

Cause and Effect in Childhood Obesity: Solutions for a National Epidemic

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Childhood obesity has reached epidemic proportions in the United States. As a result, children are at increased risk for myriad preventable acute and chronic medical problems—many of which are associated with increased morbidity and mortality. In addition, childhood obesity has serious psychosocial consequences, such as low self-esteem, lower quality of life, and depression. The multifaceted causes and solutions to this pervasive health issue are discussed in the present review, as are pertinent health policy issues. Osteopathic physicians and other healthcare providers can play an important role in patient and family education, direct care, and advocacy.

J Am Osteopath Assoc. 2008;108:545-552

Many social and environmental factors have negatively influenced the physical activity and eating behaviors of US children and adolescents. Financial and time pressures force many families to minimize food costs and meal preparation time, resulting in increased consumption of prepackaged convenience foods that are high in calories and fat.¹ In fact, fast-food restaurants are often concentrated in neighborhoods containing schools and therefore young customers.² Children are also the target of junk food advertisements.³ As a result of these and many other factors, childhood obesity has reached epidemic proportions.

Since the 1970s, the rate of obesity more than doubled among US children aged 2 to 5 years,^{1,4} and recent data from studies conducted by the Centers for Disease Control and Prevention (CDC)⁵⁻⁷ indicate that this increased prevalence of obesity applies to all ethnicities in this age group. Meanwhile, the number of obese children has tripled among youth aged 6 to 11 years and doubled among those aged 12 to 16 years.^{1,4} According to the Institute of Medicine, more than 9 million children and young adults older than 6 years are overweight or obese.¹

Childhood obesity increases the risk of multiple acute and chronic medical problems as well as psychological issues, all of which can persist into adulthood and adversely affect quality of life. Obese children can suffer from orthopedic complications, including abnormal bone growth, degenerative disease, and pain.^{8,9} They are also more likely to have low self-esteem, leading to depression and suicidal ideation, and to engage in substance abuse.¹⁰ One study¹¹ suggested that obese children may have a similar quality of life as children with cancer. Health issues related to obesity are also linked with decreased life expectancy.¹

The estimated 9 million overweight children—including 4.5 million obese children—are at higher risk for type 2 diabetes mellitus, heart disease, cancer, asthma and other pulmonary diseases, high cholesterol, elevated blood pressure, stroke, and other chronic illnesses.¹² Compared with children at a normal weight, overweight children are 70% to 80% more likely to be overweight in adulthood.¹³

Based on current trends, diabetes will occur in an estimated one in three children (30% of boys and 40% of girls) born in 2000.^{1,14} Type 2 diabetes mellitus accounted for 8% to 45% of new pediatric cases of diabetes according to case reports published in the 1990s, compared with less than 4% before 1990.¹ In fact, overweight increases lifetime risk of type 2 diabetes mellitus, potentially reversing trends of increased life expectancy.¹ If these trends continue, adolescents with type 2 diabetes mellitus may have heart disease at as early as 30 or 40 years of age.¹⁵

In the past 3 decades, the annual cost of managing obesity-related diseases among children and adolescents increased more than threefold, from \$35 million in 1979-1981 to \$127 million in 1997-1999.¹⁶ However, the CDC estimates that a 10% weight loss could decrease an overweight person's lifetime medical costs by \$2200 to \$5300.¹⁷

The present review explores the factors that contribute to childhood obesity and presents options for prevention through education, regulation, and the increased involvement of osteopathic physicians and other healthcare providers.

Causes of Childhood Obesity

The cause of childhood obesity is certainly debated. Some researchers have pointed to socioeconomic factors,¹ while advocacy groups have accused mass media as the culprit for marketing junk food to children.^{2,3} In response, food makers

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Submitted March 2, 2007; revision received November 7, 2007; accepted December 18, 2007.

have blamed physical inactivity and a lack of parent influence on diet. Regardless of the outcomes of this debate, these key factors have likely worked together to increase the prevalence of childhood overweight and obesity.

