
Cynthia L. Ogden, PhD; Richard P. Troiano, PhD, RD; Ronette R. Briefel, DrPH, RD; Robert J. Kuczmarski, DrPH, RD; Katherine M. Flegal, PhD; and Clifford L. Johnson, MSPH

ABSTRACT. Objective. To examine the prevalence of overweight among US preschool children 2 months through 5 years of age between the years 1971 through 1974 and 1988 through 1994.

Design. Nationally representative cross-sectional surveys with a physical examination, including measurement of stature, length, and weight. Between 1200 and 7500 children younger than 6 years were examined in each of four different surveys during 1971 through 1974 (first National Health and Nutrition Examination Survey [NHANES I]), 1976 through 1980 (NHANES II), 1982 through 1984 (Hispanic Health and Nutrition Examination Survey), and 1988 through 1994 (NHANES III).

Results. The prevalence of overweight increased among some sex and age groups of preschool children between 1971 through 1974 and 1988 through 1994. More than 10% of 4- and 5-year-old girls were overweight in 1988 through 1994 compared with 5.8% in 1971 through 1974. However, there was no change during this period in the prevalence of overweight among 1- to 3-year-old children. During 1988 through 1994, the prevalence of overweight among children 2 months through 5 years of age was consistently higher in girls than boys. Mexican-American children had a higher prevalence of overweight than non-Hispanic black and non-Hispanic white children. These results parallel what has been reported for older children and adults in the United States.

Conclusion. These results show that in the last 20 years the prevalence of overweight has increased among 4- and 5-year-old children but not among younger children. These findings suggest that efforts to prevent overweight, including encouragement of physical activity and improved diets, should begin in early childhood. Pediatrics 1997;99(4). URL: http://www.pediatrics.org/cgi/content/full/99/4/e1; overweight, anthropometry, preschool children.

Overweight among preschool children is a concern, because it may have long-term health consequences. Excess body weight in childhood is associated with overweight in adulthood, and excess body fat, or obesity, is recognized as a health risk for adults. Obesity and overweight in childhood also have been linked to subsequent morbidity and mortality in adulthood. Moreover, overweight preschoolers have been shown to have higher mean levels of cholesterol than other children. The concern about overweight prevalence in preschoolers is heightened by recent increases in overweight among school-aged children and adults. Overweight prevalence increased among boys and girls 6 through 11 years of age from approximately 5% in 1963 through 1965 to 11% in 1988 through 1991 and 5% to 13% among 12- through 17-year-old boys. Furthermore, at least one third of adults in the United States are overweight.

This article presents cross-sectional estimates of overweight prevalence for preschool children between 2 months and 6 years of age in the United States using weight adjusted for length or stature. Current estimates are from the third National Health and Nutrition Examination Survey (NHANES III) conducted during 1988 through 1994. In addition, trends in overweight are presented based on estimates from earlier NHANES.

METHODS

NHANES III is a nationally representative sample of the total civilian noninstitutionalized population in the 50 states and the District of Columbia. NHANES III collected information on individuals 2 months of age and older. The design was a stratified, multistage probability sample based on selection of counties, city or suburban blocks, households, and persons within households. In total, approximately 40,000 people were selected, 31,311 of whom received physical examinations. NHANES III was designed to sample large numbers of preschool children to facilitate revisiting the original National Center for Health Statistics (NCHS) and modified NCHS/Centers for Disease Control and Prevention (CDC) growth charts for children. Mexican-American persons, black persons, and persons older than 60 years were also oversampled to have large enough sample sizes for subgroup comparisons. Sample weights were used to adjust estimates back to the appropriate population distribution.

