

Physical Activity and Food Environments: Solutions to the Obesity Epidemic

JAMES F. SALLIS and KAREN GLANZ

San Diego State University; Emory University

Context: Environmental, policy, and societal changes are important contributors to the rapid rise in obesity over the past few decades, and there has been substantial progress toward identifying environmental and policy factors related to eating and physical activity that can point toward solutions. This article is a status report on research on physical activity and food environments, and it suggests how these findings can be used to improve diet and physical activity and to control or reduce obesity.

Methods: This article summarizes and synthesizes recent reviews and provides examples of representative studies. It also describes ongoing innovative interventions and policy change efforts that were identified through conference presentations, media coverage, and websites.

Findings: Numerous cross-sectional studies have consistently demonstrated that some attributes of built and food environments are associated with physical activity, healthful eating, and obesity. Residents of walkable neighborhoods who have good access to recreation facilities are more likely to be physically active and less likely to be overweight or obese. Residents of communities with ready access to healthy foods also tend to have more healthful diets. Disparities in environments and policies that disadvantage low-income communities and racial minorities have been documented as well. Evidence from multilevel studies, prospective research, and quasi-experimental evaluations of environmental changes are just beginning to emerge.

Conclusions: Environment, policy, and multilevel strategies for improving diet, physical activity, and obesity control are recommended based on a rapidly

Address correspondence to: James F. Sallis, Active Living Research, 3900 Fifth Avenue, Suite 310, San Diego, CA 92103 (email: sallis@mail.sdsu.edu).

The Milbank Quarterly, Vol. 87, No. 1, 2009 (pp. 123–154)

© 2009 Milbank Memorial Fund. Published by Wiley Periodicals Inc.

growing body of research and the collective wisdom of leading expert organizations. A public health imperative to identify and implement solutions to the obesity epidemic warrants the use of the most promising strategies while continuing to build the evidence base.

Keywords: Built environment, policy, nutrition, health behavior, ecological models.

Environmental Change as an Essential Part of the Solution to Obesity

EXPANDING PORTION SIZES, COMPUTER GAMES, HIGH-FRUCTOSE corn sweeteners, automobile-dependent community designs, food advertising everywhere, transportation investments to support only automobile travel, more and cheaper foods high in fat and sugar, school facilities off limits to the community, soft drinks in schools, Internet entertainment options, and ubiquitous fast food. Changes in these and other factors have been blamed for the obesity epidemic in the United States and across the world. Although it is unlikely that biologically based preferences for sweet and fat have changed, there now is a greater variety of these preferred foods; there are more places to get them; they are advertised more widely; and they are cheaper and come in larger sizes. Our ancestors probably obtained most of their physical activity during work, household chores, and transportation, but today these requirements for movement have been greatly reduced owing to automation and computers at work, labor-saving devices at home, and building and transportation practices that require driving for most trips. The consensus among public health experts is that changes in genes, biology, and psychology at the individual level cannot explain the rapid rise in obesity, so the explanation must lie in broader environmental, policy, and societal changes (Hill and Peters 1998; Koplan and Dietz 2000; Koplan, Liverman, and Kraak 2004; Kumanyika et al. 2000; WHO 2004).

Even though attempts to identify those environmental and policy changes responsible for the obesity epidemic have not produced any clear answers, there are, nonetheless, numerous changes that, by altering patterns of eating and physical activity, may have contributed to the epidemic (Jebb and Moore 1999; Popkin 2007; Sturm 2005). Although

it may not be possible to establish the exact degree to which various environments and policies contribute to the epidemic, substantial research progress has been made to identify environmental and policy factors that can point us toward solutions. This article is a status report on research on physical activity and food environments, and it suggests how these findings can be used to guide policy actions to control obesity.

Physical activity environments are places where people can be physically active. Of most interest are places that can be designed to support daily activities, such as parks, sidewalks, trails, schools, workplaces, playgrounds, child care settings, and private recreation facilities. Common settings for sedentary behavior include homes (filled with electronic entertainment and labor-saving devices), workplaces, sports venues (where the vast majority sits and watches others move around), schools, and roadways built to optimize travel by car. It thus is essential to consider "information environments" that directly or indirectly encourage unhealthy eating behaviors and sedentary habits through numerous media that usually do not encourage healthy behaviors. Sedentary behaviors are those that involve sitting or minimal energy expenditure. Television viewing, computer use, computer games, and driving/riding in cars are some of the largest contributors.

Several levels of the food environment have been identified. The community environment refers to the places where food can be obtained, like grocery stores, convenience stores, specialty stores, restaurants, and farmers' markets that are generally open to the public. Microenvironments accessible to limited groups include homes, workplace and school cafeterias, and churches. The consumer environment describes what a person is exposed to inside the food sources, especially in regard to the availability of different types of foods, promotions, and prices (Glanz et al. 2005).

Policies are the primary mechanism for making environmental changes and include formal and informal rules, laws, and regulations. Both government and industry policies control food environments. Policies pertaining to parks and recreation, education, transportation, and planning departments in governments at multiple levels have direct responsibility for physical activity environments. School and employer policies dictate the resources, incentives, and/or deterrents to healthy eating and active lifestyles in organizations where children and adults spend most of their days. Finally, at a very local level, family policies control food and physical activity environments in the home.

The thinking and research on eating, physical activity, sedentary behaviors, and obesity have been guided until recently by biological and psychological models and theories focusing on individuals, families, and small social groups such as friends and coworkers. The rapidity of the rise of the obesity epidemic and the discovery that most interventions to help individuals change their eating and physical activity behaviors have only weak and short-lived effects (Kumanyika et al. 2000; Marcus et al. 2000) reveal the limitations of the dominant individually focused models of behavior.

Ecological models are characterized by their specification of multiple levels of influence on behaviors, including individual (biological, psychological), social and cultural, organizational (schools, workplaces, health care), community (including physical activity and food environments), and policy levels. Although ecological models have been used for decades in public health and the behavioral sciences, their influence has been modest. More recently, improved measurement methods, advances in multilevel analyses, the development of models specific to each target behavior, and dedicated funding for environmental and policy research have enhanced the impact of ecological models (Sallis, Owen, and Fisher 2008).

A central lesson of ecological models is that because behavior is influenced at multiple levels, the most effective interventions also should operate at multiple levels. Diet and physical activity interventions that build knowledge, motivation, and behavior change skills in individuals without changing the environments in which they live are unlikely to be effective. Similarly, merely changing the physical activity or the food environment may not be sufficient for a substantial change in behavior. Based on ecological models we expect the most effective interventions to operate on multiple levels to create an environment that makes it easy to make the healthy choice (e.g., renovate the park, stock skim milk in stores), enhance social norms and social support (e.g., with a media campaign), educate and motivate individuals to take advantage of the opportunities for healthy behaviors, and use policy to reduce prices for healthy foods or to provide activity programs in parks. The benefits of including environmental and policy components in a comprehensive intervention are their ability to affect every person living in the environment or jurisdiction affected by that policy. Effects should last as long as the person is in the environment or the policy is in effect (Sallis, Owen, and Fisher 2008).

This article draws on reviews and recent studies to demonstrate the state of knowledge regarding environmental and policy correlates of eating and physical activity, especially equity of access to health-promoting environments. We then use this evidence to recommend environmental and policy changes that are likely to improve eating, physical activity, and obesity.

Lessons from Research on Physical Activity Environments

One principle of ecological models is that they need to be tailored to specific behaviors. Accordingly, environmental and policy influences are expected to have particularly behavior-specific effects (Sallis, Owen, and Fisher 2008). One recent ecological model proposes interventions for each of four domains of physical activity: occupation, recreation, transportation, and household (Sallis et al. 2006). The following section discusses research findings organized by domains of physical activity and specific settings. Because the number of research publications in this field has increased dramatically since 2000 (Sallis et al. 2009), we summarize recent review articles when available and provide examples of representative studies.