Race, Gender, and Societal Factors

Obesity among children and adolescents is spreading across lines of race, gender, and socioeconomic status, but the greatest increase in prevalence is currently seen among African American, Hispanic, and Native American children.¹⁸ In contrast to the 13% of white overweight youth, 24% of African American, 24% of Mexican American, and 20% of non-Hispanic African American adolescents are overweight.¹⁹ An estimated 39% of Native American youth are at risk of being overweight.²⁰ The prevalence of obesity is particularly high among Mexican American males (more than 27% of children and adolescents) and African American females (22% of children and 29% of adolescents).^{21,22} Obese children are five times more likely to avoid participating in sports and other school activities and have lower emotional, social, and school functioning.¹¹

Societal factors also play a role in childhood obesity. Many urban neighborhoods do not have supermarkets, outdoor produce stands, or other healthy alternatives to convenience stores and fast food outlets, making it harder for residents to purchase fresh and inexpensive produce.²³ Inner city neighborhoods have fewer open spaces for physical activity, more traffic on streets, and more violence—all of which often cause parents to keep their children inside where computers, video games, and television offer sedentary entertainment.²⁴ In addition, neighborhoods across the United States foster increased dependence on cars through insufficient public transportation and fewer sidewalks, trails, parks, and paths for walking and biking.²⁴

Physical Inactivity

The CDC reports that high school students' daily participation in physical education has declined 30% in the past decade.¹⁹ For example, in 2005, only 45% of ninth grade and 22% of 12th grade students attended daily physical education classes.²⁵ Such limited physical activity during and after school contributes to childhood obesity.²⁵

In recent years, state and federal pressure to improve performance on state proficiency tests has forced schools to attempt to meet increased expectations by reducing—or eliminating—time for recess and physical education classes.^{26,27} As a result, only 21% of school children attend physical education classes each week.²⁸

Such low levels of physical activity have been shown to contribute to obesity and consequent circulatory problems. In a 2004 study,²⁹ obese children had reduced blood flow compared with children of normal weight. Blood flow substantially improved after obese children exercised for 8 weeks. As little as 3 hours of aerobic exercise per week significantly reduced

the effects of obesity on blood vessels.³⁰ Furthermore, children in schools with more frequent physical education activity were more likely to have normal body weight.³¹

However, some studies^{32,33} have suggested that physical education classes are not enough to curb childhood obesity. Instead, children's lifestyles must change. Studies^{32,33} suggest that increased afterschool activity outdoors in parks or sport facilities may be more effective in preventing childhood obesity.

Mass Media

Concerns about advertising on children's television were first raised in the early 1970s by Action for Children's Television, a children's advocacy group that urged the Federal Trade Commission (FTC) to limit or forbid direct advertising to children.³⁴ In 1978, the FTC proposed a rule to restrict television advertising directed toward children, citing scientific literature that argued that such advertising was inherently deceptive and unfair.³⁴ This proposal was rigorously opposed by the food, broadcasting, and advertising industries with an aggressive campaign centering around First Amendment protection of their right to provide product information to consumers. Congress, in response to corporate pressure, declined to approve the FTC's proposed advertising limitations and instead passed legislation that removed the FTC's authority to restrict television advertising. However, in 1990, Congress passed the Children's Television Act, which limited commercial time during children's programming.³⁴ Today, the advertising industry maintains self-regulating policies established by the Children's Advertising Review Unit of the National Council of Better Business Bureaus, but these are only guidelines.

Children spend an average of 5.5 hours per day using various media and are exposed to an average of one food commercial every 5 minutes—40,000 television commercials annually.³⁵ Most of those commercials are for candy, high sugar cereals, and fast food.^{36,37} Fast-food outlets alone spend \$3 billion per year in advertisements targeted toward children.³⁸

Advertising campaigns link food, beverage, and candy products with enticing features such as movie and cartoon characters, toys, video games, branded kids clubs, the Internet, and educational materials.³⁹⁻⁴¹ Such advertising is especially influential among children younger than 8 years because they have limited understanding of the advertisers' persuasive intent.³⁵

