industry, and the government more than \$6 billion.⁷ Due to the rapid rise in obesity, today's youth may—for the first time in modern history—live shorter lives than their parents.⁸

The prevalence of type 2 diabetes is also rising dramatically, and the human and financial costs are devastating. Diabetes is the leading cause of blindness, non-traumatic lower-limb amputation, and kidney failure.⁹ In addition, two-thirds of people with diabetes will die from cardiovascular



Lifting Up What Works®

PolicyLink



The rising prevalence of diabetes is fueling increases in healthcare expenditures and insurance premiums, costing \$18 billion each year in California alone.

The California Health Interview Survey (CHIS)

CHIS is a telephone survey of adults, adolescents, and children from all parts of California. The survey examines public health and health care access issues. CHIS 2005 completed interviews with over 43,000 adults, drawn from every county in the state, in English, Spanish, Chinese (both Mandarin and Cantonese), Vietnamese and Korean. The CHIS sample represents the geographic diversity of California, and the available multi-language interviews accommodate the state's rich ethnic diversity. CHIS is a collaborative project of the UCLA Center for Health Policy Research, the California Department of Health Services, and the Public Health Institute. The survey has been conducted every two years since 2001. For more information about CHIS, please visit www.chis.ucla.edu.

disease or stroke.¹⁰ The rising prevalence of diabetes is fueling increases in healthcare expenditures and insurance premiums, costing \$18 billion each year in California alone.¹¹

Rates of obesity and diabetes are highest and have risen the most rapidly among people of color and in lower-income communities.^{12,13} Even after accounting for individual risk factors such as socioeconomic status and race/ethnicity, living in a lower-income community is associated with poor health outcomes, including higher rates of obesity and mortality.^{14,15} Increasingly, public health researchers, policymakers, advocates, and health care providers have acknowledged the influence of community factors, including the local food environment, on health.¹⁶

Food Environments Are Associated with Health

The availability of retail food outlets that sell high-quality, nutritious foods at affordable prices is an important factor for encouraging individuals to select a healthy diet and subsequently reduce their risk for obesity and diabetes.^{17,18} People who live near grocery stores are more likely to eat recommended amounts of fruits and vegetables¹⁹ and less likely to be obese or have a diagnosis of diabetes.^{20,21} Alternatively, eating at fast-food restaurants is associated with higher caloric intake,²² lower fruit and vegetable consumption,²³ greater consumption of sweetened beverages,²⁴ and higher rates of obesity and diabetes.²⁵ Most food sold at convenience stores is typically of similarly low nutritional quality.²⁶

The food environments of lower-income communities and communities of color are of particular concern, given that obesity and diabetes rates are highest in these communities. Lower-income neighborhoods and communities of color have fewer grocery stores and an abundance of fast-food restaurants and convenience stores compared to higher-income and predominantly Caucasian neighborhoods.²⁷⁻³¹ When grocery stores are not accessible—when residents do not have access to a private vehicle or reliable public transportation, or when grocery stores are not located within short walking distance—residents

of these communities often resort to purchasing the generally higher-calorie, lower-nutrient foods sold at nearby convenience stores and fast-food restaurants. These disparities in food access contribute to subsequent chronic health conditions, including obesity, cancer, diabetes, and cardiovascular disease, as well as to higher mortality rates and years of potential life lost.³²⁻³⁴

DATA AND METHODS

To examine the association of retail food environments with obesity and diabetes, we combined individual-level demographic and health outcome data from the 2005 California Health Interview Survey (CHIS 2005) with the locations of retail food outlets from the 2005 InfoUSA Business File. Using geographic information system (GIS) software, we calculated a Retail Food Environment Index (RFEI) for each adult CHIS respondent by dividing the total number of fast-food restaurants and convenience stores by the total number of grocery stores* (including supermarkets) and produce vendors (including produce stores and farmers' markets) within a given radius around their home address (0.5 mile in urban areas, 1 mile in smaller cities and suburban areas, and 5 miles in rural areas).^{35,36} Thus the RFEI is an indicator of the density of food outlets that are less likely to stock fresh fruits and vegetables and other healthy foods relative to those where such healthy options are more likely to be available. A higher RFEI indicates that a person lives near a larger number of fast-food restaurants and convenience stores relative to the number of grocery stores and produce vendors. For example, an individual with an RFEI of 2.0 has twice as many fast-food restaurants and convenience stores nearby compared to grocery stores and produce vendors.

