Childhood overweight and cardiovascular disease risk factors: the National Heart, Lung, and Blood Institute Growth and Health Study

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Objective To estimate the prevalence and incidence of overweight in African-American and Caucasian girls, and to examine associations between adolescent overweight and cardiovascular disease (CVD) risk factors.

Study design In the National Heart, Lung and Blood Institute Growth and Health Study (NGHS), annual measurements were obtained from girls followed longitudinally between age 9 or 10 and 18 years; self-reported measures were obtained at age 21 to 23 years. A total of 1166 Caucasian girls and 1213 African-American girls participated in the study. Childhood overweight as defined by the Centers for Disease Control and Prevention (CDC) was the independent variable of primary interest. Measured outcomes included blood pressure and lipid levels.

Results Rates of overweight increased through adolescence from 7% to 10% in the Caucasian girls and from 17% to 24% in the African-American girls. The incidence of overweight was greater at age 9 to 12 than in later adolescence. Girls who were overweight during childhood were 11 to 30 times more likely to be obese in young adulthood. Overweight was significantly associated with increased percent body fat, sum of skinfolds and waist circumference measurements, and unhealthful systolic and diastolic blood pressure, high-density lipoprotein cholesterol, and triglyceride levels.

Conclusion A relationship between CVD risk factors and CDC-defined overweight is present at age 9.

Findings from the National Health and Nutrition Examination Surveys have shown that the prevalence of childhood overweight has continued to increase with each new survey, rising from 4% to 6% in 1976-1980 to 16% in 1999-2002.1,2 Overweight in childhood is not benign. Adverse levels of cardiovascular (CVD) risk factors—increased blood pressure, serum total cholesterol (TC), low-density lipoprotein cholesterol (LDL), triglycerides (TG), and fasting insulin levels and reduced high-density lipoprotein cholesterol (HDL) level—are associated with increased body mass index (BMI).3-7 The greater the increase in BMI, the greater the increase in risk factor levels.

Obesity and cardiovascular risk factors track from childhood into adulthood.8-11 In addition, adults who were overweight in childhood have higher lipid, blood pressure, and fasting insulin levels and thus are at increased risk for coronary heart disease compared with adults who were thin as children.8-9,12

BMI has been the measure of choice in national surveys for defining overweight in children and has been recommended by health experts for use in clinical practice.13,14 Obtaining precise measurements of adiposity is impractical; however, the components of BMI—height and weight—can be easily measured with high accuracy and reliability and have been correlated with body fat in children and adolescents, including young African-American girls.15-17 The commonly used definition of overweight is the age- and sex-specific 95th percentile for BMI from the 2000 Centers for Disease Control and Prevention (CDC) National Health and Nutrition Examination Survey clinical growth charts.18 Assessing the magnitude of increased risk associated with those cutpoints would greatly enhance the utility of the CDC cutpoints for classifying overweight children.

<table>
<thead>
<tr>
<th>BMI</th>
<th>Body mass index</th>
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<tbody>
<tr>
<td>CDC</td>
<td>Centers for Disease Control and Prevention</td>
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<td>CI</td>
<td>Confidence interval</td>
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<tr>
<td>CVD</td>
<td>Cardiovascular disease</td>
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<td>DBP</td>
<td>Diastolic blood pressure</td>
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<td>HDL</td>
<td>High-density lipoprotein</td>
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<td>LDL</td>
<td>Low-density lipoprotein</td>
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<td>NHGS</td>
<td>National Growth and Health Study</td>
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<td>OR</td>
<td>Odds ratio</td>
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<td>SBP</td>
<td>Systolic blood pressure</td>
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<td>TC</td>
<td>Total cholesterol</td>
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<td>TG</td>
<td>Triglycerides</td>
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The National Heart, Lung and Blood Institute Growth and Health Study (NGHS) is a longitudinal study involving a cohort of 2379 African-American and Caucasian females, examined annually from age 9 or 10 through age 18 to 19 and later interviewed at age 21 to 23. The purpose of the NGHS was to investigate correlates and outcomes of overweight in African-American and Caucasian females to gain insight into why African-American women have higher rates of obesity and cardiovascular disease mortality than their Caucasian peers. Data collected from the NGHS cohort provides the opportunity to examine overweight and its relationship to adiposity and cardiovascular risk factors, using CDC 2000 growth chart BMI cutpoints for childhood overweight. Incidence of overweight also can be assessed in this cohort. Knowledge of the incidence of obesity across the adolescent years may help determine whether there are critical time periods when obesity incidence is greatest and when the odds of being obese during young adulthood are highest. In addition, measures of blood pressure and serum lipid levels obtained at clinic visits during adolescence allow for an assessment of the relationship between the CDC definition of overweight at each age and prevalence of adverse levels of CVD risk factors based on clinical cutpoints used for screening and risk assessment.