Environments to Support Active Recreation

People can find recreational physical activities in public parks and trails, on sidewalks or streets, at private facilities like health clubs, and in their homes. There is substantial evidence that people who live closer to a variety of recreation facilities are more physically active overall. Of the ten review articles that Bauman and Bull (2007) summarized, nine recognized the value to adults of proximity to recreation facilities. Davidson and Lawson (2006) reviewed the literature for children and concluded that living near parks, playgrounds, and recreation areas was consistently related to children's total physical activity. The research finding that people were more active in some areas of parks (e.g., basketball and racquet courts) than in other areas (e.g., baseball fields, picnic areas) (Floyd et al. 2008) can guide the design of recreation facilities.

The aesthetics of physical activity settings is consistently related to adult activity, with five of six reviews that covered aesthetics supporting

this conclusion (Bauman and Bull 2007). In addition, features like trees, attractive buildings, and water views may make recreational physical activity more pleasant. Sidewalks can be used for walking for both recreation and transport purposes, and nearly all the reviews concluded that the availability of sidewalks was positively associated with physical activity and walking (Bauman and Bull 2007) for adults and children (Sallis and Kerr 2006).

Environments to Support Active Transportation

Walking from place to place was surely a major source of physical activity in preindustrial times. Currently, in many European countries, 30 percent or more of trips are made by walking and cycling, a figure that shrinks to less than 10 percent in the United States (Pucher and Dijkstra 2003). To reduce air pollution and traffic congestion, transportation planners studied how the design of communities is related to choices of travel modes, and they consequently developed the concept of “walkability,” referring to people’s ability to walk (or cycle) to destinations. The key concepts are proximity of destinations to residences and street networks that create a relatively direct route. For thousands of years, towns and cities were built according to these principles, because most people walked to where they needed to go. But now, with the mass adoption of automobiles as the primary mode of transportation, land use and transportation practices have changed to ensure that most trips must be taken by car. Therefore, instead of the mixed-use zoning required for walkability, zoning has increasingly separated uses, and as a result, shopping areas and employment centers are far from where people live (Schilling and Linton 2005). And instead of streets built on a grid pattern providing direct routes, suburban subdivisions contain disconnected and winding streets, making trips by the street network much longer than straight-line distances. Likewise, roads are designed to facilitate high-speed travel by cars, often with little consideration of the needs of pedestrians or cyclists.

Dozens of studies show that adults who live in walkable neighborhoods walk and cycle more for transportation and are more physically active than are those who live in suburbs designed to be dependent on automobiles. In Bauman and Bull’s (2007) review of reviews, four of four reviews found that the walkability of a neighborhood or region was

positively related to physical activity, and the components of mixed use (five of six reviews), connectivity (three of three reviews), and residential density (six of six reviews) also were supported as physical activity correlates. A smaller number of recent studies showed similar associations of walkability and physical activity among youth, including active commuting to school, and among older adults (Sallis and Kerr 2006). As an example, Frank and colleagues (2005) used a walkability index based on Geographic Information Systems and measured physical activity objectively with accelerometers. They found that 37 percent of adults in the highest-walkability neighborhoods met the recommendation of physical activity for thirty minutes per day, compared with 18 percent of those in the lowest-walkability neighborhoods.

Based on a systematic review, an expert panel from the Transportation Research Board and Institute of Medicine (2005) concluded that built environment factors were indeed related to physical activity. The Centers for Disease Control and Prevention's (CDC) Task Force for Community Preventive Services determined that land-use changes are an evidence-based intervention for promoting physical activity (Heath et al. 2006).

Characteristics of transportation systems and practices have been linked with the physical activities of youths and adults. The findings for children and adolescents include parental concerns about traffic as a strong correlate of children's active transport to school (Kerr et al. 2006), and having to cross busy streets as a barrier to children's physical activity (Davidson and Lawson 2006). Among adults, people drive more when they live in low-walkable suburbs. Driving itself is an independent risk factor for obesity (Frank, Andresen, and Schmid 2004; Lopez-Zetina, Lee, and Friis 2006), whereas users of public transit are more likely to meet physical activity guidelines (Besser and Dannenberg 2005).

Physical Activity Environments and Obesity

According to a recent review by Papas and colleagues (2007), about twenty studies have examined associations between built environment attributes and indicators of weight status. Sixteen of those studies examined built environment variables related to recreation facilities or community design, and almost all of them found significant associations with obesity. For example, Frank and colleagues (2004) discovered that neighborhood walkability was related to the risk of obesity in adults

and that physical activity partially explained this association. In a national study of adolescents, Gordon-Larsen et al. (2006) demonstrated that the proximity of recreation facilities was correlated with the risk of overweight and obesity. Thus, a substantial database associates living in areas lacking recreation facilities and not supporting walking for transportation as a risk factor for obesity.

Designing Schools to Support Active Students. Because schools are central to children's lives, it is important to consider how they can be built to support physical activity. Several studies illustrate the connection. Schools with a richer activity environment, including basketball hoops and soccer goals, combined with adult supervision or equipment, had significantly more students who chose to be active after lunch or after school (Sallis et al. 2001). A controlled study in the United Kingdom found that simply marking elementary school playgrounds with designs that stimulated active games was associated with a 20 percent long-term improvement in physical activity (Ridgers et al. 2007). Although one study associated having large school grounds with physical activity (Cradock et al. 2007), there is concern that requirements for large school yards may force new schools to be placed on the periphery of communities, which ironically could prevent most students from walking or cycling there.

Designing Buildings to Support Physical Activity. Although people spend most of their lives in buildings, there is surprisingly little study of building design and physical activity (Zimring et al. 2005). Numerous studies have found that signs promoting stair use (i.e., an intervention in the information environment) had modest effects at low cost (Kahn et al. 2002). A few studies have shown that the attractiveness of stairs (Kerr et al. 2004) and more convenient access to stairs than to elevators (Nicoll 2007) were associated with greater stair use. However, *where* buildings are built may affect physical activity more than how they are designed. As described earlier, separate-use zoning forces most workers to drive to their workplaces because they are too far from their homes to walk or cycle.

Disparities in Access to Activity-Friendly Environments. Because of the dramatic disparities among race, ethnicity, and socioeconomic status in regard to obesity (Ogden et al. 2006), it is important to consider to what extent disparities in access to activity-friendly environments might explain these findings. Substantial evidence shows that access to parks and other recreation facilities is lower in low-income,

low-education, and minority communities, at least in the United States. Two national studies documented this trend (Gordon-Larsen et al. 2006; Powell et al. 2006), with one study finding less access to every category of recreation facility in low-education communities (Gordon-Larsen et al. 2006). A study in Austin, Texas, showed that low-income, majority Latino neighborhoods were more walkable than high-income, mostly non-Hispanic white neighborhoods in the suburbs. The low-income Latino neighborhoods, however, had poorer safety ratings, maintenance, and aesthetics that could interfere with residents' ability to benefit from the walkable design (Zhu and Lee 2008). MacIntyre (2007) concluded that not all studies found disparities in access to parks and other physical activity environments. Although quality of activity facilities may be more important than presence, it has seldom been studied.

A disturbing early finding was that walkability was related to physical activity (Frank et al. 2005) and obesity (Frank, Andresen, and Schmid 2004) among non-Hispanic whites, but not among African Americans. Perhaps the less favorable safety and aesthetic features of the African American neighborhoods could explain the lack of walkability effects, as suggested by Zhu and Lee's (2008) results, but further studies are needed. A contrasting result is that access to nearby recreational facilities was strongly related to physical activity among African Americans and Latinos, but not among non-Hispanic whites (Diez Roux et al. 2007). Currently there are more questions than answers about the role of physical activity environments in explaining racial, ethnic, and socioeconomic disparities in physical activity and obesity.

Evaluating Environmental Changes to Promote Physical Activity

Most of the studies of physical activity environments have been cross-sectional, leading to criticism about whether apparent effects of environments can be explained by active people tending to choose activity-friendly communities (Handy, Cao, and Mokhtarian 2006). Because it is not feasible to randomly assign people to neighborhoods, other study designs must be used to determine whether the environment is a true cause of behavior. A study of people who changed their residence found that activity levels tended to increase among those who moved to more walkable neighborhoods and that activity decreased among those

who moved to less walkable areas (Handy, Cao, and Mokhtarian 2008). A study of low-income women who moved partially supported a conclusion that changing environments can stimulate expected changes in physical activity (Wells and Yang 2008), even though a study of adolescents showed that moving was not related to changes in weight status (Ewing, Brownson, and Berrigan 2006).