To investigate the influence of community income on the relationship between the RFEI and health outcomes, this study uses data from the 2000 Census to describe community economic status. Lower-income communities are defined as census tracts in which at least 30 percent of households have incomes below 200

*In the California Center for Public Health Advocacy 2007 study, *Searching for Healthy Food: The Food Landscape in California Cities and Counties*, this category of stores was referred to as supermarkets.

percent of the federal poverty level (FPL). At the time of the 2000 Census, 200 percent of the FPL was \$21,738 for a family of two and \$34,058 for a family of four.^{37,38}

Ten nationally recognized experts with knowledge and experience in community nutrition, social marketing, health policy, consumer behavior, public health ethics, biostatistics, epidemiology, health disparities, neighborhood effects, and spatial analysis served as a Scientific Advisory

Panel for this study, reviewed the methodology and results and helped develop policy recommendations.

All statements in this report that compare rates for one group with another reflect statistically significant differences ($p < 0.05$) unless otherwise noted.

For more information on the RFEI and the study methodology, please see www.publichealthadvocacy.org/research.

A higher RFEI indicates that a person lives near a larger number of fast-food restaurants and convenience stores relative to the number of grocery stores and produce vendors.

The Retail Food Environment Index (RFEI)

The Retail Food Environment Index is constructed by dividing the total number of fast-food restaurants and convenience stores by the total number of grocery stores (including supermarkets) and produce vendors (produce stores and farmers' markets) within a radius around an individual CHIS respondent's home (0.5 mile in urban areas, 1 mile in smaller cities and suburban areas, and 5 miles in rural areas).

$$\text{RFEI} = \frac{\# \text{ Fast-Food Restaurants} + \# \text{ Convenience Stores}}{\# \text{ Grocery Stores} + \# \text{ Produce Vendors}}$$

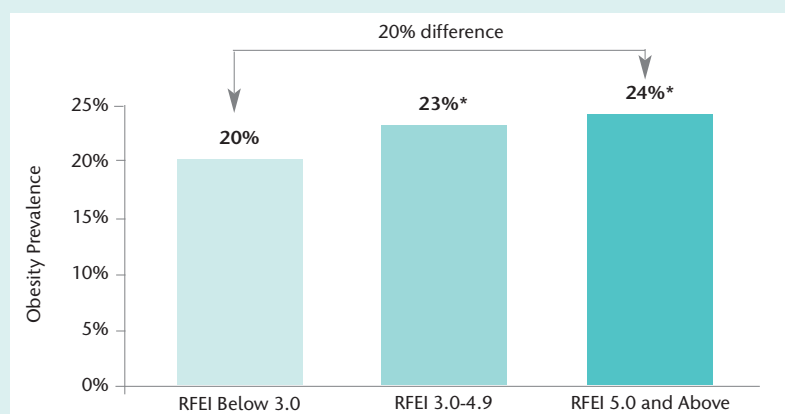
The result is the ratio of retail food outlets around an individual's home that are likely to offer little in the way of fresh fruits and vegetables or other healthy foods to those in which such products are likely to be more readily available. For example, an individual whose RFEI is 2.0 has twice as many fast-food restaurants and convenience stores nearby as grocery stores and produce vendors.



The average local RFEI for California adults is approximately 4.5, meaning that for each grocery store or produce vendor around Californians' homes, there are more than four fast-food restaurants and convenience stores.

FIGURE 1

Obesity Prevalence by Retail Food Environment Index, Adults Age 18 and Over, California, 2005

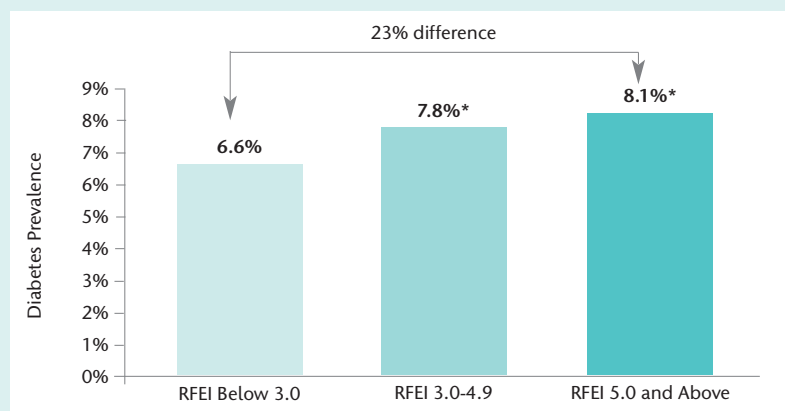


*Significantly different from "RFEI Below 3.0"; $p < 0.05$. RFEI was calculated using buffers of 0.5 mile for respondents in urban areas, 1 mile for respondents in smaller cities and suburban areas and 5 miles for respondents in rural areas. Obesity is defined as having a body mass index of 30.0 kg/m² or greater.

Source: 2005 California Health Interview Survey and 2005 InfoUSA Business File

FIGURE 2

Diabetes Prevalence by Retail Food Environment Index, Adults Age 18 and Over, California, 2005



*Significantly different from "RFEI Below 3.0"; $p < 0.05$. RFEI was calculated using buffers of 0.5 mile for respondents in urban areas, 1 mile for respondents in smaller cities and suburban areas and 5 miles for respondents in rural areas.

