Policy Statement

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Prevention of PediatricOverweight and Obesity

AMERICAN ACADEMY OF PEDIATRICS

Policy Statement

Organizational Principles to Guide and Define the Child Health Care System and/orImprove the Health of All Children

Committee on Nutrition

ABSTRACT. The dramatic increase in the prevalence of childhood overweightand its resultant comorbidities are associated with significant health andfinancial burdens, warranting strong and comprehensive prevention efforts. Thisstatement proposes strategies for early identification of excessive weight gainby using body mass index, for dietary and physical activity interventionsduring health supervision encounters, and for advocacy and research.

ABBREVIATION. BMI, body mass index.

INTRODUCTION

Prevention is one of the hallmarks of pediatric practice and includes suchdiverse activities as newborn screenings, immunizations, and promotion of carsafety seats and bicycle helmets. Documented trends in increasing prevalence ofoverweight and inactivity mean that pediatricians must focus preventive effortson childhood obesity, with its associated comorbid conditions in childhood andlikelihood of persistence into adulthood. These trends pose an unprecedentedburden in terms of children's health as well as present and future health carecosts. A number of statements have been published that address the scope of theproblem and treatment strategies.[1-6]

The intent of this statement is to propose strategies to foster preventionand early identification of overweight and obesity in children. Evidence tosupport the recommendations for prevention is

presented when available, butunfortunately, too few studies on prevention have been performed. The enormityof the epidemic, however, necessitates this call to action for pediatriciansusing the best information available.

DEFINITIONS AND DESCRIPTION OF THE PROBLEM

Body mass index (BMI) is the ratio of weight in kilograms to the square ofheight in meters. BMI is widely used to define overweight and obesity, becauseit correlates well with more accurate measures of body fatness and is derivedfrom commonly available data—weight and height.[7] It has also beencorrelated with obesity-related comorbid conditions in adults and children.Clinical judgment must be used in applying these criteria to a patient, becauseobesity refers to excess adiposity rather than excess weight, and BMI is asurrogate for adiposity. The pediatric growth charts for the US population nowinclude BMI for age and gender, are readily available online (http://www.cdc.gov/growthcharts), and allow longitudinal tracking of BMI.[8]

BMI between 85th and 95th percentile for age and sex is considered at riskof overweight, and BMI at or above the 95th percentile is considered overweightor obese.[9,10] The prevalence of childhood overweight and obesity isincreasing at an alarming rate in the United States as well as in otherdeveloped and developing countries. Prevalence among children and adolescentshas doubled in the past 2 decades in the United States. Currently, 15.3% of 6-to 11-year-olds and 15.5% of 12- to 19-year-olds are at or above the 95thpercentile for BMI on standard growth charts based on reference data from the1970s, with even higher rates among subpopulations of minority and economicallydisadvantaged children.[10,11] Recent data from the Centers forDisease Control and Prevention also indicate that children younger than 5 yearsacross all ethnic groups have had significant increases in the prevalence ofoverweight and obesity.[12,13] American children and adolescents todayare less physically active as a group than were previous generations, and lessactive children are more likely to be overweight and to have higher bloodpressure, insulin and cholesterol concentrations and more abnormal lipidprofiles.[14,15]

Obesity is associated with significant health problems in the pediatric agegroup and is an important early risk factor for much of adult morbidity andmortality.[15,16] Medical problems are common in obese children andadolescents and can affect cardiovascular health (hypercholesterolemia anddyslipidemia, hypertension),[14,17-19] the endocrine system (hyperinsulinism, insulin resistance, impaired glucose tolerance, type 2diabetes mellitus, menstrual irregularity),[20-22] and mental health(depression, low self-esteem).[23,24] Because of the increasingincidence of type 2 diabetes mellitus among obese adolescents and becausediabetes-related morbidities may worsen if diagnosis is delayed, the clinicianshould be alert to the possibility of type 2 diabetes mellitus in all obeseadolescents, especially those with a family history of early-onset (youngerthan 40 years) type 2 diabetes mellitus.[25] The psychologic stress

ofsocial stigmatization imposed on obese children may be just as damaging as themedical morbidities. The negative images of obesity are so strong that growthfailure and pubertal delay have been reported in children practicingself-imposed caloric restriction because of fears of becoming obese.[26]Other important complications and associations include pulmonary (asthma, obstructive sleep apnea syndrome, pickwickian syndrome),[27-32]orthopedic (genu varum, slipped capital femoral epiphysis),[33,34] andgastrointestinal/hepatic (nonalcoholic steatohepatitis) [35]complications. All these disturbances are seen at an increased rate in obeseindividuals and have become more common in the pediatric population. Theprobability of childhood obesity persisting into adulthood is estimated toincrease from approximately 20% at 4 years of age to approximately 80% byadolescence.[36] In addition, it is probable that comorbidities willpersist into adulthood.[16,37] Thus, the potential future health carecosts associated with pediatric obesity and its comorbidities are staggering,prompting the surgeon general to predict that preventable morbidity andmortality associated with obesity may exceed those associated with cigarettesmoking.[10,38]

Although treatment approaches for pediatric obesity may be effective in theshort term,[39-44] long-term outcome data for successful treatmentapproaches are limited.[45,46] The intractable nature of adult obesityis well known. Therefore, it is incumbent on the pediatric community to take aleadership role in prevention and early recognition of pediatric obesity.