A more powerful approach is to use quasi-experimental designs, often called “natural experiments,” to evaluate environmental changes as opportunities arise. A review of United Kingdom studies found that opening new sections of cycling trails led to long-term increases in cycling, especially when they were located in highly populated areas (NICE Public Health Collaborating Centre 2006). Evaluations of new trails in the United States have had mixed effects, with some finding increased physical activity (Gordon, Zizzi, and Pauline 2004) and others finding no impact (Evenson, Herring, and Huston 2005). These studies indicate that environmental modifications can change physical activity, but it is not clear which environmental changes are most effective.

Limitations of Available Research

The cross-sectional design of most physical activity environment studies is often cited as their major methodological limitation (Transportation Research Board and Institute of Medicine 2005), so recent prospective and quasi-experimental evaluations of environmental changes are regarded as important advances. These more rigorous designs should also be applied to other environmental attributes and to more diverse populations, including subgroups at high risk of obesity. Other areas for future research are examining more detailed environmental measures and establishing dose-response relationships so the results can be more directly applied by designers and policymakers. Although sedentary behaviors are risk factors for obesity, few studies have examined the environmental correlates of these behaviors.

Because studies use a diversity of environment and physical activity measures, it is difficult to compare findings across studies. Nonetheless, high-quality objective measures of both environments and physical activity, as well as validated self-report measures, do exist, and the environmental measures are available at www.activelivingresearch.org (accessed December 4, 2008). The challenge is for investigators to use a common core of measures routinely so that key findings can be

replicated in various populations and can facilitate meta-analyses and pooled analyses.

It is difficult to generalize built environment findings across populations or across behaviors. Most studies have been conducted with adults, and analyses stratified by race, ethnicity, or socioeconomic status are rare. It thus is a high priority to improve our understanding of environmental correlates of physical activity and sedentary behaviors in diverse samples, especially those at high risk for obesity.

Summary of Physical Activity Environment Studies

Living in walkable communities and having parks and other recreation facilities nearby has been consistently associated with higher levels of physical activity in youth, adults, and older adults. Several studies of adults link walkable communities and park access to a lower risk of overweight and obesity. At least in the United States, however, low-income populations and communities of color have less access to public and private recreation facilities. But a few studies go beyond cross-sectional designs and indicate that behavior may change when individuals move to new neighborhoods and that building trails can stimulate more people to be physically active. Traffic appears to be a barrier to physical activity, and school environments have been related to students' physical activity on campus. Many public health professionals, therefore, consider the evidence sufficient to recommend changes in urban planning, transportation, recreation, and school policies.

Lessons from Research on Food and Nutrition Environments

Several conceptual models of food and nutrition environments have been proposed (Booth et al. 2001; Story et al. 2008). One useful—and parsimonious—ecological model for understanding food and nutrition environments incorporated constructs from the fields of public health, health psychology, consumer psychology, and urban planning (Glanz et al. 2005). The model identified four types of nutrition environments (community, consumer, organizational, and information) that need to

be understood, and those environments can be affected by policies of governments and other organizations (Glanz et al. 2005).

This synthesis of knowledge related to food environments—as is the preceding section on physical activity environments—is based, whenever possible, on review articles published between 1988 and 2008. Of the twenty-one review articles, twelve focused on environmental correlates of eating and/or obesity, and nine on environmental intervention strategies. Examples of representative studies and policy reports also are provided.

Community Food Environments

The community food environment is defined as the distribution of food sources, that is, the number, type, location, and accessibility of food outlets, with stores and restaurants being the most common (Glanz et al. 2005). Many studies have cited both stores and restaurants as either indicating access to healthful food choices or reflecting high concentrations of often inexpensive foods of low nutritional value.

Food Stores. The presence of food stores appears to contribute to the eating patterns of neighborhood residents (Ford and Dzewaltowski 2008; Glanz and Yaroch 2004), and racial and ethnic disparities in access to full-service supermarkets frequently have been documented (Morland et al. 2002; Zenk, Schulz, Hollis-Neely, et al. 2005; Zenk, Schulz, Israel, et al. 2005). One study found that African Americans' intake of fruits and vegetables was significantly higher when they lived close to a supermarket (Morland, Wing, and Diez Roux 2002). Accordingly, the availability of supermarkets in neighborhoods was associated with a better-quality diet (Moore et al. 2008) and a lower prevalence of obesity and overweight in adults (Morland, Diez Roux, and Wing 2006) and adolescents (Powell et al. 2007). Although those lower-income, minority urban neighborhoods and rural areas lacking supermarkets are sometimes referred to as "food deserts" (Morton and Blanchard 2007), some studies have found no disparities in access to food stores (Apparicio, Cloutier, and Shearmur 2007; MacIntyre 2007; Pearson et al. 2005).

Restaurants. The proportion of meals eaten outside the home has increased in the United States (Kant and Graubard 2004). This greater reliance on restaurants could have negative nutritional and health consequences because individuals eating at restaurants more frequently consume, on average, more calories and fat and fewer fruits, vegetables, and fiber (French et al. 2001; Satia, Galanko, and Siega-Riz 2004; Schmidt

et al. 2005) and consequently gain more weight (Pereira et al. 2005; Thompson et al. 2004).

Fast-food restaurants in particular have been identified as a potential contributor to a higher prevalence of obesity (Brownell 2004). The higher concentration of fast-food restaurants in poorer neighborhoods (Cummins and Macintyre 2002; Powell, Chaloupka, and Bao 2007) thus is thought to partially explain the higher prevalence of obesity among economically disadvantaged populations. One analysis found that the density of fast-food restaurants accounted for 6 percent of the variance in obesity across the United States (Maddock 2004). However, evidence regarding the relationship between individuals' weight status and the density of restaurants in their neighborhood is weak and has not been supported in large studies of children and adults in both rural and urban areas (Burdette and Whitaker 2004; Simmons et al. 2005; Sturm and Datar 2005). One review concluded that the results across studies were mixed on the question of fast-food density, noting methodological limitations (Papas et al. 2007).

Policy and Environmental Interventions Related to Community Food Environments

Almost all community food environment studies have been cross-sectional, but efforts are being made to change food environments that could be evaluated as natural experiments. Although bringing new supermarkets into disadvantaged areas is not strongly supported by the available research (Cummins and Macintyre 2002; Papas et al. 2007), a moratorium on opening new fast-food restaurants in one poor area in urban Los Angeles has been proposed (Hoag 2008). As these sorts of environmental changes gather momentum, it will be important to evaluate their effects on food-purchasing patterns, eating behaviors, and, ultimately, weight outcomes.

Consumer Food Environments

Consumer food environments are what consumers encounter within and around retail food outlets (stores, restaurants, and within-organization food sources) (Glanz et al. 2005). The consumer food environment

constructs of interest include the availability and price of healthful food choices, quality of food, portion sizes, within-outlet promotions, and point-of-choice nutrition information (French, Story, and Jeffery 2001; Giskes et al. 2007; Kamphuis et al. 2006).

The target categories of food of broadest interest in retail food stores are those most closely related to the causes or prevention of obesity and other chronic diseases. The categories of foods with the highest priority for studies of consumer food environments are dairy products, meat and poultry, baked goods and sweets, high-fat snack foods, and fruits and vegetables (Cheadle et al. 1990; Cheadle et al. 1991; Glanz, Sallis, et al. 2007).

Variations in consumer nutrition environments may explain some of the racial/ethnic and socioeconomic disparities in nutrition and health outcomes. Some healthy foods, such as low-fat dairy products (Wechsler et al. 1995) and fruits and vegetables (Horowitz et al. 2004), are less often available and/or are of poorer quality in minority and lower-income areas. The fewer healthful food options in lower-income neighborhoods and in convenience stores compared with those in supermarkets were documented in a study in the Atlanta area (Glanz, Sallis, et al. 2007). Early studies of the availability of healthy foods and individual diets by Cheadle and others found that the availability of low-fat milk and cheese and lean meats was associated with a lower fat intake by the residents of surrounding neighborhoods (Cheadle et al. 1990).

