

RECOGNIZING AND PREVENTING CHILDHOOD OBESITY

Challenging pediatricians with averting this epidemic even in their littlest patients

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Childhood obesity is one of the most challenging problems facing pediatricians today. Approximately 10% of children younger than 2 years old and 21% of children between 2 and 5 years of age are overweight.¹ However, there are disparities in the prevalence of childhood obesity. For example, non-Hispanic black and Hispanic preschool-aged children have a higher prevalence of obesity than non-Hispanic white children; in older children, socioeconomic disparities also exist.^{2,3} Young children with excess weight have an increased risk for obesity in the future.⁴ Unfortunately, few effective treatments exist for children who already are overweight. Therefore, prevention of obesity is paramount.

How early should prevention begin? Experts have suggested that gestation to early infancy is a critical period in which physiologic changes occur that greatly influence a child's later risk for obesity.⁵ Will recognizing the early signs and red flags associated

with the development of obesity lead to a change in the growth trajectory and long-term health of the next generation?

Normal growth patterns in infants and toddlers

The 2000 Centers for Disease Control and Prevention (CDC) growth curves for children aged birth to 20 years have been used by clinicians throughout the United States to guide them in defining children at risk of undernutrition and overnutrition. The data is based on several sources: birth data from vital statistics files in Missouri and Wisconsin; data for 0- to 5-month-old children from the Pediatric Nutrition Surveillance System (PedNSS, a sample from predominantly low-income families); and data for children 2 to 3 months old and older collected from the National Health and Nutrition Examination Surveys (NHANES) from 1963 through 1994.⁶ The CDC body mass index (BMI [weight in

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kilograms/height in meters squared]) growth curves help providers to identify obesity and overweight in children aged 2 years and older. However, the CDC does not have a BMI growth curve for children aged 0 to 2 years. In 2007, as a surrogate for BMI in this age group, an expert committee comprised of representatives from 15 professional organizations recommended the use of weight-for-height growth curves to define overweight as those children who exceed the 95th percentile.⁷ However, a definition for obesity in children under 2 years old still does not exist.

On September 10, 2010, the CDC released a recommendation that all US medical providers use the World Health Organization (WHO) growth curves for children aged 0 to 24 months.^{8,9} The reasons for this recommendation are compelling. Although the CDC growth curves are a growth reference, describing how a particular group of children grew at a certain time, the WHO curves represent a growth standard, describing how healthy children grow in optimal conditions.⁸ In the CDC sample, the rates of breastfeeding initiation, exclusivity, and duration are variable but overall very low.¹⁰

For example, in NHANES III (1988-1994), which

is a component of the CDC growth curves, 45% of children were never breastfed, and only 21% of children were breastfed for at least 4 months.¹¹ In contrast, WHO growth standards use a sample of infants who were breastfed for 12 months and predominantly breastfed for at least 4 months. Since growth patterns differ between breastfed and formula-fed infants, the WHO growth curves show a faster weight gain in the first few months of life than the CDC growth curves; by about 3 months, this pattern reverses. In addition, the new CDC recommendations suggest the 2nd and 98th percentiles on the growth charts as the cutoffs for concerns of unhealthy growth.⁸

As clinicians begin to use the WHO charts, they will see that fewer young children will be classified as underweight. Likely, clinicians will note that a slowed weight gain between 3 and 18 months among breastfed infants is normal, and they will be more likely to reassure parents that supplementation or a switch to formula feeding is unnecessary. In addition, it is anticipated that clinicians will more easily identify formula-fed infants who are gaining weight too rapidly, because these children will more likely be crossing growth percentiles in an upward direction.

CONTINUED ON **PAGE 37**

CONTINUED FROM PAGE 33

In Study 494-01 had an afebrile seizure 6 days after the first dose, one participant in Study 494-01 had a possible seizure the same day as the third dose, and two participants in Study 5A9908 had a febrile seizure 2 and 4 days, respectively, after the fourth dose. Among the four participants who experienced a seizure within 7 days following Control vaccines, one participant had an afebrile seizure the same day as the first dose of DAPTACEL + IPOL + ActHIB vaccines, one participant had an afebrile seizure the same day as the second dose of HCPDT + POLIOVAX + ActHIB vaccines, and two participants had a febrile seizure 6 and 7 days, respectively, after the fourth dose of HCPDT + POLIOVAX + ActHIB vaccines.