The NHANES comprise a series of cross-sectional, nationally representative examination surveys conducted by the NCHS of the CDC. NHANES III is the seventh in the series, which began in 1960. NHANES I, conducted from 1971 through 1974, was the first survey to include preschool-aged children. NHANES II was conducted from 1976 through 1980. A special study of Hispanic populations, the Hispanic Health and Nutrition Examination Survey (HHANES), in three regions of the United States was conducted from 1982 through 1984. The Mexican-American subpopul-
The prevalence of overweight clearly depends on the selection of the reference population and the overweight criteria. The original NCHS and modified NCHS/CDC growth charts include several different data sources. For preschool children 6 to 11 years of age the weight-for-height charts were based on weight and stature data from the nationally representative NHANES I. For children from birth to 3 years, the weight-for-height charts were based on weight and recumbent length data from the Fels Research Institute (for the years 1929 through 1974). The Fels data were for primarily white, middle-class children. The original NCHS and NCHS/CDC charts represent smoothed versions of the data from the various surveys. Consequently, the prevalence estimates for children 6 to 11 years of age in NHANES I are not the expected 5%. Although there is concern regarding the use of the original NCHS or NCHS/CDC growth charts, the choice of the reference will not affect trend estimates of overweight.

A disjunction in the growth curves occurs at 2 years of age because of the two different measures (stature and length) and because of the different data sources used to make the charts. It has been suggested that the disjunction between infant and later curves occurs because the Fels sample was “actually taller or measured taller than the US sample.” Trend estimates and other reasons, the original NCHS and modified NCHS/CDC growth charts are currently under revision.

Because of rapid growth in children younger than 2 years, there is no agreed on definition of overweight in this age group. Consequently, the term overweight is used for children 2 through 5 years of age when compared with the weight-for-stature growth charts. When children are compared with the weight-for-height growth charts, the percentage above the 95th percentile of the weight-for-length growth curve is presented.

Data Analysis

Data were analyzed using SAS and SUDAAN software programs. All analyses included sample weights that account for the unequal probabilities of selection attributable to oversampling and nonresponse (based on participation in the examination component of the survey). Standard errors (SE) were calculated with SUDAAN to account for the sample weights and complex sample design. Tests of significant differences in prevalence estimates within NHANES III by sex, age, and race/ethnicity were done using multivariate logistic regression analysis. Trends in overweight prevalence among surveys were analyzed and tested using weighted least squares models for categorical data.

RESULTS

Current Overweight Prevalence Estimates

Sample sizes are presented in Table 1 by age in

<table>
<thead>
<tr>
<th>Age, mo</th>
<th>NHANES I*</th>
<th>NHANES II</th>
<th>HHANES</th>
<th>NHANES III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–1</td>
<td>205</td>
<td>274</td>
<td>85</td>
<td>464</td>
</tr>
<tr>
<td>2–5</td>
<td>332</td>
<td>394</td>
<td>129</td>
<td>515</td>
</tr>
<tr>
<td>6–11</td>
<td>470</td>
<td>551</td>
<td>168</td>
<td>610</td>
</tr>
<tr>
<td>12–23</td>
<td>574</td>
<td>682</td>
<td>217</td>
<td>736</td>
</tr>
<tr>
<td>24–35</td>
<td>377</td>
<td>435</td>
<td>121</td>
<td>518</td>
</tr>
<tr>
<td>36–47</td>
<td>430</td>
<td>510</td>
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<td>584</td>
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<tr>
<td>48–59</td>
<td>359</td>
<td>377</td>
<td>122</td>
<td>500</td>
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<td>60–71</td>
<td>337</td>
<td>349</td>
<td>114</td>
<td>485</td>
</tr>
<tr>
<td>Total</td>
<td>3217</td>
<td>3794</td>
<td>1158</td>
<td>5214</td>
</tr>
<tr>
<td>Girls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–1</td>
<td>251</td>
<td>326</td>
<td>95</td>
<td>490</td>
</tr>
<tr>
<td>2–5</td>
<td>374</td>
<td>437</td>
<td>137</td>
<td>550</td>
</tr>
<tr>
<td>6–11</td>
<td>527</td>
<td>596</td>
<td>194</td>
<td>687</td>
</tr>
<tr>
<td>12–23</td>
<td>708</td>
<td>820</td>
<td>247</td>
<td>965</td>
</tr>
<tr>
<td>24–35</td>
<td>459</td>
<td>519</td>
<td>170</td>
<td>564</td>
</tr>
<tr>
<td>36–47</td>
<td>513</td>
<td>575</td>
<td>185</td>
<td>601</td>
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<tr>
<td>48–59</td>
<td>430</td>
<td>482</td>
<td>153</td>
<td>487</td>
</tr>
<tr>
<td>60–71</td>
<td>401</td>
<td>450</td>
<td>142</td>
<td>488</td>
</tr>
<tr>
<td>Total</td>
<td>3413</td>
<td>3787</td>
<td>1100</td>
<td>4797</td>
</tr>
</tbody>
</table>