Assessments of the consumer food environment within restaurants, including fast-food outlets, have proved to be more challenging than those at food stores (Cheadle et al. 1994). Recent studies found that only a minority of chain restaurants provide nutrition information about their main menu items and that when they do, it is usually on websites rather than at the point of purchase (Saelens et al. 2007; Wootan and Osborn 2006; Wootan, Osborn, and Malloy 2006).

An observational study of 217 fast-food and sit-down restaurants conducted in conjunction with the development of the Nutrition Environment Measures Survey for Restaurants (NEMS-R) tool found that a minority of both types of restaurants offered *any* main dishes that could be considered healthy by current dietary guidelines, such as fresh fruit, non-fried vegetables, or whole-grain breads (Saelens et al. 2007). The study had a somewhat paradoxical finding: whereas fast-food restaurants had more “supersized” choices, promotions of overeating or unhealthy choices, and “value pricing” for multiple food items, these fast-food

restaurants were also more likely to offer at least one healthy entrée, to highlight healthy options, and to provide some form of consumer nutrition information (Saelens et al. 2007).

Policy and Environmental Interventions Related to Consumer Food Environments

One reason that the distinction between community and consumer food environments is important pertains to the different potential environmental and policy intervention strategies. *Consumer* food environments are better able to change without “bricks and mortar” or governmental intervention. That is, individual proprietors and corporations can change the foods they sell, the information they offer to consumers, their recipes, and their portion sizes, with or without encouragement from public health professionals. In fact, some local projects have been working with merchants and restaurateurs to make such changes, though to date no evaluations have been published.

Government policymakers at the local and national levels may be able to achieve broader changes in consumer food environments but also must address resistance by the industry. According to interviews with corporate executives, large restaurant chains’ main motivations are increasing sales and profits, not providing healthful choices (Glanz, Resnicow, et al. 2007). The most promising, and most active, area for policy change is providing calorie, fat, and other nutritional information on menus. Such policies are now in place in two large cities, New York and Seattle. A health impact assessment of menu labeling finds this promising, even with conservative estimates of consumers’ use of the information (Simon et al. 2008). As a result, the national debate on menu labeling is growing more insistent (Berman and Lavizzo-Mourey 2008), and ongoing evaluations should provide valuable information.

School and Worksite Food Environments

School food environments can have a large impact on children’s and adolescents’ dietary intake because students obtain and eat meals and snacks at school (see the article by Story, Nannery, and Schwartz in this issue; Story et al. 2008). Designing schools to support healthy eating habits requires policies at both the federal and local levels, as

well as local implementation, including school nutrition standards and limiting offerings of competitive foods (IOM 2007). In the past few years, there has been renewed attention to providing support and regulations for healthier school food environments, including expansion of a U.S. Department of Agriculture fruit and vegetable pilot program, farm-to-school programs that link local farmers providing fresh locally grown produce to school cafeterias, and federally mandated school wellness policies (Story et al. 2008). This topic is addressed in greater detail by Story, Nannery, and Schwartz in this special issue of *The Milbank Quarterly*.

Few school environment and policy interventions have been evaluated, despite the School Nutrition Policy Initiative, which contains school nutrition policies, menu planning, nutrition education, social marketing, and parent outreach targeting grades 4 through 6. After two years, significantly fewer children in the intervention schools became overweight (Foster et al. 2008), thereby demonstrating the potential of multilevel interventions by schools and communities.

Worksites for adults are comparable to schools for children: they are organizational environments where adults spend most of their days and consume meals and snacks. Several studies showed that changes in worksite environments are feasible and can positively affect food intake (Engbers et al. 2005). These interventions have achieved healthful changes in worksite cafeterias (Jeffery et al. 1994) and vending machines (French et al. 2001). Interventions in worksite settings are described in greater detail by Heinen and Darling in this issue of *The Milbank Quarterly*.

Home Environments

The home is a complex and dynamic food environment and has been well studied with respect to families' and, particularly, children's eating habits (Story et al. 2008). Food at home is affected by its availability in the neighborhood (Glanz et al. 2005), and its availability at home and the influence of parents are especially relevant to children (Bryant and Stevens 2006; Koplan, Liverman, and Kraak 2004).

Although family outreach has been used as an adjunct to school-based nutrition interventions and obesity treatment in clinical settings, few reports show that home-based interventions improve eating patterns

(Story et al. 2008). This remains a fertile area for future research. Policies affecting community and consumer food environments (e.g., proximity to food stores, food prices) are likely to influence home food environments that in turn determine eating behaviors.

Limitations of Available Research

Similar to research on physical activity environments, the cross-sectional design of most food environment studies is a major limitation (Black and Macinko 2007; Ford and Dzewaltowski 2008; Giskes et al. 2007; Holsten 2008; Papas et al. 2007). Additional prospective studies and field experiments (planned or “natural”) are needed for our knowledge base to expand. In addition, more multilevel intervention studies are needed, especially those that simultaneously address activity and food environments as they relate to obesity.

The advancement of research partly depends on the availability of valid, reliable measures of nutrition environments and policies (Glanz et al. 2005). Measures used in research on school food environments, neighborhood food environments (stores, restaurants), and state policies are illustrative of well-developed measurement tools in this area (Glanz, Sallis, et al. 2007; Masse et al. 2007; Saelens et al. 2007; Story et al. 2008). But much more work must be done in designing and testing food environment measures that are feasible for large studies, adaptable to a variety of locations, allow for comparability across studies, and provide nutritionally meaningful indicators (Saelens and Glanz 2009).

Summary of Food Environment Studies

Evidence is rapidly growing that proximity to supermarkets is associated with an intake of more fruits and vegetables and that proximity to fast-food restaurants is associated with an intake of higher-energy foods and a lower-quality diet. Low-income and racial/ethnic minority communities usually have less access to supermarkets and a greater concentration of fast-food restaurants, and the quality of foods offered tends to be worse in these neighborhoods. The community food environment has not been consistently related to weight status, as it has

been difficult to link the quality of food within restaurants with eating behaviors. Most restaurants provide very little nutritional information at the point of decision, although the recent enactment of menu-labeling laws offers an opportunity to evaluate these policy interventions. Food environment, policy, and pricing interventions have been successful in promoting healthier choices in schools, workplaces, and vending machines.

Ongoing Efforts to Create Healthier Places for People to Live

Environment, policy, and multilevel strategies for improving diet, physical activity, and obesity control are recommended by respected national and international groups. The World Health Organization (2004) and the International Obesity Task Force (Kumanyika et al. 2000) strongly recommend environmental and policy changes. In the United States, the surgeon general's call to action to prevent obesity (USDHHS 2001), the Institute of Medicine's report on preventing childhood obesity (Koplan, Liverman, and Kraak 2004), the Centers for Disease Control and Prevention (Koplan and Dietz 2000), and an expert panel organized by the American Medical Association and other organizations (Barlow and the Expert Committee 2007) all concluded that environmental and policy changes will be essential components of a solution to the obesity epidemic.

Box 1 highlights efforts to implement environmental and policy changes, mainly in the United States. A few of these are research-based projects; several are community demonstrations that are being evaluated; and others are part of organizations' advocacy work. Many of these initiatives target low-income communities of color because the people in these communities are at the highest risk of obesity (Ogden et al. 2006), and finding effective solutions for such groups is challenging but urgently needed. These diverse intervention models are building experience in environmental and policy change, are providing opportunities for research and evaluation, and, we hope, are offering lessons that others can use to disseminate effective approaches on a wider scale.

BOX 1

Examples of Built Environment Change Strategies in the United States

1. Active Living by Design is working with twenty-five communities across the country to increase physical activity and healthy eating through community design, public policies, and communications strategies. It is funded by the Robert Wood Johnson Foundation, www.activelivingbydesign.org (accessed December 4, 2008).

2. Healthy Eating Active Communities is working with six communities in California to demonstrate that by transforming the food and physical activity environments of resource-poor, low-income communities, it is possible to change norms that foster unhealthy food choices and inactivity. It is funded by the California Endowment, www.healthyeatingactivecommunities.org (accessed December 4, 2008).

3. Healthy Eating Active Living: Community Health Initiatives is working with twenty-seven communities across the United States to make changes like installing bike racks, getting more fresh fruits and vegetables on the shelves of corner stores, building walking paths and bike trails, planning safe routes for kids to walk or bike to school, supporting school cafeteria reforms, offering physical education in schools, and making health considerations part of planning and development decisions. It is funded by Kaiser Permanente, <http://info.kp.org/communitybenefit> (accessed December 4, 2008).

