
Childhood Obesity: A Social Ecological Approach to Understanding Determinants

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ABSTRACT

The prevalence of obesity among youth and adults in the United States has become a major public health concern, but is a problem on a global scale as well. Whereas obesity is most notably associated with physical health problems, the psychosocial problems associated with this condition cannot be ignored. Because of the great physical, psychosocial, and economic consequences of obesity, there is a need to identify and address the causes of this disorder. This paper describes potential determinants of childhood obesity using individual, interpersonal, institutional, and community level factors consistent with a social ecological framework.

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Introduction

The prevalence of obesity among youth and adults in the United States has been rising dramatically over the last several decades and has become a major public health concern (United States Department of Health and Human Services [USDHHS], 2001). Since the *Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity* (USDHHS) was published in 2001, the rates of obesity have continued to rise. Nationally, approximately 32% of children aged 2-19 are considered overweight or obese (Ogden, Carroll, Kit, & Flegal, 2012); and about 69% of adults over the age of 19 years in the United States are considered overweight, obese, or extremely obese (Flegal, Carroll, Kit, & Ogden, 2012).¹

¹ Obesity in children is defined as a body mass index (BMI)-for-age at or above the 95th percentile on the sex-specific growth charts, whereas being overweight is defined as a BMI-for-age at or above the 85th percentile and below the 95th percentile on the sex-specific growth charts (Centers for Disease Control and Prevention [CDC], 2011a). Overweight in adults is defined as a BMI of 25.0-29.9, obesity is defined as a BMI of 30.0-39.9, and extreme obesity is defined as a BMI of 40.0 or greater (CDC, 2011b). BMI is calculated by dividing weight (in kilograms) by the square of height (in meters) (CDC, 2011b). In this paper, the terms overweight and obesity will be used interchangeably to refer to excess body fat except when the more specific definitions of the terms are more appropriate.

In their report, *Preventing Childhood Obesity. Health in the Balance* (Koplan, Liverman, & Kraak, 2005), the Institute of Medicine (IOM) summarized the major physical, psychosocial, and economic consequences of childhood obesity. The increased prevalence of obesity among youth has sparked concern not only because of its relationship with disease in later life, but also because of increased risk factors and illness during childhood. Obesity among children has been associated with hypertension, glucose intolerance/insulin resistance, dyslipidemia, and other conditions – disorders more traditionally seen in adults. The incidence of type 2 (“adult-onset”) diabetes among youth has risen dramatically, and scientists are forecasting premature death for young people who develop the major complications of diabetes-- neuropathy, nephropathy, and retinopathy. However, the greatest physical health threat of childhood obesity is feared to be a dramatic increase in the metabolic syndrome, which is associated with type 2 diabetes, cardiovascular disease, and increased mortality. Approximately 30% of obese youth have the metabolic syndrome.

Whereas obesity is most notably associated with physical health problems, the psychosocial problems associated with this condition cannot be ignored. Obese youth are subject to stigmatization, negative stereotyping, and discrimination by peers, parents, teachers, and health-care professionals (Koplan et al., 2005). The negative treatment experienced by obese

youth is hypothesized to result in negative body image, poor self-esteem, and depression. Long-term, obese young women may experience economic consequences because they tend to have a lower educational attainment level, lower earnings, and be unmarried.

Not only are there great physical and psychosocial consequences of obesity, but the economic cost of obesity is also a national concern (Koplan et al., 2005). The combined direct and indirect health-care costs of obesity for the nation have been estimated to be between \$98-\$129 billion annually. For youth aged 6-17 years, the direct hospital costs associated with obesity are estimated to be about \$127 million annually.

Because of the great physical, psychosocial, and economic consequences of obesity, there is a need to identify and address the causes of this disorder. It is commonly understood that obesity occurs when energy intake exceeds energy output. However, those who have studied the problem of obesity know that the causes are much more complex than this simplistic explanation suggests. The causes, determinants, or, perhaps more appropriately, correlates of obesity among youth have been reviewed extensively (e.g., Davison & Birch, 2001; Center for Weight and Health [CWH], 2001; Koplan et al., 2005; Spruijt-Metz, 2011). A social ecology of health model considers the influence of the social and physical environments on health (Coreil, Bryant, & Henderson, 2001). Social ecology models recognize that the various components of the system interact with and influence one another and are constantly adapting to change. Determinants of obesity are found within all levels of an ecological model, for example, at the individual, interpersonal, institutional, or community level. Policy underlies many of these determinants, particularly at the institutional or community level. Some of the determinants of childhood obesity are reviewed here by social ecological level. Because the determinants of obesity are so diverse and inter-related, this review is not exhaustive, but attempts to represent some of the most current knowledge on obesity risk factors.