METHODS

Participants and Recruitment

The NGHS was designed to have a sample of adequate size to permit comparisons of indicators of obesity by race. Although there was some geographic diversity, the sample was not designed to be nationally representative. As reported previously, 2379 African-American and Caucasian girls who were age 9 or 10 years at study entry were recruited at 3 institutions: University of California at Berkeley, University of Cincinnati/Cincinnati Children’s Hospital Medical Center, and Westat, Inc, Rockville, MD. The Maryland Medical Research Institute served as the coordinating center, and the National Heart, Lung, and Blood Institute also participated. Participants were recruited from schools, health maintenance organizations, and Girl Scout troops. Areas selected were based on census tract data to include a wide distribution of household incomes and parental education within each race. Eligibility criteria were few: age 9 or 10 years, self-identification as African-American or Caucasian, non-Hispanic, and racially concordant parents or guardians. Eligible participants were invited to enroll until the target sample size was attained; an effort was made to enroll all eligible girls, to minimize the risk of sample bias. All girls who enrolled in the study had assented, and their parents (or guardian) had provided written informed consent. The study protocol was approved by the institutional review boards of all participating institutions.

During 1986-1997, the girls attended 10 annual “clinic visits” (visits 1 to 10). Retention rates were very high at visits 2 to 4 (96%, 94%, 91%), declined to a low of 82% at visit 7, and increased to 89% at visit 10. Data were collected at the 3 clinic sites or, if a girl was unable to travel to a site, at her home, using standardized procedures. Between 1998 and 2001, a single telephone interview (NGHS-Wave II) was conducted with 2054 NGHS participants (991 Caucasians and 1063 African-Americans) who were then age 21 to 23 (mean age, 21.5; SD, 0.6).

Instruments and Measures

Only instruments and measures relevant to the present report are described here. Physical measures were obtained annually at all 10 visits when girls were age 9 or 10 (visit 1) through 18 to 19 (visit 10), unless stated otherwise.

Demographic Information. Information regarding age and race/ethnicity was collected at study entry from girls and their parents (or guardians) by self-report, using US Census categories. Age was coded as age at last birthday, except that age in months was used to classify overweight by the CDC definition.

Height, Weight, and Waist Circumference. Central training sessions were conducted annually to train and certify data collectors to follow a common measurement protocol. Data collectors obtained 2 measurements of height and weight and then obtained a third measurement if the first 2 differed by a predetermined amount. The average of all measurements was determined and used. In NGHS-Wave II, participants were asked during the telephone interview to self-report their current weight. BMI was calculated as weight in kilograms divided by height in square meters (kg/m²). Beginning with visit 2, waist circumference (at the narrowest part of the torso) was also measured annually.

Childhood Overweight and Young Adult Obesity. The CDC’s age-specific 95th percentile for girls was used to classify overweight at age 9 to 18 years (CDC growth charts; available at http://www.cdc.gov/growthcharts/). Young adult obesity (ages 21 and up) was defined as BMI ≥ 30 kg/m².

