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Childhood Obesity: Future Directions and Research Priorities

James O. Hill, PhD*, and Frederick L. Trowbridge, MD†

ABSTRACT. The threat of obesity is greater than ever for US children and adolescents. All indications are that the current generation of children will grow into the most obese generation of adults in US history. Furthermore, there is every expectation that the next generation of children is likely to be fatter and less fit

than the current generation. Despite the recognition of the severe health and psychosocial damage done by childhood obesity, it remains low on the public agenda of important issues facing policy makers. Perhaps this is because the most serious health effects of obesity in today's children will not be seen for several decades. Action must be taken now to stem the epidemic of childhood obesity. This action will require a prioritization of research into the etiology, treatment, and prevention of childhood obesity. It is unlikely that sufficient resources for such research will be available from public and private sources until the issue of childhood obesity is moved higher on the public

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ABBREVIATIONS. NIDDM, noninsulin-dependent diabetes mellitus; BMI, body mass index.

Obesity is one of the most serious health problems facing the youth of the United States, and evidence suggests that the problem is worsening rapidly. The increase in the prevalence of childhood obesity, outlined by Troiano and Flegal,¹ parallels the large increase in the prevalence of adult obesity that has occurred over the past 2 decades.² Depending on how overweight in children is defined, at least 11% and possibly as many as 25% of US children and adolescents are overweight.¹ These numbers may be much higher in some ethnic groups. We are facing a future generation of overweight and obese adults, perhaps even more obese than the current generation of adults in the United States, of whom one third (approximately 58 million) are overweight or obese. Because of the close association of obesity with many chronic diseases,³ this condition presents an enormous challenge to our health care system. It has been estimated that diet and activity patterns contribute to ~300 000 preventable deaths in the United States, or ~1000 deaths per day,⁴ second only to smoking. In dealing with childhood obesity, we face a crisis that demands immediate action in the form of coordinated efforts on the part of policy makers, health professionals, community leaders, and parents.

REVIEW

A major concern about childhood obesity is that obese children tend to become obese adults, facing increased risk for diabetes, cardiovascular disease, and many other chronic diseases.⁵ However, as described by Dietz,⁶ even before reaching adulthood, overweight and obese children already are experiencing medical and psychosocial effects related to their overweight condition. Pediatricians are seeing hypertension, dyslipidemia, and noninsulin-dependent diabetes mellitus (NIDDM) in the most obese children and adolescents. If these trends continue, it is possible that we will be devoting more efforts to treating adult diseases in obese children. The implications for our health care system are enormous. The economic costs of obesity were estimated to be \$69 billion in 1990 (~8% of total health care costs).⁷ The economic cost of obesity in the United States will likely increase as the population ages and as the prevalence of obesity grows. In addition, there is concern that childhood and adolescent obesity may be associated with significant negative psychosocial consequences. This may involve discrimination by adults and peers and, for adolescents, low self-esteem. Finally, there is some information to suggest that obesity in childhood, even if it does not continue into adulthood, may be associated with long-lasting negative medical and psychosocial consequences.

We understand surprisingly little about how and why childhood obesity develops. Rosenbaum and

Leibel⁸ show that obesity is a complex disease with genetic, metabolic, and behavioral determinants. Obesity results from an imbalance between intake and expenditure, and there are strong genetic influences of these components of energy balance. We have long appreciated that obesity has strong genetic determinants, and now the specific genes that are involved in obesity, which influence energy intake and energy expenditure, are being identified. These discoveries will provide the basis for more informed counseling and preventive efforts.

Despite obesity having strong genetic determinants, the genetic composition of the population does not change rapidly. Therefore, the large increase in the prevalence of obesity that has been seen over the past 2 decades must reflect major changes in nongenetic factors. Increases in consumption of high-fat, energy-dense foods and declines in spontaneous and work-related physical activity over the past several decades are two of the major environmental factors thought to contribute to the current epidemic of obesity. Our challenge is to identify how genes and environmental factors interact to lead to obesity in some individuals. Research into the genetics of obesity is already increasing our understanding of how obesity develops. In the near future, genetics may allow us to identify those individuals most likely to become obese. However, we also may identify metabolic, behavioral, and environmental predictors of obesity. We must continue to learn how environmental factors promote obesity and how to modify them to keep obesity from developing, especially in susceptible individuals.

To affect obesity, both genetic and environmental factors must influence one or more components of energy balance. Goran⁹ reviews techniques for assessing energy intake, energy expenditure, and body composition in children. Because obesity may develop from a very small energy imbalance over time, it is necessary to develop procedures to assess energy intake, energy expenditure, and body composition with a great deal of precision and accuracy to detect small changes.

