

Chapter 2

Behavioral Science Perspectives on Designing the Environment to Promote Child Health

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Most of the 13,000 child deaths each day are due to the dangers present in the environments in which they live, learn, play and grow.

(World Health Organization (WHO), 2002)

Abstract In general, there is a need for large, well-integrated studies that both assess environmental characteristics and measure health outcomes in children. Results from these studies would demonstrate to policymakers the positive impact of thoughtful community design and comprehensive multilevel interventions on child health outcomes. This is essential for both the design of new health-promoting communities and the revitalization of existing communities.

2.1 The Built Environment

In addition to the over three million children that die each year due to a disease related to the environment (Gavidia et al. 2009), countless more suffer from accidents, injuries, and illnesses that are environmentally influenced. These outcomes greatly impact children's quality of life, with lasting consequences for future health and development, family dynamics, and community sustainability. Children, like all humans, have a right to health (Cummins and Jackson 2001) and their position in society as minor, developing, dependent individuals necessitates that others recognize the threats to child health, strive to understand how these threats interact and impact health, and work to revitalize and reshape current systems and spaces,

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and build new environments and interventions that effectively promote child health. Such efforts require collaboration across disciplines and strong and sustained commitments from multiple stakeholders at various levels of society to make child health a priority now and for future generations.

To this end, this chapter sets out to broadly explore a variety of well-recognized, environmentally based health issues and offer multilevel solutions and preventative measures that can be employed to enhance child health. In order to better elucidate how factors at various levels of the individual and society impact the health of a child, we review an ecological model of health behavior that places the child at the center of multiple levels of influence, with specific domains within each. We then review the epistemology of social and behavioral research in epidemiology first put forward by Sallis and colleagues (Sallis et al. 2000), and later expanded for use with research with children by Tercyak and colleagues (Tercyak et al. 2006). These phases help define the progression of evidence-based research, illustrating ways that this research can help determine and define the connections among various factors in the built environment that affect a child's health and can subsequently be used to inform future design and interventions.

The well-recognized and alarming obesity epidemic among children in the USA is further used as an example of how social and behavioral research can be employed to explore and explicate how factors and interventions at various levels of influence within the ecological model can be used to address this pressing child health issue.

Finally, we offer suggestions for continued and effective measurement of environmental and intervention-related impact on child health. We end with a call for continued and sustained collaboration and partnership among those that design and build environments and interventions to improve child health, those that create policies and laws that protect children, those that raise and care for children, and those that explore and measure the behavioral and health impact of these multilevel efforts benefiting children's health and well-being.

2.2 The Obesity Epidemic

One of the most pressing public health issues at hand is the growing prevalence of obesity throughout the societies of Western and non-Western nations around the world (Sallis et al. 2009). According to the US Centers for Disease Control and Prevention, obesity has reached an epidemic status; one-fifth of children in the USA are overweight or obese (Ogden et al. 2010). As a major preventable cause of death, swift action must be taken to reduce obesity rates (Cummins and Jackson 2001). The built environment can play a role in shaping the everyday decisions that people make and contribute to the problem of obesity by providing an environment that simultaneously encourages high caloric intake and low energy output (Hill et al. 2003). At the same time, the built environment affects availability-based consumption of foods from fast-food restaurants (vs. more nutritional options at supermarkets) (Morland et al. 2002). The increase in suburban sprawl over the past few decades, marked by low accessibility to safe spaces in which to be active and larger distances

between buildings (Ewing et al. 2003), has led to a higher reliance on motor vehicle transportation as opposed to opportunities for physical activity, such as walking or biking (Saelens et al. 2003). This is evidenced by aspects of the built environment that promote sedentary behavior and are linked with obesity, such as design elements of neighborhoods (i.e., cul-de-sacs and low street connectivity) (Berrigan and Troiano 2002) and heavy traffic (Timperio et al. 2010).