4. New York City's restaurant menu-labeling regulations that require some restaurants to display calorie information are now in effect; see www.nyc.gov/html/doh/html/cdp/cdp_pan-calorie.shtml (accessed December 4, 2008).

5. The mission of Philadelphia's Food Trust is to ensure that everyone has access to healthful, affordable food. Its programs emphasize environments, policies and education in communities, schools, farmers' markets, and stores; see www.thefoodtrust.org/ (accessed December 4, 2008).

6. Shape Up Somerville is a project in this city near Boston to make environmental changes to prevent obesity in culturally diverse, elementary school children. This intervention is focused on increasing the number of physical activity options available to children throughout the day and improving dietary choices in schools and the whole community. It is funded by the Centers for Disease Control and Prevention, <http://www.shapeupsomerville5k.org/aboutsus.html> (accessed December 4, 2008), and for evaluation results, see Economos et al. 2007.

7. Smart growth and the new urbanism are related movements that advocate community designs, transportation investments, zoning ordinances, and community participation that lead to walkable and environmentally sustainable neighborhoods and cities. The principal membership organizations are Congress for the New Urbanism (www.cnu.org; accessed December 4, 2008) and Smart Growth America (www.smartgrowthamerica.org; accessed December 4, 2008).

(Continued)

BOX 1—*Continued*

8. PolicyLink is a national research and action institute for economic and social equity. It provides technical training and capacity building, policy advocacy, and communications training for advocates working to create healthier communities. These advocates are working to improve socioeconomic and environmental conditions that affect health and are related to income, segregation, pollution, crime, availability of fresh foods and safe recreational facilities, transit-oriented community design, and accessible quality housing. It has multiple funders; see www.policylink.org (accessed December 4, 2008).

What Is Needed to Accelerate Movement toward Nonobesogenic Environments?

The anticipated health and economic consequences of the obesity epidemic mean that we must find and implement solutions quickly. Because changes in policy and practice rarely wait for definitive answers from research, we need to draw lessons from the best available research (a point well made by the Institute of Medicine; see Koplan, Liverman, and Kraak 2004) and experience from the field. There is, in fact, a great deal of consensus on some promising approaches, and this section discusses some of the principles and practices. As research advances and experience with environmental and policy intervention deepens, these approaches should be updated.

Intersectoral Collaboration

Physical activity and food environments are controlled by a wide range of public and private interests involving government agencies at all levels, multiple major industries, professional organizations, and non-profits. Those sectors of society with obvious relevance are agriculture, food manufacturing and sales, recreation, transportation, education, real estate, architecture, communication media, advertising, and entertainment industries. All these groups are stakeholders, along with the public health, medicine, and health care industries, that need to be engaged in efforts to create less obesogenic environments. Although some of these stakeholders will perceive benefits from recommended changes, others will oppose them. A good model of intersectoral collaboration is the

whole-of-government approach to physical activity promotion pioneered by New South Wales in Australia (Sallis, Bauman, and Pratt 1998). Every government department was instructed to promote physical activity, with an emphasis on environmental and policy change.

Community Engagement and Participation

The involvement of community residents is essential to advocating for, and implementing, changes to create more healthful environments and policies. Community engagement also is critical to the success of new initiatives (Minkler, Wallerstein, and Wilson 2008). Even though scientists and public health experts may determine that environmental change could help reduce obesity—for example, by restricting the number of fast-food restaurants in a disadvantaged neighborhood—the residents may regard such a regulation as punitive or stigmatizing (“blame the victim”) because they depend on cheap, convenient food sources and lack reliable transportation options. Accordingly, those people living in the neighborhood or working in local organizations should be asked to help identify what is acceptable and promising for increasing the healthfulness of their environments.

Changing Policies on Land Use, Transportation, Recreation, and Building Codes

Zoning ordinances continue to favor low-walkable developments; transportation investments for pedestrian and cycling facilities are trivial; parks are low priorities in many communities; school-siting decisions are not coordinated with community planning; and building codes do not consider physical activity inside and around buildings. Thus every day, buildings, communities, and roads are constructed that discourage or prevent physical activity, and these built environments will last a long time. Zoning laws and tax incentives can attract grocery stores and prevent an excess of fast-food restaurants in communities, demonstrating that policy changes are the key to creating healthy physical activity and food environments. To achieve these policy changes, public health professionals must improve their advocacy skills, develop partnerships with advocacy organizations, and establish intersectoral collaborations.

Evaluating, Building the Evidence Base, and Growing Knowledge in Changing Times

Many ideas about changing environments to improve eating and physical activity are promising but speculative, so they need to be evaluated for effectiveness, unintended consequences, and, ultimately, their effects on health and weight. First-level evaluations should be close to the change, for example, studying customers at a new supermarket instead of conducting a communitywide survey that may include few of the new store's customers. Policymakers and public health experts should thoughtfully construct case studies to better understand how environmental and policy innovations will affect their communities. Studies should be designed to inform policy debates, and the search for evidence should be both unbiased and multilayered.

Connections with Climate Change and Energy Policy. Similar to obesity, the predicted consequences of climate change are near the top of the public agenda (Ewing et al. 2008). Many actions recommended to control obesity are also expected to decrease carbon emissions. Reducing driving by walking and cycling more helps solve several problems, and people living in walkable neighborhoods are estimated to generate about 30 percent less carbon than suburban residents do, largely because they drive less (Ewing et al. 2008). More compact, walkable development patterns can preserve (1) forests that absorb carbon, (2) open space where people can be physically active, and (3) farmland that enhances access to local produce while reducing carbon from transporting food long distances. Policies with beneficial effects for both obesity and climate change need to be evaluated, and opportunities for collaboration with the environmental protection movement should be considered.

A New Environmental Education

Some of the success of the environmental protection movement has been attributed to effective educational curricula in schools (Economos et al. 2001), many of which include hands-on learning. Teaching students about their food and physical activity environments could produce a generation of advocates for healthy community environments. Examples of class projects are observations of the food and physical activity environments in their local areas, surveys of community preferences, comparison of results with neighborhoods of contrasting sociodemographic

characteristics, written reports, and the presentation of findings and recommendations to community leaders. These activities could be integrated into health, science, social studies, math, and physical education lessons. This is a topic ripe for research.

Additional strategies that engage the community, involve multiple stakeholders, and strengthen advocacy need to be developed, evaluated, and refined to implement the evidence-based policy changes expected to lead to nonobesogenic food and physical activity environments. Even though widespread environmental changes may take years to show results, the beneficial effects can be expected to contribute to long-lasting improvements in physical activity, eating, and obesity.

References

- Apparicio, P., M.S. Cloutier, and R. Shearmur. 2007. The Case of Montreal's Missing Food Deserts: Evaluation of Accessibility to Food Supermarkets. *International Journal of Health Geography* 12(6):4.
- Barlow, S., and the Expert Committee. 2007. Expert Committee Recommendations on the Assessment, Prevention, and Treatment of Child and Adolescent Overweight and Obesity: Summary Report. *Pediatrics* 120:S254–88.
- Bauman, A.E., and F.C. Bull. 2007. *Environmental Correlates of Physical Activity and Walking in Adults and Children: A Review of Reviews*. London: National Institute of Health and Clinical Excellence. Available at <http://www.nice.org.uk/guidance/index.jsp?action=download&o=34740> (accessed July 15, 2008).
- Berman, M., and R. Lavizzo-Mourey. 2008. Obesity Prevention in the Information Age: Caloric Information at the Point of Purchase. *Journal of the American Medical Association* 300(4):433–35.
- Besser, L.M., and A.L. Dannenberg. 2005. Walking to Public Transit: Steps to Help Meet Physical Activity Recommendations. *American Journal of Preventive Medicine* 29:273–80.
- Black, J.L., and J. Macinko. 2007. Neighborhoods and Obesity. *Nutrition Reviews* 66:2–20.
- Booth, S.L., J.F. Sallis, C. Ritenbaugh, J.O. Hill, L.L. Birch, L.D. Frank, K. Glanz, et al. 2001. Environmental and Societal Factors Affect Food Choice and Physical Activity: Rationale, Influences, and Leverage Points. *Nutrition Reviews* 59:S21–39.
- Brownell, K.D. 2004. Fast Food and Obesity in Children. *Pediatrics* 113:132.

