Commentary: Pediatric Obesity: Systems Science Strategies for Prevention

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Objectives Pediatric obesity is a major public health problem that undermines the physical and mental health of children and increases their risk for adult obesity and other chronic illnesses. Although health care providers, including pediatric psychologists, have implemented prevention programs, effects have been minimal, with no solid evidence of sustainable programs. Methods A systems science framework that incorporates the multiple interacting factors that influence pediatric obesity may be useful in guiding prevention. Results The National Prevention Strategy provides recommendations that can be incorporated into systems science designs, including (1) Healthy and Safe Environments, (2) Clinical and Community Preventive Services, (3) Empowering People, and (4) Elimination of Health Disparities. In addition, our recommendation is that future obesity prevention programs target early in life (pre-pregnancy through toddlerhood) and use multilevel multidisciplinary designs. Conclusions The benefits of preventing pediatric obesity extend from the health and well-being of individual children to the economic security of the nation.

In the past 3 decades, obesity has become a major public health problem with negative consequences that extend from individual health to the economics of the U.S. health care system (Ogden, Carroll, Kit, & Flegal, 2012; Trasande & Elbel, 2012). The epidemic has spread to children. The prevalence of obesity (body mass index [BMI] >95th percentile) is 18.2% among children and adolescents, aged 6–19 years, with even higher rates among African American and Hispanic children (25.7% and 22.9%, respectively), far exceeding the Healthy People 2010 obesity goal of 5% (Ogden et al., 2012; National Center for Health Statistics, 2012). Patterns of obesity begin early in life; prevalence rates are 9.7% among children of age <2 years and 12.1% among 2–5-year-old children (Ogden et al., 2012). Again, rates are higher among Hispanic and African American children, illustrating that the disparities associated with obesity are well in place by toddlerhood. Although health care providers, including pediatric psychologists, have been extremely concerned about pediatric obesity and have launched multiple strategies aimed at either prevention or treatment, the effects have been minimal, with no solid evidence of sustainable programs to ensure that the country can return to healthier patterns of weight gain among children and meet national goals (Zenzen & Kridli, 2009).

Systems Science

What we have learned is that obesity is influenced by multiple factors that extend from individual behavior to community policies. The failure of single-level interventions highlights the emphasis on multilevel interventions and the need for models to guide integrated interventions. Systems science is a framework that may be useful in developing strategies to prevent pediatric obesity (Skinner & Foster, 2013). Systems science is characterized by recognition of the complex relationships among systems components, influenced by responses to both positive and negative feedback (Sterman, 2006). For example, a community with a vision of preventing pediatric obesity
may build a playground, thereby providing a safe place for children to play. However, if the playground is not maintained, if children and families do not use it, or if there is pressure to use the land for another purpose, such as economic development, the community may alter or abandon their original vision by closing the playground. Without access (or perceptions of access) to parks, playgrounds, and gyms, children are at risk for unhealthy eating and low rates of physical activity (Carroll-Scott et al., 2013), illustrating the interplay between environmental opportunities and individual behavior.

Consistent with social ecological theory (Bronfenbrenner & Ceci, 1994), it is easier for children to implement health-promoting skills if their neighborhood includes health-promoting opportunities (such as playgrounds) and the social norms in their home and school are consistent with health-promoting behaviors. One explanation for the weak findings from single-level obesity prevention and intervention trials may be the lack of attention to the physical and social systems that influence health-related behavior (Skinner & Foster, 2013).

Applied to obesity, systems science is often used to understand the physical environment and social networks that drive interventions and health-related behavior (Figure 1). The multilevel basis of systems science is captured by the first National Prevention Strategy, laid out by the Surgeon General’s Office (National Prevention Council, 2011). It focuses on wellness and is designed to make the nation healthier for all Americans by laying out a series of four Strategic Directions: (1) Healthy and Safe Community Environments, (2) Clinical and Community Preventive Services, (3) Empowering People, and (4) Elimination of Health Disparities. The *Journal of Pediatric Psychology*’s decision to focus on innovative strategies to prevent and treat pediatric obesity is timely and illustrates the need to focus beyond traditional single-level models. We have organized our comments on the papers using the National Prevention Science Strategic Directions, and we view the papers from a systems science perspective and discuss how they could incorporate systems science principles into future designs.