Just as there are elements of the built environment that contribute to sedentary lifestyles among children, there are also aspects that can encourage physical activity and healthy eating behaviors. Thus, the built environment may be a risk factor or a protective factor to children's health. For instance, proximity to parks and recreational facilities has been shown to correlate well with increased physical activity and decreased risk for obesity (Giles-Corti and Donovan 2002). Ewing and colleagues (2004) observed a positive association between miles of sidewalks and numbers of children who traveled to school either by walking or riding a bike (Ewing et al. 2004). Jago and colleagues (2007) show a positive correlation between proximity to small grocery stores and consumption of low-fat vegetables (Jago et al. 2007). Findings such as these demonstrate that there are aspects of the built environment that can be altered to aid in the prevention of obesity vis-à-vis facilitation of physical activity and promotion of nutritional eating. We further address the issue of obesity and multilevel approaches to prevention and control later in this chapter.

2.3 Environmental Health

Obesity is one among many child health issues with an environmental risk component that are well worth noting. The World Health Organization's Healthy Environments for Children Alliance (HECA) has compiled information identifying the primary sources of environmental risks to children's health worldwide, as well as examples of how to reduce potentially harmful exposures (Centers for Disease Control and Prevention (CDC) 2006; World Health Organization (WHO) 2010). In Table 2.1, we highlight some of these risks and preventative measures at various levels of intervention and oversight, adding some of our own recommendations as well.

The environmental risks to child health presented here contribute greatly to child mortality and morbidity worldwide. As stated earlier, all children have a right to health and we have a responsibility to use knowledge and resources to ensure and maintain child health globally. The preventative measures discussed herein provide some suggestions for approaches that can be taken at home, at school, in the community, and by governmental and nongovernmental organizations to combat environmentally influenced health risks. However, without an overarching understanding of how factors within each level impact and interact with each other to influence child health overall, it remains challenging to understand the complex and multifaceted ways in which the environment contributes to child health. A model that illustrates these interactions and contributions is useful in understanding child health behaviors, health-related risk and protective factors, and for the development interventions that will promote child health.

Table 2.1 Approaches to reducing environmental risks: From individuals to society

Sources of environmental risk	At home	At school	In the community	Government
Accidents and injuries	Review and ensure use of home safety and safety equipment (e.g., seatbelts, safety helmets, smoke alarms, gates, fences) Parents should learn first aid and have basic supplies available	Classroom teachers can instruct children about safety and self-protection Provide safe transportation to school, bicycle safety and pedestrian safety awareness training	Create child safety education centers Community fundraising and support for local emergency personnel and first responders	Change engineering and structural building and development requirements (e.g., installations of road signs) Enforce stronger penalties for driving while under the influence
Air pollution	Children should avoid direct and secondhand exposure to tobacco smoke Family members who smoke should stop smoking, or only smoke outdoors and away from children	Create smoke-free school zones Respect public air quality announcements during school activities Teachers should never smoke on school property	Promote the purchase of unleaded gasoline and good vehicle maintenance Encourage the use of mass transportation system	Implement laws and regulations to raise awareness (e.g., The Clean Air Act of 1990, which requires the setting of regulations for pollutants) Air pollution control regulations should be enforced in cities, especially ending leaded gasoline consumption
Chemicals	Avoid purchasing repackaged or unsafely packaged chemicals Store chemicals in secured locations and out of the reach of children	Teachers should inform children about chemical exposure as part of raising awareness School administrators must review the safe use and storage of chemicals in the school	Community organizations and leaders should join forces to improve local handling of hazardous chemicals Engage in advocacy efforts for policy changes and awareness-raising of decision-makers	Invest in research on effects of chemical exposure on children's health Provide more consistent risk assessment and toxicity testing for chemicals and children (e.g., Consumer Product Safety Improvement Act of 2008)

Human settlements	Use improved stoves and safe energy sources in the home	Encourage construction and use of sidewalks and transportations to/from school	Promote bicycle and pedestrian-oriented design Organize community groups to improve the provision and maintenance of water and sanitation facilities Advocate for effective regulation and policy setting to decrease lead exposure Healthcare professionals should increase their knowledge about lead poisoning, screen children for lead, and report results	Assist with awareness-building, public information, and outreach, regarding livability and safe housing Promote housing opportunities by creating economic and public assistance policies
Lead	Identify possible sources of in-home lead (paint, water, food containers) and seek professional assistance for safe removal Run the water for 30 s before drinking to reduce the buildup in pipes	Locate schools away from major roads to avoid exposure to lead-laden fumes Use professional assistance for removal of lead-based paint after identification		Create and enforce regulations for the testing and reporting of results on lead found in soil, air, water, foods, toys, and other items that children use
Water and sanitation	Use and encourage good personal (hand washing), household, and food hygiene Store treated water safely in a container with a narrow opening, preferably with a tap to avoid recontamination	Provide clean and safe drinking water to children Teach, model, and provide access to good hygiene practices	Continue progress toward providing all with access to piped water supplies to reduce childhood illness Track and assess progress on water and sanitation infrastructure	Set and enforce water quality requirements and standards Invest in water and sanitation infrastructure, including maintenance and replacement of aging resources