- Bryant, M., and J. Stevens. 2006. Measurement of Food Availability in the Home. *Nutrition Reviews* 64:67–76.
- Burdette, H.L., and R.C. Whitaker. 2004. Neighborhood Playgrounds, Fast Food Restaurants, and Crime: Relationships to Overweight in Low-Income Preschool Children. *Preventive Medicine* 38:57–63.
- Cheadle, A., B. Psaty, E. Wagner, P. Diehr, T. Koepsell, S. Curry, and M. Von Korff. 1990. Evaluating Community-Based Nutrition Programs: Assessing the Reliability of a Survey of Grocery Store Product Displays. *American Journal of Public Health* 80(6):709–11.
- Cheadle, A., B.M. Psaty, S. Curry, E. Wagner, P. Diehr, T. Koepsell, and A. Kristal. 1991. Community-Level Comparisons between the Grocery Store Environment and Individual Dietary Practices. *Preventive Medicine* 20(2):250–61.
- Cheadle, A.D., B.M. Psaty, S. Curry, E. Wagner, P. Diehr, T. Koepsell, A.R. Kristal, and D. Patrick. 1994. Assessing the Validity of a Survey of the Restaurant Health Promotion Environment. *American Journal of Health Promotion* 9:88–91.
- Cradock, A.L., S.J. Melly, J.G. Allen, J.S. Morris, and S.L. Gortmaker. 2007. Characteristics of School Campuses and Physical Activity among Youth. *American Journal of Preventive Medicine* 33(2):106–13.
- Cummins, S., and S. Macintyre. 2002. “Food Deserts”—Evidence and Assumption in Health Policy Making. *British Medical Journal* 325:436–38.
- Davidson, K.K., and C. Lawson. 2006. Do Attributes of the Physical Environment Influence Children’s Level of Physical Activity? *International Journal of Behavioral Nutrition and Physical Activity* 3(19):1–17.
- Diez Roux, A.V., K.R. Evenson, A.P. McGinn, D.G. Brown, L. Moore, S. Brines, and D.R. Jacobs. 2007. Availability of Recreational Resources and Physical Activity in Adults. *American Journal of Public Health* 97:493–99.
- Economos, C.D., R.C. Brownson, M.A. DeAngelis, S.B. Foerster, C. Tucker Foreman, J. Gregson, S.K. Kumanyika, and R.R. Pate. 2001. What Lessons Have Been Learned from Other Attempts to Guide Social Change? *Nutrition Reviews* 59(3):S40–56.
- Economos, C.D., R.R. Hyatt, J.P. Goldberg, A. Must, E.N. Naumova, J.J. Collins, and M.E. Nelson. 2007. A Community Intervention Reduces BMI z-score in Children: Shape Up Somerville First Year Results. *Obesity* 15(5):1325–36.
- Engbers, L.H., M.N. van Poppel, M.J. Chin, A. Paw, and W. van Mechelen. 2005. Worksite Health Promotion Programs with Environmental Changes: A Systematic Review. *American Journal of Preventive Medicine* 29:61–70.

- Evenson, K.R., A.H. Herring, and S.L. Huston. 2005. Evaluating Change in Physical Activity with the Building of a Multi-Use Trail. *American Journal of Preventive Medicine* 28(2S2):177–85.
- Ewing, R., K. Bartholomew, S. Winkelman, J. Walters, and D. Chen. 2008. *Growing Cooler: The Evidence on Urban Development and Climate Change*. Washington, D.C.: Urban Land Institute.
- Ewing, R., R.C. Brownson, and D. Berrigan. 2006. Relationship between Urban Sprawl and Weight of United States Youth. *American Journal of Preventive Medicine* 31(6):464–74.
- Floyd, M.F., J.O. Spengler, J.E. Maddock, P.H. Gobster, and L.J. Suau. 2008. Park-Based Physical Activity in Diverse Communities of Two U.S. Cities: An Observational Study. *American Journal of Preventive Medicine* 34:299–306.
- Ford, P.B., and D.A. Dziewaltowski. 2008. Disparities in Obesity Prevalence Due to Variation in the Retail Food Environment: Three Testable Hypotheses. *Nutrition Reviews* 66:216–28.
- Foster, G.D., S. Sherman, K.E. Borradaile, K.M. Grundy, S.S. Vander Veur, J. Nachmani, A. Karpyn, S. Kumanyika, and J. Shults. 2008. A Policy-Based School Intervention to Prevent Overweight and Obesity. *Pediatrics* 121(4):e794–802.
- Frank, L.D., M.A. Andresen, and T.L. Schmid. 2004. Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars. *American Journal of Preventive Medicine* 27:87–96.
- Frank, L.D., T.L. Schmid, J.F. Sallis, J. Chapman, and B.E. Saelens. 2005. Linking Objectively Measured Physical Activity with Objectively Measured Urban Form. Findings from SMARTRAQ. *American Journal of Preventive Medicine* 28(2S2):117–25.
- French, S.A., R.W. Jeffery, M. Story, K.K. Breitlow, J.S. Baxter, P. Hannan, and M.P. Snyder. 2001. Pricing and Promotion Effects on Low-Fat Vending Snack Purchases: The CHIPS Study. *American Journal of Public Health* 91(1):112–17.
- French, S.A., M. Story, and R.W. Jeffery. 2001. Environmental Influences on Eating and Physical Activity. *Annual Review of Public Health* 22:309–35.
- Giskes, K., C. Kamphuis, F.J. van Lenthe, S. Kremers, M. Droomers, and J. Brug. 2007. A Systematic Review of Associations between Environmental Factors, Energy and Fat Intake among Adults: Is There Evidence for Environments That Encourage Obesogenic Dietary Intakes? *Public Health Nutrition* 10:1005–17.
- Glanz, K., K. Resnicow, J. Seymour, K. Hoy, H. Stewart, M. Lyons, and J. Goldberg. 2007. How Major Restaurant Chains Plan Their Menus: The Role of Profit, Demand, and Health. *American Journal of Preventive Medicine* 32:383–88.

- Glanz, K., J.F. Sallis, B.E. Saelens, and L.D. Frank. 2005. Healthy Nutrition Environments: Concepts and Measures. *American Journal of Health Promotion* 19:330–33.
- Glanz, K., J.F. Sallis, B.E. Saelens, and L.D. Frank. 2007. Nutrition Environment Measures Survey in Stores (NEMS-S): Development and Evaluation. *American Journal of Preventive Medicine* 32:282–89.
- Glanz, K., and A.L. Yaroch. 2004. Strategies for Increasing Fruit and Vegetable Intake in Grocery Stores and Communities: Policy, Pricing, and Environmental Change. *Preventive Medicine* 39(9, suppl. 2):S75–80.
- Gordon, P.M., S.J. Zizzi, and J. Pauline. 2004. Use of a Community Trail among New and Habitual Exercisers: A Preliminary Assessment. *Preventing Chronic Disease* 1:A11.
- Gordon-Larsen, P., M.C. Nelson, P. Page, and B.M. Popkin. 2006. Inequality in the Built Environment Underlies Key Health Disparities in Physical Activity and Obesity. *Pediatrics* 117:417–24.
- Handy, S., X. Cao, and P.L. Mokhtarian. 2006. Self-Selection in the Relationship between the Built Environment and Walking. *Journal of the American Planning Association* 72:55–74.
- Handy, S., X. Cao, and P.L. Mokhtarian. 2008. The Causal Influence of Neighborhood Design on Physical Activity within the Neighborhood: Evidence from Northern California. *American Journal of Health Promotion* 22(5):350–58.
- Heath, G.W., R.C. Brownson, J. Kruger, R. Miles, K.E. Powell, L.T. Ramsey, and the Task Force on Community Preventive Services. 2006. The Effectiveness of Urban Design and Land Use and Transport Policies and Practices to Increase Physical Activity: A Systematic Review. *Journal of Physical Activity and Health* 3:S55–76.
- Heinen, L., and H. Darling. 2009. Addressing Obesity in the Workplace: The Role of Employers. *The Milbank Quarterly* 87(1):101–22.
- Hill, J.O., and J.C. Peters. 1998. Environmental Contributions to the Obesity Epidemic. *Science* 280:1371–74.
- Hoag, C. 2008. *Los Angeles Wants to Take a Bite Out of Fast Food*. Associated Press, July 29.
- Holsten, J. 2008. Obesity and the Community Food Environment: A Systematic Review. *Public Health Nutrition* 14(5):1–9.
- Horowitz, C.R., K.A. Colson, P.L. Hebert, and K. Lancaster. 2004. Barriers to Buying Healthy Foods for People with Diabetes: Evidence of Environmental Disparities. *American Journal of Public Health* 94:1549–54.
- Institute of Medicine (IOM). 2007. *Nutrition Standards for Foods in Schools: Leading the Way toward Healthier Youth*. Washington, D.C.: National Academies Press.

