



Published in final edited form as:

Prim Prev Insights. 2015 ; 5: 1–4. doi:10.4137/PPRI.S12291.

Obesity Prevention and Treatment in School-aged Children, Adolescents, and Young Adults—Where Do We Go from Here?

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Abstract

The rise in the rate of obesity in school-aged children, adolescents, and young adults in the last 30 years is a clear healthcare crisis that needs to be addressed. Despite recent national reports in the United States highlighting positive downward trends in the rate of obesity in younger children, we are still faced with approximately 12.7 million children struggling with obesity. Given the immediate and long-term health consequences of obesity, much time and effort has been expended to address this epidemic. Yet, despite these efforts, we still only see limited, short-term success from most interventions. Without changes to how we address childhood obesity, we will continue to see inadequate improvements in the health of our children. Clinicians and researchers need to be lobbying for evidence-based policy changes, such as those identified by systems science, in order to improve the nation's health.

Keywords

obesity prevention; obesity treatment; children; adolescents; systems science

Worldwide, the rate of obesity has doubled since 1980, with 1.4 billion adults identified as overweight and more than 10% of the world's adult population being obese (body mass index [BMI] to 30),¹ leading the World Health Organization to declare obesity as a worldwide epidemic.² In the United States, 68.5% of adults are overweight or obese, with 34.9% of those obese.³ For children in the United States, 31.8% of youth 2–19 years of age are overweight, with 16.9% of those obese.³ The percent of obese children in the United States has not changed significantly since 2003–2004,³ resulting in a healthcare crisis that needs to be addressed. Clinicians, researchers, and laypersons are all aware that this current generation of children will “live less healthy and possibly even shorter lives than their

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COMPETING INTERESTS: Authors disclose no potential conflicts of interest.

Author Contributions

Developed the structure and discussion for the manuscript: SK and SG. Contributed to the writing of the manuscript: SK and SG. Made critical revisions and approved final version: SK and SG. Both authors reviewed and approved of the final manuscript.

parents,”⁴(p.1143) as a result of the consequences of overweight and subsequent medical conditions such as type 2 diabetes.

Overweight and obese children are at risk for immediate and long-term health consequences, including cardiovascular and metabolic risks, and additional comorbidities, including obstructive sleep apneas, nonalcoholic fatty liver diseases, and musculoskeletal disorders,^{5,6} many of which are preventable. Other complications of childhood obesity include psychosocial consequences, including disordered eating.⁶ Decreased self-esteem is noted as a significant sequela and is associated with sadness, loneliness, nervousness, and high-risk behaviors. Children are stereotyped, ostracized, and bullied because of their weight.⁷ Adverse psychosocial effects are more often seen and have increased severity in White children, especially girls.⁵ Recent evidence further highlights the vulnerability of these children, identifying a significant relationship between being overweight and being bullied as a teen and continued increasing obesity in young adulthood.⁸

Obesity has gained national attention, including attention from the First Lady Michelle Obama, with her Let’s Move campaign (<http://www.letsmove.gov/>), and significant time, attention, and money have been invested in community programs and scientific research to identify, prevent, and treat childhood obesity. Recent national reports have been highlighted as showing potentially positive improving trends in the percent of young children (2–4 years of age) who are considered overweight/obese.^{9,10} In a national sample of data collected between 2008 and 2011 from 40 states and territories, a statistically significant decrease in the prevalence of obesity among children 2–4 years old was noted in 19 states/territories; however, 20 states experienced no changes and 3 states actually had an increase in prevalence.⁹ These are the numbers being cited as giving hope to many that the efforts to improve the childhood obesity epidemic through public health initiatives are working and that the health of children in the United States is moving in the right direction.^{9,11} While it is encouraging that some improvements are occurring, there is clearly still much work to be done. We cannot forget about the approximately 12.7 million children of all ages who continue to struggle with obesity.¹²

While the plateauing trend of overall obesity rates in children is positive news, the number of *severely* obese children in the United States is distressingly on the rise. Data indicate that in the last 14 years, all classes of obesity have increased in children.¹³ Evaluation of data from the National Health and Nutritional Examination Survey from 1999 to 2012 showed that 5.9% (95% confidence interval [CI]: 4.4–7.4) of children aged 2–19 years met the American Heart Association definition of *severe obesity* (ie, BMI greater than 120% of the 95th percentile for age and sex or a BMI of 35 or greater, whichever is lower), the equivalent to class II obesity in adults (BMI = 35.0–39.9). This was a statistically significant increase from the 1999–2000 data that identified 3.8% (95% CI: 2.7–4.9) of all children meeting this criteria. In addition, 2.1% (95% CI: 1.6–2.7) of children in the 2011–2012 data had a BMI equivalent to class III obesity in adults (ie, BMI ≥ 40),¹⁴ compared to 0.9% (95% CI: 0.6–1.3) of children in the 1999–2000 data, with rates highest in adolescents and non-Hispanic black children.¹³