Serious Adverse Events In Study P3T06, within 30 days following any of Doses 1-3 of Pentacel or Control vaccines, 19 of 484 (3.9%) participants who received Pentacel vaccine and 50 of 1,455 (3.4%) participants who received DAPTACEL + IPOL + ActHIB vaccines experienced a serious adverse event. Within 30 days following Dose 4 of Pentacel or Control vaccines, 5 of 431 (1.2%) participants who received Pentacel vaccine and 4 of 418 (1.0%) participants who received DAPTACEL + ActHIB vaccines experienced a serious adverse event. In Study 494-01, within 30 days following any of Doses 1-3 of Pentacel or Control vaccines, 23 of 2,506 (0.9%) participants who received Pentacel vaccine and 11 of 1,032 (1.1%) participants who received HCPDT + POLIOVAX + ActHIB vaccines experienced a serious adverse event. Within 30 days following Dose 4 of Pentacel or Control vaccines, 6 of 1,862 (0.3%) participants who received Pentacel vaccine and 2 of 739 (0.3%) participants who received HCPDT + POLIOVAX + ActHIB vaccines experienced a serious adverse event. Across Studies 494-01, 494-03 and P3T06, within 30 days following any of Doses 1-3 of Pentacel or Control vaccines, overall, the most frequently reported serious adverse events were bronchiolitis, dehydration, pneumonia and gastroenteritis. Across Studies 494-01, 494-03, 5A9908 and P3T06, within 30 days following Dose 4 of Pentacel or Control vaccines, overall, the most frequently reported serious adverse events were dehydration, gastroenteritis, asthma, and pneumonia. Across Studies 494-01, 494-03, 5A9908 and P3T06, two cases of encephalopathy were reported, both in participants who had received Pentacel vaccine (N = 5,979). One case occurred 30 days post-vaccination and was secondary to cardiac arrest following cardiac surgery. One infant who had onset of neurologic symptoms 8 days post-vaccination was subsequently found to have structural cerebral abnormalities and was diagnosed with congenital encephalopathy. A total of 5 deaths occurred during Studies 494-01, 494-03, 5A9908 and P3T06: 4 in children who had received Pentacel vaccine (N = 5,979) and one in a participant who had received DAPTACEL + IPOL + ActHIB vaccines (N = 1,455). There were no deaths reported in children who received HCPDT + POLIOVAX + ActHIB vaccines (N = 1,032). Causes of death among children who received Pentacel vaccine were asphyxia due to suffocation, head trauma, Sudden Infant Death syndrome, and neuroblastoma (8, 23, 52 and 256 days post-vaccination, respectively). One participant with ependymoma died secondary to aspiration 222 days following DAPTACEL + IPOL + ActHIB vaccines.

Data from Post-Marketing Experience The following additional adverse events have been spontaneously reported during the post marketing use of Pentacel vaccine worldwide, since 1997. Between 1997 and 2007, Pentacel vaccine was primarily used in Canada. Because these events are reported voluntarily from a population of uncertain size, it may not be possible to reliably estimate their frequency or establish a causal relationship to vaccine exposure. The following adverse events were included based on one or more of the following factors: severity, frequency of reporting, or strength of evidence for a causal relationship to Pentacel vaccine. Cardiac disorders (cyanosis); gastrointestinal disorders (vomiting, diarrhea); general disorders and administration site conditions (injection site reactions [including inflammation, mass, abscess and sterile abscess], extensive swelling of the injected limb [including swelling that involved adjacent joints], vaccination failure/therapeutic response decreased [invasive *H influenzae* type b disease]; immune system disorders (hypersensitivity, such as rash and urticaria); infections and infestations (meningitis, rhinitis, viral infection); metabolism and nutrition disorders (decreased appetite); nervous system disorders (somnolence, HHE, depressed level of consciousness); psychiatric disorders (screaming); respiratory, thoracic and mediastinal disorders (apnea, cough); skin and subcutaneous tissue disorders (erythema, skin discoloration); vascular disorders (pallor).

DRUG INTERACTIONS Concomitant Administration with Other Vaccines In clinical trials, Pentacel vaccine was administered concomitantly with one or more of the following US licensed vaccines: hepatitis B vaccine, 7-valent pneumococcal conjugate vaccine, MMR and varicella vaccines. When Pentacel vaccine is given at the same time as another injectable vaccine(s), the vaccine(s) should be administered with different syringes and at different injection sites.

STORAGE AND HANDLING Pentacel vaccine should be stored at 2° to 8°C (35° to 46°F). Do not freeze. Product which has been exposed to freezing should not be used. Do not use after expiration date shown on the label.