RISK FACTORS

Development of effective prevention strategies mandates that physiciansrecognize populations and individuals at risk. Interactions between genetic, biological,psychologic, sociocultural, and environmental factors clearly are evident inchildhood obesity. Elucidation of hormonal and neurochemical mechanisms thatpromote the energy imbalance that generates obesity has come from moleculargenetics and neurochemistry. Knowledge of the genetic basis of differences inthe complex of hormones and neurotransmitters (including growth hormone,leptin, ghrelin, neuropeptide Y, melanocortin, and others) that are responsiblefor regulating satiety, hunger, lipogenesis, and lipolysis as well as growthand reproductive development will eventually refine our understanding of riskof childhood overweight and obesity and may lead to more effective therapies.[47,48]

Genetic conditions known to be associated with propensity for obesityinclude Prader-Willi syndrome, Bardet-Biedl syndrome, and Cohen syndrome. Inthese conditions, early diagnosis allows collaboration with subspecialists,such as geneticists, endocrinologists, behavioralists, and nutritionists, tooptimize growth and development while promoting healthy eating and activitypatterns from a young age. For example, data suggest that growth hormone mayimprove some of the signs of Prader-Willi syndrome.[49-51]

It has long been recognized that obesity "runs in families"—highbirth weight, maternal diabetes, and obesity in family members all arefactors—but there are likely to be multiple genes and a strong interactionbetween genetics and environment that influence the degree of adiposity.[47,48,52,53]For young children, if 1 parent is obese, the odds ratio is approximately 3 forobesity in adulthood, but if both parents are obese, the odds ratio increasesto more than 10. Before 3 years of age, parental obesity is a strongerpredictor of obesity in adulthood than the child's weight status.[54]Such observations have important implications for recognition of risk androutine anticipatory guidance that is directed toward healthy eating andactivity patterns in families.

There are critical periods of development for excessive weight gain. Extentand duration of breastfeeding have been found to be inversely associated withrisk of obesity in later childhood, possibly mediated by physiologic factors inhuman milk as well as by the feeding and parenting patterns associated with nursing.[55-58]Investigations of dietary factors in infancy, such as high protein intake orthe timing of introduction of complementary foods, have not consistentlyrevealed effects on childhood obesity. It has been known for decades thatadolescence is another critical period for development of obesity.[59]The normal tendency during early puberty for insulin resistance may be anatural cofactor for excessive weight gain as well as various comorbidities ofobesity.[60] Early menarche is clearly associated with degree ofoverweight, with a twofold increase in rate of early menarche associated withBMI greater than the 85th percentile.[61] The risk of obesitypersisting into adulthood is higher among obese adolescents than among youngerchildren.[54] The roles of leptin, adiponectin, ghrelin, fat mass, andpuberty on development of adolescent obesity are being actively investigated.Data suggest that adolescents who engage in high-risk behaviors, such assmoking, ethanol use, and early sexual experimentation also may be at greaterrisk of poor dietary and exercise habits.[62]

Environmental risk factors for overweight and obesity, including family andparental dynamics, are numerous and complicated. Although clinicalinterventions cannot change these factors directly, they can influencepatients' adaptations to them, and the physician can advocate for change at thecommunity level. Food insecurity may contribute to the inverse relation ofobesity prevalence with socioeconomic status, but the relationship is a complexone.[63] Other barriers low-income families may face are lack of safeplaces for physical activity and lack of consistent access to healthful foodchoices, particularly fruits and vegetables. Low cognitive stimulation in thehome, low socioeconomic status, and maternal obesity all predict development ofobesity.[64] In research settings, there is accumulating evidence forthe detrimental effects of overcontrolling parental behavior on children'sability to self-regulate energy intake. For example, maternal-child feedingpractices, maternal perception of daughter's risk of overweight,[65]maternal restraint, verbal prompting to eat at mealtime, attentiveness tononeating behavior, and close parental monitoring[66] all may promoteundesired consequences for children's eating behaviors. Parental food

choicesinfluence child food preferences,[67] and degree of parental adiposityis a marker for children's fat preferences.[68] Children andadolescents of lower socioeconomic status have been reported to be less likelyto eat fruits and vegetables and to have a higher intake of total and saturatedfat.[69-71] Absence of family meals is associated with lower fruit andvegetable consumption as well as consumption of more fried food and carbonatedbeverages. Although our understanding of the development of eating behaviors isimproving, there are not yet good trials to demonstrate effective translationof this knowledge base into clinical practices to prevent obesity. At aminimum, however, pediatricians need to proactively discuss and promote healthyeating behaviors for children at an early age and empower parents to promotechildren's ability to self-regulate energy intake while providing appropriatestructure and boundaries around eating.

