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JAMA. 2002;288(14):1728-1732 (doi:10.1001/jama.288.14.1728)

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Prevalence and Trends in Overweight Among US Children and Adolescents, 1999-2000

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THE PREVALENCE OF OVERweight among children in the United States has been increasing. Between the 1960s and 1988-1994, the prevalence among 6-through 11-year-old children increased from 4% to 11%. During this same period, the prevalence among 12-through 19-year-olds increased from 5% to 11%.¹ Overweight children often become overweight adults,² and overweight in adulthood is a health risk.³ Although childhood overweight may not result in adult health risk,⁴ immediate consequences of overweight in childhood are often psychosocial and also include cardiovascular risk factors such as hypertension, high cholesterol levels, and abnormal glucose tolerance.⁵

This article presents the most recent national estimates of overweight prevalence in US children. It is based on examination data from the 1999-2000 National Health and Nutrition Examination Survey (NHANES).

METHODS

NHANES is a series of cross-sectional, nationally representative examination surveys conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention. Beginning in 1999, NHANES became a continuous survey. The procedures followed to select the sample and con-

See also pp 1723, 1758, and 1772.

Context The prevalence of overweight among children in the United States increased between 1976-1980 and 1988-1994, but estimates for the current decade are unknown.

Objective To determine the prevalence of overweight in US children using the most recent national data with measured weights and heights and to examine trends in overweight prevalence.

Design, Setting, and Participants Survey of 4722 children from birth through 19 years of age with weight and height measurements obtained in 1999-2000 as part of the National Health and Nutrition Examination Survey (NHANES), a cross-sectional, stratified, multistage probability sample of the US population.

Main Outcome Measure Prevalence of overweight among US children by sex, age group, and race/ethnicity. Overweight among those aged 2 through 19 years was defined as at or above the 95th percentile of the sex-specific body mass index (BMI) for age growth charts.

Results The prevalence of overweight was 15.5% among 12- through 19-year-olds, 15.3% among 6- through 11-year-olds, and 10.4% among 2- through 5-year-olds, compared with 10.5%, 11.3%, and 7.2%, respectively, in 1988-1994 (NHANES III). The prevalence of overweight among non-Hispanic black and Mexican-American adolescents increased more than 10 percentage points between 1988-1994 and 1999-2000.

Conclusion The prevalence of overweight among children in the United States is continuing to increase, especially among Mexican-American and non-Hispanic black adolescents.

JAMA. 2002;288:1728-1732

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duct the interviews and examinations were similar to those for previous surveys. Two or more years of data are necessary to have adequate sample sizes for subgroup analyses. This report is based on the first 2 years of the continuous NHANES data collection (1999-2000). Previous survey results presented include NHANES III conducted from 1988-1994,⁶ NHANES II conducted from 1976-1980,⁷ NHANES I conducted from 1971-1974⁸; the National Health Examination Survey (NHES) cycle 3 conducted from 1966-1970⁹; and NHES cycle 2 conducted from 1963-1965.¹⁰

NHANES 1999-2000 is a nationally representative cross-sectional survey of the total civilian noninstitutionalized population in the United States. The de-

sign was a stratified multistage probability sample based on selection of counties, blocks, households, and persons within households. NHANES 1999-2000 was designed to oversample Mexican Americans, non-Hispanic blacks, and adolescents to improve estimates for these groups.

All surveys included a standardized physical examination with measurement of recumbent length, stature, and weight. Recumbent length was measured in children younger than 4 years

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and stature in children aged 2 years or older. The NHANES 1999-2000 sample included weight and height measurements for 4722 children and youth from birth through age 19 years.

Overweight prevalence from NHANES 1999-2000 was estimated by age at examination, sex, and race/ethnicity. Race/ethnicity was reported by a member of the household. For the purposes of this analysis, children were categorized as non-Hispanic white, non-Hispanic black, Mexican American, or other. Numbers for racial/ethnic groups in the "other" category were too small for meaningful analysis when considered separately, but these children were included in the totals. Trend estimates based on all the surveys were estimated by age at examination and sex. Trend estimates by race/ethnicity are available only for NHANES III and NHANES 1999-2000 because these were the only surveys with comparable racial/ethnic information.