* NHANES indicates National Health and Nutrition Examination Survey; and HHANES, Hispanic Health and Nutrition Examination Survey.
months for each of the surveys. NHANES III oversampled preschool-aged children and, therefore, has the largest sample sizes.

The percentage of children younger than 1 and 1 to 2 years who exceeded the 95th percentile on the weight-for-length growth curves is presented in Table 2 overall and by age, sex, and racial/ethnic group. More than 5% of children younger than 1 and 1 to 2 years by sex and race/ethnicity were above the 95th percentile of weight-for-length. Among 1- to 2-year-old children, the percentage above the 95th percentile on the weight-for-length growth curves was 9.4%. It is unclear whether this relatively high percentage is a reflection of a problem in the population or an artifact of the growth charts for this age group.29

There was no difference in the percentage above the 95th percentile of the weight-for-length growth curve between the younger than 1-year age group and the 1- to 2-year age group. However, within age groups there were significant differences by gender and race/ethnicity. The percentage above the 95th percentile of weight-for-length was significantly higher among girls than boys (P < .01) after accounting for differences by age group and race/ethnicity in a multivariate logistic regression model. The percentage above the 95th percentile was highest among Mexican-American children, intermediate among non-Hispanic black children, and lowest in non-Hispanic white children. The differences in the percentage above the 95th percentile between non-Hispanic white and non-Hispanic black children (P < .05) and between non-Hispanic white and Mexican-American children were statistically significant (P < .01).

The prevalence of overweight among children 2 to 3 and 4 to 5 years of age based on weight-for-stature is presented in Table 3. In general, the prevalence of overweight was higher among children 4 to 5 years of age than among children 2 to 3 years of age. In both age groups, the prevalence of overweight was lowest among non-Hispanic white boys. The prevalence of overweight among girls was higher than among boys for all racial/ethnic and age groups. More than 10% of all girls 4 to 5 years of age were overweight. Among the three different racial/ethnic groups, Mexican-American children had the highest prevalence of overweight (12.0% for boys and 13.2% for girls); non-Hispanic black children had intermediate prevalence, and non-Hispanic white children had the lowest prevalence of overweight. Differences by age group, sex, and race/ethnicity were statistically significant (P < .05) in multivariate logistic regression models. For children 2 to 3 years of age, prevalence estimates for most subgroups were near or less than 5%. There was one notable exception in which 10.5% of Mexican-American girls were overweight.

The effect of the disjunction29 in the growth charts is evident in the NHANES III results. The percentage of 1- to 2-year-old children above the 95th percentile on the weight-for-length growth curve (Table 2) was 9.4%, whereas only 3.4% of the 2- to 3-year-old age group was overweight based on weight-for-stature (Table 3). Although data are not shown, the prevalence of overweight among 2-year-old children based on weight-for-stature was substantially lower than the prevalence among the same children based on weight-for-length.

### Trends Across National Surveys

Table 4 contains estimates of the percentage of children overall and separately by race above the 95th percentile of weight-for-length for NHANES I through III and for Mexican-American children in the HHANES and NHANES III. Among children younger than 24 months, estimates based on weight-for-length showed an increase over time in the percentage of children above the 95th percentile. This change was greater for girls than boys. In the youngest age group (younger than 1 year) the percentage above the 95th percentile rose from 6.2% in NHANES II to 10.8% in NHANES III. Among girls 12 to 23 months of age, the percentage above the 95th percentile increased from 6.1% to 9.5% between NHANES I and NHANES III. Among black girls 12 to 23 months of age, the percentage above the 95th percentile of weight-for-length rose from 8.9% to 15.2%. There was no change in the percentage above the 95th percentile among boys 12 to 23 months of age.