**Healthy and Safe Community Environments**

The built environment (all aspects of the surroundings, natural and man-made) may influence risk for obesity by creating a climate that supports inactivity and unhealthy eating (Papas et al., 2007). Aspects of the built environment linked to physical activity and healthy food consumption include access to physical activity facilities, parks, or food stores; pleasing aesthetics; mixed land use; and residential density, walkability, and safety (crime and traffic) (Ding, Sallis, Kerr, Lee, & Rosenberg, 2011; Dunton, Kaplan, Wolch, Jerrett, & Reynolds, 2009). Children’s behavior is influenced both by the built environment and by their perceptions of the environment, illustrating the relevance of a multilevel perspective, including the environment, as recommended by systems science. For example, a study among fifth and sixth graders

![Figure 1. A systems science framework of pediatric obesity prevention, including feedback mechanisms involving families, the physical and social environment, the health care system, and local, state, and national policies (modified from Nader et al., 2012).](image-url)
in Connecticut showed that living within a 5-min walk to a fast food restaurant was associated with a higher BMI (Carroll-Scott et al., 2013). Disparities in the built environment put certain populations at increased risk for an unhealthy diet and inactivity, resulting in obesity.

In this issue, Rogers et al. (Rogers et al., 2013) provide the only example of a program that extends into the community. They illustrated that the Let’s Go! Model, implemented through media, could be used to promote awareness and health-promoting behavior among parents and implementation of environmental changes in childcare programs, schools, and after-school programs. Using Obesity Prevention 5-2-1-0 (5 or more servings of fruit and vegetables, no more than 2 hr of screen time, at least 1 hr of physical activity, and limit sugary drinks), the media campaign had strong and consistent messages on health-promoting behaviors. During the time of the campaign, parents’ awareness of the program increased and children’s dietary behavior improved, illustrating how community-level interventions can contribute to improvements in individual health-related behavior. An example of a systems science extension could be an integrated intervention that also includes individual or family-based components.

A systems science framework can be used to describe how local, state, and national policies and practices influence health behaviors of children and families by affecting (directly or indirectly) a community’s physical, social, and economic environment and community institutions such as schools, childcare centers, and the health care system (Nader et al., 2012). Systems science interventions are complex in that they are geared toward continually changing real-world situations; however, they can address contextual issues unique to each community (Nader et al., 2012).

Clinical and Community Preventive Services
Obesity preventive services for children are often incorporated into health care, childcare, schools, and recreational facilities. In 2007, the American Academy of Pediatrics published guidelines based on Expert Committee Recommendations for the Prevention and Treatment of Pediatric Obesity (Barlow, 2007), including a graded approach to the prevention and treatment of pediatric obesity that incorporates a multidisciplinary team and family-based behavioral intervention. A recent national survey of >800 pediatricians and family practice physicians found that although almost all measured weight and height and questioned patients about dietary intake and physical activity, 50% did not calculate BMI percentiles and most did not use standardized measures to assess diet or physical activity and did not refer children for further evaluation or management (Huang et al., 2011). Concerns about motivation and follow-through, along with discomfort in addressing weight-related issues, may interfere with physician engagement in obesity prevention and treatment (Jelalian, Boergers, Alday, & Frank, 2003). Pediatric psychologists have a long history of collaborating with pediatricians, and the pediatric obesity epidemic may provide more opportunities for collaboration related to both prevention and treatment.

One study in this issue evaluates a pilot school-based study to reduce the risk of eating disorders and obesity (Wilksch & Wade, 2013). The preliminary findings related to shape and weight concern are encouraging, intervention content has been modified, and a trial is underway. A systems science recommendation would be to integrate the intervention into school activities, thereby providing more opportunities for students to practice newly acquired skills in real-life settings, rather than conducting the intervention exclusively in classes.

Empowering People
Motivational interviewing (MI) (Rollnick, Miller, & Butler, 2008) has been an effective intervention strategy that promotes provider–family relationship, clarifies expectations, and focuses on the family’s role in change. Two studies in the current issue focus on motivational strategies. One study (Walpole, Dettmer, Morrongiello, McCrindle, & Hamilton, 2013) conducted among overweight/obese 10–18-year-old youths compared therapy plus MI versus therapy alone and found better retention in the therapy plus MI group, but no group differences in weight loss or self-efficacy. Taken together, the groups experienced a weight loss that trended toward significance and a significant improvement in self-efficacy, suggesting that the therapy may have been beneficial. Extending the intervention into the youths’ homes or communities by involving families is an example of how the study could include a systems science extension.