Overweight Definition

The definition of overweight among children is a statistical definition based on the 2000 Centers for Disease Control and Prevention growth charts for the United States.¹¹ Overweight is defined as at or above the 95th percentile of body mass index (BMI; calculated as weight in kilograms divided by the square of height in meters) for age. At risk for overweight is defined as at or above the 85th percentile, but less than the 95th percentile of BMI for age. The BMI-for-age growth charts were developed from 5 of the national data sets used in this analysis (NHES 2 and NHES 3; NHANES I and NHANES II; and NHANES III for children <6 years). The Committee on Clinical Guidelines for Overweight in Adolescent Preventive Services recommended use of the 95th percentile of BMI to classify adolescents as overweight.¹² There are no BMI-for-age references or consistent definitions for overweight for children younger than 2 years. However, nutrition programs such as the Special Supplemental Nutrition Program for Women, Infants and Children have

used weight-for-length recommendations to determine overweight and thus program eligibility.^{13,14} Consequently, overweight in this age group is defined as at or above the 95th percentile of weight for length.

For adults 20 years or older, the definition of obesity recommended by the National Heart, Lung, and Blood Institute and the World Health Organization is a BMI of 30 or higher.^{15,16} We calculated the percentage of 12- through 19-year-old adolescents that met the adult definition of obesity.

Data Analysis

Data were analyzed using SAS (Version 8.02; SAS Institute Inc, Cary, NC) and SUDAAN (Version 8.0; Research Triangle Institute, Research Triangle Park, NC) statistical software programs. All analyses included sample weights that account for the unequal probabilities of selection, oversampling, and nonresponse. The SEs were estimated using the SUDAAN program. The SEs for NHANES 1999-2000 were estimated by means of the delete 1 jackknife method.¹⁷ For NHES and prior NHANES, the Taylor series linearization method was used to estimate SEs. Both methods incorporate the sample weights and account for the complex sample design.

Differences by sex, age group, race/ethnicity, and survey were tested univariately at the .05 significance level using the *t* statistic. Differences between the 3 most recent surveys only were tested for statistical significance. These 3 surveys were independently designed and independently drawn with no intended overlap. Therefore, in testing differences between surveys, a covariance of zero was assumed. For racial/ethnic differences within age and age differences within race/ethnicity, the Bonferroni method of multiple comparisons was applied. Because there were 3 implied comparisons, the α level was .05 divided by 3 (a value of .01667).

RESULTS

The sample sizes from NHANES 1999-2000 for children by sex, age group, and race/ethnicity are shown in TABLE 1.

Table 1. Number of Survey Respondents by Sex, Race/Ethnicity, and Age Groups: NHANES 1999-2000*

Subgroup	Male	Female	Total
Non-Hispanic white			
Birth to 2 y	97	71	168
2-5 y	101	103	204
6-11 y	120	122	242
12-19 y	244	226	470
Non-Hispanic black			
Birth to 2 y	59	58	117
2-5 y	108	97	205
6-11 y	165	158	323
12-19 y	326	304	630
Mexican American			
Birth to 2 y	164	145	309
2-5 y	132	127	259
6-11 y	229	194	423
12-19 y	513	460	973
Total†			
Birth to 2 y	371	314	685
2-5 y	381	358	739
6-11 y	546	508	1054
12-19 y	1155	1089	2244

*NHANES indicates National Health and Nutrition Examination Survey.

†Includes racial/ethnic groups not shown separately (eg, other category).

The prevalence of overweight (BMI for age \geq 95th percentile) was approximately 10% for 2- through 5-year-olds and approximately 15% for 6- through 11-year-olds and 12- through 19-year-olds (TABLE 2). The prevalence of overweight among males was not significantly different than among females, although among Mexican-American adolescents a trend toward an increase in males was seen ($P=.06$). Non-Hispanic black and Mexican-American 2- through 5-year-olds had lower prevalences of overweight than did the older age groups ($P<.001$ and $P=.002$, respectively). Comparisons between racial/ethnic groups showed that the prevalence of overweight among 12- through 19-year-old non-Hispanic blacks (23.6%) and Mexican Americans (23.4%) was significantly higher than among non-Hispanic whites (12.7%) ($P<.001$ for both comparisons).

Among infants from birth through 23 months, 11.4% were overweight (weight for length \geq 95th percentile; TABLE 3). There were no differences in prevalence between younger boys and girls. However, as with the older children, there were differences between racial/ethnic groups. About 10% of non-Hispanic whites were at or above the

Table 2. Prevalence of Overweight or at Risk for Overweight in Children by Sex, Race/Ethnicity, and Age Group: NHANES 1999-2000*