PATIENT COUNSELING INFORMATION Before administration of Pentacel vaccine, health-care personnel should inform the parent or guardian of the benefits and risks of the vaccine and the importance of completing the immunization series unless a contraindication to further immunization exists. The health-care provider should inform the parent or guardian about the potential for adverse reactions that have been temporally associated with Pentacel vaccine or other vaccines containing similar ingredients. The health-care provider should provide the Vaccine Information Statements (VIS) which are required by the National Childhood Vaccine Injury Act of 1986 to be given with each immunization. The parent or guardian should be instructed to report adverse reactions to their health-care provider.

REFERENCES 1. Stratton KR, et al. editors. Adverse events associated with childhood vaccines; evidence bearing on causality. Washington, DC: National Academy Press; 1994. p. 67-117. 2. Braun MM. Report of a US Public Health Service workshop on hypotonic-hyporesponsive episode (HHE) after pertussis immunization. *Pediatrics* 1998;102(5):1-5.

Product information as of December 2009.

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Pediatricians will then have an opportunity to counsel parents of these infants at an age at which the amount and type of infant feeding can be modified.

Risk factors for obesity Pregnancy/Prenatal

In agreement with the Barker hypothesis that events in utero and early in life greatly affect the risk of adult disease,¹² some in utero risk factors appear to affect a fetus' later risk of obesity. Although controversy exists over what exactly constitutes appropriate gestational weight gain (GWG), excess GWG appears to be related to the child's later risk of being overweight.¹³

Recommendations for appropriate GWG set forth by the Institute of Medicine and adopted by the American College of Obstetricians and Gynecologists have been recently revised (Table).^{14,15} Excess GWG appears to be associated with delivering a large-for-gestational age (LGA) infant.¹⁶ Subsequently, a higher birth weight places these infants at an increased risk for future obesity.¹⁷ Excess GWG also has been associated with offspring obesity in the early childhood years, independent of the effects of birth weight.¹⁸

In addition, pregestational maternal obesity leads to an increased risk of obesity in the child throughout life.¹⁹ Gestational diabetes mellitus and maternal smoking during pregnancy are other factors strongly associated with future obesity of a child.^{20,21} Although limited and somewhat controversial data are available, high levels of stress and food insecurity during pregnancy are possible additional risk factors that may be related to future obesity.^{22,23}

Aside from obesity, these risk factors lead to other detrimental health outcomes. For example, excess GWG is strongly associated with preterm birth, and both maternal obesity and gestational diabetes mellitus are associated with an increased risk of intrauterine or neonatal death and congenital malformations, including cardiac defects and neural tube defects.²⁴⁻²⁶ To prevent obesity and other medical complications, these are all important topics to address when counseling future parents.

TABLE Appropriate gestational weight gain

Prepregnancy BMI	Appropriate weight gain, lb
<18.5	28-40
18.5-24.9	25-35
25.0-29.9	15-25
≥30	11-20

Abbreviation: BMI, body mass index.

Adapted from Committee to Reexamine IOM Pregnancy Weight Guidelines.¹⁵

Birth weight and early infant growth

Evidence points to early infancy as one of the most critical time periods in the development of risk for obesity and chronic disease. Babies with a higher birth weight have an increased risk for future obesity.¹⁷

In addition, babies are at an increased risk for obesity if they grow too rapidly during infancy.⁴ In fact, the rate of weight gain in the *first 6 months of life* can predict the development of overweight by age 4 years.²⁷ Interestingly, in 1 formula-fed population, weight gain in the *first week of life* was directly associated with obesity in adulthood.²⁸ Many pediatricians have experienced relief when their infant patients rapidly cross weight curves in the upward instead of downward direction.

The evidence suggests, however, that excitement about a “thriving baby” needs to be tempered with caution and that pediatricians need to closely monitor these infants.

Breastfeeding

Many studies have suggested a relationship between breastfeeding and a decreased risk of later obesity. A meta-analysis of 9 studies of more than 69,000 children found that breastfeeding was inversely associated with future childhood obesity.²⁹ Another meta-analysis evaluated 29 studies and found that breastfed children had a lower odds of future obesity

compared with formula-fed children. Some argue that breastfeeding is simply a marker of a healthier mom or a better socioeconomic status; however, 6 of these studies were adjusted for these factors and yielded the same result.³⁰ Duration of breastfeeding also appears important in future obesity risk. In fact, the odds of future overweight are reduced by 4% for every month of breastfeeding.³¹

So, what aspect of breastfeeding is protective against obesity? A number of hypotheses have been proposed. Endocrine responses to breast milk versus formula may lead to differential fat deposition.³² Others suggest that flavors of food come through in breast milk, leading to lower levels of “pickiness” in childhood.^{32,33} Another hypothesis is that breastfed infants learn to regulate food intake and satiety more than those who are bottle-fed.³² One study found that infants fed exclusively at the breast for the first 6 months of life were about half as likely to empty a bottle or cup in the second half of infancy compared with infants fed via the bottle exclusively.³⁴ Unfortunately, these hypotheses are difficult to study. Although the exact mechanism remains unknown, pediatricians should encourage breastfeeding as a means to help prevent obesity.