Body Fat. Resistance and reactance measures of bioelectrical impedance were evaluated using bioelectrical impedance (PFL Systems model 10, Detroit, MI). Percent body fat was computed as \( \beta_0 + \beta_1 e^*(\text{height}^2/\text{resistance}) + \beta_2 e^* \text{weight} + \beta_3 e^* \text{reactance} \), where \( \beta_0, \ldots, \beta_3 \) are ethnicity-specific coefficients (\( e = 1 \) if Caucasian and 2 if African-American) from predictive models of fat-free mass (based on dual energy x-ray anthropometry, \( R^2 = 0.99^2 \)), developed with a separate sample of 126 African-American and Caucasian girls, age 6 to 17.

Skinfolds. Skinfold measurements at the triceps, suprailiac, and subcapsular sites were obtained following standard protocol. These measures were added together to yield the sum of skinfolds.
BLOOD PRESSURE. Blood pressure was measured 3 times, with measurements taken at least 60 seconds apart using a standard mercury sphygmomanometer with a cuff of appropriate size for arm circumference. The second and third measurements were used to calculate the mean systolic ($K_s$) and diastolic ($K_d$) blood pressures (SBP and DBP, respectively). The elevated range was defined as at or above the sex- and age-specific 95th percentile for SBP and DBP, also taking height into account.27

LIPIDS. Overnight fasting blood specimens were obtained in the morning at visits 1, 3, 5, 7, and 10. TC and HDL cholesterol levels were determined using the CHOD-PAP method.28 TG were analyzed enzymatically using a commercially available method, and LDL cholesterol was calculated using the Friedewald formula,29 modified based on the Lipid Research Clinics data: LDL cholesterol = total cholesterol − HDL cholesterol − (TG/5.5).30 High lipid levels were defined as >200 for total cholesterol, >130 for LDL cholesterol, and ≥130 for TG;31 HDL cholesterol levels ≤50 were considered low.32

INCIDENCE (NEW ONSET) OF CHILDHOOD OVERWEIGHT. New onset of childhood overweight during the NGHS was determined as follows. Girls who were overweight at the first visit were excluded from the analyses of overweight onset. Girls who were not overweight at the first visit could experience onset of overweight from the second visit onward. The percent of new onset cases was computed at each age as the number of new onset cases at that age, divided by the total number of girls with BMI data for each age between study entry (age 9 or 10) and that age. Girls were excluded from the “risk set” (denominator) at a given age if at any previous age at which they were overweight or their overweight status was unknown.

Statistical Analysis
The association of overweight prevalence with age and race (including the interaction) was computed using mixed logistic regression to account for the repeated measurements.33,34 To test hypotheses about the association of incidence (onset of overweight) with age and race, the time to first onset of overweight was modeled using a piecewise exponential accelerated failure time model.35 The degree of association between overweight and 3 indicators of body fatness (ie, percent body fat from bioelectric impedance measures, sum of skinfolds, and waist circumference) was estimated using linear mixed models, adjusting for age, race, and their interactions with overweight. Logistic regression was used to establish the association at each age in childhood and obesity in early adulthood, adjusting for race. Finally, mixed logistic regression was used to examine the association of overweight with the probability of developing elevated (or, for HDL cholesterol, low) levels of CVD risk factors, adjusting for age, race, and their interactions with overweight. In addition to the variables mentioned earlier, all analyses were adjusted for study site. For outcomes with small samples in some analysis cells (ie, incidence of overweight and CVD risk factors at specific ages), age effects were modeled using 2 age segments, 9 to 12 and >12 to 18;36 the segmentation was at age 12 because this was the approximate mean age of menarche in this cohort.20 A separate effect for each age was estimated in all other models. Direct likelihood estimation or multiple imputation was used to account for missing data.37-39 SAS 9.1 (SAS Institute, Cary, NC) was used for all analyses. P values <.05 were considered statistically significant.