Individual Level

Determinants at the individual level are either biological or behavioral. Some argue that the human gene pool could not have transformed so much as to explain the vast increase in obesity prevalence we have seen in just one generation, yet others suggest that a biological predisposition for some individuals to become obese exists (Bouchard, 2007). Recent evidence suggests there may be several genotypes that may be partially responsible for the obesity epidemic (Bouchard, 2007). Some of these genotypes may be expressed by behaviors such as overeating or physical

inactivity.

The behavioral link to obesity is clearly very strong and the best understood determinant of obesity. Specific behaviors with the strongest link to weight include: physical activity, television viewing, fruit and vegetable intake, sugar-sweetened beverage intake, energy-dense food intake, and breastfeeding (CDC, 2012a). Recently, however, focus has shifted toward inadequate sleep as a risk factor for obesity (Spruijt-Metz, 2011). The effects of inadequate sleep on obesity may be indirect (through its effect on diet and physical inactivity) or direct. For example, if people are tired, they may not want to be physically active. If they are awake for more hours in the day, they may eat more. The direct effect is not entirely understood, but inadequate sleep appears to influence hormones that regulate metabolic rate (Spruijt-Metz, 2011).

Interpersonal Level

For children, one of the greatest influencers at the interpersonal level is the parent. A child of just one obese parent is approximately 2-3 times more likely to become obese as an adult than a child of normal weight parents (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). This concordance between child and parent weight may be due to genetic factors, but it may also be due to the shared environment. Specific parenting practices may also influence child weight or behaviors. Parenting practices that should be *encouraged* because of their apparent association with healthier eating behaviors or a healthier weight among children include:

- Adopting an authoritative parenting style (e.g., Cullen, Baranowski, Rittenberry, Cosart, Hebert, & deMoor, 2001; Cullen, et al., 2000; Drucker, Hammer, Agras, & Bryson, 1999; Kremers, Brug, De Vries, & Engels, 2003; Lytle, et al., 2003; Rhee, Lumeng, Appugliese, Kaciroti, & Brandley, 2006; Young, Fors, & Hayes, 2004);
- Monitoring what children eat or do in general (e.g., Arredondo et al., 2006; Blissett, Meyer, & Haycraft, 2006; Brann & Skinner, 2005; Faith et al., 2004; Kaur et al., 2006; Klesges, Stein, Eck, Isbell, & Klesges, 1991; Lee, Mitchell, Smiciklas-Wright, & Birch, 2001; Spruijt-Metz, Lindquist, Birch, Fisher, & Goran, 2002; Young & Fors, 2001);
- Establishing healthy food rules (e.g., Zabinski et al., 2006);
- Providing verbal praise for healthy eating behaviors (e.g., Arredondo et al., 2006; Vereecken, Keukelier, & Maes, 2004);
- Making healthy foods available and accessible to their children (and do not make unhealthy foods available) (e.g., Bere & Klepp, 2004; Cullen et al., 2004; Cullen, et al., 2001; Cullen, et al., 2000;

Grimm, Harnack, & Story, 2004; Neumark-Sztainer, Story, Perry & Casey, 1999; Young et al., 2004).

- Preparing healthier meals (e.g. Cullen et al., 2004; Neumark-Sztainer et al., 1999);
- Eating meals together as a family (e.g., Gillman et al., 2000; Kusano-Tsunoh et al., 2001; Videon & Manning, 2003); and
- Modeling healthy eating behaviors (e.g., Bere & Klepp, 2004; Brown & Ogden, 2004; Cullen et al., 2001; Matheson, Robinson, Varady, & Killen, 2006; Young et al., 2004).