We must learn more about how eating and physical activity patterns develop throughout childhood and adolescence and how these track into adulthood before we can develop effective obesity prevention strategies. Birch and Fisher¹⁰ and Kohl and Hobbs¹¹ review our current understanding of this area. Children are becoming more sedentary and are consuming diets thought to promote obesity (ie, diets high in fat and low in fruits and vegetables). We must learn how preferences for high-fat, energy-dense foods and sedentary behaviors develop and how they can be modified at different stages of development. Birch and Fisher¹⁰ provide extensive evidence to suggest that children's food preferences are shaped by early experience with food and eating and that the family environment and parenting practices may affect dietary practices of children permanently. Insights gained from research in this area can assist in developing interventions to improve child-feeding practices, which may lead to development of healthier eating patterns.

The current generation of children may be the most sedentary in our history. We must find ways to reverse this disturbing trend toward sedentary lifestyles. Although our ability to measure physical activity accurately is limited, the existing data from national surveys in the United States and Canada suggest a downward trend in childhood physical activity.^{12,13} A recent Harris poll (Harris-Black survey, unpublished data) found that ~25% of children do not participate in any regular physical activity; low levels of physical activity are seen more frequently in older than in younger children and in girls more than in boys.¹⁴ It has often been suggested that modern lifestyles are contributing to a decline in physical activity by providing more and more opportunities to be sedentary and fewer demands to be even moderately active. Kohl and Hobbs¹¹ describe our understanding of the development of physical activity patterns and suggest ways that we may be able to modify the environment to increase physical activity in children. First, however, we must learn more about the determinants of physical activity in childhood. Although there may be genetic influences on physical activity, there appear to be strong environmental influences as well. There is a growing concern that declines in physical activity in the schools may be contributing to the overall decline in childhood physical activity. This is a problem particularly with older children and adolescents, for whom mandatory physical education in schools is becoming rare. Overall, only ~36% of youth participate in physical activity in school on a daily basis.¹⁵ In addition, even when physical education classes exist, they are often taught by teachers who are not certified physical education specialists, and they often involve little time spent in actual physical activity.

Trends toward increasing amounts of time spent in sedentary activities also may be contributing to the increase in childhood obesity. The attractiveness of television, video games, and computer games may be leading to less time spent in more physically active behaviors. Research suggests that efforts to decrease time spent in sedentary activities may be an intervention that should be pursued in addition to interventions designed specifically to promote physical activity. Additionally, there appear to be both parental and peer influences on physical activity. Active parents tend to have more active children, which suggests that it may be possible to intervene in the family environment and through parenting practices.

We may be more successful in dealing with obesity in children and adolescents than in dealing with adult obesity. As discussed by Epstein et al,¹⁶ efforts to deal with childhood obesity may be more cost-effective than efforts to deal with adult obesity. Currently, we devote substantially more resources to management of adult than to childhood obesity. Some success has been achieved in managing childhood obesity in the clinical setting. Treatment has focused on using behavioral modification techniques to modify diet and physical activity in children and adolescents, a strategy not substantially different from that used often with adults. Because children

may have engaged in unhealthy behaviors for less time than adults, ultimately we may be more successful in modifying their behavior. The research conducted to date suggests that parental involvement may be an important part of the treatment of children and adolescents. Behavioral economic research and particularly behavioral choice theory may hold some promise for obesity treatment. Researchers have found success in increasing physical activity by providing choices, with different reinforcing value, about whether to be sedentary or physically active.

Given the current prevalence of childhood obesity, it is unlikely that the problem can be managed solely in the clinical setting. It is critical that we develop and improve preventive strategies that are implemented through schools and community-based programs. However, our initial efforts in this area indicate that it will be difficult to achieve and sustain behavioral change through such programs.

RESEARCH NEEDS

In addition to reviewing the current state of knowledge, the previous articles have identified priorities for future research. We need better methods of assessing childhood overweight and obesity. Currently, overweight and obesity are defined on the basis of age-specific percentiles of body mass index (BMI). We need better means of defining moderate and severe obesity, which may be based on BMI in combination with other variables such as indicators of visceral fat (eg, waist circumference). In addition, we need to learn whether and how these measures of moderate and severe obesity vary with age, sex, and ethnicity. Finally, we need to understand how and why the distribution of BMI is changing over time in children and adolescents and determine whether specific intervention efforts should be targeted at the more overweight children and adolescents, who may be at the greatest risk of additional weight gain.

