Overweight in Southeastern Pennsylvania Children: 2002 Household Health Survey Data

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SYNOPSIS

Objective. The authors sought to estimate the prevalence of overweight and risk for overweight and to examine relationships between body mass index (BMI) and socioeconomic and demographic characteristics among children in Philadelphia and four neighboring counties.

Methods. Data from the 2002 Philadelphia Health Management Corporation Household Health Survey was examined.

Results. Of 2,621 children aged 2 to 17 years, 36% were overweight or at risk for overweight and 23% were overweight. Prevalences of overweight and at risk for overweight were higher among younger children than among older children and adolescents. African American, Hispanic, and Asian children had higher prevalences than non-Hispanic white children. Childhood overweight was positively associated with household poverty, lower educational status, and higher BMI in the adult survey respondents.

Conclusions. The observed inverse relationship between age and the prevalence of overweight among Southeastern Pennsylvania children and adolescents differs from previous reports of the prevalence of overweight in samples of U.S. children and adolescents. The high prevalence of overweight among children aged 2 to 9 years should focus attention on improving nutrition and increasing opportunities for physical activity and exercise among preschool and early school-age children.

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Childhood overweight is recognized as a risk factor for adult cardiovascular disease. It is also associated with significant comorbidities in children and adolescents including hypertension, insulin resistance, glucose intolerance, type 2 diabetes, liver disease, and polycystic ovarian disease, as well as respiratory and orthopedic disorders.[1,2] As the epidemic of overweight has entered the public consciousness, federal, state, and local organizations have initiated programs directed at decreasing the prevalence of overweight and obesity in children as well as adults. Local, population-based data provide a basis for policy development and resource allocation, directing interventions to areas with the greatest need. Telephone surveys are a relatively inexpensive method for obtaining population-based data. Repeated surveys in particular regions or municipalities can provide information for the evaluation of intervention effectiveness.

The Philadelphia Health Management Corporation (PHMC) conducts a biannual Household Health Survey in Philadelphia and four neighboring counties in Southeastern Pennsylvania.[3] This telephone survey of more than 10,000 households examines the health and social well-being of residents in Bucks, Chester, Delaware, Montgomery, and Philadelphia counties. The survey is conducted as part of PHMC's Community Health Database, which contains information about local residents' health status, use of health services, and access to care. The 2002 Survey included, for the first time, questions regarding the height and weight of children and adolescents. The collection of these data permitted calculation and analysis of the body mass indices of children and adolescents included in the survey sample. Body mass index (BMI)-for-age curves were included in the 2000 Centers for Disease Control and Prevention (CDC) growth charts for the United States as new screening tools to aid in identification of children from 2 to 20 years of age who are at risk for overweight or are overweight. These sex-specific BMI-for-age curves are based on data from five national surveys conducted from 1963 to 1994.[4] Children or adolescents can be classified as at risk of overweight if their BMI corresponds to a value ≥85th percentile and <95th percentile value. An individual with a BMI ≥95th percentile value can be classified as overweight. In this report, we will describe the PHMC 2002 Household Health Survey child and adolescent BMI data and will examine the relationships between BMI and several demographic factors.

METHODS

The Household Health Survey was conducted using a probability sample of 10,163 households located in Philadelphia, Bucks, Chester, Delaware, and Montgomery counties. Data collection was conducted from July 1, 2002, through October 30, 2002. A minimum sample size of 100 households was obtained in each of the 54 sub-areas within the region. The computer-assisted telephone interview system used in the survey fielding draws a sample for dialing in a systematic order. Before accessing a fresh number, it scans the callback file to see if there are any callbacks scheduled, busy signals, no-answers, and answering machines. A minimum of 10 calls were conducted according to an algorithm designed for maximum probability of contact and participation before a number was dropped. The survey response rate for the 2002 Southeastern Pennsylvania Household Health Survey was approximately 46%. In each household contacted in which there were children, a child subject was randomly selected. No child information was collected from households in which there was an adult older than age 60, because the addition of questions specific to the selected child and to the older adult would have made the survey impractically long. An adult proxy respondent (the adult identified as most knowledgeable about the child's health) reported information about the selected child. Mothers provided information on 73% of the weighted sample, and fathers on 22%; the remainder were other relatives or household members. Interviews were conducted in English or Spanish. Asian households were oversampled to improve the accuracy of estimates for this population. Of 10,163 households surveyed, 3,641 (35.8%) reported having one or more children. Of these, 3,313 (91%) agreed to provide information on a selected child; 2,925 of these children were from 2 to 17 years of age.