Trends in national estimates of overweight prevalence based on weight-for-stature are presented in Table 5. Among 2- to 3-year-old girls and boys there was no significant change in the prevalence of overweight between 1971 through 1974 and 1988 through

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### Table 2. Percentage of Children Younger Than 3 Years Above the 95th Percentile of the Weight-For-Length Growth Reference, Third National Health and Nutrition Examination Survey (1988 Through 1994)

<table>
<thead>
<tr>
<th>Children</th>
<th>Age</th>
<th>% (SE)</th>
<th>% (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both sexes*</td>
<td>&lt;1 y</td>
<td>10.3 (0.8)</td>
<td>9.4 (0.8)</td>
</tr>
<tr>
<td></td>
<td>1-2 y</td>
<td>7.5 (1.0)</td>
<td>6.4 (1.2)</td>
</tr>
<tr>
<td>Boys*</td>
<td>&lt;1 y</td>
<td>9.6 (1.2)</td>
<td>7.5 (1.0)</td>
</tr>
<tr>
<td></td>
<td>1-2 y</td>
<td>6.4 (1.2)</td>
<td>8.9 (1.8)</td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>&lt;1 y</td>
<td>9.1 (1.5)</td>
<td>6.4 (1.2)</td>
</tr>
<tr>
<td></td>
<td>1-2 y</td>
<td>8.9 (1.8)</td>
<td>10.8 (1.4)</td>
</tr>
<tr>
<td>Mexican-American</td>
<td>&lt;1 y</td>
<td>12.8 (3.1)</td>
<td>10.8 (1.4)</td>
</tr>
<tr>
<td></td>
<td>1-2 y</td>
<td>13.0 (1.6)</td>
<td>11.2 (2.1)</td>
</tr>
<tr>
<td>Girls*</td>
<td>&lt;1 y</td>
<td>11.0 (0.9)</td>
<td>11.5 (1.2)</td>
</tr>
<tr>
<td></td>
<td>1-2 y</td>
<td>8.4 (1.2)</td>
<td>14.0 (2.4)</td>
</tr>
<tr>
<td>Mexican-American</td>
<td>&lt;1 y</td>
<td>10.2 (1.2)</td>
<td>15.5 (3.1)</td>
</tr>
<tr>
<td></td>
<td>1-2 y</td>
<td>14.0 (2.4)</td>
<td>16.8 (2.9)</td>
</tr>
</tbody>
</table>

* Includes data for children from other racial/ethnic groups.

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### Table 3. Prevalence of Overweight Based on Percentage of 2- to 5-Year-Old Children Above the 95th Percentile of the Weight-For-Stage Growth Reference, Third National Health and Nutrition Examination Survey (1988 Through 1994)

<table>
<thead>
<tr>
<th>Children</th>
<th>Age</th>
<th>% (SE)</th>
<th>% (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both sexes*</td>
<td>2 and 3 y</td>
<td>3.4 (0.5)</td>
<td>7.9 (0.9)</td>
</tr>
<tr>
<td></td>
<td>4 and 5 y</td>
<td>2.1 (0.6)</td>
<td>5.0 (0.9)</td>
</tr>
<tr>
<td>Boys*</td>
<td>2 and 3 y</td>
<td>1.1 (0.6)</td>
<td>2.7 (1.1)</td>
</tr>
<tr>
<td></td>
<td>4 and 5 y</td>
<td>2.8 (1.0)</td>
<td>8.5 (1.9)</td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>2 and 3 y</td>
<td>6.2 (1.7)</td>
<td>12.0 (2.4)</td>
</tr>
<tr>
<td></td>
<td>4 and 5 y</td>
<td>4.8 (0.8)</td>
<td>10.8 (1.4)</td>
</tr>
<tr>
<td>Non-Hispanic black</td>
<td>2 and 3 y</td>
<td>2.8 (0.8)</td>
<td>9.0 (1.7)</td>
</tr>
<tr>
<td></td>
<td>4 and 5 y</td>
<td>5.6 (1.4)</td>
<td>11.2 (2.1)</td>
</tr>
<tr>
<td>Mexican-American</td>
<td>2 and 3 y</td>
<td>10.5 (2.0)</td>
<td>13.2 (1.8)</td>
</tr>
<tr>
<td></td>
<td>4 and 5 y</td>
<td>5.6 (1.4)</td>
<td>11.2 (2.1)</td>
</tr>
</tbody>
</table>