Current Efforts

While obesity is a multifactorial, complex disorder, with genetic and environmental origins, behavioral and familial factors are key determinants in children's risk for becoming overweight or obese.^{15–18} Behavioral factors (ie, diet, activity, screen time) appear to be the most amenable to change.¹⁹ Given that children spend most of their time in either school or home, numerous clinical trials have focused on these settings, particularly schools, to improve nutrition and increase activity in children.^{20–22} Recent high-quality systematic reviews and meta-analyses have identified over 200 studies investigating childhood obesity prevention and treatment programs,^{20–22} highlighting the attention being given to this epidemic. Many of the studies seek to address recommendations from organizations such as the American Academy of Pediatrics (AAP) and the Institute of Medicine (IOM) to encourage positive changes at both home and in schools to support healthy diet and activity changes for children.^{23,24} The IOM has specifically called for schools to modify policies to provide adequate physical education and recess time and meet established nutritional guidelines for all foods offered in schools, including those in vending machines.²⁴

Clinical trials focused on childhood overweight and obesity can be divided into two types: prevention or treatment. In most prevention trials, focus is on preventing normal-weight children from becoming overweight. Many prevention trials also include overweight and obese children and monitor for weight maintenance and loss, which is considered as important a success as preventing normal-weight children from changing weight categories. In contrast, treatment trials focus on weight loss and maintenance of weight loss over time following the intervention. Key outcomes for both types of trials are assessed by using one or more weight-related measure such as BMI, BMI *z*-score, prevalence of obesity or overweight, percent body fat, and skinfold thickness, making comparisons across studies difficult. In addition, many explore secondary or intermediate outcomes including behavior changes, such as increasing physical activity or fruit and vegetable intake or decreasing intake of sugar-sweetened beverages, many of which are also measured in different manners, and often inadequately (activity and nutrition are simple concepts but difficult to measure accurately), making comparisons impossible.^{20–22}

A Cochrane review of the published clinical trials aimed at *treating* childhood overweight and obesity identified that combined behavioral lifestyle interventions can produce statistically significant and clinically meaningful reductions in overweight in children and adolescents, although outcomes vary.²² For children over 12 years of age, data indicate small, but encouraging changes in several measures, with an notable overall decrease in absolute BMI of -3.04 (95% CI: -3.14 to -2.94) for children in behavioral intervention versus those receiving standard care.²² More importantly, specific meta-analyses of treatment trials also indicate that weight loss can be maintained at 6 and 12 months follow-up in specific groups including children in lifestyle interventions and adolescents in lifestyle interventions that may or may not include medications.²² However, in many trials, long-term outcomes (beyond 12 months) are frequently not assessed or reported. The limited success of these trials highlights the difficulty of treating existing obesity, particularly severe obesity, among children and adolescents.

A systematic review of pediatric obesity *prevention* trials also reports that there is moderate-to-strong support for school-based interventions that focus on augmenting school curriculum to increase physical activity, education for children regarding healthy nutrition and activity, and improve the quality of food offered in school cafeterias to prevent the development of overweight and obesity in children and adolescents.²¹ These findings are further supported by another more recent systematic review of obesity prevention programs, which reported that combined diet and physical activity interventions in school, home, and community-based settings have been found to have significant positive outcomes related to obesity prevention.²⁰ The current Cochrane review of childhood obesity prevention interventions states that programs can be effective in reducing adiposity in children, particularly school-aged children (6–12 years old), but with children in the intervention arm of studies having only an overall mean statistically significant difference in adiposity (BMI or BMI z-score) of -0.15 kg/m^2 (95% CI: -0.21 to -0.09).²¹ Findings were similar from the current AHRQ review (-0.17 kg/m^2) (95% CI: -0.57 to 0.23), although not statistically significant.²⁰ While it is noted that these findings are encouraging on a population level, it is unclear what the implications are for individual children and adolescents struggling to maintain a healthy weight or lose a significant amount. Furthermore, the heterogeneity in study designs, samples, measures, and analyses make it “not possible to distinguish which of these components contributed most to the beneficial effects observed,”^{21(p.2)} thus only supporting broad recommendations that are consistent with the established AAP and IOM guidelines and limited in promoting new, truly innovative practices, not helping to move either implementation science or clinical practice forward.