To assess overweight in children, the proxy respondents were asked to report the child's height to the nearest inch and weight to the nearest pound. This reported data was then used to calculate BMI (weight [kg]/height [m]^2), and the BMIs were compared to standard national reference values[4] to determine a sex- and age-specific BMI percentile. Because children's ages were reported in years and reference values are based on age in months, the means of the 12 age-in-months-specific values were used for each individual year-of-age. Height, weight, or age data were missing for 304 of these children, who were therefore excluded from these analyses. The resulting sample consisted of 2,621 children from the five-county area, including 954 from Philadelphia.

The prevalence of overweight or at risk of overweight (BMI ≥85th percentile) and overweight (BMI ≥95th percentile) were calculated for the sample as a whole, and for subpopulations defined by sex, age group, race/ethnicity, poverty status, adult respondent's educational status, and adult respondent's BMI, both for the five-county sample and for the Philadelphia residents only. Differences between groups were evaluated with chi-square tests. We used logistic regression models to assess which demographic variables were independently associated with BMI-for-age percentile ≥95th percentile. The Household Health Survey weighted observations based on race, age, sex, household size, and income to adjust for differential probability of selection and non-response. Use of unweighted data did not substantially change the results.

To test the sensitivity of the results to extreme values (there were reported weights for two- and three-year-olds of over 100 pounds, for example), we re-analyzed the data excluding children whose reported weights were more than three standard deviations above the mean for their age and sex.

Because of concerns about the accuracy of reported heights, we repeated our analyses using reported weight-for-age rather than BMI-for-age, using the same methods described above to estimate age in months. We also determined the proportion of subjects whose reported heights were under the 50th percentile of sex-specific height-for-age using the same method, as an indicator of the likely extent of height misreporting.[5]

RESULTS

The study sample (Table 1) is representative of the population of Southeastern Pennsylvania.[6]

A total of 36% were overweight or at risk of overweight (BMI ≥85th percentile) and 23% were overweight (BMI ≥95th percentile) (Table 2). The results differed by sex: 20% of girls and 26% of boys were overweight. The percents overweight and at risk of overweight were strongly associated with age; younger children had higher prevalences. African-American and Latino children had the highest prevalence; non-Hispanic whites had the lowest prevalence. Both household poverty and lower educational status of the adult respondent were associated with higher prevalence of overweight. Overweight among children was positively associated with the adult respondent's BMI.

Children in Philadelphia had a higher prevalence of overweight (30%) than the five-county average. The age and sex patterns were the same as in the five-county sample, while differences by racial/ethnic group and respondent's educational status and BMI were somewhat smaller.

Multivariable analyses (Table 3) indicated that in the five-county sample, controlling for the other variables, each of the variables associated with prevalence of overweight except

Table 1. Sample characteristics

	Southeastern Pennsylvania		*Philadelphia*	
	N *(unweighted)*	*Weighted percent of sample*	N *(unweighted)*	*Weighted percent of sample*
Sex				
Girls	1,260	49%	464	50%
Boys	1,361	51%	490	50%
Age group				
Ages 2–4	432	15%	156	14%
Ages 5–9	704	28%	253	29%
Ages 10–14	854	34%	336	37%
Ages 15–17	631	22%	209	20%
Race/ethnicity				
Non-Hispanic white	1,566	64%	291	32%
African American	593	25%	457	53%
Latino	159	5%	101	9%
Asian	206	3%	70	4%
Poverty status				
Poor	231	14%	172	29%
Non-poor	2,390	86%	782	71%
Adult respondent's education				
Less than high school graduate	168	8%	122	16%
High school graduate	803	32%	358	39%
Some college	591	23%	238	25%
College graduate	651	24%	158	14%
Post-college	397	13%	72	6%
Adult respondent's BMI category				
Underweight (BMI <18.5)	58	2%	21	2%
Normal weight (BMI 18.5–< 25)	1,127	42%	339	33%
Overweight (BMI 25–<30)	861	34%	317	35%
Obese (BMI 30+)	532	22%	262	30%
Adult respondent's relation to child				
Mother	1,861	72%	667	72%
Father	605	22%	191	18%
Sibling	52	1%	33	2%
Grandparent	52	2%	33	3%
Other	50	2%	29	3%
County				
Bucks	405	16%		
Chester	330	12%		
Delaware	401	14%		
Montgomery	531	20%		
Philadelphia	954	38%		