Widespread and profound societal changes during the last several decadeshave affected child rearing, which in turn has affected childhood patterns ofphysical activity as well as diet. National survey data indicate that childrenare currently less active than they have been in previous surveys. Leisureactivity is increasingly sedentary, with wide availability of entertainmentsuch as television, videos, and computer games. In addition, with increasingurbanization, there has been a decrease in frequency and duration of physicalactivities of daily living for children, such as walking to school and doinghousehold chores. Changes in availability and requirements of school physicaleducation programs have also generally decreased children's routine physicalactivity, with the possible exception of children specifically enrolled inathletic programs. All these factors play a potential part in the epidemic ofoverweight.[72]

National survey data indicate that 20% of US children 8 to 16 years of agereported 2 or fewer bouts of vigorous physical activity per week, and more than25% watched at least 4 hours of television per day.[73] Children whowatched 4 or more hours of television per day had significantly greater BMI,compared with those watching fewer than 2 hours per day.[73] Furthermore,having a television in the bedroom has been reported to be a strong predictorof being overweight, even in preschool-aged children.[74] Somecross-sectional data have found significant correlation between obesityprevalence and television viewing,[75-77] but others have not.[78,79]The results of a randomized trial to decrease television viewing forschool-aged children has provided the strongest evidence to support the role oflimiting television in prevention of obesity. In this study, decreasing"media use" without specifically promoting more active behaviors inthe intervention group resulted in a significantly lower increase in BMI at the1-year follow-up, compared with the control group.[80] Additionalsupport for the importance of decreasing television viewing comes fromcontrolled investigations that demonstrated that obese children who werereinforced for decreasing sedentary activity (and following anenergy-restricted diet) had significantly greater weight loss than those whowere reinforced for increasing physical activity.[42] These findingshave important implications for anticipatory guidance and provide additionalsupport for recommendations to limit television exposure for young children.[2]

EARLY RECOGNITION

Routine assessments of eating and activity patterns in children andrecognition of excessive weight gain relative to linear growth are essentialthroughout childhood. At any age, an excessive rate of weight gain relative tolinear growth should be recognized, and underlying predisposing factors shouldbe addressed with parents and other caregivers. The Centers for Disease Controland Prevention percentile grids for BMI are important tools for anticipatoryguidance and discussion of longitudinal tracking of a child's BMI. Significantchanges on growth patterns (eg, upward crossing of weight for age or BMIpercentiles) can be recognized and addressed before children are severelyoverweight.[81] An increase in BMI percentiles should be discussedwith parents, some of whom may be overly concerned and some of whom may notrecognize or accept potential risk.[82]

Although data are extremely limited, it is likely that anticipatory guidanceor treatment intervention before obesity has become severe will be moresuccessful. Discussions to raise parental awareness should be conducted in anonjudgmental, blame-free manner so that unintended negative impact on thechild's self-concept is avoided.[24] Data from adult patient surveysindicate that those who were asked by their physician about diet were morelikely to report positive changes.[83] Similarly, the efficacy ofphysicians discussing physical activity,[84] breastfeeding,[85]and smoking prevention[86] is well documented. Thus, pediatricians arestrongly encouraged to incorporate assessment and anticipatory guidance aboutdiet, weight, and physical activity into routine clinical practice, beingcareful to discuss habits rather than focusing on habitus to avoid stigmatizingthe child, adolescent, or family.

ADVOCACY

Abundant opportunities exist for pediatricians to take a leadership role inthis critical area of child health, including action in the following areas:opportunities for physical activity, the food supply, research, and third-partyreimbursement. Change is desperately needed in opportunities for physical activityin child care centers, schools, after-school programs, and other communitysettings. As leaders in their communities, pediatricians can be effectiveadvocates for health- and fitness-promoting programs and policies. Foods thatare nutrient rich and palatable yet low in excess energy from added sugars andfat need to be readily available to parents, school and child care foodservices, and others responsible for feeding children. Potential affordablesources include community gardens and farmers' market projects. Advertising andpromotion of energy-dense, nutrient-poor food products to children may need tobe regulated or curtailed. The increase in carbonated beverage intake has beenlinked to obesity[87]; therefore, the sale of such beverages shouldnot be promoted at school. Pediatricians are encouraged to work with schooladministrators and others in the community on ways to decrease the availabilityof foods and beverages with

little nutritional value and to decrease thedependence on vending machines, snack bars, and school stores for schoolrevenue. Regarding physical activity, advocacy is sorely needed for physicaleducation programs that emphasize and model learning of daily activities forpersonal fitness (as opposed to physical education limited to a few teamsports).