Although the research that is published is somewhat encouraging, what is lost in the fine print is that change in individual weight-based outcomes are minimal and behavioral and lifestyle changes are only modest and short-lived, many disappearing when the intense focus of the intervention is gone.^{20–22} Furthermore, there is a publication bias to highlight the *positive* impact of obesity prevention interventions and to overemphasize secondary outcomes.²⁵ For example, a recent innovative trial that was well-designed and theory driven, with moderate intensity and incorporated new technologies such as smart-phone applications and Web technology, showed no change in measures of body composition or physical activity.²⁶ However, mild-to-moderate effects for secondary outcomes, such as sweetened beverage consumption, screen-time reduction, and improvement in muscular fitness were touted as evidence that the intervention demonstrated *favorable impact* and has a promising influence on key behaviors that affect weight and cardiometabolic risk.^{26(p.e730)} Another intense 3-year, school-based physical activity trial emphasized that there were positive changes in percent body fat between children in the treatment and control arms of their intervention, although the authors then acknowledge that differences diminished in summer months and were gone by the end of the study (33 months).²⁷ A recent meta-analysis provided strong evidence that physical activity interventions to date have also had only small effects (amounting to an increase of 4 minutes of activity per day).²⁸

Clearly, we are making some improvements, but it is not enough to make tremendous headway in significantly decreasing child and adolescent obesity rates. Perhaps if we change our thinking and focus on interconnected systems and not only on changing individual

children's behavior, new, innovative answers will become clearer. Funders and policy makers need to be brought into these discussions because there needs to be an extensive shift in the focus and funding of future research. Until there is a shift in policy and support for research that allows for application and testing of system changes, we will not move science forward and risk losing a generation of children.

Where Do We Go from Here?

The literature continues to call for further study of larger, varied samples and longitudinal evaluation of outcomes. However, it could be questioned that continuing to investigate answers to the obesity epidemic in the same fashion as we currently do is possibly a waste of valuable resources. Few obesity prevention and intervention trials report detailed cost-effectiveness analyses; thus, we have no true idea of the return on investment for small changes in children's overweight status. It has been suggested that an *ingrained over-optimism* in believing that population change will be affected by "educational and motivational means" clouds judgment of researchers and policy makers as to how to continue to investigate and address this issue.^{25(p.e846)} Are we intervening on the right people at the right time? Are school-age children and adolescents the populations that should be concentrated on for prevention and intervention? Should we focus on more aggressive treatment of those adolescents most at risk? Should we move prevention efforts further back in the lifecycle of obesity?²⁹ Is it more important to target individual and family factors or broader *system* factors? How do we cost-effectively address an epidemic with multiple causes, many of social and environmental origin?³⁰

Systems science may point to the most promising prevention and intervention efforts, although it appears there is a hesitancy to make the bold policy changes these analyses support. A population-based analysis that pooled data from four large German studies (>30,000 children) highlights the specific difficulties of tackling childhood obesity from a social perspective. Estimates show that if prevention programs were developed to tackle all determinants of obesity, child overweight could be reduced by 77.7%, with the strongest partial effects coming from treating parental overweight (42.5%), improving social/socioeconomic status (14.3%), and decreasing media/screen time to less than 1 hour a day (11.4%).³¹ Developing programs to address all determinants at once is clearly not feasible, and targeting higher level determinants such as social status would require momentous shifts in policy and social change,³⁰ yet interventions that are not multilevel or system level have been demonstrated to be inadequate.

Juxtaposed to this tension of how much and at what level to intervene, a recent provocative study used computer simulations to determine the expected impact of three potential and feasible federal policies related to childhood obesity: (1) the effect of a 1-cent-per-ounce excise tax on drinks with added caloric sweeteners, (2) the implementation of after-school programs that feature 60–90 minutes of moderate to vigorous physical activity 3–5 days per week, and (3) a ban on television advertising for fast food that targets children 12 and under.³² Most notably, the study found that an excise tax on sugar-sweetened beverages would have the most impact, resulting in a 2.4 percentage point decrease in obesity among adolescents in the next 20 years,³² which theoretically would then also improve future

obesity rates in adults, and their offspring. Kristensen and colleagues further present an interesting discussion, noting that the implementation of a tax on sugar-sweetened beverage is also an untapped revenue generator for local, state, and/or federal governments. They provide supporting data, which estimate that such a tax could have generated over \$13 billion dollars in 2010.³³ Despite the growing body of literature that provides clear evidence to support this public health intervention,^{34–37} there is public hesitancy to institute such changes, limiting the ability to investigate the effects of the intervention in a real-world environment. Currently, only one American city, Berkeley, CA, has passed a soda tax by public vote this year, while this tax proposition has failed to pass in other cities. Ignoring evidence-based policy recommendations is unethical. Can we afford to ignore what could be one of the simplest and most attainable strategies to counteract the childhood obesity epidemic, or not learn our lesson from prior dealings with the tobacco industry?³⁸ As clinicians and researchers, this is an ideal opportunity to speak out and lobby for a single policy change that can and will have a direct impact on the health of children.