(continued)

Table 2.1 (continued)

Sources of environmental risk	At home	At school	In the community	Government
Pesticides	Reduce or eliminate use of pesticides in and outside the home and carefully follow directions Avoid use of pesticides and repellents on infants and young children	Seek alternatives to pesticides for controlling pests in and around food storage Apply pesticides only when children are not present	Advocate for pesticide reduction and safe practices Establish poison control centers	Develop food safety and pesticides regulations Provide funding for research on risk assessments based on child-specific vulnerabilities
Vector-borne diseases	Eliminate and control potential mosquito breeding grounds (standing water, garbage) Use insecticide impregnated mosquito nets and screen doors	Inform children how vector-borne diseases are transmitted Teach children about breeding sites	Record incidence and other information on vector-borne diseases Provide immediate and effective treatment	Invest in infrastructure to reduce breeding grounds Support media campaigns to increase awareness

Note: Tabled material adapted from the WHO Healthy Environments for Children Alliance Issue Briefs Series, and the authors opinions (CDC 2006; WHO 2010)

2.4 Ecological Models of Children's Health and Health-Related Risk and Protective Factors

Ecological models focus on the interactions between people and their environments. These models emphasize multilevel influences on behavior that can be observed at the individual, social and cultural, organizational, community, and policy levels (Glanz and Bishop 2010). In these models, the environment is conceived of as anything outside of the individual. The environment includes not only the physical environment, but also social and built environments (Sallis and Owen 2002). This understanding is parallel to the definition put forth by the US Department of Health and Human Service (2000) in its Healthy People 2010 initiative: "In its broadest sense, environmental health comprises those aspects of human health, disease, and injury that are determined or influenced by factors in the environment. This includes not only the study of the direct pathological effects of various chemical, physical, and biological agents, but also the effects on health of the broad physical and social environment, which includes housing, urban development, land-use and transportation, industry, and agriculture" (Chap. 8, p. 3) (US Department of Health and Human Services 2000).

Environmental influences on disease and behavior have long been recognized in public health. In public health, the host-agent-environment model has been used to explain population level change in disease rates that may be attributed to changes at any of the three levels in the model (McLeroy et al. 1988). B.F. Skinner, an influential American psychologist, was a strong proponent of environmental influences on behavior. His research designed specific environments and tools to shape and measure individual environmentally controlled actions. In the later part of the twentieth century, Albert Bandura purposed the Social Cognitive Theory in which aspects of both the environment and personal factors were seen as influencing individual behavior (Bandura 1986; Sallis and Owen 2002). Contemporary ecological models and theories of health behavior are informed by these early conceptual traditions.

In the 1970s, Urie Bronfenbrenner proposed an ecological model for human development in which he described nested levels of influence on behavior, and highlighted interactions between and among them (Bronfenbrenner 1979). In this model, the environment is divided into micro-, meso-, exo-, and macrosystems of influence that affect and interact with individual development. McLeroy and colleagues (1988) purposed an ecological model for health promotion that drew upon Bronfenbrenner's model and the works of others. In that model, behavior is conceived of as being determined by five levels of influence, each of which can be assessed and addressed to improve health behavior. The five levels are: (1) intrapersonal factors (including characteristics and developmental history of the individual); (2) interpersonal processes and primary groups (such as social networks and support systems); (3) institutional factors; (4) community factors; and (5) public policy.

A social-ecological approach to health has been employed to conceptualize various health behaviors including physical activity, child abuse, and eating behavior (Belsky 1980; Booth et al. 2005). Within this perspective, environments

are conceived of as multidimensional, with human–environment interactions occurring at all levels of society, with feedback across each (Stokols 1996). Social-ecological models and theories recognize and identify the ways in which physical and social environments impact and interact with human behavior to influence health outcomes, and have been tapped for use in health-promotion interventions (Glanz and Bishop 2010; Stokols 1996).