Source: 2005 California Health Interview Survey and 2005 InfoUSA Business File

FINDINGS

The average Retail Food Environment Index (RFEI) for California adults included in this study is 4.5, meaning that the average California adult has more than four times as many fast-food restaurants and convenience stores near home as they do grocery stores and produce vendors.³⁹ For 25 percent of California adults the RFEI is 5.0 and above; for 21 percent, it is between 3.0 and 4.9; and for 26 percent it is below 3.0. An additional 28 percent of California adults have no grocery stores or produce vendors within the buffer around their homes. The RFEI cannot be calculated for these individuals; therefore they were not included in the analyses for this study.

Higher RFEIs Are Associated with Higher Prevalence of Obesity and Diabetes

Obesity

Obesity prevalence is highest for California adults who have the most fast-food restaurants and convenience stores near their homes relative to grocery stores and produce vendors. Nearly one in four adults with local RFEIs of 5.0 and above is obese, compared to one in five adults with local RFEIs below 3.0, representing a 20 percent difference between the lowest and highest RFEI groups presented here (Figure 1).

Diabetes

Similarly, California adults with the most fast-food restaurants and convenience stores near their homes relative to grocery stores and produce vendors have the highest prevalence of diabetes. Approximately 8 percent of adults with local RFEIs of 5.0 and above have been diagnosed with diabetes, compared to 6.6 percent of those with RFEIs below 3.0, representing a 23 percent difference between the lowest and highest RFEI groups presented here (Figure 2).

Residents of Lower-Income Neighborhoods Have Higher Local RFEIs

The RFEI is related to community income. Statewide, the average RFEI is 20 percent higher for people living in lower-income communities (average RFEI of 4.9) compared to those in higher-income areas (average RFEI of 4.1) (Figure 3).

Obesity and Diabetes Prevalence Are Highest for Adults with Higher Local RFEIs Who Live in Lower-Income Communities

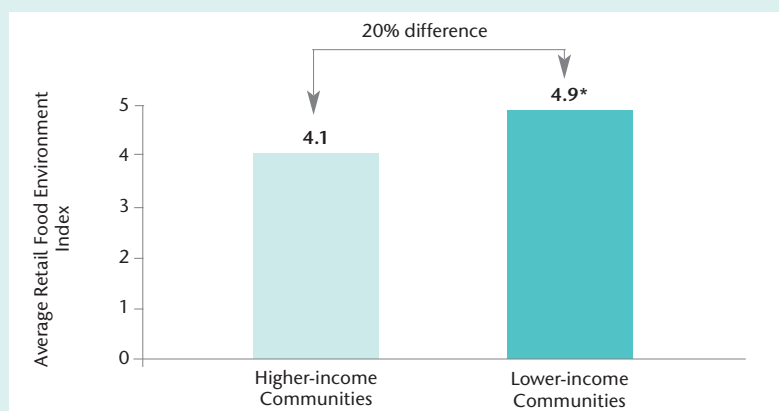
As with having higher local RFEIs, living in lower-income communities is associated with higher rates of obesity and diabetes.⁴⁰ However, obesity and diabetes prevalence are highest among adults who live in lower-income communities and who *also* have local RFEIs of 5.0 or greater.

Obesity

In lower-income communities, obesity prevalence is 17 percent higher among adults whose local RFEI is 5.0 or greater compared to those whose local RFEI is below 3.0 (28 percent vs. 24 percent) (Figure 4). Similarly, in higher-income communities, obesity prevalence is 19 percent higher among adults whose local RFEI is 5.0 or greater compared to those whose local RFEI is below 3.0 (19 percent vs. 16 percent). Although the relationship between RFEI and obesity is consistent in lower-income and higher-income communities, obesity prevalence is highest for those who live in lower-income communities *and* have RFEIs of 5.0 or greater (28 percent).

FIGURE 3

Average Retail Food Environment Index by Community Income, Adults Age 18 and Over, California, 2005

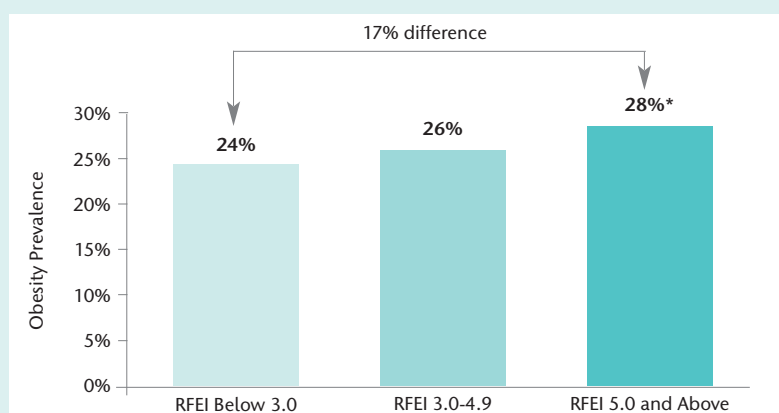


* Significantly different from "Higher-Income Communities"; $p < 0.05$. RFEI was calculated using buffers of 0.5 mile for respondents in urban areas, 1 mile for respondents in smaller cities and suburban areas and 5 miles for respondents in rural areas. Survey respondents were characterized as living in lower-income communities if more than 30% of households in their census tract had incomes below 200% of the federal poverty level.