Summary

Without changes to how we address the epidemic of childhood obesity, we will continue to only see inadequate improvements in the health of our children. While sweeping policy and societal changes may not be feasible, we certainly can advocate for single evidence-based policy changes, such as a soda tax. Clinicians and researchers must continue to advocate and work for innovative, evidence-based policy changes so we truly help families help their children.

Acknowledgments

FUNDING: S.B. Gesell was supported by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD) grant number K23 HD064700. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the NICHD.

REFERENCES

1. World Health Organization. Obesity and Overweight. Media Centre Fact Sheets 2014. Available at: <http://www.who.int/mediacentre/factsheets/fs311/en/>
2. World Health Organization. Obesity: Preventing and Managing the Global Epidemic. Report of a WHO Consultation World Health Organization. Geneva: WHO; 2000. p. 1-252.
3. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA*. 2014; 311(8):806–814. [PubMed: 24570244]
4. Olshansky SJ, Passaro DJ, Hershow RC, et al. A potential decline in life expectancy in the United States in the 21st century. *N Engl J Med*. 2005; 352(11):1138–1145. [PubMed: 15784668]
5. Ebbeling CB, Pawlak DB, Ludwig DS. Childhood obesity: public-health crisis, common sense cure. *Lancet*. 2002; 360(9331):473–482. [PubMed: 12241736]
6. Kelly AS, Barlow SE, Rao G, et al. American Heart Association Atherosclerosis, Hypertension, and Obesity in the Young Committee of the Council on Cardiovascular Disease in the Young, Council on Nutrition, Physical Activity and Metabolism, and Council on Clinical Cardiology. Severe obesity in children and adolescents: identification, associated health risks, and treatment approaches: a scientific statement from the American Heart Association. *Circulation*. 2013; 128(15):1689–1712. [PubMed: 24016455]
7. Puhl RM, Peterson JL, Luedicke J. Weight-based victimization: bullying experiences of weight loss treatment-seeking youth. *Pediatrics*. 2013; 131(1):e1–e9. [PubMed: 23266918]