A key aspect of ecological theories is their multilevel approach. There has been general acceptance within the field of public health that multilevel interventions are essential to improving the health of populations (US Department of Health and Human Services 2000; Sallis and Owen 2002). The behavioral concept of reinforcement contingencies has been used to explain how multiple levels of reinforcement interact to create meta-contingencies that promote healthy behavior. The more an individual is exposed to health-promoting reinforcement on multiple levels (i.e., through social interactions, community initiatives, special events, media campaigns, governmental policy, etc.) the more likely they are to change their behavior in a way that improves health outcomes. In turn, these healthy behaviors become integrated into the multiple levels of reinforcement, including structure, systems, policies, and cultural norms (Hovell et al. 2002). Thus, it can be argued that health behavior interventions might be more effective when they address multiple levels of environmental factors that assist positive health behavior in order to create a health-promoting environment (Stokols 1996).

The model presented here places the child at the center of multiple levels of environmental determinants, providing several domains at each level (Fig. 2.1). In order to demonstrate how each level can impact the health of an individual child, the issue of child safety and injury prevention is employed, with a specific example offered at each level of influence. This example is critical in the discussion of children's health in that unintentional injury is the leading cause of death for children aged 1–18 years in the USA (Centers for Disease Control and Prevention (CDC) 2009) and many clear steps can be taken to prevent injury and ensure child safety.

At the core, a child's personal behaviors, knowledge, and attitudes impact his or her health. For example, a child's belief that wearing a helmet when riding a bicycle is essential and consistent use of protective gear could lead to improved health outcomes in the unfortunate circumstance of a bicycle accident.

At the Interpersonal level, children's families, peers, and caretakers also influence health by promoting or modeling certain health behaviors and controlling access and opportunities within the home and in daily activities. The use of window barriers in homes represents an effective home-based measure for ensuring child safety and preventing falls (Cummins and Jackson 2001).

Determinants within the Institutional/Organizational level include schools and child-care centers, community centers, and religious or cultural organizations. These represent settings and structures in which children may spend significant amounts of time and through which rules, norms, and beliefs are shaped and enforced. Within these settings, there are opportunities to teach, promote, and support healthy behaviors, as well as to design healthy environments in which children can thrive, remaining safe and healthy. The installation and maintenance of smoke

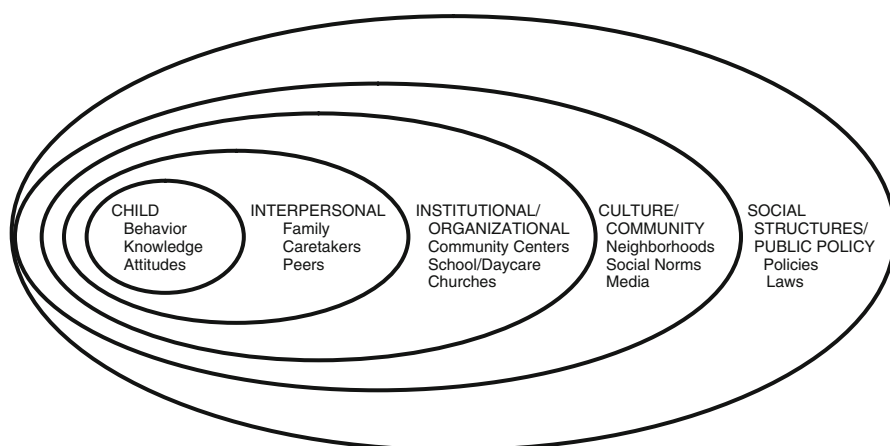


Fig. 2.1 Multilevel models of influence on children's health and development

detector, fire alarms, and sprinkler systems represents one way in which buildings within the Institutional/Organizational level can ensure child safety and decrease risk.

At the Culture/Community level, neighborhood design, media, and social norms influence access, exposure to, and reinforcement of health behaviors and beliefs and may also represent physical and social barriers to health. An example of how neighborhood design can improve child health is building sidewalks and walkways where children can freely walk and safely move about.