Supplemental feeding

The American Academy of Pediatrics (AAP) supports exclusive breastfeeding for a minimum of 4 months but preferably 6 months for most infants.³⁵ However, the most recent Feeding Infants and Toddlers Study 2008 (FITS) shows that 10.9% of infants younger than 4 months already consume supplemental foods.³⁶ The evidence for an association between early introduction to solids and the development of future obesity is mixed. In 1 study, infants fed solid food before 4 months of age had a faster rate of weight gain through 14 months of age compared with infants who did not eat solids until at or after 4 months.³⁷

In contrast, some observation studies have found no association between the timing of introduction of solids and measures of later adiposity.^{38,39} One randomized, controlled trial of timing of solid food initiation has been conducted in a developed country and showed that infants who started solid foods early (at 3 to 4 months of age) or late (6 months of age) did not differ in body composition, weight, or body mass index in the first year of life.⁴⁰

Points Taken

➤ Higher birth weights place infants at an increased risk for future obesity.

➤ The rate of weight gain in the first 6 months of life can predict the development of overweight by age 4 years.

Possible explanations for the lack of a clear relationship are that studies differ on the definition of early introduction of solid foods, timing of follow-up, and adjustment for potential confounders. In addition, research has not sufficiently evaluated the use of specific types of food for early solid feeding. Although data are limited, pediatricians should continue to recommend that parents start supplemental feeding no sooner than 4 months but preferably at 6 months of age.³⁵

Sugar-sweetened beverages and juice

One type of caloric intake that has been pervasive and problematic for many years and for many reasons is sugar-sweetened beverages. The latest FITS shows that 7% of infants between 4 and 6 months of age consume 100% fruit juice on any given day, and this amount increases to 61% of children before 2 years of age. In addition, although less than 1% of infants between 4 and 6 months of age consume nonjuice, sugar-sweetened beverages on a given day, 38% of children regularly consume these beverages by age 2 years.³⁶

Although some parents regard juice as a healthy food, even 100% juice is associated with toddlers' diarrhea, dental caries, and obesity when it is excessive and in addition to food calories.⁴¹ Among overweight 1- to 5-year-old children, the amount of daily fruit juice consumed is associated with an increased adiposity gain.⁴² Among children between 2 and 3 years of age, the intake of sugar-sweetened beverages is associated with an increased risk of future obesity for those children already overweight and an increased risk of remaining obese for already obese children.⁴³

Although the information is limited, the AAP recommends not introducing juice to infants younger than 6 months old and to allow a maximum of 4 to 6 ounces per day of juice for children 1 to 6 years old.⁴¹ In addition, intake of other high-calorie, nutrient-poor drinks should be limited.⁴⁴ Since many young children are consuming sugar-sweetened beverages, pediatricians should ask about consumption of these beverages at well visits and encourage adherence with the AAP guidelines.

Other determinants of obesity

Overencouragement and overrestriction of feeding each seem to be associated with later increased

Resources for further reading

For pediatricians

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| CDC growth charts | www.cdc.gov/growthcharts |
| WHO growth standards | www.who.int/childgrowth/standards/en |
| AAP recommendations | Barlow SE; Expert Committee. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. <i>Pediatrics</i> . 2007;120(suppl 4):S164-S192. |
| Preventing obesity in your practice | www.nationwidechildrens.org/ounce-of-prevention |
| Early childhood feeding | Butte N, Cobb K, Dwyer J, Graney L, Heird W, Rickard K; American Dietetic Association; Gerber Products Company. The Start Healthy Feeding Guidelines for Infants and Toddlers. <i>J Am Diet Assoc</i> . 2004;104(3):442-454. |