RESULTS
Prevalence and Incidence of Childhood Overweight
Table I reports the number of participants with BMI data by age and shows the prevalence and incidence (new onset) of overweight in African-American and Caucasian girls at each age. Overweight was more prevalent in African-American girls than Caucasian girls (odds ratio = 4.9; 95% confidence interval [CI] = 1.6 to 8.2; P < .0001). The rate of overweight differed significantly by age (P < .0001), tending to increase as the girls grew older, with the increase with age stronger in the African-American girls than in the Caucasian girls, although the interaction term was not significant (age-by-race interaction, P = .06).

The percent of new onset cases (ie, incidence) of childhood overweight ranged from 2% to 5% through age 12, after which the annual incidence was generally lower, approximately 1% to 2%. The estimated instantaneous risk (hazard) of experiencing overweight was greater at age 9 to 12 than at above age 12 (hazard ratio = 1.6; 95% CI = 1.1 to 2.3; P = .03). The risk of experiencing onset of overweight at any given time was about 1.5 times greater for African-American girls than for Caucasian girls (hazard ratio = 1.5; 95% CI = 1.2 to 2.0, P = .003).

To examine the possibility that changes in incidence across age were an artifact of using a BMI-based definition of overweight, which includes a lean body mass component, an analogous analysis was conducted, with overweight defined as being above the age-specific 95th percentile of sum of skinfolds for the NGHS sample. The results were very similar; the incidence of overweight at age 9 to 12 was 1.7 times greater (95% CI = 1.2 to 2.5; P = .008) than it was after age 12.

Childhood Overweight and Obesity in Young Adulthood
Table II shows the percentage of girls who were obese in young adulthood (NGHS Wave II, age 21 to 23) by their overweight status at each age from 9 to 18 inclusive. Compared with nonoverweight girls, girls who were overweight at age 9 to 18 were much more likely to be obese as young adults (P < .0001).
Table I. Prevalence and annual incidence of overweight, by age and race*

| Age (years) | Caucasian | | African-American | |
|-------------|-----------| |-----------|-----------|
| n | % overweight | % new onset | n | % overweight | % new onset |
| 9 | 612 | 7.4% | NA† | 533 | 17.4% | NA† |
| 10 | 1098 | 8.7% | 3.1% (16/523) | 1159 | 18.2% | 2.7% (114/407) |
| 11 | 1024 | 9.9% | 2.5% (22/888) | 1092 | 20.0% | 4.8% (41/860) |
| 12 | 1010 | 10.3% | 2.1% (17/794) | 1100 | 21.5% | 4.2% (32/760) |
| 13 | 958 | 9.9% | 1.8% (13/718) | 1074 | 20.9% | 1.8% (12/677) |
| 14 | 856 | 9.6% | 2.0% (12/607) | 967 | 22.3% | 1.0% (6/6572) |
| 15 | 811 | 8.3% | 0.4% (2/509) | 931 | 22.6% | 2.2% (11/489) |
| 16 | 852 | 8.8% | 1.1% (5/460) | 940 | 21.1% | 0.7% (3/423) |
| 17 | 904 | 10.4% | 1.4% (6/422) | 934 | 23.7% | 0.8% (3/369) |
| 18 | 873 | 10.1% | 0.8% (3/373) | 896 | 23.3% | 1.7% (5/302) |
| 9 to 12‡ | 5.8% (55/947) | | | | 9.4% (84/929) |
| 13 to 18§ | 5.7% (41/718) | | | | 5.9% (40/677) |

NA, not applicable.
*At study entry, approximately half of the NGHS girls were age 9 at study entry, and about half were 10 years old.
†No new onset data are given for age 9, because all age-9 data were collected during the girls’ first visit, and data from the first visit were not included in incidence calculations.
‡The incidence estimate for years 9 to 12 combined.
§The incidence estimate for years 13 to 18 combined.