* Includes data for children of other racial/ethnic groups.
However, among 4- to 5-year-old children there was an increase, especially in girls overall and by race. From NHANES I to NHANES III the prevalence among 4- to 5-year-old girls rose from 5.0% to 10.8%. The prevalence of overweight among 4- to 5-year-old girls in NHANES III was statistically different from the prevalence of overweight in the other two surveys (P < .01). Among black girls the prevalence more than doubled from 5.0% to 12.6% between 1971 through 1974 and 1988 through 1994. Among black boys the prevalence of overweight increased from 3.0% to 6.5% between 1971 through 1974 and 1988 through 1994. Statistical tests were not performed on changes in overweight prevalence for individual racial/ethnic groups.

The prevalence of overweight based on weight-for-stature also has increased among most groups of Mexican-American preschool children. Among 2- to 3-year-old Mexican-American girls the prevalence increased from 4.2% to 10.5%. Among Mexican-American 4- to 5-year-old boys the prevalence increased from 4.9% in the HHANES to 12.0% in NHANES III.

**DISCUSSION**

These results are the most recent nationally representative prevalence estimates of overweight among preschool children in the United States. We found that during the past two decades in the United States, there was no change in the prevalence of overweight among 2- to 3-year-old children, but there was an increase among 4- to 5-year-old children, especially in girls. Currently 10.8% of 4- to 5-year-old girls are overweight. In addition, these data show that the prevalence of overweight among preschool children is higher among girls than boys and that overweight prevalence is highest among Mexican-American children. All of these results parallel what has been seen among older children and adults in the same surveys. These findings are based on highly reliable, standardized measures of weight, stature, and length across a series of national surveys.

The higher prevalence of overweight among girls than boys may be attributable to gender differences in behavior and is unlikely to be an artifact of the growth charts. In at least one study preschool boys were found to be more physically active than preschool girls, and similar gender differences in overweight...
weight prevalence have been observed in older children and adults.8,9

The use of the NCHS growth charts in some Hispanic48 and African-American37 populations should be done with caution, particularly among children younger than 2 years. The charts for this age group are based exclusively on white, middle-class children, and there is some evidence that growth differences do exist between these ethnic groups. However, the use of the NCHS growth charts does provide a uniform basis for estimating prevalence in different populations, and measurements taken from privileged children in developing countries in Africa, Latin America, and the Caribbean do not differ significantly from the NCHS reference population.38–42

The high prevalence of overweight found among Mexican-American preschool children may have an environmental basis. Trend estimates within racial/ethnic groups indicate an increase in overweight between the HHANES and NHANES III for Mexican-American children, strongly suggesting that environmental influences are affecting the observed increase in overweight. Furthermore, findings from the CDC Pediatric Nutrition Surveillance System indicate that low-income Hispanic children 2 to 4 years of age in the United States showed a relative increase in overweight prevalence of nearly 20% between 1980 and 1991.21

The difference in overweight prevalence between the white and non-Hispanic white children in NHANES III may reflect demographic changes in the population of the United States. The prevalence of overweight among preschool-aged children is higher in the Mexican-American population, and this population makes up a greater percentage of the population than it did in the early 1970s (4% in 1972 and 8% of children younger than 5 years in 1991).43,44 The total population estimates may reflect this change.