For parents

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| www.healthychildren.org/english/health-issues/conditions/obesity/ | |
| How to feed a young child | Satter E. <i>Child of Mine: Feeding With Love and Good Sense</i> . 3rd ed. Boulder, CO: Bull Publishing Co; 2000. |
| | Dietz W, Birch LL, eds. <i>Eating Behaviors of the Young Child: Prenatal and Postnatal Influences on Healthy Eating</i> . Elk Grove Village, IL: American Academy of Pediatrics; 2008. |
| | www.eatright.org/public
www.mypyramid.gov |

weight.^{45,46} The hypothesis is that by imposing external cues, the feeder is essentially overriding the infant's innate ability to determine what, when, and how much food to consume. When infants and toddlers are left alone, they adapt their intake to the energy content of food. This natural regulation is dampened when they are encouraged to do things such as "clean their plate."⁴⁷ For example, a bottle-fed infant who is pushing the bottle away or turning his or her head away during a feeding may be indicating fullness and should not be

expected to empty the bottle. In practice, pediatricians should counsel parents to allow children to respond to internal hunger cues and learn to self-regulate food intake.

Lack of appropriate duration and quality of sleep is emerging as a strong risk factor for the development of overweight and obesity in older children.⁴⁸ Little research has focused on the relationship between sleep in children younger than 2 years and overweight or obesity. However, 1 study found that children aged 6 months to 2 years with a sleep duration of fewer than 12 hours per day had twice the odds of being overweight at 3 years of age compared with children

sleeping at least 12 hours per day.⁴⁹ Although the evidence is limited at this time, sleep is one possible modifiable risk factor, and adequate sleep in children should be encouraged.

Television viewing is a potential risk factor for overweight and obesity in this age group but may act synergistically with other risk factors, such as sleep. Although the AAP recommends discouraging television use by children younger than 2 years

old, approximately 90% of children regularly watch television, DVDs, or videos by age 2 years.^{50,51}

Young children who sleep fewer than 12 hours a day and watch more than 2 hours of TV a day have 6 times the odds of being overweight by age 3 compared with their well-rested, TV-free counterparts. However, among children with adequate sleep, the same study showed no statistically significant effect of television-viewing time on the future odds of being overweight.⁴⁹ The effects of TV on obesity are not very well studied in this age group; however, research suggests that early childhood television viewing time likely impairs language and cognitive development and increases the likelihood of future attention problems.⁵² Therefore, pediatricians should assess and strongly discourage television viewing in young children.

Another potential risk factor for children developing obesity is the child care setting. Much like the school setting for older children, the child care

setting provides nutrition and physical activity for a substantial portion of the day. The overall time spent in nonparental child care from birth to 6 months of age is associated with increased measures of adiposity at 1 and 3 years of age. This effect is strongest for children cared for in someone else's home.⁵³

Infants receiving care from a relative have a larger weight gain in the first 9 months of life than children in parental care.⁵⁴ Children in informal child care (care by a relative, friend, or nonregistered nanny) between 9 months and 3 years have an increased risk of overweight at 3 years of age, particularly if a grandparent is providing care.⁵⁵

One reason for this relationship could be that child care settings have different practices related to breastfeeding and introduction of solid foods compared with the home environment.⁵³⁻⁵⁵ To help parents place their children in healthy child care settings, pediatricians should encourage parents to ask child care personnel about their practices regarding healthy behavior, such as limiting the use of television, encouragement of active play, and the availability of healthy food options.

Early identification and prevention are key

Childhood obesity remains a challenge for primary care providers. Preventing the problem, or identifying it early and intervening, is clearly the best solution. Physicians should counsel mothers early in pregnancy about weight gain, smoking, and nutrition. Pediatricians should use WHO growth curves to track infant growth from 0 to 24 months and closely watch young children who cross growth percentiles upward.

In addition, pediatricians should encourage breastfeeding, recommend minimal juice and other sweet-drink consumption, discuss feeding practices that are guided by the infant's cues, and encourage proper sleep duration and avoidance of screen time as part of anticipatory guidance.

Delayed introduction of solids also may be beneficial to encourage. Pediatricians can advocate for making child care settings healthy places for young children and assist parents with choosing healthy child care options. In their offices, pediatricians also can set good examples by providing private rooms for nursing mothers, eliminating televisions in waiting rooms,

Points Taken

➤ The AAP supports exclusive breastfeeding for a minimum of 4 months.

➤ Lack of appropriate duration and quality of sleep is emerging as a risk factor for overweight and obesity in children.

and offering only healthy vending options for patients and families. In addition, there are resources for pediatricians and for patients that can be used directly (see, "Resources for Further Reading," page 39). Working with parents to prevent obesity in the early years can place young children on a lifelong trajectory toward good health. 

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