Table II. Percent (number) of girls who were overweight in young adulthood (age 21 to 23) among those who were overweight and those who were not overweight in childhood, by age

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>% (number) overweight in young adulthood, among those girls who were...</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overweight at age</td>
</tr>
<tr>
<td>9</td>
<td>71.3% (87/122)</td>
</tr>
<tr>
<td>10</td>
<td>69.0% (187/271)</td>
</tr>
<tr>
<td>11</td>
<td>68.9% (195/283)</td>
</tr>
<tr>
<td>12</td>
<td>67.4% (211/313)</td>
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<tr>
<td>13</td>
<td>72.3% (209/289)</td>
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<tr>
<td>14</td>
<td>72.3% (196/271)</td>
</tr>
<tr>
<td>15</td>
<td>76.2% (202/265)</td>
</tr>
<tr>
<td>16</td>
<td>78.0% (202/259)</td>
</tr>
<tr>
<td>17</td>
<td>79.7% (235/295)</td>
</tr>
<tr>
<td>18</td>
<td>78.0% (220/282)</td>
</tr>
</tbody>
</table>

*The descriptive statistics were computed using only those girls who had nonmissing BMI at both the age in childhood and in young adulthood; thus, the sample sizes were smaller than those given in Table I.
‡The odds ratios and 95% confidence intervals were estimated following multiple imputation of missing data. Descriptive statistics (columns 2 and 3) were based on sample data before multiple imputation.

Childhood Overweight and Other Adiposity Indicators

Table III shows the association between childhood overweight and 3 indicators of body fatness by age. For all indicators, the mean values were greater for overweight girls than for nonoverweight girls (P < .0001), and the differences between the measures for overweight and nonoverweight girls tended to increase with age (overweight-by-age interaction, P < .0001). All measures increased with age (P < .0001). For percent body fat and waist circumferences, means were greater for African-American girls (P < .0001) by approximately 5.7% (95% CI = 4.4 to 7.1) and 2.8% (95% CI = 1.9 to 3.7), respectively, but there was no racial difference for sum of skinfolds (P = .09). There were significant race-by-overweight interactions for percent body fat and sum of skinfolds (P < .0003), but not for waist circumference (P = .81). For percent body fat, the difference between overweight and nonoverweight girls was greater in Caucasian girls (percent difference = 14.6%; 95% CI = 12.6 to 16.5) than in African-American girls (percent difference = 11.2%; 95% CI = 9.4 to 13.0). The converse was true for sum of skinfolds (percent difference = 39.5% for Caucasian girls and 48.4% for African-American girls; 95% CI = 35.8 to 43.2 for Caucasian girls and 43.3 to 53.7 for African-American girls).
Based on results of the mixed-models technique, which is analogous to partial $R^2$ in ordinary multiple regression, overweight was most strongly associated with sum of skinfolds and waist circumference and less strongly (albeit significantly) associated with percent body fat, even after adjusting for study site, age, and race.

**Childhood Overweight and Outcomes**

Table IV shows the percentage of girls with high levels of blood pressure and lipids (low levels for HDL), by age and overweight. Compared with nonoverweight girls, overweight girls were more likely to exhibit elevated SBP and elevated DBP ($P = .01$). Rates of elevated SBP and DBP also changed with age, but these changes depended on overweight. In overweight girls, rates of elevated SBP increased between age 9 and 12 ($P = .03$) and decreased thereafter ($P < .0001$); in nonoverweight girls, rates of elevated SBP did not change with age. In nonoverweight girls only, rates of elevated DBP decreased during early adolescence (age 9 to 12; $P = .01$); in both overweight and nonoverweight girls, rates of elevated DBP tended to decrease after age 12 ($P = .005$). Neither measure of elevated blood pressure varied by race ($P > .08$).

Compared with nonoverweight girls, overweight girls were more likely to exhibit decreased HDL ($P < .0001$) and elevated triglyceride levels ($P = .002$). Overweight was not
significantly associated with elevated LDL or elevated TC level ($P > .06$).