Source: 2005 California Health Interview Survey, 2000 Census, and 2005 InfoUSA Business File

FIGURE 4

Obesity Prevalence by Retail Food Environment Index, Adults Age 18 and Over Living in Lower-Income Communities, California, 2005

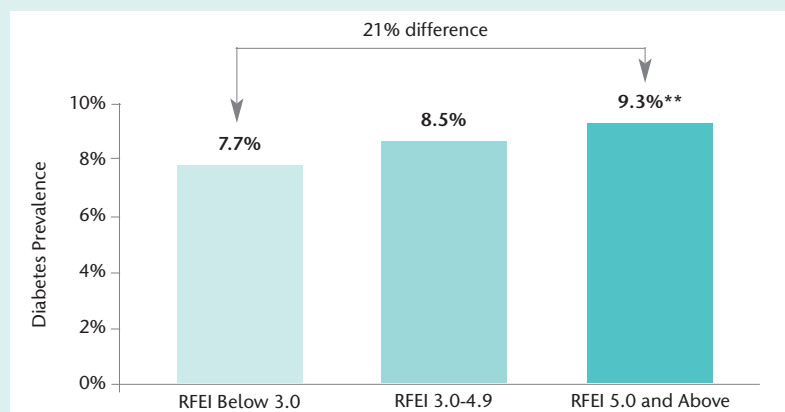


* Significantly different from "RFEI Below 3.0"; $p < 0.05$. RFEI was calculated using buffers of 0.5 mile for respondents in urban areas, 1 mile for respondents in smaller cities and suburban areas and 5 miles for respondents in rural areas. Obesity is defined as having a body mass index of 30.0 kg/m² or greater. Survey respondents were characterized as living in lower-income communities if more than 30% of households in their census tract had incomes below 200% of the federal poverty level.

Source: 2005 California Health Interview Survey, 2000 Census, and 2005 InfoUSA Business File

FIGURE 5

Diabetes Prevalence by Retail Food Environment Index, Adults Age 18 and Over Living in Lower-Income Communities, California, 2005



** Significantly different from “RFEI Below 3.0”; $p < 0.10$. RFEI was calculated using buffers of 0.5 mile for respondents in urban areas, 1 mile for respondents in smaller cities and suburban areas and 5 miles for respondents in rural areas. Survey respondents were characterized as living in lower-income communities if more than 30% of households in their census tract had incomes below 200% of the federal poverty level.

Source: 2005 California Health Interview Survey, 2000 Census, and 2005 InfoUSA Business File

Even after accounting for individual characteristics and community income, adults with a higher Retail Food Environment Index (RFEI) are more likely to be obese and to have diabetes than those with lower local RFEIs.

Diabetes

As with obesity, higher local RFEIs are associated with higher diabetes prevalence in both higher-income and lower-income communities; however, diabetes prevalence is highest among adults who live in lower-income communities and also have the highest RFEIs.

In lower-income communities, diabetes prevalence is 21 percent higher among adults with a local RFEI of 5.0 and above compared to those with a local RFEI below 3.0 (9.3 percent vs. 7.7 percent; $p < 0.10$) (Figure 5). Similarly, in higher-income communities, diabetes prevalence is higher among individuals with RFEIs above 5.0 compared to those with RFEIs below 3.0 (6.8 percent vs. 5.8 percent), although this difference is not statistically significant.

Again, although the association between RFEI and diabetes is consistent for Californians living in lower-income and higher-income communities, diabetes prevalence is highest among those who live in lower-income communities and have RFEIs of 5.0 or greater (9.3 percent).

The Association Between RFEI and Health Outcomes Remains Even After Controlling for Individual Characteristics and Community Income

People of color and lower-income individuals have higher local RFEIs. A greater proportion of African Americans (30 percent), Latinos (29 percent), and people of mixed race/ethnicity (31 percent) have RFEIs of 5.0 or greater compared to Caucasians (23 percent). In addition, a greater proportion (30 percent) of adults from lower-income households have RFEIs of 5.0 or greater compared with those from higher-income households (23 percent). However, the Retail Food Environment Index remains associated with both obesity and diabetes after accounting for these individual characteristics (race/ethnicity and household income) as well as for age, gender, physical activity, and community income. After controlling for these factors, adults with local RFEIs of 5.0 and above are 18 percent more likely to be obese and 24 percent more likely to have been diagnosed with diabetes than adults with local RFEIs below 3.0.