In the past 2 decades, advertising to children and adolescents in schools has followed the path of marketing and corporate contracts at universities. From 1990 to 2000, commercialism in the form of sponsorship, exclusive agreements, and incentive programs jumped 395%.⁴² Brand preferences begin before purchasing behavior, so exposure of children and adolescents to advertisements can influence purchases made.^{40,43} As a result, today's youth are increasingly targeted with aggressive marketing and advertising practices. They have been deemed consumers because they spend an esti-

mated \$140 to \$160 billion and may influence spending for another \$250 billion annually.⁴⁴⁻⁴⁶

According to a report by the US General Accounting Office (GAO), food sales are the most prevalent form of commercial activity in schools.⁴⁷ The GAO report⁴⁷ also found that the sale of soft drinks by school-exclusive contracts is the fastest growing activity of all product sales in schools.⁴⁷ In addition, the number of fast-food vendors in schools are increasing, as are other types of food-related direct advertising in school computer screen savers, yearbook pages, in-school media channels, and textbook covers.⁴⁸ Typical of schools nationwide, nearly 72% of school districts in California allow campus-based advertising for fast food and beverages, most commonly on vending machines, signs, scoreboards, and posters.⁴⁹ Many school districts, faced with increased budget cuts, are offered money through beverage contracts that allow advertisements through multiple venues.

The nation's three major beverage manufacturers spend ever-increasing sums to boost the amount of soda consumed by US youth because the adult market is stagnant.³⁸ At the 1997 Kids Power Marketing Conference, attendees were told to "discover your own river of revenue at the schoolhouse gates."³⁸ It's working. Soft drink (soda, fruit-flavored sport juice, and partial juice drinks) and sports drink consumption has increased almost 500% in the past 50 years.⁴⁷

Adolescents, on average, get 11% of their calories from soft drinks and consume twice as much soda as milk.⁵⁰ A *Lancet* survey⁵¹ showed that for each additional serving of sugar-sweetened beverage children consumed, the frequency of childhood obesity and average body mass index (BMI) increased. In addition, frequency of exposure to sugary liquids, such as during school hours, increases the risk and severity of tooth decay. In fact, dental caries is the single most common chronic childhood disease and is five times more common than asthma.⁷

Diet—Home and Away

As described, schools provide an increasing amount of unhealthy fast food to their students. In addition to the problems created by competitive fast foods, limited financial resources have reduced interest within schools in meeting federally established nutritional standards for meal programs.²⁰

At-home family meals have been reported to promote healthier dietary patterns.⁵² In addition, obese children and adolescents eat substantially more servings of sugary drinks, potato chips, meat and meat substitutes, and grains when consumption occurs away from home, contributing to an overall higher calorie, fat, and sugar intake.⁵³ Such diets—which are often energy dense, low in fiber, and high in fat—have also been reported to contribute to childhood obesity.⁵⁴

Prevention

Many professional health organizations and advocacy groups support legislation that would address the growing problem

of childhood obesity. However, advocacy groups underwritten by the food and beverage and advertising industries advocate for self-regulation. In considering both sides of the regulation issue, as well as research outside the realm, osteopathic physicians and other healthcare providers can work with their patients and community leaders to influence nutritional and physical activity standards to fight the epidemic.

Advocacy and Regulation

Many strategies have been suggested to curb the problem of childhood obesity. In June 2007, the Expert Committee on the Assessment, Prevention, and Treatment of Child and Adolescent Overweight and Obesity,^{28,55} which comprises representatives from 15 national health and nutrition organizations, issued recommendations for the assessment (*Figure 1*) and treatment (*Figure 2*) of overweight and obese children.

The US Department of Agriculture approves school meal programs, but they do not regulate the nutritional content of

- Obtain annual weight status using body mass index and plot measures on standard growth charts
- Assess dietary patterns
 - self-regulation and readiness to change
 - frequency of eating outside the home
 - excessive consumption of sweetened beverages, 100% fruit juice, and high energy-dense food
 - excessive food portion size
 - low consumption of fruit and vegetables
 - meal frequency and quality; snacking patterns
- Assess physical activity level and sedentary behaviors
 - self-regulation and readiness to change
 - environment, social support, and barriers to physical activity
 - moderate daily activity (1 hour)
 - level of sedentary behavior
- Obtain focused family history for obesity, type 2 diabetes mellitus, cardiovascular disease, and early death from heart disease or stroke
- Physical examination
 - pulse
 - blood pressure
 - fasting lipid profile*
 - AST††
 - ALT††
 - fasting glucose††
 - BUN‡
 - creatinine‡