Both overweight and nonoverweight girls exhibited significant decreases in rates of unhealthful TC, LDL, and HDL levels from age 9 to 12 ($P < .05$); further, in nonoverweight girls, unhealthful triglyceride levels increased between age 9 and 12 ($P = .001$). Overweight and nonoverweight girls showed different age trends after age 12; in overweight girls, rates of unhealthful TC and LDL levels ($P < .002$) tended to increase, whereas in nonoverweight girls, after age 12 there was an increase in low HDL but a decrease in elevated TG ($P < .05$). Nonoverweight African-American girls were more likely to exhibit elevated TC than were nonoverweight Caucasian girls (odds ratio [OR] for race = 1.6; 95% CI = 1.1 to 2.4; $P = .02$), whereas overweight African-American girls were less likely to exhibit elevated TC (OR for race = 0.6; 95% CI = 0.1 to 1.0; $P = .03$). Regardless of overweight, African-American girls were less likely than Caucasian girls to exhibit unhealthful HDL and TG levels (for HDL, OR for race = 0.6, 95% CI = 0.6 to 0.7; for TG, OR for race = 0.5, 95% CI = 0.4 to 0.6; $P < .0001$). No racial differences were seen in LDL level ($P > .31$).

Pubertal maturation has been associated with lipids.\textsuperscript{42,43} If maturation explains some of the variation in unhealthful lipid levels above and beyond that due to age, then maturation may affect the estimated association of lipids with overweight. Therefore, as a secondary analysis, the association of overweight with unhealthful lipid levels was reestimated in models controlling for both maturation and age (with maturation stage represented as either prepubertal, pubertal, postmenarchal <2 years, or postmenarchal ≥2 years). Although the estimates were generally similar (see Table IV), adding maturation tended to produce tighter CIs. One consequence was that in the model controlling for maturation, unhealthful LDL level was significantly associated with overweight ($P = .01$).

**DISCUSSION**

The aims of the present study were to examine racial differences in females in the prevalence and incidence of overweight using the CDC definition, to compare overweight with several other adiposity indicators, to estimate the association between childhood overweight and obesity in young adulthood, and to examine relations between overweight and unhealthful high (or low) levels of CVD risk factors. The NGHS offered a unique opportunity to achieve these aims because of its high-quality measures of height, weight, adiposity, blood pressure, and lipid levels collected longitudinally on a large and ethnically diverse sample during an important developmental period encompassing childhood and adolescence.

Our findings point to 2 useful areas in which to focus obesity prevention efforts. First, in accordance with earlier studies reporting high rates of childhood overweight for African-Americans,\textsuperscript{1,2,44} in the NGHS, the African-American girls had higher prevalence rates and also experienced weight onset at a significantly faster rate than the Caucasian girls. This finding highlights the importance of prevention efforts that take into account cultural differences.\textsuperscript{45} Second, the incidence of overweight in the NGHS was significantly higher at age 9 to 12 than at older ages; this observation was true both for the BMI-based definition of overweight and for a definition based on sum of skinfolds. The pubertal period, a time of rapid deposition of body fat, may be a vulnerable period during which risk for overweight becomes pronounced.\textsuperscript{20,46,47} The rapid increase in overweight at age 9 to 12 years suggests that this may be an especially important period on which to focus clinical and public health interventions to prevent overweight.

Our data suggest that childhood overweight may have serious short-term and long-term consequences. They indicate that a relationship between CVD risk factors and CDC-defined overweight is already present at age 9 and suggest that pediatricians should address the health correlates of overweight during childhood.\textsuperscript{47} Girls who were overweight were 3 to 10 times more likely to be assessed in the “risk” range on 4 of 6 health indicators (SDP, DBP, HDL, and TG), and had 3 times greater odds of having elevated LDL levels in a model controlling for maturation ($P = .01$). Freedman et al\textsuperscript{5} found similar results in 5- to 17-year-olds in seven cross-sectional studies. These findings also suggest that the CDC definition of overweight based on BMI is valid and that it provides a useful standard for classifying overweight in both African-American and Caucasian adolescent girls in clinical and research settings.\textsuperscript{5,48-50} Consistent with findings of others,\textsuperscript{48-50} percent body fat, sum of skinfolds, and waist circumference were substantially higher in overweight girls of both races compared with nonoverweight girls, illustrating that the measures of height and weight that make up BMI are strongly related to these indicators of adiposity.