New initiatives for pilot projects to test prevention strategies have beenfunded by the National Institutes of Health and other organizations, but along-term commitment of substantial funds from many sources and to manydisciplines will be needed to attack this serious, widespread, and potentiallyintractable problem. Support for development and testing of primary preventionstrategies for the primary care setting will be critical. Likewise, investmentof substantial resources will be required for development of effectivetreatment approaches for normalizing or improving body weight and fitness andfor determining long-term effects of weight loss on comorbidities of childhoodobesity. Collaboration and coalitions with nutrition, behavioral health,physical therapy, and exercise physiology professionals will be needed. Workingwith communities and schools to develop needed counseling services, physicalactivity opportunities, and strategies to reinforce the gains made in clinicalmanagement is also important.

Pediatric referral centers will need to develop specialized programs fortreatment of complex and difficult cases, and for research into etiology andnew methods of prevention and treatment. Efforts are needed to ensure adequatehealth care coverage for preventive and treatment services. Even when seriouscomorbidities are documented, insurance reimbursement is limited.[88]Lack of reimbursement is a disincentive for physicians to develop preventionand treatment programs and presents a significant barrier to families seekingprofessional care.

SUMMARY/CONCLUSIONS

1. Prevalence of overweight and its significant comorbidities in pediatric populations has rapidly increased and reached epidemic proportions.
2. Prevention of overweight is critical, because long-term outcome data for successful treatment approaches are limited.
3. Genetic, environmental, or combinations of risk factors predisposing children to obesity can and should be identified.
4. Early recognition of excessive weight gain relative to linear growth should become routine in pediatric ambulatory care settings. BMI (kg/m^2 [see http://www.cdc.gov/growthcharts]) should be calculated and plotted periodically.
5. Families should be educated and empowered through anticipatory guidance to recognize the impact they have on their children's development of lifelong habits of physical activity and nutritious eating.
6. Dietary practices should be fostered that encourage moderation rather than overconsumption, emphasizing healthful choices rather than restrictive eating patterns.

7. Regular physical activity should be consciously promoted, prioritized, and protected within families, schools, and communities.
8. Optimal approaches to prevention need to combine dietary and physical activity interventions.
9. Advocacy is needed in the areas of physical activity and food policy for children; research into pathophysiology, risk factors, and early recognition and management of overweight and obesity; and improved insurance coverage and third-party reimbursement for obesity care.

RECOMMENDATIONS

1. Health supervision
    a. Identify and track patients at risk by virtue of family history, birth weight, or socioeconomic, ethnic, cultural, or environmental factors.
    b. Calculate and plot BMI once a year in all children and adolescents.
    c. Use change in BMI to identify rate of excessive weight gain relative to linear growth.
    d. Encourage, support, and protect breastfeeding.
    e. Encourage parents and caregivers to promote healthy eating patterns by offering nutritious snacks, such as vegetables and fruits, low-fat dairy foods, and whole grains; encouraging children's autonomy in self-regulation of food intake and setting appropriate limits on choices; and modeling healthy food choices.
    f. Routinely promote physical activity, including unstructured play at home, in school, in child care settings, and throughout the community.
    g. Recommend limitation of television and video time to a maximum of 2 hours per day.
    h. Recognize and monitor changes in obesity-associated risk factors for adult chronic disease, such as hypertension, dyslipidemia, hyperinsulinemia, impaired glucose tolerance, and symptoms of obstructive sleep apnea syndrome.
2. Advocacy
    a. Help parents, teachers, coaches, and others who influence youth to discuss health habits, not body habitus, as part of their efforts to control overweight and obesity.
    b. Enlist policy makers from local, state, and national organizations and schools to support a healthful lifestyle for all children, including proper diet and adequate opportunity for regular physical activity.
    c. Encourage organizations that are responsible for health care and health care financing to provide coverage for effective obesity prevention and treatment strategies.
    d. Encourage public and private sources to direct funding toward research into effective strategies to prevent overweight and obesity and to maximize limited

family and community resources to achieve healthful outcomes for youth.

e. Support and advocate for social marketing intended to promote healthful food choices and increased physical activity.