Parenting practices that should be *discouraged* because of their apparent association with less healthy eating behaviors or obesity among children include:

- Using controlling feeding practices (e.g., Arredondo et al., 2006; Brown & Ogden, 2004; Cullen et al., 2001; Johnson & Birch, 1994; Ogden, Reynolds, & Smith, 2006; Robinson, Kierman, Matheson, & Haydel, 2001; Saelens, Ernst, & Epstein, 2000; Wardle, Carnell, & Cooke, 2005; Wardle, Sanderson, Guthrie, Rapoport, & Plomin, 2002; Young et al., 2004);
- Pressuring, pushing, prompting, or encouraging children to eat (e.g., Arredondo et al., 2006; Baughcum, et al., 2001; Blissett et al., 2006; Bourcier, Bowen, Meischke, & Moinpour, 2003; Brann & Skinner, 2005; Drucker et al., 1999; Faith et al., 2004; Fisher, Mitchell, Smiciklas-Wright, & Birch, 2002; Kaur et al., 2006; Keller, Pietrobelli, Johnson & Faith, 2006; Klesges et al., 1983; Lee et al., 2001; Matheson et al., 2006; Spruijt-Metz et al., 2002; Vereecken et al., 2004; Wardle et al., 2005; Wardle et al., 2002);
- Restricting children's intake (e.g., Arredondo et al., 2006; Blissett et al., 2006; Brann & Skinner, 2005; Faith et al., 2004; Fisher & Birch, 1999; Fisher, Mitchell, Smiciklas-Wright, & Birch, 2000; Kaur et al., 2006; Lee et al., 2001; Matheson et al., 2006; Spruijt-Metz et al., 2002; Vereecken et al., 2004; Zabinski et al., 2006);
- Using food as a reward (e.g., Vereecken et al., 2004; Wardle et al., 2002); and
- Having disordered eating practices themselves (e.g., Francis & Birch, 2005; Hood et al., 2000; Birch & Fisher, 2000).

Some interactions between and adaptations that occur within the individual and interpersonal levels are apparent in the propositions of the obesity proneness model (Costanzo & Woody, 1985), which suggest that if a child is showing signs of becoming overweight, parents who value weight highly will become concerned about the child's weight and may make weight-related comments to the child, who may internalize the weight concerns. In addition, when the parent becomes concern about the child's weight, they

may impose restrictive feeding practices such that the child is not able to learn to self-regulate their eating. The unintended consequences of the parents' concerns are that their children develop weight-related concerns while concurrently being unable to control their eating. Costanzo and Woody (1985) refer to this as *eating guilty* behavior, which is characteristic of disordered eating. An adaptation of the obesity proneness model was found plausible in an adolescent population (Nickelson, Bryant, McDermott, Buhi, & DeBate, 2012).

Sallis, Prochaska, and Taylor (2000) reviewed the correlates of physical activity among youth. Parental correlates of youth's physical activity include:

- Parent physical activity/modeling;
- Parent benefits of physical activity;
- Parent barriers to physical activity;
- Parental encouragement, persuasion, or support;
- Parent provides transportation; and
- Parent pays fees

Clearly, parents have a profound influence on the development of children's eating and physical activity behaviors that influence weight. Other interpersonal influencers for children may be grandparents and other family members, friends/peers, teachers or day care providers, and medical care providers.

Institutional Level

The institutions that most likely influence children are day care centers and schools. With regard to obesity prevention, attention has been focused on school lunches, competitive foods, physical education, and recess (Wechsler, McKenna, Lee, & Dietz, 2004). Whereas care has been taken to improve the federal school lunch program, foods that are sold outside of the program (competitive foods), are not subject to federal regulations. These are foods that might be sold in vending machines, school stores, concession stands, or as á la carte items in the cafeteria. According to a state policy analysis of competitive foods and beverages in U.S. schools conducted by the CDC (2012b), in 2010, 39 states had enacted laws requiring schools to implement competitive food and beverage policies, but the policies varied and many were voluntary. Vending policies may influence children's intake of soft drinks at schools, but do not appear to have an effect on their total consumption of soft drinks, body mass index, or overweight or obesity status (Fletcher, Frisvold, & Tefft, 2010). Again, interactions occur between ecological levels. For example, youth were less likely to purchase soft drinks from school vending machines or consume soft drinks if their parents imposed strict limits on soft drink consumption (Nickelson, Roseman, & Forthofer, 2010).