Table 2. Percent overweight and at risk for overweight

	Southeastern Pennsylvania		*Philadelphia*	
	Percent overweight or at risk (BMI ≥85th percentile)	*Percent overweight (BMI ≥95th percentile)*	*Percent overweight or at risk (BMI ≥85th percentile)*	*Percent overweight (BMI ≥95th percentile)*
All children ages 2–17	36%	23%	44%	30%
Sex	$p<0.01$	$p<0.01$	n.s.	$p<0.01$
Girls	33%	20%	42%	26%
Boys	40%	26%	46%	34%
Age Group	$p<0.01$	$p<0.01$	$p<0.01$	$p<0.01$
Ages 2–4	58%	50%	70%	63%
Ages 5–9	48%	34%	60%	44%
Ages 10–14	28%	13%	32%	16%
Ages 15–17	19%	7%	24%	11%
Race/ethnicity	$p<0.01$	$p<0.01$	$p=0.05$	$p<0.01$
Non-Hispanic white	31%	18%	37%	22%
African American	47%	33%	47%	34%
Latino	44%	32%	47%	33%
Asian	37%	26%	36%	28%
Poverty status	$p<0.01$	$p<0.01$	$p<0.01$	$p<0.01$
Poor	49%	34%	52%	37%
Non-poor	34%	21%	40%	27%
Adult respondent's education	$p<0.01$	$p<0.01$	n.s.	n.s.
Less than high school graduate	49%	37%	46%	33%
High school graduate	40%	25%	47%	32%
Some college	39%	24%	41%	27%
College graduate	30%	18%	39%	22%
Post-college	26%	19%	35%	35%
Adult respondent's BMI	$p<0.01$	$p<0.01$	n.s.	n.s.
Underweight (BMI <18.5)	37%	19%	37%	24%
Normal wt. (BMI 18.5–<25)	32%	20%	40%	27%
Overweight (BMI 25–<30)	35%	22%	43%	28%
Obese (BMI 30+)	46%	31%	49%	35%

NOTE: *p*-values are for differences between categories, based on chi-square tests.
n.s.= $p<0.05$

poverty was independently associated with overweight. County of residence (Philadelphia vs. other) was not independently associated with overweight in models including the other demographic predictors of overweight (data not shown), indicating that the higher prevalence of overweight among Philadelphia children was attributable to the higher proportion of children in high-risk demographic groups based on race/ethnicity, poverty, and education. The analyses for Philadelphia residents only were similar to those for the five-county sample, except that the associations with Asian race/ethnicity and adult respondent's education were not statistically significant.

Excluding children with extreme weight values reduced the prevalence of overweight by less than one percentage point; none of the bivariate or multivariate results were substantially altered (data not shown).

Analyzing overweight based on weight-for-age rather than BMI-for-age produced a substantially lower estimated prevalence of overweight (not shown). Differences between groups were similar to those for overweight based on BMI-for-age, except that the associations of lower age and educational status with higher prevalence of overweight were reduced and no longer statistically significant.