The most distal level of Social Structures/Public Policy includes local, governmental, and international laws and policies, which regulate and support individual behavioral and organizational actions and have the potential to enact change with a broad impact on child health. Title X of the Housing and Community Development Act is an example of such legislation in that its enactment had an impact on child safety by reducing lead poisoning through the implementation of regulations, standards, and training in lead-hazard control (Cummins and Jackson 2001).

2.5 Evidence-Based Social and Behavioral Epidemiology

Changes in the physical environment that will serve to positively impact health necessarily require an understanding of the interactions between the environment and health from those who plan and build children's environments (Jackson 2003). Evidence-based research into social and behavioral epidemiology provides a means to address many of the aforementioned issues in efficient and effective ways. Evidence-based research can determine and define the connections between the various factors in the built environment that affect a child's health and subsequently inform future design and interventions.

2.5.1 *Phases of Social and Behavioral Epidemiology*

In 2000, Sallis and colleagues created a structure for understanding the progression of knowledge about social and behavioral epidemiology – consisting of five phases of research (Sallis et al. 2000). This system focuses on behaviors as they relate to health within populations. The primary function of the phases is to describe a rationally ordered sequence of studies, thus enabling scarce research resources to be used in a more efficient manner. These phases allow behavioral interventions to be based on empirically recognized determinants. For example, the phases can allow researchers to determine the current state of development within a subject area and guide future work, including interventions (Sallis et al. 2000). More recently, these phases have been shown to generalize to research with children (Tercyak et al. 2006).

Phase 1: Establish links between behaviors and health. Phase 1 studies are those in which correlations and relationships are established between and among variables (Sallis et al. 2000). These studies examine the effects of specific behaviors, including social and psychological behaviors, on children's health (Tercyak et al. 2006). This phase provides valuable information from which population health guidelines could be established and creates the foundation for continued examination into the causalities of these relationships.

One of the most well-documented environmental risks to children is lead exposure. Stanek and colleagues demonstrated through a 12-month longitudinal study that low-level lead exposure in childhood directly effects growth as measured by head circumference (Stanek et al. 1998). This cause-and-effect of lead exposure through consumption (children's behavior) and abnormal growth patterns (health) exemplify Phase 1 research.

Phase 2: Develop measures of behavior. New measurement tools are needed and used to further evaluate variables that Phase 1 studies may have identified as important (Sallis et al. 2000). This phase focuses on the development of measures through the establishment of their standard properties, such as reliability and validity. Reliability refers to the stability and consistency of a measure, while validity refers to the extent to which a tool measures what it sets out to measure.

A study by Rosenberg and colleagues provides an example of a study that can be classified as Phase 2 research (Rosenberg et al. 2009). Phase 1–like research determined an association between health and walking/cycling among youth (Yeung et al. 2008). While the Neighborhood Environment Walkability Scale (NEWS), which had been shown to measure environmental factors thought to influence physical activity, could be effectively used in studies with adults, there was no corresponding measurement tool for children (De Bourdeaudhuij et al. 2003). In this study, researchers adapted the NEWS for Youth (NEWS-Y). Many studies, this one included, concurrently test a new measurement approach, and validate it within a given population, thereby moving knowledge in the field forward.

Phase 3: Identify influences on behavior. Sallis and colleagues propose several purposes for this third phase (Sallis et al. 2000). First, to examine sociodemographic and other foundational relationships that might affect behavior and, secondly, to test

hypotheses about the causes and directionality of relationships between variables of interest (Sallis et al. 2000). Included in this are studies that identify mediators and moderators of both the behavioral independent and dependent variables. These studies examine social, psychological, behavioral, and other contextual factors. A majority of social and behavioral research in this area can be classified as Phase 3. These studies can help to identify modifiable factors – those that are amenable to change (e.g., smoking cessation) – as opposed to those hereditary factors that predispose someone to a disease. This phase further validates the measures developed in Phase 2, as well as testing hypotheses and exploring correlations.

Early phase research has demonstrated that physical activity is associated with lower weight and obesity prevention (Dionne et al. 2000). However, to move toward an intervention for weight loss or a program engineered to prevent weight gain, other information about factors that affect the physical activity of children is needed. A study examining the correlates of vigorous exercise among adolescent males found that the differences in physical activity stemmed from the presence of a greater number of sports facilities and parks available to these adolescents (Zakarian et al. 1994). In an environmental design context, such resources would need to be strategically placed within communities to permit maximal access to achieve population health benefit. We will explore other environmental design opportunities that can be implemented to address the obesity epidemic later in this chapter.