CONCLUSIONS

This study demonstrates a link between the retail food environment and the prevalence of obesity and diabetes in California adults. Even after accounting for individual characteristics and community income, adults with a higher Retail Food Environment Index (RFEI)—that is, with greater availability of fast-food restaurants and convenience stores relative to grocery stores and produce vendors near their homes—are more likely to be obese and to have diabetes than those with lower local RFEIs.

The highest prevalence of both obesity and diabetes is among adults who have higher local RFEIs and live in lower-income communities. However, for people living in lower-income and higher-income communities alike, the higher the ratio of fast-food restaurants and convenience stores to grocery stores and produce vendors near home, the greater the prevalence of obesity and diabetes.

These findings suggest that improving the retail food environment—in both lower- and higher-income California communities—may be a promising strategy for decreasing the prevalence of obesity and diabetes in California adults.

POLICY RECOMMENDATIONS

To date, many efforts to reduce obesity and diabetes have focused on encouraging individuals to change their eating habits. However, given the association shown in this study between the retail food environment and health outcomes, additional measures should be aimed at improving the retail food environment to support individuals in making such changes.

Although healthy eating habits are ultimately a matter of individual choice, local food environments influence those choices. It is difficult to follow recommended dietary guidelines in a food environment characterized by an abundance of fast-food restaurants and few grocery stores—a situation faced by many Californians, particularly those in lower-income communities. Reversing obesity and diabetes trends in California requires a range of interventions, including a systematic approach to improving local food environments.

Environmental and policy interventions can improve conditions for large numbers of people. Directing resources toward communities most in need, such as lower-income communities, can maximize the impact of such interventions.

Food environments can be made healthier by increasing the availability of grocery stores and produce vendors relative to fast-food restaurants and convenience stores, by improving the availability of healthy foods relative to unhealthy foods in existing retail outlets, and by increasing consumer awareness of the nutritional content of restaurant food. Based on the findings presented in this brief, insights gained from the national Scientific Advisory Panel convened for this study, and existing policy initiatives in other parts of the country,⁴¹ policymakers are urged to consider the following strategies for improving local food environments:

- **Increase access to healthy foods by providing incentives for retail store development and improvement.** Because grocery chains have historically been less likely to locate in lower-income communities and communities of color,⁴² new policies and market-based incentives are needed to reverse these trends. New funding could be used to stimulate development of retail projects by offering technical assistance and financing options, such as

low-interest loans or seed grants for the purchase of refrigeration equipment and other supplies necessary to store and preserve fresh fruits and vegetables.

- **Promote retail innovations, including smaller-scale markets selling healthy foods.** Attention should be given to smaller-scale community innovations, such as mobile vendors, vending machines, farmers' markets, co-operatives, community-supported agriculture, and improved transportation to existing retailers. For example, farmers' markets and mobile vendors typically need less time to transition from vision to operation and can produce added benefits by supporting local farmers.
- **Maximize the opportunities presented by the changes in the WIC food package.** The inclusion of fresh fruits and vegetables, whole grains, and low-fat dairy products in the updated WIC food package is expected to increase demand for these healthy foods. Policymakers should adopt measures to ensure that the expanded food package is accessible in lower-income communities by building the capacities of existing WIC-authorized stores, expanding the number of authorized WIC vendors, and facilitating grocery store expansion.
- **Implement zoning designed to limit fast-food restaurants in overburdened communities.** The health implications of fast-food restaurants should be considered in the community planning and development permitting process. Local governments should strive to achieve a balance of retailers that supports community health.
- **Require menu labeling.** Restaurants should be required to provide consumers with nutritional information on in-store menus and menu boards for all standard menu items. Given the proliferation of fast-food restaurants and the high fat and calorie content of many items on their menus, prominent posting of the nutrient content of items for sale can help consumers make healthier choices.

Although healthy eating habits are ultimately a matter of individual choice, local food environments influence those choices.