There was some indication that reported heights were misestimated (Table 4). Overall, 53.3% of all children in the survey were reported to have heights below the 50th percentile. However, the proportion of children with reported height below the 50th percentile was strongly associated with age, ranging from 69% in the 2–4-year-old age group to 38% among 15–17-year-olds. Respondents living in poverty, those of lower educational status, and Latinos and Asians were more likely than others to report heights below the 50th

Table 3. Factors associated with BMI-for-age percentile 95+

	Southeastern Pennsylvania	*Philadelphia*
	Odds ratio (95% confidence interval)	*Odds ratio (95% confidence interval)*
Year of age	0.79 (0.77, 0.81)	0.79 (0.76, 0.82)
Male sex	1.53 (1.25, 1.87)	1.74 (1.28, 2.37)
African American (vs. Non-Hispanic white)	2.15 (1.68, 2.76)	2.12 (1.46, 3.08)
Latino (vs. Non-Hispanic white)	1.99 (1.28, 3.09)	2.02 (1.13, 3.62)
Asian (vs. Non-Hispanic white)	1.78 (1.02, 3.08)	1.50 (0.63, 3.58)
Poverty	1.19 (0.89, 1.60)	1.34 (0.94, 1.91)
Adult respondent's education	0.82 (0.74, 0.90)	0.94 (0.81, 1.09)
Adult respondent's BMI category	1.33 (1.17, 1.51)	1.30 (1.08, 1.58)

NOTE: All parameters are adjusted for the other variables.

percentile. The proportions with reported heights below the 50th percentile were not significantly associated with sex or adult respondent's BMI.

DISCUSSION

The inverse relationship between age and the prevalence of overweight in children and adolescents in the 2002 Household Health Survey differs strikingly from other reports of the prevalence of overweight in U.S. children and adolescents. Over the last 30 years, the prevalence of overweight has increased in children and adolescents[7,8] and in preschool children.[9,10] However, in none of these reports were estimates of overweight in preschool or early school-age children as high as those found in the Survey. Data from the National Health and Nutrition Examination Survey (NHANES) 1999 to 2000 showed the prevalences in children 2–5 years of age of BMI ≥85th percentile and BMI ≥ 95th percentile to be 20.6% and 10.4%, respectively.[7] In the Survey data for children 2–4 years of age, these prevalences were 58% and 50%, respectively, for the five-county sample and 70% and 63%, respectively, for the Philadelphia sample.

In addition to some misclassification associated with our use of age in years rather than age in months, the accuracy of reporting of heights and weights by adult respondents in the Household Health Survey has not been validated. Limited research in this area indicates that parental reports may be substantially inaccurate, especially for heights. In a study of Mexican American mothers' reports of their children's weight and height, height underreporting was particularly serious for boys and among respondents with lower incomes and those who were not high school graduates, which would tend to cause overestimates of BMI for these groups.[11] At the same time, reported weights tended to underestimate higher weights, which would tend to underestimate the prevalence of overweight based on BMI.

Age-related differences in the prevalence of high BMI's might be attributable in part to differential inaccuracy in reported heights. Our assessment of the proportions of children with reported heights below the age and sex specific 50th percentile of normative values indicated that adult respondents may have misreported children's heights, underestimating heights of younger children and overestimating heights of older children. In the Household Health Survey sample of 209 Philadelphia adolescents 15 to 17 years of age, the prevalences of BMI ≥85th percentile and BMI ≥95th

Table 4. Percent under 50th percentile height-for-age

	Southeastern Pennsylvania	*Philadelphia*
All children ages 2–17	53%	55%
Sex	n.s.	n.s.
Girls	54%	54%
Boys	53%	57%
Age Group	$p<0.01$	$p<0.01$
Ages 2–4	69%	73%
Ages 5–9	64%	65%
Ages 10–14	47%	49%
Ages 15–17	38%	40%
Race/ethnicity	$p<0.01$	n.s.
Non-Hispanic white	52%	55%
African American	53%	53%
Latino	62%	62%
Asian	63%	64%
Poverty status	$p<0.01$	$p<0.01$
Poor	61%	60%
Non-poor	52%	53%
Adult respondent's education	$p<0.01$	n.s.
Less than high school graduate	58%	58%
High school graduate	55%	57%
Some college	53%	55%
College graduate	52%	52%
Post-college	48%	49%
Adult respondent's BMI	n.s.	n.s.
Underweight (BMI <18.5)	56%	68%
Normal weight (BMI 18.5–<25)	55%	54%
Overweight (BMI 25–<30)	53%	59%
Obese (BMI 30+)	50%	51%