Phase 4: Evaluate interventions to change behavior. This phase takes the results from the previous three observational phases, and designs interventions that target those behaviors and factors found to influence health outcomes (Sallis et al. 2000). Successful Phase 4 interventions have good efficacy and effectiveness in achieving the desired outcomes.

An example of a Phase 4 study is the piloting of the PATHWAYS to Health Program conducted by Riggs and colleagues (Riggs et al. 2007). These researchers assembled information regarding age and behaviors associated with weight gain derived from early phase studies in order to determine that they would target children in elementary schools, and focus on a combination of eating and physical activity behaviors (Westenhoefer 2002). This school-based program consisted of two separate intervention components aimed at obesity prevention through self-regulation and decision-making skills. These learned skills aided in achieving significant increases in self-regulatory attitudes with regard to food and physical activity.

Phase 5: Translate research into practice. The final phase synthesizes data into a reproducible intervention. Phase 5 studies implement the interventions that may have proved successful in Phase 4, and introduce them to expanded and divergent populations in order to determine sustainability (Sallis et al. 2000).

An example of a Phase 5 intervention is the N-O-T on Tobacco program created in partnership with the American Lung Association (Kohler et al. 2008). This is a voluntary program aimed at aiding adolescents in stopping smoking via an interactive 10-week program conducted at school. This program has translated research on best practices in smoking cessation into a national program that continues to be studied. One of the functions of this phase is to test the ability for a program to generalize across different populations. For instance, after 9 years of implantation across 48

states, new findings which demonstrate negative outcome results of the N-O-T program in the state of Alabama can provide feedback on how to adapt the program for success in differing settings (Horn and Dino 2009). Such findings can help direct modifications for continuous program development.

2.6 Lessons from Obesity and Environmental Health

The remainder of this chapter will focus on the obesity epidemic and various ways of addressing it. As mentioned previously, obesity in the USA for both children and adults has reached an alarming prevalence, with one-fifth of children currently overweight or obese (Ogden et al. 2010). Not only is this a well-recognized problem by the health professional community, but a majority of interventions focus attention on weight loss and maintenance in children (Flynn et al. 2006; Serdula et al. 1999). Obesity is a natural starting point for community health because by addressing the problem of obesity, other chronic health conditions related to obesity are addressed as well, such as cardiovascular disease and Type 2 diabetes risk (Flynn et al. 2006). Most importantly, childhood is a time period when many health behaviors and habits are formed; therefore, those behaviors contributing to obesity can be modified prior to reaching adulthood (Gruber and Haldeman 2009; Crockett et al. 1988).

Along with the increased awareness of obesity as a prominent health issue, an increase in evidence-based research on the factors, especially environmental factors, that either contribute to or prevent risk for obesity, has emerged (Handy et al. 2002; Sallis and Glanz 2006). Barriers to physical activity and nutritional food sources are two of the main ways through which the built environment influences obesity rates (Sallis and Glanz 2009). Sallis and colleagues point to the importance of examining physical activity and access to nutritional food options as factors of obesity that should be addressed in tandem (Sallis and Glanz 2009). As we have discussed, the built environment can detrimentally affect child health, but evidence-based research into those factors that reduce obesity can also shape how the built environment is redesigned, revitalized, and newly created to promote health.

The ecological model provides a framework through which the issue of obesity can be examined in an effective manner. An ecological approach to obesity addresses multiple levels that impact individual behavior, and will be able to affect whole populations (Flynn et al. 2006). In the absence of a unifying and overarching framework that takes into account the multiple levels of influence on behavior, obesity-related interventions have largely focused on teaching individuals new ways of thinking and interacting with food and physical activities. For example, in the PATHWAYS to Health Program described earlier (Riggs et al. 2007), attempts may have been less successful because the environment within which the individual thinks and acts is not consistently conducive to encouraging lifestyle changes (Sallis and Glanz 2009). Therefore, it is important to target not only an individual's behaviors, but the other levels that interact with and impact the individual. Reviews of the literature suggest that effective ways to change physical activity and food behaviors

include changing aspects of the built environment – from the family to policies and laws (Handy et al. 2002; Sallis and Glanz 2006, 2009).