**Lead authors*

REFERENCES

1. American Academy of Pediatrics, Committee on Sports Medicine and Fitness. Promotion of healthy weight-control practices in young athletes. *Pediatrics.* 1996;97:752-753
2. American Academy of Pediatrics, Committee on Public Education. Children, adolescents, and television. *Pediatrics.* 2001;107:423-426
3. American Dietetic Association. Position of the American Dietetic Association. Dietary guidance for healthy children aged 2 to 11 years. *J Am Diet Assoc.* 1999;99:93-101
4. Gidding SS, Leibel RL, Daniels S, Rosenbaum M, Van Horn L, Marx GR. Understanding obesity in youth. A statement for healthcare professionals from the Committee on Atherosclerosis and Hypertension in the Young of the Council on Cardiovascular Disease in the Young and Nutrition Committee, American Heart Association. *Circulation.*

1996;94:3383-3387
5. American Medical Association, Council on Scientific Affairs. *Obesity as a Major Public Health Problem.* Chicago, IL: American Medical Association; 1999. Available at: http://www.ama-assn.org/meetings/public/annual99/reports/csa/rtf/csa6.rtf. Accessed September 4, 2002
6. Barlow SE, Dietz WH. Obesity evaluation and treatment: expert committee recommendations. The Maternal and Child Health Bureau, Health Resources and Services Administration and the Department of Health and Human Services. *Pediatrics.* 1998;102 (3). Available at: http://www.pediatrics.org/cgi/content/full/102/3/e29
7. Pietrobelli A, Faith MS, Allison DB, Gallagher D, Chiumello G, Heymsfield SB. Body mass index as a measure of adiposity among children and adolescents: a validation study. *J Pediatr*. 1998;132:204-210
8. Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, et al. CDC growth charts: United States. *Adv Data.* 2000 Jun 8;(314):1-27
9. Himes JH, Dietz WH. Guidelines for overweight in adolescent preventive services: recommendations from an expert committee. *Am J Clin Nutr*. 1994;59:307-316
10. US Dept Health and Human Services. *The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity.* Rockville, MD: US Department of Health and Human Services, Public Health Service, Office of the Surgeon General; 2001
11. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999-2000. *JAMA*. 2002;288:1728-1732
12. Mei Z, Scanlon KS, Grummer-Strawn LM, Freedman DS, Yip R, Trowbridge FL. Increasing prevalence of overweight among US low-income preschool children: The Centers for Disease Control and Prevention Pediatric Nutrition Surveillance, 1983 to 1995. *Pediatrics.* 1998;101(1). Available at: http://www.pediatrics.org/cgi/content/full/101/1/e12
13. Ogden CL, Troiano RP, Breifel RR, Kuczmarski RJ, Flegal KM, Johnson CL. Prevalence of overweight among preschool children in the United States, 1971 through 1994. *Pediatrics.* 1997;99(4). Available at: http://www.pediatrics.org/cgi/content/full/99/4/e1
14. Gidding SS, Bao W, Srinivasan SR, Berenson GW. Effects of secular trends in obesity on coronary risk factors in children: the Bogalusa Heart Study. *J Pediatr*. 1995;127:868-874
15. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa heart study. *Pediatrics*. 1999;103:1175-1182
16. Must A, Jacques PF, Dallal GE, Bajema CJ, Dietz WH. Long-term morbidity and mortality of overweight adolescents. A follow-up of the Harvard Growth Study of 1922 to 1935. *N Engl J Med*. 1992;327:1350-1355
17. Clarke WR, Woolson RF, Lauer RM. Changes in ponderosity and blood pressure in childhood: the Muscatine Study. *Am J Epidemiol*. 1986;124:195-206
18. Johnson AL, Cornoni JC, Cassel JC, Tyroler HA, Heyden S, Hames CG. Influence of race, sex and weight on blood pressure behavior in young adults. *Am J Cardiol*. 1975;35:523-