REFERENCES AND NOTES

1. *Healthy food, healthy communities: Improving access and opportunities through food retailing*. PolicyLink; 2005.
2. *Searching for healthy food: The food landscape in California cities and counties*. California Center for Public Health Advocacy; 2007.
3. Must A, Spadano J, Coakley EH, Field AE, Colditz G, Dietz WH. The disease burden associated with overweight and obesity. *JAMA*. Oct 27 1999;282(16):1523-1529.
4. Mokdad AH, Serdula MK, Dietz WH, Bowman BA, Marks JS, Koplan JP. The spread of the obesity epidemic in the United States, 1991-1998. *JAMA*. Oct 27 1999;282(16):1519-1522.
5. Overweight, obesity, and health risk. National Task Force on the Prevention and Treatment of Obesity. *Arch Intern Med*. Apr 10 2000;160(7):898-904.
6. Sutocky J. *Obesity-related morbidity and mortality: California, 2000-2002*. California Department of Health Services Center for Health Statistics, Office of Health Information and Research; 2005.
7. *The economic costs of physical inactivity, obesity, and overweight in California adults: Health care, workers' compensation and lost productivity*. California Department of Health Services and Public Health Institute; 2005.
8. Olshansky SJ, Passaro DJ, Hershow RC, et al. A potential decline in life expectancy in the United States in the 21st century. *N Engl J Med*. Mar 17 2005;352(11):1138-1145.
9. *National diabetes fact sheet: General information and national estimates on diabetes in the United States, 2005*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2005.
10. *National diabetes fact sheet: General information and national estimates on diabetes in the United States, 2005*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2005.
11. *Fast facts on diabetes*. California Department of Health Services; August 2003.
12. *Healthy People 2010: Understanding and improving health*. U.S. Department of Health and Human Services; 2002.
13. Deitel M. The Surgeon-General's call to action to prevent an increase in overweight and obesity. *Obes Surg*. Feb 2002;12(1):3-4.
14. Haan M, Kaplan GA, Camacho T. Poverty and health. Prospective evidence from the Alameda County study. *Am J Epidemiol*. Jun 1987;125(6):989-998.
15. Black JL, Macinko J. Neighborhoods and obesity. *Nutr Rev*. Jan 2008;66(1):2-20.
16. Haan M, Kaplan GA, Camacho T. Poverty and health. Prospective evidence from the Alameda County study. *Am J Epidemiol*. Jun 1987;125(6):989-998.
17. Wrigley N, Warm D, Margetts B. Deprivation, diet and food-retail access: Findings from the Leeds 'food deserts' study. *Environ Plan A*. 2003;35(1):151-188.
18. *Healthy food, healthy communities: Improving access and opportunities through food retailing*. PolicyLink; 2005.
19. Morland K, Wing S, Diez Roux A. The contextual effect of the local food environment on residents' diets: The atherosclerosis risk in communities study. *Am J Public Health*. Nov 2002;92(11):1761-1767.
20. Auchincloss AH, Diez Roux AV, Brown DG, Erdmann CA, Bertoni AG. Neighborhood resources for physical activity and healthy foods and their association with insulin resistance. *Epidemiology*. Jan 2008;19(1):146-157.
21. Morland K, Diez Roux AV, Wing S. Supermarkets, other food stores, and obesity: The atherosclerosis risk in communities study. *Am J Prev Med*. Apr 2006;30(4):333-339.
22. Satia JA, Galanko JA, Siega-Riz AM. Eating at fast-food restaurants is associated with dietary intake, demographic, psychosocial and behavioral factors among African Americans in North Carolina. *Public Health Nutr*. Dec 2004;7(8):1089-1096.
23. Taveras EM, Berkey CS, Rifas-Shiman SL, et al. Association of consumption of fried food away from home with body mass index and diet quality in older children and adolescents. *Pediatrics*. Oct 2005;116(4):e518-524.
24. Taveras EM, Berkey CS, Rifas-Shiman SL, et al. Association of consumption of fried food away from home with body mass index and diet quality in older children and adolescents. *Pediatrics*. Oct 2005;116(4):e518-524.
25. Jeffery RW, Baxter J, McGuire M, Linde J. Are fast food restaurants an environmental risk factor for obesity? *Int J Behav Nutr Phys Act*. 2006;3:2.
26. Morland K, Diez Roux AV, Wing S. Supermarkets, other food stores, and obesity: The atherosclerosis risk in communities study. *Am J Prev Med*. Apr 2006;30(4):333-339.
27. Zenk SN, Schulz AJ, Israel BJ, James SA, Bao S, Wilson ML. Neighborhood racial composition, neighborhood poverty, and the spatial accessibility of supermarkets in metropolitan Detroit. *Am J Public Health*. Apr 2005;95(4):660-667.
28. Block JP, Scribner RA, DeSalvo KB. Fast food, race/ethnicity, and income: A geographic analysis. *Am J Prev Med*. Oct 2004;27(3):211-217.
29. Shaffer A. *The persistence of L.A.'s grocery gap: The need for a new food policy and approach to market development*. Center for Food and Justice, Urban and Environmental Policy Institute, Occidental College; 2002.
30. Morland K, Wing S, Diez Roux A, Poole C. Neighborhood characteristics associated with the location of food stores and food service places. *Am J Prev Med*. Jan 2002;22(1):23-29.
31. Helling A. Race and residential accessibility to shopping and services. *Housing Policy Debate*. 2003;14(1-2):69-102.
32. *Examining the impact of food deserts on public health in Detroit*. Mari Gallagher Research & Consulting Group; 2007.
33. *Examining the impact of food deserts on public health in Chicago*. Mari Gallagher Research & Consulting Group; 2006.
34. Liu GC, Wilson JS, Qi R, Ying J. Green neighborhoods, food retail and childhood overweight: Differences by population density. *Am J Health Promot*. Mar-Apr 2007;21(4 Suppl):317-325.