Over the longer term, childhood overweight is strongly associated with young adult obesity, even measured more than 10 years apart. Consistent with others,\textsuperscript{9-11} we found that childhood overweight confers a 10-fold or greater increase in risk for being overweight in early adulthood relative to children who were not overweight at the same age. One limitation to our study is that young adult weight was self-reported, and the study did not assess the reliability of self-reported weight. Although self-reported body weight may be subject to bias, it is noteworthy that young adult obesity was strongly associated with childhood overweight, and the strength of this association was similar to that observed in previous studies in girls of both races, providing some assurance that there was no large, systematic bias.

Interventions to address childhood obesity and unfavorable CVD risk factors levels have been conducted primarily in school settings.\textsuperscript{51} Although changes in food intake and physical activity in the desired directions have been observed in some studies,\textsuperscript{52,53} success in reducing BMI has been found in only a few studies conducted in schools.\textsuperscript{54-56} Intervention studies in community settings have begun to specifically address childhood obesity in African-American girls.\textsuperscript{57,58} Community outreach programs addressing eating behavior and
physical activity for parents and their children are currently under way in more than 95 communities across the country. Pediatricians and primary care practitioners need to support public health and societal efforts to prevent childhood overweight by monitoring growth and providing advice to parents on the importance of their children maintaining a healthy weight during adolescence through healthy eating and regular physical activity. The challenge for clinicians, community leaders, researchers, and public health officials will be to develop effective innovative obesity prevention interventions that can be widely generalized and disseminated, so that the dire prediction that deaths related to obesity will soon become the leading cause of mortality in the United States does not come to pass.

REFERENCES

The authors reported a 1-month-old infant who was normal except for a mild right upper lid ptosis. The mother noted that during breast feeding, the drooping right upper eyelid would shoot up. This phenomenon is referred to as Marcus Gunn jaw winking. It was first described by Marcus Gunn, an English ophthalmologist, in 1883. Perhaps better known than the jaw winking phenomenon is the Marcus Gunn pupil, a test for a unilateral optic nerve disease. In either case, a hypphen should not be placed between Marcus and Gunn.

The Marcus Gunn jaw winking phenomenon characterized by the movement of 1 upper eyelid in a rapid rising motion each time the jaw moves is thought to be due to anomalous wiring of the motor division of the trigeminal nerve to the oculomotor nerve supplying the levator muscle. The wink reflex consists of a brief upper eyelid retraction or elevation to an equal or higher level than the other eye with stimulation of the ipsilateral pterygoid muscle. As in this case report, the Marcus Gunn jaw winking phenomenon is often first noted in infancy with breast or bottle feeding.

Of particular importance to the pediatrician is that the Marcus Gunn jaw winking phenomenon is often associated with a high incidence of strabismus and amblyopia. If these conditions are not diagnosed at an early age, a permanent visual impairment may result.

The Marcus Gunn jaw winking phenomenon accounts for approximately 5% of all congenital ptosis and is almost always sporadic, although rare familial presentations with an autosomal inheritance pattern have been reported. The pediatrician should make certain to test all children with ptosis to determine whether the ptosis changes with jaw movements, given that Marcus Gunn syndrome is associated with strabismus in more than 50% of cases. This phenomenon is evident at birth, and often parents are the first to notice this jaw winking as their infants feed.

If the ptosis is mild, no treatment is usually necessary. It has been postulated that this phenomenon improves as children age. More likely is that the patient adapts or learns to compensate by masking the wink response and using jaw movements to prevent wide eye fluctuations. If the ptosis is either moderate or severe, there are multiple surgical approaches to be considered that involve either unilateral or bilateral lid surgery. If surgery is contemplated, it is important to first treat any associated amblyopia.

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