- Jebb, S.A., and M.S. Moore. 1999. Contribution of a Sedentary Lifestyle and Inactivity to the Etiology of Overweight and Obesity: Current Evidence and Research Issues. *Medicine and Science in Sports and Exercise* 31(11, suppl.):S534–41.
- Jeffery, R.W., S.A. French, C. Raether, and J.E. Baxter. 1994. An Environmental Intervention to Increase Fruit and Salad Purchases in a Cafeteria. *Preventive Medicine* 23:788–92.
- Kahn, E.B., L.T. Ramsey, R.C. Brownson, G.W. Heath, E.H. Howze, K.E. Powell, E.J. Stone, M.W. Rajab, and P. Corso. 2002. The Effectiveness of Interventions to Increase Physical Activity: A Systematic Review. *American Journal of Preventive Medicine* 22(4S):67–72.
- Kamphuis, C., K. Giskes, W. Wendel-Vos, G.J. de Bruijn, J. Brug, and F. van Lenthe. 2006. Environmental Determinants of Fruit and Vegetable Consumption—A Systematic Review. *British Journal of Nutrition* 96:620–35.
- Kant, A.K., and B.I. Graubard. 2004. Eating Out in America, 1987–2000: Trends and Nutritional Correlates. *Preventive Medicine* 38:243–49.
- Kerr, J., D. Rosenberg, J.F. Sallis, B.E. Saelens, L.D. Frank, and T.L. Conway. 2006. Active Commuting to School: Associations with Built Environment and Parental Concerns. *Medicine and Science in Sports and Exercise* 38:787–94.
- Kerr, K.A., M.A. Yore, S.A. Ham, and W.H. Dietz. 2004. Increasing Stair Use in a Worksite through Environmental Changes. *American Journal of Health Promotion* 5:312–15.
- Koplan, J.P., and W.H. Dietz. 2000. Caloric Imbalance and Public Health Policy. *Journal of the American Medical Association* 282:1579–81.
- Koplan, J.P., C.T. Liverman, and V.I. Kraak. 2004. *Preventing Childhood Obesity: Health in the Balance*. Washington, D.C.: Institute of Medicine.
- Kumanyika, S.K., L. Van Horn, D. Bowen, M.G. Perri, B.J. Rolls, S.M. Czajkowski, and E. Schron. 2000. Maintenance of Dietary Behavior Change. *Health Psychology* 19(1):42–56.
- Lopez-Zetina, J., H. Lee, and R. Friis. 2006. The Link between Obesity and the Built Environment. Evidence from an Ecological Analysis of Obesity and Vehicle Miles of Travel in California. *Health and Place* 12:656–64.
- MacIntyre, S. 2007. Deprivation Amplification Revisited; or, Is It Always True That Poorer Places Have Poorer Access to Resources for Healthy Diets and Physical Activity? *International Journal of Behavioral Nutrition and Physical Activity* 4:32. doi:10.1186/1479-5868-4-32.

- Maddock, J. 2004. The Relationship between Obesity and the Prevalence of Fast Food Restaurants: State-Level Analysis. *American Journal of Health Promotion* 19:137–43.
- Marcus, B.H., P.M. Dubbert, L.H. Forsyth, T.L. McKenzie, E.J. Stone, A.L. Dunn, and S.N. Blair. 2000. Physical Activity Behavior Change: Issues in Adoption and Maintenance. *Health Psychology* 19(1):32–41.
- Masse, L.C., M.M. Frosh, J.F. Chiqui, A.L. Yaroch, T. Agurs-Collins, H.M. Blanck, A.A. Atienza, M.L. McKenna, and J.F. Igoe. 2007. Development of a School Nutrition-Environment State Policy Classification System (SNESPCS). *American Journal of Preventive Medicine* 33(4, suppl.):S277–91.
- Minkler, M., N. Wallerstein, and N. Wilson. 2008. Improving Health through Community Organization and Community Building. In *Health Behavior and Health Education: Theory, Research and Practice*, 4th ed., edited by K. Glanz, B. Rimer, and K. Viswanath, pp. 279–311. San Francisco: Jossey-Bass.
- Moore, L.V., A.V. Diez Roux, J.A. Nettleton, and D.R. Jacobs. 2008. Associations of the Local Food Environment with Diet Quality: A Comparison of Assessments Based on Surveys and Geographic Information Systems. *American Journal of Epidemiology* (EPub).
- Morland, K., A.V. Diez Roux, and S. Wing. 2006. Supermarkets, Other Food Stores and Obesity: The Atherosclerosis Risk in Communities Study. *American Journal of Preventive Medicine* 30:333–39.
- Morland, K., S. Wing, and A. Diez Roux. 2002. The Contextual Effect of the Local Food Environment on Residents' Diets: The Atherosclerosis Risk in Communities Study. *American Journal of Public Health* 92:1761–68.
- Morland, K., S. Wing, A. Diez Roux, and C. Poole. 2002. Neighborhood Characteristics Associated with the Location of Food Stores and Food Service Places. *American Journal of Preventive Medicine* 22:23–29.
- Morton, L.W., and T.C. Blanchard. 2007. Starved for Access: Life in Rural America's Food Deserts. *Rural Realities* 1:1–10.
- NICE Public Health Collaborating Centre—Physical Activity. 2006. *Physical Activity and the Environment: Transport Evidence Review*. Available at <http://www.nice.org.uk/nicemedia/pdf/word/Transport%20evidence%20review%20summary.doc> (accessed July 15, 2008).
- Nicoll, G. 2007. Spatial Measures Associated with Stair Use. *American Journal of Health Promotion* 21(4, suppl.):346–52.
- Ogden, C.L., M.D. Carroll, L.R. Curtin, M.A. McDowell, C.J. Tabak, and K.M. Flegal. 2006. Prevalence of Overweight and Obesity in the United States. *Journal of the American Medical Association* 295(13):1549–55.