Other researchers have also found a higher than expected prevalence of overweight among preschool children. A cross-sectional study of urban kindergarten found excess overweight in 4- to 5-year-old children.37 In this study, the prevalence of overweight was highest among Hispanic children, but the overall growth of children was on par with the NCHS/CDC reference curve. In addition, among low-income preschool children, overweight has been found to be highest in Hispanic children compared with white, black, and Asian children.45,46 The prevalence of overweight among American Indian preschool children has also been shown to be in excess of 5% and increasing over time. Using data from the CDC Pediatric Nutrition Surveillance System, the prevalence of overweight among American Indian preschoolers 2 to 4 years of age was estimated at 9.0% in 198847 and 11.9% in 1991.21

The reasons for the increase in the prevalence of overweight among 4- to 5-year-old children are complex. Excess weight gain is ultimately a function of energy intake exceeding energy expenditure, with sociocultural factors influencing lifestyle and diet choices. However, the influence of bottle feeding, early introduction of solid foods, balanced food selection, and other dietary practices on overweight in preschool-aged children is less clear. Dietary intake data from the NHANESs suggest that mean energy and fat intakes among preschoolers have not increased in the last 20 years.17 A review of the literature suggests that overweight among preschool children, as well as older children, may be associated less with increased energy intake and more with low physical activity.48 In the Framingham Children’s Study, inactive preschool children gained substantially more subcutaneous fat by the time they reached first grade than did more active children.35 Some researchers attribute the increasing prevalence of overweight among school-aged children to decreased physical activity as a result of television watching.49 Others, however, insist that the link between television and fatness is weak.50

Because of an increase in the percentage of high birth weight infants, the relationship between birth weight and overweight during childhood has become a concern. From 1971 through 1985 there was an increase in the proportion of high birth weight infants (≥4000 g) for both white and black infants.51 A small positive relationship has been found between birth weight and BMI. However, there was no indication that an increase in the distribution of birth weights would lead to increased prevalence of overweight during childhood.52

Cross-sectional surveys such as those used in this analysis cannot investigate growth patterns in individuals. Moreover, the statistical definition of overweight is not based on risks of morbidity and mortality, and cross-sectional population-based estimates of overweight do not account for variation associated with genetic predisposition of the individual or familial patterns of overweight. In pediatric clinics, these are important considerations and should be considered along with an assessment of the individual based on serial measures of stature or length and weight over time.

The increasing prevalence of overweight among 4- to 5-year-old children indicates that prevention activities need to begin in the preschool years. As recommended in the Dietary Guidelines for Americans,25 these efforts include encouraging physical activity to maintain a healthy weight, eating at least five servings of fruits and vegetables per day, and after the age of 2 years gradually decreasing dietary fat to a level of no more than 30% of energy. The Committee on Nutrition of the American Academy of Pediatrics also recommends energy balance over specific caloric intake restrictions for obese children.53 The Special Supplemental Nutrition Program for Women, Infants, and Children and Head Start are potential avenues for educating low-income parents and children about healthy behavior choices such as lower-fat foods and physical activity. In addition, preschool and day care programs might include more education related to diet and physical activity.

It is important to encourage healthy choices regarding diet and physical activity during the preschool years, because behavior patterns may begin in these years.54,55 In addition, the normal growth of a child is such that a child’s adiposity during the first year of life increases rapidly then decreases until approximately 6 years of age, when adiposity again
develops. Young children who go through this “adiposity rebound” early (4 and 5 years of age) have higher adiposity in adulthood than children who go through the adiposity rebound later. The increase in the prevalence of overweight reported among adults, school-aged children, and preschoolers makes it even more critical to influence behavior among preschoolers. It has been suggested that the most successful treatment of preadolescent obesity is early and regular treatment and that this preferred approach be adapted for prevention activities during the preschool years. An observational study of white middle-class 3- to 5-year-old children found that modifiable risk factors such as dietary intake and physical activity accounted for more of the variance in BMI in a 3-year period than did nonmodifiable risk factors such as obese parents. The authors concluded that encouragement of healthy diets and physical activity can decrease weight gain in preschool children.

Pediatric practitioners should emphasize the importance of diet and physical activity as two important components of a healthy lifestyle, with considerably more emphasis on adequate amounts of physical activity. Continued clinical, community, and national monitoring and surveillance of weight among preschool children is essential. To investigate factors associated with overweight among preschool children further, assessments of dietary habits and activity levels are needed for different sociocultural groups.

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