We need to better understand when the medical risks of childhood obesity begin. It is disturbing that adult diseases such as NIDDM, hyperlipidemia, and hypertension are becoming more common in severely overweight children. How should these diseases be treated, and how does treatment affect the risk for adult disease? Does moderate childhood obesity lead to a worsening of risk factors for NIDDM and cardiovascular disease, and does this begin in childhood or adulthood? What are the effects of childhood obesity on the risk for adult chronic disease, even if the obesity does not persist into adulthood? Does the risk of obesity-associated comorbidities vary with the age of onset, duration, or severity of childhood obesity?

We also need to know more about how childhood obesity affects socialization. Does childhood obesity alter relationships of the obese child with adults or other children systematically? How does childhood obesity affect socialization as an adult?

Obesity has both genetic and environmental determinants. Although research into genetic determinants of obesity is flourishing, there remains a great need to understand how environmental factors can

affect body weight regulation given a particular genetic pattern. This understanding may be facilitated as our ability increases to genetically identify children who are predisposed to obesity. However, we need to continue research that might identify at-risk individuals on the basis of metabolic or behavioral characteristics.

A great deal of research is needed to better understand how eating and physical activity patterns develop and how patterns learned in childhood track into adulthood. Most existing studies are cross-sectional, and there is a great need for longitudinal studies, following subjects throughout childhood and adolescence. Our lack of accurate techniques to assess food intake and physical activity in children is a serious limitation in understanding the development of eating and physical activity patterns. Development of better techniques to assess food intake and physical activity should be a very high priority.

Finally, we need to improve techniques to treat and prevent obesity. There are substantial reasons to think that efforts directed toward obesity treatment and prevention may be more effective in children and adolescents than in adults. Treatment and prevention programs should be developed outside the clinical setting, in the school and community. Development and evaluation of such programs should be a high research priority.

CONCLUSIONS

Childhood obesity is a crisis facing US youth, and action to control it must be taken now. Efforts to both manage and prevent childhood obesity must involve education, research, and intervention. Educational efforts should be directed toward policy makers, health care professionals, community leaders, and parents. All projections are that the prevalence of both childhood and adult obesity is increasing, a situation that is increasingly challenging to our health care system. Most health care costs associated with obesity are found in adults, but there are indications that the situation is changing and that we will be treating more chronic diseases in obese children. Policy makers must be aware of this crisis and be encouraged to work with scientists and health professionals to develop public policy to manage the problem.

We also need to educate health care professionals about the problems associated with childhood obesity. Pediatricians will be seeing more overweight and obese children and will likely see more risk factors for NIDDM and cardiovascular disease in their obese patients. They need to be informed about the health risks associated with childhood obesity and about the treatment options that are available.

Childhood obesity must be addressed at the community level. Community leaders should be made aware of how they can be involved in preventing obesity. Schools must take responsibility for providing optimum nutrition and physical activity opportunities to students and for educating students about the importance of nutrition and physical activity in

overall health. There is an urgent need for schools to reconsider and revise their physical activity policies and programs. Additionally, community programs must interact with school programs to provide opportunities for children to be physically active, both during and after school hours.

Finally, parents must be made more aware of the role they can play in preventing obesity in their children. It is likely that any effective interventions will be family-based. In addition, there is substantial evidence that children model the behavior of their parents. Parents must be willing and able to make changes in their own eating and physical activity patterns. Parents should be encouraged to become involved in school and community programs aimed at improving nutrition and physical activity in their children.

We have identified a broad range of research needs in the area of childhood obesity. The major social, financial, and health implications of these issues indicate the need for priority attention by both governmental and private scientific funding agencies. Increased attention to the clinical management of childhood obesity is required, but the problem cannot be solved without a way to alter the environmental factors that contribute to obesity. If we are to prevent and not just attempt to treat childhood obesity, the issue must be addressed as a public health problem, and we must seek public health solutions. Broad changes in eating and physical activity behaviors are needed. These can be achieved only through coordinated efforts among policy makers, business and community leaders, schools, parents, and concerned individuals.

The funding necessary to address the research issues identified above will not be forthcoming until childhood obesity moves higher on the public agenda. Childhood obesity represents a threat to the health of the US population that must be considered equal to that presented by AIDS, breast cancer, and teen pregnancy. Only when childhood obesity becomes high on the public agenda will the necessary research funds from government and private agencies become available.

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