NOTE: *p*-values are for differences between categories, based on chi-square tests.
n.s.= $p<0.05$

percentile were 24% and 11%, respectively. These values were somewhat lower than data from the 2001 Youth Risk Behavior Survey (YRBS),[12] which included self-reported heights and weights for a sample of 1,037 Philadelphia adolescents in grades 9 through 12. In this group, the proportions with BMI ≥85th percentile were 32%, and BMI ≥95th percentile, 15%. This difference is consistent with the possibility that adult respondents overestimated heights of adolescents. However, the associations of a higher reported frequency of height below the 50th percentile with poverty, lower educational status, and ethnicity may reflect real differences in height, as measured height has been found to be associated with childhood socioeconomic status.[13–15]

In an analysis of data on 8,270 children aged 4–12 years born to women enrolled in the National Longitudinal Study of Youth, a nationally representative sample, parental reports of height and weight were used for 19% and 24% of the sample, respectively. There were no significant differences in the rate of increase of overweight between the children with measured heights and weights and those for whom parental reports of height and weight were used.[8] This suggests that either the reported heights and weights were substantially accurate or their changes over time were strongly correlated with changes in measured heights and weights. If changes over time in overweight based on parental reports are consistent with those based on measured heights and weights, analyses of additional waves of data from the biannual Household Survey should provide accurate data on changes in the prevalence of overweight among children in Southeastern Pennsylvania.

These findings underline the importance of obtaining additional data on the validity of parental reports of weight and height. A large-scale validation study to clarify the expected degree and direction of height and weight misreporting for different population groups could improve our ability to interpret and use readily accessible, inexpensively obtained local data for public health planning. NHANES, which collects measured weights and heights on a large, nationally representative sample of all ages, would be one potential vehicle for such a study. Presently, although NHANES collects self-reported weights and heights for sample individuals aged 16 years and older, interview data that could be compared to measured values is not collected for children younger than 16 years of age.

There are other data that suggest that the increase in the prevalence of overweight may be greatest in the younger age groups. In the NHANES surveys, the prevalence of overweight increased among preschool children from 1971 to 1994, with the greatest changes among girls 2–5 years of age.[9] Similarly, among low income children younger than 5 years of age who were examined in the Centers For Disease Control and Prevention's Pediatric Nutrition Surveillance System, the prevalence of overweight increased significantly from 1983 to 1995, with the greatest increases among children 2–5 years of age.[10]

Even if the underestimate of height accounted for a portion of the children with elevated BMI's among those from 2–9 years of age, the prevalence of overweight and risk for overweight in this age group should still be a subject of intense concern. There is a positive correlation between overweight in early childhood and overweight in adolescence and adulthood.[16,17] In a cohort of young African Americans prospectively studied from birth through young adulthood, BMI in early childhood was found to be strongly predictive of adult BMI. Essential hypertension and insulin resistance were associated with increased body weight in members of this group, putting them at increased risk of adult cardiovascular disease.[18] An analysis of data from 2,430 males and females aged 12 to 19 who had participated in NHANES III (1988–1994) indicated that nearly 30% of overweight adolescents met the criteria for the metabolic syndrome, placing them at risk for premature development of type 2 diabetes and coronary artery disease.[19]

The age-related results we have presented are cross-sectional and do not reflect decreasing prevalence of overweight over time within the same cohort of children. To the contrary, longitudinal data on children's weight changes over time indicate that the prevalence of overweight within child and adolescent cohorts increases over time.[10,20,21] The 2002 Household Health Survey should alert us to the possibility that very young children in the Philadelphia area may be at substantially increased risk of both childhood and adult consequences of overweight. These observations, which are consistent with numerous prior studies, contribute to an increasing body of data that defines the magnitude of childhood obesity and the predictable consequences of this major public health problem. The affected children and adolescents require treatment and preventive services. These interventions should focus particularly on improving nutrition and increasing opportunities for physical activity among preschool and early school-age children.

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