35. Fast-food restaurants were defined following the National Restaurant Association's distinction between "table service" and "quick service (fast-food)" restaurants. In addition to counter service, fast-food restaurants are characterized by meal service (vs. snacks, dessert, coffee) and lower price (less than \$7/meal). We began with businesses with a North American Industry Classification System (NAICS) code for restaurants (72211002, 72211011, 72211012, 72211013, 72211016, 72211020, 72221101, 72221103, 72221104, and 72221105). From these businesses, we selected restaurants with five or more locations with the same name and that provided counter-service meals. Major fast-food chains were included (e.g., McDonald's, Taco Bell, Carl's Jr.), as were smaller, regional, or locally owned chains. Convenience stores were defined as businesses with NAICS code 44512001 that do not sell gasoline or other fuel. This list includes primarily 7-Elevens and other chains. In order to include smaller chains and family-owned convenience stores, we included businesses with NAICS codes for supermarkets and grocery stores (44511001, 44511002, 44511003, 44511004, and 44511005) that had two or fewer employees. Supermarkets and grocery stores (referred to collectively as grocery stores in this study) were identified based on a modification of the Food Marketing Institute (FMI) definition of a supermarket. FMI defines supermarkets and grocery stores as businesses that earn annual revenues of \$2 million or more each year; however, in this study, we defined supermarkets and grocery stores as those that earn annual revenues of \$1 million. We made this modification to include smaller markets that sometimes play an important role in urban communities. Members of a chain (either a national chain, such as Safeway, Albertsons, Trader Joe's, or a regional chain, such as La Superior, Nugget, Henry's, and Ranch 99) or stores with the word "supermarket" in the business name were included. NAICS codes included 44511001, 44511002, 44511003, 44511004, and 44511005. Produce vendors were defined as produce stores and farmers' markets. Produce stores included all businesses with NAICS codes 44523001 and 44523003. Farmers' markets included all certified farmers' markets listed on the website of the California Federation of Certified Farmers' Markets (www.cafarmersmarkets.com). We adjusted the number of farmers' markets to include only markets in unique places. For example, the Davis Farmers' Market is held both Wednesdays and Saturdays; we included only a single location record for this market. This information was then geocoded in ArcGIS 9. Actual physical locations (which were provided in downloadable files from the website) were used instead of mailing addresses.
36. Claritas, a marketing information resources company, assigns ZIP codes to urbanization categories based on the analysis of population density grids of 1990 geoboundaries, 2000 redistricting updates, and 2001 population estimates. The following four classes were identified: 1) Urban areas have population density scores mostly between 85 and 99. They include both the downtowns of major cities and surrounding neighborhoods. Households within this classification live within the classic high-density neighborhoods found in the heart of America's largest cities. While almost always anchored by the downtown central business district, these areas often extend beyond city limits and into surrounding jurisdictions to encompass most of America's earliest suburban expansions. 2) Smaller cities are less densely populated than urban areas, with population density scores typically between 40 and 85, and are the population centers of their surrounding communities. This category also includes thousands of satellite cities—higher-density suburbs encircling major metropolitan centers. 3) Suburbs have population density scores between 40 and 90. Unlike smaller cities, they are not the population center of their surrounding community, but rather a continuation of the density decline moving out from the city center. 4) Rural areas, collapsed into a single urbanization category, have population density scores under 40. This category includes exurbs, towns, farming communities, and other sparsely populated portions of the state.
37. Bishaw A, Iceland J. *Poverty: 1999*. U.S. Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau; 2003.
38. Analysts have used cutoffs of 20, 30, and 40 percent to determine whether or not a given neighborhood is low-income. See Jargowsky PA. *Stunning progress, hidden problems: The dramatic decline of concentrated poverty in the 1990s*. The Brookings Institution Center on Urban and Metropolitan Policy, 2003; Kingsley GT, Pettit KLS. *Concentrated poverty: A change in course*. Urban Institute, 2003; and Bishaw A. *Areas with concentrated poverty: 1999*. U.S. Census Bureau, 2005.
39. In its 2007 study, CCPHA reported a statewide RFEI of 4.18, calculated by dividing the total number of fast-food restaurants and convenience stores in California by the total number of grocery stores and produce vendors in California. In the current study, the average RFEI of 4.48 was calculated by taking an average of all RFEIs for CHIS respondents for whom an RFEI could be calculated, based on the number of fast-food restaurants, convenience stores, grocery stores, and produce vendors within the appropriate buffer around their home addresses.
40. Obesity prevalence is 25 percent among adults living in lower-income communities compared to 18 percent among adults in higher-income communities. Diabetes prevalence is 8.4 percent among adults living in lower-income communities compared to 5.8 percent among adults in higher-income communities. Source: 2005 California Health Interview Survey and 2000 Census.
41. Examples include menu labeling legislation passed in New York City and under consideration in a number of additional cities and states nationwide, and The Food Trust's Supermarket Campaign, which seeks to improve access to supermarkets in underserved communities through leveraging economic development resources, active public/private partnerships, research, and policy advocacy to address the negative impacts related to the lack of food retail choices in communities across the country. More information about the Supermarket Campaign can be found at www.thefoodtrust.org/php/programs/super.market.campaign.php. Retrieved March 27, 2008.
42. *Healthy food, healthy communities: Improving access and opportunities through food retailing*. PolicyLink; 2005.