Following the ecological model as described earlier, we will provide examples of studies that take a multilevel approach and address the Interpersonal, Institutional/Organizational, Culture/Community, and Social Structures/Public Policy levels. We will use these studies to demonstrate the effectiveness of addressing childhood obesity through multilevel approaches with a focus on the role of the environment in improving and promoting child health.

Beginning at the Interpersonal level, research has noted that with a focus on the role of the environment in child health, the household is an effective place in which to target childhood obesity. A review by Gruber and Haldeman found that involving the entire family in interventions that target both nutrition and physical activity is more effective compared to targeting only the child (Gruber and Haldeman 2009). The authors found support from the family as an effective means of intervention because of parental influence over food choices and exercise habits through modeling and access to materials. A review has also shown that peer relations affect child eating habits through expectations and social norms; those interventions which incorporate social support can improve eating behaviors (Larson and Story 2009). Although research has shown the family to be an important component in addressing childhood obesity, little research has shown that targeting the family alone is effective in the long term (Eisenmann et al. 2008). Several studies have succeeded in addressing some of the gaps left by family-based interventions by expanding to the next level of the ecological model, the Institutional/Organizational.

Schools provide a good setting for shaping childhood health because of the large amount of time children spend there (Flynn et al. 2006; Franks et al. 2007). One multilevel example, the Coordinated Approach to Child Health (CATCH) Trial, which ran in California, Louisiana, Minnesota, and Texas, targeted elementary schools in addition to involving families (Franks et al. 2007). CATCH exposed children to the skills they needed to make informed choices around food and physical activity, as well as provided them with an opportunity to engage in physical activity during physical education classes and proper nutritional foods while at school. The program was successful, and later expanded to include a community-based level, in addition to the family and school areas (Franks et al. 2007).

A variation of the CATCH Trial was implemented in El Paso, Texas, to determine whether CATCH could achieve similar results in lower-income schools (Coleman et al. 2005). The El Paso study adapted the national CATCH Trial to local community standards and resources (Coleman et al. 2005). A Travis County study drew upon the results from the CATCH Trial and incorporated an additional level by involving community leaders, as well as creating partnerships between the school and the broader community via programming. The Travis County study found significant reductions in children's body mass index relative to those who participated in the standard CATCH Trial (Hoelscher et al. 2010).

Similar to CATCH, SWITCH is an intervention that targets children at the familial, school, and community levels to increase physical activity and intake of healthy food through habit building and teaching them to "Switch what you Do, Chew, and

View” (Eisenmann et al. 2008). At the familial level, SWITCH provided families with methods of measuring and promoting exercise, such as activity jars and charts, as well as monthly information packets to help facilitate a home environment that encourages healthy habits. Children received additional reinforcement in their schools; they were provided with information on healthy recipes and support for active living. SWITCH combined written materials with activities led by interventionists who formed partnerships within each level. In addition, the community had a kickoff party to increase awareness of the intervention, as well as public service announcements.

The Healthy Living Cambridge Kids (HLCK) study succeeded in intervening on the community level through city policy changes to local food preferences that remained in place beyond the time of this Massachusetts intervention (Chomitz et al. 2010). At the Institutional/Organizational level, HLCK provided students with information on healthy choices as well as offering classes on meal preparation and school gardens in which to grow the recommended foods. Families were encouraged to attend fitness expos and family-oriented exercise events, with additional family programs available to children already qualifying as obese. Following the HLCK intervention, researchers found reductions in body mass index in participating children.

While most of the studies included in this chapter have occurred in the USA, a study conducted in the UK provides another example of a multilevel approach to controlling childhood obesity (Maynard et al. 2009). This intervention, DiEt and Active Living (DEAL), targeted children from minority backgrounds and their families within schools and places of worship. DEAL consisted of focus groups at each level to address barriers to healthy eating and physical activity, and offered ways to combat them. The researchers found that by implementing an aspect of the intervention in a place of worship they were able to more effectively target specific cultures through influencing social norms.