- Papas, M.A., A.J. Alberg, R. Ewing, K.J. Helzlsouer, T.L. Gary, and A.C. Klassen. 2007. The Built Environment and Obesity. *Epidemiologic Reviews* 29:129–43.
- Pearson, T., J. Russell, M.J. Campbell, and M.E. Barker. 2005. Do “Food Deserts” Influence Fruit and Vegetable Consumption?: A Cross-Sectional Study. *Appetite* 45(2):195–97.
- Pereira, M.A., A.I. Kartashov, C.B. Ebbeling, L. Van Horn, M.L. Slatery, D.R. Jacobs Jr., and D.S. Ludwig. 2005. Fast-Food Habits, Weight Gain, and Insulin Resistance (The CARDIA Study): 15-Year Prospective Analysis. *Lancet* 365(9453):36–42.
- Popkin, B.M. 2007. Global Context of Obesity. In *Handbook of Obesity Prevention: A Resource for Health Professionals*, edited by S. Kumanyika and R.C. Brownson, pp. 227–38. New York: Springer.
- Powell, L.M., M.C. Auld, F.J. Chaloupka, P.M. O’Malley, and L.D. Johnston. 2007. Association between Access to Food Stores and Adolescent Body Mass Index. *American Journal of Preventive Medicine* 33(4S):S301–7.
- Powell, L.M., F.J. Chaloupka, and Y. Bao. 2007. The Availability of Fast-Food and Full-Service Restaurants in the United States: Associations with Neighborhood Characteristics. *American Journal of Preventive Medicine* 33(4S):S240–45.
- Powell, L.M., S. Slater, F.J. Chaloupka, and D. Harper. 2006. Availability of Physical Activity–Related Facilities and Neighborhood Demographic and Socioeconomic Characteristics: A National Study. *American Journal of Public Health* 96:1676–80.
- Pucher, J., and L. Dijkstra. 2003. Promoting Safe Walking and Cycling to Improve Public Health: Lessons from the Netherlands and Germany. *American Journal of Public Health* 93(9):1509–16.
- Ridgers, N.D., G. Stratton, S.J. Fairclough, and T.W. Twisk. 2007. Long-Term Effects of Playground Markings and Physical Structures on Children’s Recess Physical Activity Levels. *Preventive Medicine* 44(5):393–97.
- Saelens, B.E., and K. Glanz. 2009. Measures of the Food and Physical Activity Environments: Instruments. *American Journal of Preventive Medicine*, forthcoming.
- Saelens, B.E., K. Glanz, J.F. Sallis, and L.D. Frank. 2007. Nutrition Environment Measures Study in Restaurants (NEMS-R): Development and Evaluation. *American Journal of Preventive Medicine* 32:273–81.
- Sallis, J.F., A. Bauman, and M. Pratt. 1998. Environmental and Policy Interventions to Promote Physical Activity. *American Journal of Preventive Medicine* 15:379–97.
- Sallis, J.F., R.B. Cervero, W. Ascher, K.A. Henderson, M.K. Kraft, and J. Kerr. 2006. An Ecological Approach to Creating More Physically Active Communities. *Annual Review of Public Health* 27:297–322.

- Sallis, J.F., T.L. Conway, J.J. Prochaska, T.L. McKenzie, S.P. Marshall, and M. Brown. 2001. The Association of School Environments with Youth Physical Activity. *American Journal of Public Health* 91:618–20.
- Sallis, J.F., and J. Kerr. 2006. Built Environment and Physical Activity. *PCPFS (President's Council on Physical Fitness and Sports) Research Digest* 7(4):1–8.
- Sallis, J.F., L.S. Linton, M.K. Kraft, C.L. Cutter, J. Kerr, J. Weitzel, A. Wilson, et al. 2009. The Active Living Research Program: Six Years of Grantmaking. *American Journal of Preventive Medicine*, 36(2, suppl.):S10–S21.
- Sallis, J.F., N. Owen, and E.B. Fisher. 2008. Ecological Models of Health Behavior. In *Health Behavior and Health Education: Theory, Research, and Practice*, 4th ed., edited by K. Glanz, B.K. Rimer, and K. Viswanath, pp. 465–86. San Francisco: Jossey-Bass.
- Satia, J.A., J.A. Galanko, and A.M. Siega-Riz. 2004. Eating at Fast-Food Restaurants Is Associated with Dietary Intake, Demographic, Psychosocial and Behavioral Factors among African Americans in North Carolina. *Public Health Nutrition* 7:1089–96.
- Schilling, J., and L.S. Linton. 2005. The Public Health Roots of Zoning: In Search of Active Living's Legal Genealogy. *American Journal of Preventive Medicine* 28(S2):96–104.
- Schmidt, M., S.G. Affenito, R. Striegel-Moore, P.R. Khoury, B. Barton, P. Crawford, S. Kronsberg, G. Schreiber, E. Obarzanek, and S. Daniels. 2005. Fast-Food Intake and Diet Quality in Black and White Girls: The National Heart, Lung, and Blood Institute Growth and Health Study. *Archives of Pediatrics and Adolescent Medicine* 159(7):626–31.
- Simmons, D., A. McKenzie, S. Eaton, N. Cox, M.A. Khan, J. Shaw, and P. Zimmet. 2005. Choice and Availability of Takeaway and Restaurant Food Is Not Related to the Prevalence of Adult Obesity in Rural Communities in Australia. *International Journal of Obesity* 29(6):703–10.
- Simon, P., C.J. Jarosz, T. Kuo, and J.E. Fielding. 2008. *Menu Labeling as a Potential Strategy for Combating the Obesity Epidemic: A Health Impact Assessment*. Los Angeles: Division of Chronic Disease and Injury Prevention, County of Los Angeles Public Health, May.
- Story, M., K.M. Kaphingst, R. Robinson-O'Brien, and K. Glanz. 2008. Creating Healthy Food and Eating Environments: Policy and Environmental Approaches. *Annual Review of Public Health* 29:253–72.
- Story, M., M.S. Nannery, and M.B. Schwartz. 2009. Schools and Obesity Prevention: Creating School Environments and Policies to Promote Healthy Eating and Physical Activity. *The Milbank Quarterly* 87(1):71–100.

- Sturm, R. 2005. Childhood Obesity—What We Can Learn from Existing Data on Societal Trends, Part 2. *Preventing Chronic Disease* 2(2): 1–9. Available at www.cdc.gov/pcd/issues/2005/apr/04_0039.htm (accessed July 15, 2008).
- Sturm, R., and A. Datar. 2005. Body Mass Index in Elementary School Children, Metropolitan Area Food Prices and Food Outlet Density. *Public Health* 119:1059–68.
- Thompson, O.M., C. Ballew, K. Resnicow, A. Must, L.G. Bandini, H. Cyr, and W.H. Dietz. 2004. Food Purchased Away from Home as a Predictor of Change in BMI z-score among Girls. *International Journal of Obesity* 28(2):282–89.
- Transportation Research Board and Institute of Medicine. 2005. Transportation Research Board Special Report 282: *Does the Built Environment Influence Physical Activity? Examining the Evidence*. Washington, D.C.: National Academies Press.
- U.S. Department of Health and Human Services (USDHHS). 2001. *The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity*. Rockville, Md.: U.S. Department of Health and Human Services, Public Health Service, Office of the Surgeon General.
- Wechsler, H., C.E. Basch, P. Zybert, R. Lantigua, and S. Shea. 1995. The Availability of Low-Fat Milk in an Inner-City Latino Community: Implications for Nutrition Education. *American Journal of Public Health* 85:1690–92.
- Wells, N.M., and Y. Yang. 2008. Neighborhood Design and Walking: A Quasi-Experimental Longitudinal Study. *American Journal of Preventive Medicine* 34(4):313–19.
- Wootan, M.G., and M. Osborn. 2006. Availability of Nutrition Information from Chain Restaurants in the United States. *American Journal of Preventive Medicine* 30:266–68.
- Wootan, M.G., M. Osborn, and C.J. Malloy. 2006. Availability of Point-of-Purchase Nutrition Information at a Fast-Food Restaurant. *Preventive Medicine* 43(6):458–59.
- World Health Organization (WHO). 2004. *Global Strategy on Diet, Physical Activity and Health*. Geneva: WHO. Available at <http://www.who.int/dietphysicalactivity/> (accessed July 15, 2008).
- Zenk, S.N., A.J. Schulz, T. Hollis-Neely, R.T. Campbell, N. Holmes, G. Watkins, R. Nwankwo, and A. Odoms-Young. 2005. Fruit and Vegetable Intake in African Americans: Income and Store Characteristics. *American Journal of Preventive Medicine* 29(1): 1–9.
- Zenk, S.N., A.J. Schulz, B.A. Israel, S.A. James, S. Bao, and M.L. Wilson. 2005. Neighborhood Racial Composition, Neighborhood Poverty, and the Spatial Accessibility of Supermarkets in Metropolitan Detroit. *American Journal of Public Health* 95:660–67.

- Zhu, X., and C. Lee. 2008. Walkability and Safety around Elementary Schools: Economic and Ethnic Disparities. *American Journal of Preventive Medicine* 34:282–90.
- Zimring, C., A. Joseph, G.L. Nicoll, and S. Tsepas. 2005. Influences of Building Design and Site Design on Physical Activity: Research and Intervention Opportunities. *American Journal of Preventive Medicine* 28(2S2):186–93.

Acknowledgments: Work on this article was supported by the Active Living Research Program of the Robert Wood Johnson Foundation, NIH grant HL083454 (Sallis), and a Distinguished Research Scholar Award from the Georgia Cancer Coalition (Glanz).