Suggested Citation

Designed for Disease: The Link Between Local Food Environments and Obesity and Diabetes. California Center for Public Health Advocacy, PolicyLink, and the UCLA Center for Health Policy Research. April 2008.

COLLABORATING ORGANIZATIONS AND AUTHORS

The following individuals (listed alphabetically by affiliation) contributed to the conceptualization, development, and writing of this brief:

California Center for Public Health Advocacy

www.publichealthadvocacy.org

Harold Goldstein, DrPH, Executive Director
Stefan Harvey, Assistant Director

PolicyLink

www.policylink.org

Rajni Banthia, PhD, Program Associate
Rebecca Flournoy, MPH, Associate Director
Victor Rubin, PhD, Vice President of Research
Sarah Treuhart, MCP, Senior Associate

UCLA Center for Health Policy Research

www.healthpolicy.ucla.edu

Susan H. Babey, PhD, Senior Research Scientist
Allison L. Diamant, MD, MSHS, Associate Professor, Division of General Internal Medicine, David Geffen School of Medicine at UCLA
Theresa A. Hastert, MPP, Senior Research Associate

California Center for Public Health Advocacy is an independent, nonpartisan, non-profit organization that raises awareness about public health issues and mobilizes communities to promote the establishment of effective health policies.

PolicyLink is a national research and action institute advancing economic and social equity. The PolicyLink Center for Health and Place conducts research, builds the capacity of local leaders, and develops policy alternatives to eliminate disparities and promote healthy communities.

UCLA Center for Health Policy Research serves to improve the public's health by advancing health policy through research, public service, community partnership, and education. Established in 1994, the UCLA Center for Health Policy Research is based in the School of Public Health and affiliated with the School of Public Affairs.

SCIENTIFIC ADVISORY PANEL

The Scientific Advisory Panel (listed alphabetically) included: Hannah Burton Laurison, MA, Public Health Law and Policy; Diana Cassady, DrPH, University of California, Davis; Catherine Cubbin, PhD, University of California, San Francisco and University of Texas, Austin; Ana Diez Roux, MD, PhD, MPH, University of Michigan, Ann Arbor; Calvin Freeman, MA,

Calvin Freeman and Associates; Susan Handy, PhD, University of California, Davis; Shiriki Kumanyika, PhD, MPH, University of Pennsylvania School of Medicine; Gilbert Liu, MD, Indiana University School of Medicine; Kevin Rafter, PhD, James Irvine Foundation; and John Talmage, Social Compact. Affiliations are listed for identification only.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the following individuals: Diana Cassady, DrPH and Susan Handy, PhD of the University of California, Davis for refinement of the 2005 InfoUSA Business File and general consultation; Nancy Adess for editing; Linda Herman of Glyph Publishing Arts for graphic design. Winnie Huang, MS; Brandon Traudt, MS; and Hongjian Yu, PhD of the UCLA Center for Health Policy Research for statistical and GIS support and guidance; and E. Richard Brown, PhD, Director of the UCLA Center for Health Policy Research and Principal Investigator

of the California Health Interview Survey for guidance and helpful comments.

Development of this policy brief was a joint project of the California Center for Public Health Advocacy (with funding from the California Vitamin Cases Consumer Settlement Fund), the UCLA Center for Health Policy Research (with funding from The California Endowment), and PolicyLink (with support from the California Center for Public Health Advocacy's California Vitamin Cases Consumer Settlement Fund funding).

Copyright © 2008 by the Regents of the University of California, PolicyLink, and the California Center for Public Health Advocacy.

The views expressed in this policy brief are those of the authors and do not necessarily represent the UCLA Center for Health Policy Research, the Regents of the University of California, members of the Scientific Advisory Panel or their institutions, or the funders of this study.

Printed on recycled paper with 100% post-consumer waste content using soy-based inks.