A second study did include families by comparing a self-directed intervention focused on motivation and autonomy with a prescribed intervention among overweight/obese 7–11-year-old children and their families (Saelens, Lozano, & Scholz, 2013). The parents and children in both groups demonstrated similar patterns, characterized by a significant decline in BMI z-scores at the conclusion of treatment, followed by no further significant change over the 2-year follow-up period. Thus the two treatment conditions (self-directed motivational intervention and prescribed intervention) yielded similar results. A system science perspective may be to extend the
intervention into the community by having families identify and address enablers and barriers to health-promoting behaviors in their communities.

**Elimination of Health Disparities**

Obesity-related health disparities have been associated with poverty, racial-ethnic background, gender, and geographic location (urban vs. rural). Disparities early in life often continue, particularly when the factors that contribute to the disparities remain.

Several studies in this special issue focused on African American or Hispanic children and families, illustrating the benefits of contextualizing interventions through family involvement. In one case, a randomized trial of parent–adolescent communication among African American adolescents and their caregivers was effective in reducing sedentary behaviors (St. George, Wilson, Schneider, & Alia, 2013). Another study conducted among African American and Hispanic girls and their mothers showed that participants in a summer program reduced their abdominal fat and improved their aerobic endurance (Olvera, Leung, Kellam, & Liu, 2013). From a systems science perspective, both studies could focus on sustainability by incorporating social and environmental variables, such as availability of peers and opportunities for physical activity, into the interventions.

Two studies examined innovative programs implemented in rural settings versus standard administration. One study developed a family-based behavior intervention that was delivered to rural children and families either through telemedicine or through structured physician visits (Davis, Sampilo, Gallagher, Landrum, & Malone, 2013). Both groups demonstrated improvements in BMI z-score, nutrition, and physical activity, with no significant differences between the two treatment groups. Another study implemented a Lifestyle Modification Program for adolescent weight loss, comparing group and self-guided intervention sessions in urban and rural settings (Berkowitz et al., 2013). Both strategies produced similar weight reductions, with no significant differences by delivery method. These two studies illustrate that with a strong theory-based program, innovative delivery methods may be as effective as traditional methods in reaching rural children and families. However, in both cases, a systems science perspective would suggest social and environmental extensions into understanding how the health-promoting behaviors can be operationalized and maintained in rural contexts. For example, involving friends or other family members in the activities could be an effective extension.

A third study conducted focus groups among African American girls, parents, and community leaders to examine the feasibility of implementing interpersonal psychotherapy to prevent excessive weight gain and binge eating among rural African American girls (Cassidy et al., 2013). The authors modified their program based on participant recommendations regarding the importance of interpersonal family relationships. The inclusion of stakeholders from multiple sources in the focus groups is consistent with recommendations from systems science. Incorporating community-level recommendations into the intervention should increase the likelihood of their meeting their goal of launching an intervention that overcomes potential barriers to recruitment and participation.

**Specific Recommendations Beyond National Prevention Strategy**

In addition to the recommendations from the National Prevention Strategy, we recommend two additional foci for future obesity prevention research informed by systems science: (1) target early in life (pre-pregnancy through toddlerhood), and (2) multilevel multidisciplinary intervention designs.

**Early in Life**

Interventions that target the first 1,000 days (from conception through 24 months of age) have attracted much attention. The Institute of Medicine has recommended that obesity prevention begin at pre-conception with assurance that women enter pregnancy both physically and emotionally healthy (Institute of Medicine [IOM], 2011). Rapid weight gain early in life increases children’s risk for obesity (Ong, 2010). Pediatric obesity increases the likelihood of adult obesity, making prenatal visits an ideal time to begin an intervention to reduce the likelihood of prematurity or low birth weight, and pediatric well-child visits an ideal time to help families adopt patterns of eating and active living that are associated with healthy weight gain. A systems science perspective would include family and community components for both the prenatal and well-child visits, helping families identify resources and enabling relationships and strategies to adopt health-promoting behaviors.