530
19. Morrison JA, Laskerzewski PM, Rauh JL, et al. Lipids, lipoproteins, and sexual maturation during adolescence: the Princeton Maturation Study. *Metabolism*. 1979;28:641-649
20. Shinha R, Fisch G, Teague B, et al. Prevalence of impaired glucose tolerance among children and adolescents with marked obesity. *N Engl J Med*. 2002;346:802-810
21. Pinhas-Hamiel O, Dolan LM, Daniels SR, Standiford D, Khoury PR, Zeitler P. Increased incidence of non-insulin-dependent diabetes mellitus among adolescents. *J Pediatr*. 1996;128:608-615
22. Richards GE, Cavallo A, Meyer WJ III, et al. Obesity, acanthosis nigricans, insulin resistance, and hyperandrogenemia: pediatric perspective and natural history. *J Pediatr*. 1985;107:893-897
23. Strauss RS. Childhood obesity and self-esteem. *Pediatrics.* 2000;105(1). Available at: http://www.pediatrics.org/cgi/content/full/105/1/e15
24. Davison KK, Birch LL. Weight status, parent reaction, and self-concept in five-year-old girls. *Pediatrics*. 2001;107:46-53
25. Mitchell BD, Kammerer CM, Reinhart LJ, Stern MP. NIDDM in Mexican-American families. Heterogeneity by age of onset. *Diabetes Care*. 1994;17:567-573
26. Pugliese MT, Lifshitz F, Grad G, Fort P, Marks-Katz M. Fear of obesity. A cause of short stature and delayed puberty. *N Engl J Med*. 1983;309:513-518
27. American Academy of Pediatrics, Section on Pediatric Pulmonology, Subcommittee on Obstructive Sleep Apnea Syndrome. Clinical practice guideline: diagnosis and management of childhood obstructive sleep apnea syndrome. *Pediatrics.* 2002;109:704-712
28. Rodriguez MA, Winkleby MA, Ahn D, Sundquist J, Kraemer HC. Identification of population subgroups of children and adolescents with high asthma prevalence: findings from the Third National Health and Nutrition Examination Survey. *Arch Pediatr Adolesc Med*. 2002;156:269-275
29. Riley DJ, Santiago TV, Edelman NH. Complications of obesity-hypoventilation syndrome in childhood. *Am J Dis Child*. 1976;130:671-674
30. Boxer GH, Bauer AM, Miller BD. Obesity-hypoventilation in childhood. *J Am Acad Child Adolesc Psychiatry*. 1988;27:552-558
31. Mallory GB Jr, Fiser DH, Jackson R. Sleep-associated breathing disorders in obese children and adolescents. *J Pediatr*. 1989;115:892-897
32. Silvestri JM, Weese-Mayer DE, Bass MT, Kenny AS, Hauptman SA, Pearsall SM. Polysomnography in obese children with a history of sleep-associated breathing disorders. *Pediatr Pulmonol*. 1993;16:124-129
33. Dietz WH, Gross WL, Kirkpatrick JA Jr. Blount disease (tibia vara): another skeletal disorder associated with childhood obesity. *J Pediatr*. 1982;101:735-737
34. Loder RT, Aronson DD, Greenfield ML. The epidemiology of bilateral slipped capital femoral epiphysis. A study of children in Michigan. *J Bone Joint Surg*. 1993;75:1141-1147

35. Rashid M, Roberts EA. Nonalcoholic steatohepatitis in children. *J Pediatr Gastroenterol Nutr*. 2000;30:48-53
36. Guo SS, Chumlea WC. Tracking of body mass index in children in relation to overweight in adulthood. *Am J Clin Nutr.* 1999;70(suppl):145S-148S
37. Wisemandle W, Maynard LM, Guo SS, Siervogel RM. Childhood weight, stature, and body mass index among never overweight, early-onset overweight and late-onset overweight groups. *Pediatrics.* 2000;106(1). Available at: http://www.pediatrics.org/cgi/content/full/106/1/e14
38. Wolf AM, Colditz GA. Current estimates of the economic cost of obesity in the United States. *Obes Res*. 1998;6:97-106
39. Becque MD, Katch VL, Rocchini AP, Marks CR, Moorehead C. Coronary risk incidence of obese adolescents: reduction by exercise plus diet intervention. *Pediatrics*. 1988;81:605-612
40. Sothern MS, von Almen TK, Schumacher H, et al. An effective multidisciplinary approach to weight reduction in youth. *Ann N Y Acad Sci*. 1993;699:292-294
41. Jacobson MS, Copperman N, Haas T, Shenker IR. Adolescent obesity and cardiovascular risk: a rational approach to management. *Ann N Y Acad Sci*. 1993;699:220-229
42. Epstein LH, Myers MD, Raynor HA, Saelens BE. Treatment of pediatric obesity. *Pediatrics*. 1998;101(suppl):554-570
43. Harrell JS, Gansky SA, McMurray RG, Bangdiwala SI, Frauman AC, Bradley CB. School-based interventions improve heart health in children with multiple cardiovascular disease risk factors. *Pediatrics.* 1998;102:371-380
44. Willi SM, Oexmann MJ, Wright NM, Collup NA, Key LL Jr. The effects of a high protein, low-fat, ketogenic diet on adolescents with morbid obesity: body composition, blood chemistries, and sleep abnormalities. *Pediatrics*. 1998;101:61-67
45. Epstein LH, Valoski A, Wing RR, McCurley J. Ten-year follow-up of behavioral family-based treatment for obese children. *JAMA.* 1990;264:2519-2523
46. Wadden TA, Foster GD, Letizia KA. One-year behavioral treatment of obesity: comparison of moderate and severe caloric restriction and the effects of weight maintenance therapy. *J Consult Clin Psychol.* 1994;62:165-171
47. Rosenbaum M, Leibel RL, Hirsch J. Obesity. *N Engl J Med.* 1997;337:396-407
48. Rosenbaum M, Leibel RL. The physiology of body weight regulation: relevance to the etiology of obesity in children. *Pediatrics.* 1998;101(suppl):525-539
49. Ritzen EM, Lindgren AC, Hagenas L, Marcus C, Muller J, Blichfeldt S. Growth hormone treatment of patients with Prader-Willi syndrome. Swedish Growth Hormone Advisory Group. *J Pediatr Endocrinol Metab.* 1999 Apr;12(suppl 1):345-349
50. Whitman BY, Myers S, Carrel A, Allen D. The behavioral impact of growth hormone treatment for children and adolescents with Prader-Willi syndrome: a 2-year, controlled study. *Pediatrics.* 2002;109(2). Available at: http://www.pediatrics.org/cgi/content/full/109/2/e35