Physical education requirements also vary by state (National Association of State Boards of Education [NASBE], 2013), and tend to be regulated by school districts. For example, physical education is not required by the state of Alaska, although the statute encourages each school district to include instruction in physical education (NASBE, 2013). The chances of elementary schools offering at least the recommended 150 minutes per week of physical education (National Association of Sport and Physical Education [NASPE], 2004) were almost 3 times greater if they were located in states with a policy requiring the recommended levels of physical education as opposed to being located in those states that did not have such a policy (Slater, Nicholson, Chriqui, Turner, & Chaloupka, 2012). Similarly, elementary schools were almost 2 times as likely to meet the recommended 20 minutes of recess daily if they were located in states with a recess policy (Slater et al., 2012). However, schools were less likely to meet the recess standard if they met the physical education standard, and vice versa, suggesting that schools are providing one form of physical activity or the other, instead of offering the recommended amount of both (Slater et al., 2012). Schools were not likely to meet the recess standards when competing time demands were a factor; in contrast, schools with longer days were more likely to meet the NASPE standards for both physical education and recess. School administrators must be concerned with meeting academic standards as well, and some may not be willing to sacrifice academic time for physical activity time; even though evidence suggests that physical activity improves academic achievement (Slater et al., 2012).

Community Level

At the community level, we can consider both the physical environment and policies that influence the environment. The physical environment includes both the natural and built environments (Secretary's Advisory Committee, 2010), both of which may influence physical activity and nutrition behaviors that affect weight. A review of 20 studies examining the association between the built environment and obesity found that most of them identified some aspect of the built environment that was associated with obesity, but the methodological rigor was questioned (Papas, Alberg, Ewing, Helzlouer, Gary, & Klassen, 2007). Sallis and colleagues (2009) studied neighborhood environments in 11 countries to determine the associations of environmental attributes with physical activity among adults. The neighborhood environment factor most strongly associated with meeting physical activity guidelines was having sidewalks present, followed by transit stops and shops near home,

bicycling facilities, and low-cost recreational facilities. In a review by Ding and colleagues (2011), the most-supported environmental correlates of physical activity for children were walkability, traffic speed/volume, access or proximity to recreation facilities, land use mix or destinations, and residential density. However, some researchers (Ferdinand, Sen, Rahrkar, Engler, & Menachemi, 2012) determined that studies focusing on children were unlikely to find a beneficial relationship between the built environment and physical activity and called for more rigorous study designs. Cross-sectional studies cannot prove causation, and it could be that more active people move into neighborhoods that support their active lifestyle.

Similarly, the evidence linking the nutrition environment with obesity also is inconclusive. Much attention has been placed on "food deserts," neighborhoods that lack convenient options for fresh, healthy, and affordable food (United States Department of Agriculture [USDA], n.d.). To qualify as a food desert, a census tract must be considered low income and at least one-third of the population living within the tract must live more than one mile (or ten miles for non-metropolitan census tracts) from a grocery store or supermarket (USDA, n.d.). Some evidence suggests that the presence of grocery stores and supercenters lowers obesity risk (Jilcott, Keyserling, Crawford, McGuirt, & Ammerman, 2011), but other recent studies have suggested that there is little evidence to support the hypothesis that living in a food desert or being exposed to varying types of food suppliers (e.g., convenience stores versus grocery stores) is linked to obesity among children (An & Sturm, 2012; Lee, 2012). Likewise, although fast food restaurants tend to have fewer healthy food options than full service restaurants and to be more prevalent in minority and low-income neighborhoods than higher income neighborhoods, the presence of these restaurants is not a strong predictor of obesity (Sallis & Glanz, 2006). Efforts have been directed toward increasing the availability of fresh fruits and vegetables through community gardens and farmers' markets (Kettel Khan et al., 2009). Having more farmers' markets in an area is inversely related to obesity in non-metropolitan counties, but this association is attenuated when the presence of grocery stores and supercenters also are considered (Jilcott, et al. 2011).