At the Policy level there are numerous opportunities to make changes to laws and systems that could improve the environments in which children are physically active and eat. Such policies include requiring land and building developers to construct sidewalks and bike paths, enforcing zoning laws that regulate location of restaurants and grocery stores, and devoting funding toward health education campaigns (Dietz et al. 2009; Perdue et al. 2003). One example of a policy that has been implemented to improve the food environment of children and encourage healthier choices is the Childhood Nutrition Act – a federal legislation which regulates school food policy and resources. Despite the numerous legal interventions that have been offered as important components of an ecological approach to the obesity epidemic, those that have been implemented remain in early stages and the direct and indirect impact of policy changes are not yet fully understood (Dietz et al. 2009). A recent study used computer modeling simulations to explore the impact of introducing new chain grocers in targeted areas on body mass index, concluding that by targeting certain areas with high-prevalence of obesity-related disease policy, implementation can have a positive impact on the health of individuals in those areas (Chen and Florax 2010).

2.7 Partnerships

In order to ensure that there is effective coordination and collaboration across the multiple levels described herein, the development and ongoing commitment of overarching partnerships will be important. A national partnership around obesity prevention allows for multiple sectors, disciplines, and stakeholders to come together with the joint goal of improving child health through changing the environment. The newly formed Partnership for a Healthier America proposes to do just that. According to their website, this organization will “fill a unique niche among childhood obesity initiatives across the United States ... work alongside the federal government to build target industry specific solutions to fighting obesity that can be measured and tracked ... the Partnership will concentrate on mobilizing leadership from across sectors and at every level to take action that can have a significant impact on organizational goals” (Partnership for a Healthier America 2010). Through collaboration with First Lady Michelle Obama’s national campaign, “Let’s Move,” this partnership holds great potential to integrate multilevel action following an ecological perspective and to ensure collaboration between a variety of stakeholder, policy makers, experts, and organizations that have the potential and resources to shape the environment children live in to encourage healthy behavior and combat the obesity epidemic in the USA.

2.8 Evaluation and Measurement

In all of the potential and realized interventions discussed, there is a need for clear definition and evaluation of effectiveness within and across the multiple levels of influence. It is important to not only understand how domains at each level impact child health, but also to measure the ways in which interventions that target one or more domains impact children’s behavior and health (Dannenberg et al. 2003; Richter et al. 2000). Many of the obesity prevention and control efforts reviewed have used body mass index as an outcome measure for effectiveness. However, there is no uniform standard by which to compare improvements. Moreover, it is unclear whether this measurement is indeed capturing significant changes in behavior or truly conveying the impact of interventions. Assessment strategies should include measurement of relevant health behaviors and outcomes along with appropriate and reliable measures of the environment so that the environment–behavior interactions can be fully understood.

In light of the ecological perspective, it is important that these assessments occur in the natural settings in which children live and play – in the environment where they actually engage in health behaviors (Richter et al. 2000). One tool that has been suggested for use in the measurement of broad multilevel campaigns, and as a way to effectively translate research into action, is the health impact assessment. Health impact assessment is designed to predict potential health impact of a policy, program,

or plan, such as a land-use project, that may fall outside the realm of traditional public health initiatives but will likely have a multifaceted impact on health (Northridge et al. 2003). This measurement tool will be valuable as interventions and environments are built with the goal of improving child health. Health impact assessment will be particularly useful in the evaluation of Phase 5 research that aims to disseminate effective health behavior interventions across diverse populations of children, families, and communities.

2.9 Conclusions

In general, there is a need for large, well-integrated studies that both assess environmental characteristics and measure health outcomes in children. Results from these studies would demonstrate to policymakers the positive impact of thoughtful community design and comprehensive multilevel interventions on child health outcomes. This is essential for both the design of new health-promoting communities and the revitalization of existing communities (Dannenberg et al. 2003).

In order to design the environment to improve child health, there must be an understanding and recognition of the multiple elements of the built and social environment that have the potential to promote child health (Jackson 2003) along with comprehensive research to evaluate interventions which target these domains (Dannenberg et al. 2003). This will require a commitment on the part of planners, architects, policymakers, researchers, and public health professionals to work together to implement and evaluate interventions, plan and build health-promoting environments, and develop cross-disciplinary partnerships to achieve healthier environments and healthier children (Cummins and Jackson 2001). Just as the health status of children will affect future well-being, changes to the built environment can continue to have a positive impact on the health of children as they age, research advances, and intervention, policy, and environmental designs evolve. This is true not only for the critical issue of childhood obesity, but for all child health issues globally. Now is the time for research, collaboration, and action around building the environment to promote child health.

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