Figure 1. Recommendations for the assessment of childhood overweight and obesity. *A fasting lipid profile is recommended for overweight children with no risk factors. †The aspartate aminotransferase (AST), alanine aminotransferase (ALT), and fasting glucose measurements are recommended for overweight children with a risk factor in family history or in the physical examination. ‡Measurements of AST, ALT, fasting glucose, blood urea nitrogen (BUN), and creatinine are recommended for obese children, regardless of risk factors. Adapted from Barlow et al.²⁸

most snacks and other high-calorie foods. The American Academy of Pediatricians (AAP) favors limiting high-calorie foods for children in schools and restricting advertising on television and in schools.^{56,57} The American Public Health Association also favors regulation of food and beverages available in elementary and secondary schools.

In a national study of 395 public schools in 38 states, vending machines were available in 82% of middle schools and 97% of high schools.⁵⁸ A la carte items were in approximately 92% of middle and high schools. Three-quarters of those had low-nutrient, energy-dense food or beverages.⁵⁸

The Public Health Institute (PHI), a nonprofit organization dedicated to promoting health, points out that the most prevalent forms of direct (advertisements) and indirect (corporate sponsorship) marketing to children occur on television and in school. Schools are seen as an opportunity to make direct sales, to cultivate brand loyalty, and to be a source of credibility for marketing actions through the association of products with trusted schools and teachers. The PHI recommends off-setting the impact of marketing through legislated restrictions and by funding extracurricular activities sufficiently at all levels so that schools do not have to rely on revenues from soft drink and snack consumption. The PHI also advocates establishing autonomous school district control over beverage and food sales at schools.⁵⁹

In a 2005 report,⁶⁰ the Institute of Medicine concluded that current food marketing and advertising has a negative impact on children's health. They recommended immediate corrective steps to curb this problem, including establishing voluntary guidelines for advertising and marketing to children and developing a means to track changes in marketing and children's health. Previous reports from the Institute of Medicine recommended setting nutritional standards for all food and beverages served and sold in schools and increasing opportunities for frequent, intense physical activity during and after school.⁶⁰

Such initiatives are not without controversy, however. The Center for Consumer Freedom (CCF), an advocacy group underwritten largely by food makers, opposes federal intervention and insists that advertising aimed at children is not a main contributing factor for childhood obesity.^{31,61,62} As stated in one study,⁶³ "It is often assumed that the increase in pediatric obesity has occurred because of an increase in caloric intake. However, the data do not substantiate this." The CCF points to scientific evidence⁶³⁻⁶⁵ which shows that the most meaningful contributor to childhood obesity is a lack of physical activity.

Emphasizing the potential impact of soft drinks, the CCF cites another study,⁶⁴ which revealed that children from schools with and without sales of soft drinks consumed an average of 33.5 and 32.5 grams of sucrose per day, respectively. The researchers maintain that the extra gram of sucrose accounted for approximately 4 calories and conclude that soft drink consumption in schools is not associated with increased risk of

■ Stage I—Preventive protocol

- dietary habits
 - daily breakfast
 - ≥5 servings of fruit and vegetables daily
 - no sugar-sweetened beverages
 - limited meals outside the home
 - ≥5 family meals per week
 - self-regulation of meals
- physical activity
 - ≤2 hours of daily "screen time" (eg, computer, television, video games) and no television in child's bedroom
 - ≥1 hour daily physical activity

■ Stage II—Structured weight management

- dietary habits
 - balanced macronutrient diet
 - structured daily meals and snacks
- physical activity
 - active play ≥1 hour daily
 - ≤1 hour of screen time daily
- increased adult monitoring of child's dietary habits and physical activity

■ Stage III—Comprehensive multidisciplinary protocol

- eating and activity goals as in Stage II
- structured behavioral modification program with short-term diet and activity goals
- involvement of family caregivers for behavioral modifications

■ Stage IV—Tertiary care protocol

- diet and activity counseling; possible meal replacement
- very low calorie diet, medications, or surgery may be necessary

Figure 2. A staged approach for the treatment of overweight and obese children. The recommendations at each subsequent stage are to be used if the previous stage does not improve the patient's body mass index or weight status. Adapted from Barlow et al.²⁸

overweight.⁶⁴ The CCF also cites a Harvard study⁶⁵ of more than 14,000 adolescents that found no link between soft-drink consumption and obesity. Further, the CCF counters the argument for substitution of healthy fruit juices for soft drinks by pointing out that "fruit juice and other healthy alternatives often have more calories than soda."⁶² As a result, the CCF maintains that school-aged children in the United States have a severe deficit in physical activity.