Menu labeling has the potential to prevent weight gain if people reduce their caloric intake as a result (Kuo, Jarosz, Simon, & Fielding, 2009). However, reviews of the literature suggest that people do not consume less when menus are labeled with calorie information (Harnack & French, 2008; Swartz, Braxton, & Viera, 2011). One qualitative study examined the reasons why menu labeling has not been

more effective at influencing calorie consumption (Schindler, Kiszko, Abrams, Islam, & Elbel, 2013). Most of the participants in this study did not use menu labels even though they were aware of them. Their main reasons cited for not using the labels were price and time limitations, confusion over caloric values, and preference, hunger, and habits taking priority over calorie restriction. For menu labeling to be effective as an obesity prevention strategy, consideration must be given to what influences labeling use and food ordering habits.

Citing the effectiveness of tobacco taxation on reducing smoking, some policy analysts are calling for taxes on sugar-sweetened beverages (Brownell & Frieden, 2009). Estimates suggest that sweetened beverage consumption would be decreased by more than 10 percent with a penny-per-ounce excise tax. In theory, sales taxes are less effective in reducing consumption, because these are only seen at the register. Despite the potential of soda taxes to reduce consumption, one study found no difference in calories consumed from soda, total calories, overweight or obesity status, or body mass index z-score between children and adolescents living in states that had a soda tax versus those living in states that did not (Fletcher et al., 2010). However, these researchers did not examine the differences between states that imposed an excise tax versus those that imposed a sales tax. The type of tax (excise versus sales) is important. Excise taxes are thought to be more effective than sales taxes (Brownell & Frieden, 2009). Excise taxes are usually passed onto the consumer and are reflected in price of the product, so consumers see the price when they make their product selection, whereas sales taxes are only seen at the register (Brownell & Frieden, 2009). Support for soda taxes is generally high, especially if revenues will be used for obesity prevention programs (Brownell & Frieden, 2009).

However, there is less support for regulations on portion sizes, despite the parallel trends in overweight and obesity and large-size portions (Young & Nestle, 2012). The mayor of New York City attempted to enact legislation to regulate soft drink portion sizes, only to have it shot down by the state Supreme Court (Susman, 2013). The governor of Mississippi, the state with the highest rate of obesity in the nation (CDC, 2012c), signed a law that prevents municipalities from enacting policies that limit portion sizes (Yan, 2013). To affect portion size, voluntary non-governmental measures might be a more practical approach. For example, instead of giving a price break for up-sizing, restaurants could institute incentives for ordering smaller portions (Young & Nestle, 2012). Some fast food chains seem to be bowing to the pressure to adopt healthier practices. In 2011, McDonalds reduced the

size of French fries provided in Happy Meals from 2.4 to 1.1 ounces, while adding a small serving of produce (Strom, 2011).

Finally, marketing of foods to children continues to be an issue of concern. Although McDonalds reduced their Happy Meal French fries portion size, they still offer a free toy with the meal (Strom, 2011). Researchers from the Rudd Center for Food Policy and Obesity and the International Obesity Task Force have described how food marketing contributes to childhood obesity, suggest possible solutions to this problem, and describe barriers to change (Harris, Pomeranz, Lobstein, & Brownell, 2009). Marketing food to children begins early, develops brand loyalty, and influences children's intention to buy the products being promoted. Almost all of the foods marketed to children are low-nutrient products that are high in fat, sugar, and/or sodium. Solutions range from holding the family responsible, to self-regulation by the food industry, and to local, national, and international regulation. One of the barriers to change is the prevailing belief that obesity is a function of personal responsibility. This attitude precludes discussions of population-level approaches, including regulation of food marketing to children. However, individual-level, education based approaches must compete against the food industry's \$1.6 billion advertising budget and multi-million dollar lobbying budget. According to the Rudd Center report, in one year Coca-Cola spent more than \$1.7 million in the U.S. to lobby against marketing regulations, school nutrition legislation, and industry and trade issues (Harris et al., 2009). Plainly, combating the effects of food marketing to children will require a multi-level approach.

In summary, it is clear that the causes of childhood obesity are complex and that a multifactorial approach will be needed to address this national crisis. The IOM (Koplan et al., 2005) report on *Preventing Childhood Obesity* recommends action at numerous environmental levels: the national, state, and local governments; the marketplace and media environments; communities; schools; and the home. Perhaps some of the efforts being taken are beginning to have an effect on obesity rates. In the 2009-2010 reporting period, obesity rates in children and adolescents did not continue their rising trajectory as compared to the previous reporting period (Ogden et al., 2012). Continued multi-level efforts will be necessary to turn the obesity rate curve in the downward direction.

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