51. Carrel AL, Myers SE, Whitman BY, Allen DB. Sustained benefits of growth hormone on body composition, fat utilization, physical strength and agility, and growth in Prader-Willi syndrome are dose-dependent. *J Pediatr Endocrinol Metab*. 2001;14:1097-1105
52. Stunkard AJ, Harris JR, Pedersen NL, McClearn GE. The body mass index of twins who have been reared apart. *N Engl J Med*. 1990;322:1483-1487
53. Bouchard C, Tremblay A, Despres JP, et al. The response to long-term overfeeding in identical twins. *N Engl J Med*. 1990;322:1477-1482
54. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med*. 1997;337:869-873
55. Agras SW, Kraemer HC, Berkowitz RI, Hammer LD. Influence of early feeding style on adiposity at 6 years of age. *J Pediatr*. 1990;116:805-809
56. von Kries R, Koletzko B, Sauerwald T, et al. Breast feeding and obesity: cross sectional study. *BMJ*. 1999;319:147-150
57. Gilman MW, Rifas-Shiman SL, Camargo CA Jr, et al. Risk of overweight among adolescents who were breastfed as infants. *JAMA*. 2001;285:2461-2467
58. Hediger ML, Overpeck MD, Kuczmarski RJ, Ruan WJ. Association between infant breastfeeding and overweight in young children. *JAMA*. 2001;285:2453-2460
59. Heald FP. Natural history and physiological basis of adolescent obesity. *Fed Proc*. 1966;25:1-3
60. Travers SH, Jeffers BW, Bloch CA, Hill JO, Eckel RH. Gender and Tanner stage differences in body composition and insulin sensitivity in early pubertal children. *J Clin Endocrinol Metab*. 1995;80:172-178
61. Adair LS, Gordon-Larsen P. Maturational timing and overweight prevalence in US adolescent girls. *Am J Public Health*. 2001;91:642-644
62. Irwin CE Jr, Igra V, Eyre S, Millstein S. Risk-taking behavior in adolescents: the paradigm. *Ann N Y Acad Sci*. 1997;817:1-35
63. Alaimo K, Olson CM, Frongillo EA Jr. Low family income and food insufficiency in relation to overweight in US children: is there a paradox? *Arch Pediatr Adolesc Med*. 2001;155:1161-1167
64. Strauss RS, Knight J. Influence of the home environment on the development of obesity in children. *Pediatrics*. 1999;103(6). Available at: http://www.pediatrics.org/cgi/content/full/103/6/e85
65. Birch LL, Fisher JO. Mothers' child-feeding practices influence daughters' eating and weight. *Am J Clin Nutr*. 2000;71:1054-1061
66. Klesges RC, Stein RJ, Eck LH, Isbell TR, Klesges LM. Parental influence on food selection in young children and its relationships to childhood obesity. *Am J Clin Nutr*. 1991;53:859-864
67. Ray JW, Klesges RC. Influences on the eating behavior of children. *Ann N Y Acad Sci*. 1993;699:57-69
68. Fisher JO, Birch LL. Fat preferences and fat consumption of 3- to 5-year-old children are