The National Restaurant Association (NRA), the Grocery Manufacturers of America, and the Association of National Advertisers are all in agreement. The NRA, the leading business association for the US restaurant industry, opposes federal intervention, stating that the problem needs to be addressed through "education, personal responsibility, moderation, and healthier lifestyles."⁶⁶ The group argues that holding restaurants and food companies responsible for food choices is irrational and attempts to make food sellers, manufacturers, or distributors liable for obesity.^{66,67} The NRA cites its proactive commitment to nutrition and healthy lifestyles and

encourages “promoting balance and moderation in diet and physical activity as keys to healthier living.”⁶⁷

As the world’s leading branded food, beverage, and consumer product organization, the Grocery Manufacturers of America opposes all legislation that would restrict or regulate sales of food and beverages in schools. Instead, they advocate for self-regulation of the industry and its advertising efforts.⁶⁸ The Association of National Advertisers, a trade organization representing more than 340 companies with 9000 brands that collectively spend \$100 billion in advertising, communication, and marketing,⁶⁹ opposes restrictions on advertising during children’s television programming, citing First Amendment rights and the economic interests of its members.⁷⁰ This group opposes linking food advertising to childhood obesity, stating that decisions regarding “good” and “bad” foods belong in the hands of responsible parents.³⁸

The Osteopathic Approach

Osteopathic physicians, their allopathic counterparts, and other healthcare professionals have numerous opportunities to encourage children, adolescents, and their parents to engage in healthy lifestyles, to influence their awareness of obesity as a health issue, and to offer education regarding prevention and treatment options. For example, they can provide children and adolescents—and their parents—with age-appropriate strategies to make more informed choices concerning diet, nutrition, physical activity, and other lifestyle modifications. Explanations of the consequences of obesity should also be provided. However, in order for healthcare professionals to play a pivotal role in combating childhood obesity, their approach will have to go beyond routine medical office encounters.

It is important to recognize the influence of family, educational, social, cultural, environmental, economic, and political forces on the health of children.⁷¹ Systematic threats to the health of US children, including obesity, cannot be adequately addressed by individual efforts that are limited to the clinical office setting.⁷² Osteopathic physicians, who are trained to treat the whole patient, are particularly suited for this endeavor.

Physicians need to assume a key role in creating, organizing, and implementing changes in continuing efforts to improve children’s health. This work can be accomplished through collaborative efforts with colleagues, professional organizations, health departments, educators, schools, youth agencies and programs, childcare providers, and policymakers. Physicians can use local community data to elevate the understanding of children’s health and social issues to identify and decrease barriers for optimal health and to promote supportive neighborhood structures. As a collaborative effort, they can also urge schools—which have substantial influence on the eating and exercise habits of US children—to assess students’ BMI, to offer daily physical activity programs, and to secure nutritional standards for food served in schools.

The Coordinated Approach to Child Health (CATCH) is a national program designed to build a multidisciplinary coalition of alliances among children, parents, educators, and others to teach children lifelong healthy practices.⁷³ The implementation of CATCH programs has been responsible for efforts to reduce fat content of school lunches, increase physical activity and the number of physical education classes, and influence students’ self-reported eating habits and levels of physical activity.⁷⁴

Together, CATCH and the AAP have shown that combined efforts to prevent childhood obesity can be successful. A search on the AAP Web site (<http://www.aap.org/comm/peds/grantsdatabase/grantsdb.cfm>) reveals the numerous grants funded by CATCH in these efforts, as follows:

- promote healthy lifestyle choices
- provide nutritional fitness and psychological counseling to overweight adolescents
- replace television with fun and simple exercise
- enhance awareness about the scope and complications of childhood obesity and its effect on school performance
- modify school policy regarding foods served in school lunches
- create obesity clinics and clinic-based healthy lifestyle programs

The AAP also advocates for physicians to assume leadership positions where they can serve as agents of change in the abundant areas of opportunity in childhood obesity prevention. Such efforts include promoting physical activity in many settings, decreasing availability of low-nutrition foods in schools, working with policymakers to support healthy lifestyles for children, and encouraging research into mechanisms to prevent overweight and obesity in children.⁷⁵

Osteopathic physicians, who are in key positions to take roles as leaders and advocates, should consider using their influence to emphasize that preventing obesity is as important as other well-accepted health strategies such as routine immunizations. The American Osteopathic Association recently took steps to support some of these efforts (Resolution B02 [M/2008]—Pediatric Obesity; Resolution B03 [M/2008]—Pediatric Obesity/Measurement; and Resolution B04 [M/2008]—Pediatric Nutrition). Further resolutions should be considered by the osteopathic medical profession that would require physical activity in schools. Likewise, we may wish to assess the effect of advertising aimed at youth regarding poor nutritional choices, such as discontinuing the availability of high sugar-content beverages in schools.

Comment

There is no universal agreement among stakeholders regarding how best to address the issue of childhood obesity. Historically, decisions about education and behavior have been left to individual school districts and families. More recent piecemeal

solutions have not proven effective. Because obesity is a complex sociocultural issue, many advocate that only a multifaceted approach spearheaded at the federal level will offer the best opportunity to address this pervasive challenge.

Preventive strategies have to be directed at children, parents, school systems, and educators. Regulations may need to be enacted to curtail the negative impact of the media on children's eating habits. Abundant evidence demonstrates the benefit of behavioral change to combat obesity and its comorbidities.⁷⁶

Most researchers and medical practitioners agree that exercise and appropriate nutrition are essential for obesity prevention and optimal health. Federal agencies such as the US Department of Health and Human Services could train childhood educators on obesity prevention and provide grants to promote collaborative services to at-risk youth. Academic centers could develop programs focused on behavior modification, improved nutrition, and increased physical activity. However, nutritional information, though helpful, will not have much impact if school menus do not change. Likewise, increased physical activity may help prevent and reduce childhood obesity, but recommending more exercise will not have much impact if physical education programs are not available.

A key part of any multifaceted solution to the childhood obesity problem may be to consider national guidelines to regulate the advertising and marketing of foods. As long as children are exposed to ubiquitous advertising at home, at school, and on sports fields, even nutrition education and increased physical education may not be effective countermeasures. Federal guidelines and sanctions may be needed to protect children and adolescents from advertisers who not only promote unhealthy dietary choices, but who also reinforce sedentary leisure activities.

Conclusion

Many complex social, environmental, and financial forces influence the eating behavior and activity levels of US children and adolescents. Whatever actions individual physicians and medical organizations take, the time for focused multidisciplinary action is now. The current epidemic of childhood obesity, if left unchecked, may result in today's children having shorter and less healthy lives than their parents.

Acknowledgments

I sincerely thank Nancy Cooper, BSEd, Coordinator of the AOA Health Policy Fellowship, for her invaluable input and editorial assistance and Susan Wetzel for her assistance in manuscript preparation. I also thank Lisa Travis, MS, medical librarian at Lincoln Memorial University-DeBusk College of Osteopathic Medicine in Harrogate, Tenn, for her invaluable input.

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Editor's Note: In conjunction with the 80th National Child Health Day on October 6, 2008, events were held nationwide to promote physical activity, healthy eating habits, and healthy choices among US youth. To learn more about this cause, visit <http://mchb.hrsa.gov/childhealthday/>.

To learn more about childhood obesity and type 2 diabetes mellitus, readers are encouraged to view the September article by Malcolm S. Schwartz, DO, and Anila Chadha, MD, titled "Type 2 Diabetes Mellitus in Childhood: Obesity and Insulin Resistance" (*J Am Osteopath Assoc*. 2008;108:518-524). This article is available online at <http://www.jaoa.org/cgi/content/full/108/9/518>.