8. Mamun AA, O'Callaghan MJ, Williams GM, Najman JM. Adolescents bullying and young adults body mass index and obesity: a longitudinal study. *Int J Obes (Lond)*. 2013; 37(8):1140–1146. [PubMed: 23164697]
9. Centers for Disease Control and Prevention (CDC). Vital signs: obesity among low-income, preschool-aged children-United States, 2008–2011. *MMWR Morb Mortal Wkly Rep*. 2013; 62(31): 629–634. [PubMed: 23925173]
10. Pan L, Blanck HM, Sherry B, Dalenius K, Grummer-Strawn LM. Trends in the prevalence of extreme obesity among US preschool-aged children living in low-income families, 1998–2010. *JAMA Pediatr*. 2012; 308(24):2563–2565.
11. Wabitsch M, Moss A, Kromeyer-Hauschild K. Unexpected plateauing of childhood obesity rates in developed countries. *BMC Med*. 2014; 12:17. [PubMed: 24485015]
12. Centers for Disease Control and Prevention. *Childhood Obesity Facts: Prevalence of Childhood Obesity in the United States, 2011–2012*. Atlanta, GA: Centers for Disease Control and Prevention; 2014.
13. Skinner AC, Skelton JA. Prevalence and trends in obesity and severe obesity among children in the United States, 1999–2012. *JAMA Pediatr*. 2014; 168(6):561–566. [PubMed: 24710576]
14. World Health Organization. *Global Database on Body Mass Index: BMI Classification*. Geneva: World Health Organization; 2014.
15. Freemark M. Predictors of childhood obesity and pathogenesis of comorbidities. *Pediatr Ann*. 2014; 43(9):357–360. [PubMed: 25198443]
16. Bouchard C. Defining the genetic architecture of the predisposition to obesity: a challenging but not insurmountable task. *Am J Clin Nutr*. 2010; 91(1):5–6. [PubMed: 19939981]
17. Huang TT, Drewnoski A, Kumanyika S, Glass TA. A systems-oriented multilevel framework for addressing obesity in the 21st century. *Prev Chronic Dis*. 2009; 6(3):A82. [PubMed: 19527584]
18. Davison KK, Birch LL. Childhood overweight: a contextual model and recommendations for future research. *Obes Rev*. 2001; 2(3):159–171. [PubMed: 12120101]
19. Must A, Barish EE, Bandini LG. Modifiable risk factors in relation to changes in BMI and fatness: what have we learned from prospective studies of school-aged children? *Int J Obesity (Lond)*. 2009; 33(7):705–715.
20. Wang, Y.; Wu, Y.; Wilson, RF., et al. *Childhood Obesity Prevention Programs: Comparative Effectiveness Review and Meta-Analysis*. Rockville, MD: Agency for Healthcare Research and Quality (US); 2013. [13-EHC081-EF]
21. Waters E, de Silva Sanigorski A, Hall B, et al. Interventions for preventing obesity in children (review). *Cochrane Collab*. 2011; 12:1–212.
22. Oude Luttikhuis H, Baur L, Jansen H, et al. Interventions for treating obesity in children. *Cochrane Database Syst Rev*. 2009; 1:1.
23. Barlow SE. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics*. 2007; 120(suppl 4):S164–S192. [PubMed: 18055651]
24. IOM Committee on Prevention of Obesity in Children and Youth Food and Nutrition Board. *Preventing Childhood Obesity: Health in the Balance*. Washington, DC: National Academies Press (US), Institute of Medicine; 2005.
25. Wake M, Lycett K. Let's call it as it is: on results, reach, and resolution in population-based obesity trials. *Pediatrics*. 2014; 134(3):e846–e847. [PubMed: 25157019]
26. Smith JJ, Morgan PJ, Plotnikoff RC, et al. Smart-phone obesity prevention trial for adolescent boys in low-income communities: the ATLAS RCT. *Pediatrics*. 2014; 134(3):e723–e731. [PubMed: 25157000]
27. Yin Z, Moore JB, Johnson MH, Vernon MM, Gutin B. The impact of a 3-year after-school obesity prevention program in elementary school children. *Child Obes*. 2012; 8(1):60–70. [PubMed: 22799482]
28. Metcalf B, Henley W, Wilkin T. Effectiveness of intervention on physical activity of children: systematic review and meta-analysis of controlled trials with objectively measured outcomes (*EarlyBird 54*). *BMJ*. 2012; 345:e5888. [PubMed: 23044984]

29. Gesell S, Karp S. The role of families and providers in preventing childhood obesity when we take a systems approach to ending the epidemic. *Rev Health Care*. 2013; 4(1):3–9.
30. Whitaker RC. The childhood obesity epidemic: lessons for preventing socially determined health conditions. *Arch Pediatr Adolesc Med*. 2011; 165(11):973–975. [PubMed: 22065178]
31. Plachta-Danielzik S, Kehden B, Landsberg B, et al. Attributable risks for childhood overweight: evidence for limited effectiveness of prevention. *Pediatrics*. 2012; 130(4):e865–e871. [PubMed: 22945402]
32. Kristensen AH, Flottemesch TJ, Maciosek MV, et al. Reducing childhood obesity through U.S. federal policy: a microsimulation analysis. *Am J Prev Med*. 2014; 47(5):604–612. [PubMed: 25175764]
33. Andreyeva T, Chaloupka FJ, Brownell KD. Estimating the potential of taxes on sugar-sweetened beverages to reduce consumption and generate revenue. *Prev Med*. 2011; 52(6):413–416. [PubMed: 21443899]
34. Brownell KD, Farley T, Willett WC, et al. The public health and economic benefits of taxing sugar-sweetened beverages. *N Engl J Med*. 2009; 361(16):1599–1605. [PubMed: 19759377]
35. Harding, M.; Lovenheim, M. *The Effect of Prices on Nutrition: Comparing the Impact of Product- and Nutrient-Specific Taxes*. Cambridge, MA: National Bureau of Economic Research; 2014.
36. Lewis KH, Rosenthal MB. Individual responsibility or a policy solution—cap and trade for the US diet? *N Engl J Med*. 2011; 365(17):1561–1563. [PubMed: 22029976]
37. Wang YC, Coxson P, Shen Y-M, Goldman L, Bibbins-Domingo K. A penny-per-ounce tax on sugar-sweetened beverages would cut health and cost burdens of diabetes. *Health Aff (Millwood)*. 2012; 31(1):199–207. [PubMed: 22232111]
38. Perry CL, Creamer MR. The childhood obesity epidemic: lessons learned from tobacco. *J Pediatr*. 2014; 164(1):178–185. [PubMed: 24011763]