related to parental adiposity. *J Am Diet Assoc*. 1995;95:759-764
69. Neumark-Sztainer D, Story M, Resnick MD, Blum RW. Correlates of inadequate fruit and vegetable consumption among adolescents. *Prev Med*. 1996;25:497-505
70. Krebs-Smith SM, Cook A, Subar AF, Cleveland L, Friday J, Kahle LL. Fruit and vegetable intakes of children and adolescents in the United States. *Arch Pediatr Adolesc Med*. 1996;150:81-86
71. Kennedy E, Powell R. Changing eating patterns of American children: a view from 1996. *J Am Coll Nutr*. 1997;16:524-529
72. Berkey CS, Rockett HR, Field AE, et al. Activity dietary intake, and weight changes in a longitudinal study of preadolescent and adolescent boys and girls *Pediatrics.* 2000;105(4). Available at: http://www.pediatrics.org/cgi/content/full/105/4/e56
73. Anderson RE, Crespo CJ, Bartlett SJ, Cheskin LJ, Pratt M. Relationship of physical activity and television watching with body weight and level of fatness among children: results from the Third National Health and Nutrition Examination Survey. *JAMA*. 1998;279:938-942
74. Dennison BA, Erb TA, Jenkins PL. Television viewing and television in bedroom associated with overweight risk among low-income preschool children. *Pediatrics*. 2002;109:1028-1035
75. Pate RR, Ross JG. The National Children and Youth Fitness Study II: factors associated with health-related fitness. *J Physical Educ Recreation Dance*. 1987;58:93-96
76. Dietz WH Jr, Gortmaker SL. Do we fatten our children at the TV set? Obesity and television viewing in children and adolescents. *Pediatrics*. 1985;75:807-812
77. Gortmaker SL, Must A, Sobol AM, Peterson K, Colditz GA, Dietz WH. Television viewing as a cause of increasing obesity among children in the United States, 1986-1990. *Arch Pediatr Adolesc Med*. 1996;150:356-362
78. Tucker LA. The relationship of television viewing to physical fitness and obesity. *Adolescence*. 1986;21:797-806
79. Robinson TN, Hammer LD, Killen JD, et al. Does television viewing increase obesity and reduce physical activity? Cross-sectional and longitudinal analyses among adolescent girls. *Pediatrics*. 1993;91:273-280
80. Robinson T. Reducing children's television viewing to prevent obesity: a randomized controlled trial. *JAMA*. 1999;282:1561-1567
81. Miller LA, Grunwald G, Johnson SL, Krebs NF. Disease severity at time of referral for pediatric failure to thrive and obesity: time for a paradigm shift? *J Pediatr*. 2002;141:121-124
82. Jain A, Sherman SN, Chamberlin DL, Carter Y, Powers SW, Whitaker RC. Why don't low-income mothers worry about their preschoolers being overweight? *Pediatrics.* 2001;107:1138-1146
83. Nawaz H, Adams ML, Katz DL. Physician-patient interactions regarding diet, exercise, and smoking. *Prev Med*. 2000;31:652-657

84. Calfas KJ, Long BJ, Sallis JF, Wooten WJ, Pratt M, Patrick K. A controlled trial of physician counseling to promote the adoption of physical activity. *Prev Med*. 1996;25:225-233
85. Lu MC, Lange L, Slusser W, Hamilton J, Halfon N. Provider encouragement of breast-feeding: evidence from a national survey. *Obstet Gynecol*. 2001;97:290-295
86. Epps RP, Manley MW. The clinician's role in preventing smoking initiation. *Med Clin North Am*. 1992;76:439-449
87. Ludwig DS, Peterson KE, Gortmaker SL. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet*. 2001;357:505-508
88. Tershakovec AM, Watson MH, Wenner WJ Jr, Marx AL. Insurance reimbursement for the treatment of obesity in children. *J Pediatr*. 1999;134:573-578

ADDITIONAL RESOURCES

American Academy of Pediatrics, Committee on Nutrition.Cholesterol in childhood. *Pediatrics.* 1998;101:141-147

- American Academy of Pediatrics, Committee onSports Medicine and Fitness and Committee on School Health. Physical fitnessand activity in schools. *Pediatrics.* 2000;105:1156-1157

Centers for Disease Control and Prevention. *2000 CDC Growth Charts:United States.* Atlanta, GA: Centers for Disease Control and Prevention;2000. Available at: http://www.cdc.gov/growthcharts

Jacobson MS, Rees J, Golden NH, Irwin C. Adolescent nutritional disorders. *AnnN Y Acad Sci.* 1997;817

National Association for Sports and Physical Activity Web site. Availableat: http://www.aahperd.org

National Institutes of Health, National Heart, Lung, and Blood Institute. *ThePractical Guide: Identification, Evaluation, and Treatment of Overweight andObesity in Adults.* Rockville, MD: National Heart, Lung, and BloodInstitute; 2000. NIH Publ. No. 00-4084

Story M, Holt K, Sofka D, eds. *Bright Futures in Practice: Nutrition.*Arlington, VA: National Center for Education in Maternal and Child Health; 2000

US Department of Health and Human Services, Office of Public Health andScience, Office of Disease Prevention and Health Promotion, Public HealthFoundation. *Healthy People 2010 Toolkit: A Field Guide to Health Planning.*Washington, DC: Public Health Foundation; 2002.

Available at: http://www.health.gov/healthypeople/state/toolkitor by calling toll-free 877/252-1200 (Item RM-005)

Weight-control Information Network Web site. Available at:http://www.niddk.nih.gov/health/nutrit/win.htm

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