Recent evidence has shown that pre- and postnatal risk factors during the first 1,000 days increase the risk for pediatric obesity and could be the target of preventive interventions (Monteiro & Victora, 2005). A recent review of evidence-based pediatric obesity prevention strategies early in life found support for the following eight strategies: (1) promote optimal preconception weight, (2) avoid excessive gestational weight gain, (3) return toward a healthy postpartum weight, (4) breastfeeding...
promotion, (5) monitor infant growth for rapid weight gain, (6) promotion of healthy weaning foods, (7) limit screen time, and (8) childcare practices that promote healthy nutrition and physical activity for young children (Nader et al., 2012). Interventions focusing on these strategies would benefit from a multidisciplinary team of investigators, including a pediatric psychologist, and an environmental component.

Young children are fully dependent on others for their care, therefore any intervention aimed at improving the health of very young children needs to include caregivers. Data from our laboratory have shown that mothers of overweight toddlers are not aware of their toddler’s body size and do not desire for them to be smaller (Hager et al., 2012). In-clinic discussions with parents regarding their child’s weight status improve parental accuracy (Hernandez, Cheng, & Serwint, 2010). Universal assessments of parental perceptions of child body size have been recommended in clinical settings (Parry, Netuveli, Parry, & Saxena, 2008) and can be used by pediatric psychologists. Extending the recommendations to the identification of community resources and opportunities may increase the likelihood of parents adopting health-promoting recommendations.

Young children who are temperamentally difficult with behavioral/mental health problems are at increased risk for obesity (Anzman-Fraca, Stifter, & Birch, 2012). Although there may be multiple contributing factors, pediatric obesity has been associated with children’s behavioral/mental health problems and with parenting practices that include managing behavior with food, restricting food, or pressuring children to eat specific food (Anzman-Fraca et al., 2012). Psychologists can screen for temperamental/behavior/mental health problems and work with children and parents to implement adaptive behavior management strategies. From a systems science perspective, interventions that incorporate the child’s home and community environment into the intervention have the highest likelihood of success and sustainability.

**Multilevel Multidisciplinary Interventions**

Early prevention strategies often target the individual, without reaching out to others, including family, peers, school, and community. Relying exclusively on clinic-based or single-site approaches is not feasible, given the magnitude of the obesity epidemic and the multiple factors that promote and maintain obesity (Maziak, Ward, & Stockton, 2008). In response, investigators have begun to implement multilevel multisectorial interventions that extend from single sites to homes and communities (Black et al., 2010). Many of the articles in this special issue include the family in the intervention design, illustrating that obesity prevention extends beyond individual behavior. However, most of the interventions have not embraced the principles of systems science by extending the intervention into other levels or involving stakeholders beyond other health care providers.

In addition to multilevel designs, a multidisciplinary team of investigators can provide a breadth of experience and expertise to an intervention design and evaluation. Although psychologists are often experienced in collaborating with physicians, nutritionists, and exercise scientists, partnering with policy-makers and community stakeholders can inform the research, and facilitate in translating research into practice. Multidisciplinary collaboration can increase the reach and sustainability of obesity prevention programs, consistent with the recommendations of systems science (Sterman, 2006).

**Conclusions**

In conclusion, the studies in this issue highlight the advances that have been made in innovative prevention and treatment of pediatric obesity. However, the serious consequences of the obesity epidemic and the lack of effective interventions have led us to consider how to apply a systems science perspective to obesity prevention. In addition to the recommendations from the National Prevention Strategy that address healthy and safe community environments, clinical and community services, empowering people, and eliminating health disparities, we recommend a pre- and postnatal focus and also multilevel multidisciplinary interventions that incorporate community opportunities. In addition, studies should include enough participants to examine the mechanisms of behavior change and a long enough follow-up to examine sustainability.

Systems science provides a framework that extends beyond the child and family focus familiar to many health care providers, including pediatric psychologists, to include the physical and social environment and the connections and feedback loops with the health care system and local, state, and national policies (see Figure 1, modified from Nader et al., 2012). Although most of the articles in this special issue did not extend beyond the child and family level, they have the potential to extend into children’s physical and social context. A broad perspective that recognizes the complex interplay among systems components is necessary to overcome the obesity epidemic that is threatening our lives (Greenberg, 2013) and undermining the health and well-being of our children.
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References