Sex	Age, y	Overweight or at Risk†				Overweight‡			
		All§	Non-Hispanic White	Non-Hispanic Black	Mexican American	All§	Non-Hispanic White	Non-Hispanic Black	Mexican American
Both sexes	2-5	20.6 (1.8)	20.5 (2.7)	19.3 (3.5)	22.7 (3.0)	10.4 (1.7)	10.1 (2.4)	8.4 (2.3)	11.1 (2.5)
	6-11	30.3 (2.4)	26.2 (3.6)	35.9 (3.0)	39.3 (3.0)	15.3 (1.7)	11.8 (2.4)	19.5 (2.0)	23.7 (2.0)#
	12-19	30.4 (1.9)	26.5 (2.4)	40.4 (2.2)	43.8 (2.6)	15.5 (1.2)	12.7 (1.7)	23.6 (2.1)#	23.4 (2.1)#
Male	2-5	20.9 (2.4)	21.4 (3.7)	12.6 (3.1)	26.0 (4.9)	9.9 (2.2)	8.8 (3.2)	5.9 (2.4)	13.0 (3.9)
	6-11	32.7 (3.7)	29.4 (5.7)	34.5 (3.6)	43.0 (4.2)	16.0 (2.3)	12.0 (3.0)	17.1 (2.8)	27.3 (3.1)#
	12-19	30.5 (2.1)	27.4 (3.0)	35.7 (2.8)	44.2 (3.0)	15.5 (1.6)	12.8 (2.4)	20.7 (2.6)	27.5 (3.0)#
Female	2-5	20.4 (3.0)	19.7 (4.1)	26.6 (6.4)	19.5 (4.0)	11.0 (2.5)	11.5 (3.3)	11.2 (3.8)	9.2 (2.9)
	6-11	27.8 (3.2)	22.8 (4.7)	37.6 (3.6)	35.1 (4.4)	14.5 (2.5)	11.6 (3.5)	22.2 (3.3)	19.6 (3.1)
	12-19	30.2 (2.8)	25.4 (3.3)	45.5 (3.0)	43.5 (4.2)¶	15.5 (1.6)	12.4 (2.1)	26.6 (2.7)#	19.4 (2.8)

*Values are expressed as percentage (SE). NHANES indicates National Health and Nutrition Examination Survey.

†Body mass index for age is at the 85th percentile or higher.

‡Body mass index is at the 95th percentile or higher.

§Includes racial/ethnic groups not shown separately (eg, other category).

||Does not meet standard of statistical reliability and precision (relative SE >30%).

¶Includes one influential observation. When this observation is deleted, the prevalence (SE) is 39.6 (2.3).

#Significantly different from non-Hispanic whites at $P < .05$ (with Bonferroni adjustment).

Table 3. Prevalence of Overweight by Sex and Race/Ethnicity for Birth Through 23 Months: NHANES 1999-2000*

Subgroup	Total	Male	Female
Non-Hispanic white	10.1 (2.5)	9.2 (3.3)†	11.7 (5.0)†
Non-Hispanic black	18.5 (2.2)	16.2 (3.9)	20.9 (4.5)
Mexican American	13.7 (2.9)	13.6 (3.4)	13.8 (3.6)
Total‡	11.4 (1.7)	10.4 (2.1)	12.8 (2.8)

*Overweight defined as weight for length at the 95th percentile or higher. Values are expressed as percentage (SE). NHANES indicates National Health and Nutrition Examination Survey.

†Does not meet standard of statistical reliability and precision (relative SE >30%).

‡Includes racial/ethnic groups not shown separately (eg, other category).

95th percentile, whereas 18.5% of non-Hispanic blacks were at or above the 95th percentile ($P = .009$). Differences by race/ethnicity within sex were not significant possibly because of the small sample sizes.

TABLE 4 contains the prevalence of overweight for preschool and school-aged children and adolescents from national surveys. The changes between the earlier surveys and NHANES III have been previously published.^{1,18,19} After no change in the prevalence of overweight between NHANES I and NHANES II, there was an increase between NHANES II and NHANES III. Between NHANES III and NHANES 1999-2000, the increase in overweight prevalence was the same or greater than

between NHANES II and NHANES III. Overweight has increased 5 percentage points among 12- through 19-year-olds from 10.5% to 15.5% between NHANES III and NHANES 1999-2000. There was a significant increase in overweight among non-Hispanic black and Mexican-American adolescents. The prevalence (95% confidence interval) of overweight for non-Hispanic black adolescents increased from 13.4% (10.8%-16.0%) to 23.6% (19.4%-27.8%) between 1988-1994 and 1999-2000. For Mexican Americans, the prevalence (95% confidence interval) increased from 13.8% (9.5%-18.1%) to 23.4% (19.3%-27.5%). The FIGURE shows the increase in overweight from NHANES III to NHANES 1999-2000 for adolescents in each racial/ethnic group. Among non-Hispanic black males ($P < .001$) and females ($P = .002$), the prevalence increased 10 percentage points. Among Mexican-American males, the prevalence increased 13 percentage points ($P < .001$). Among all adolescent boys virtually no difference existed between racial/ethnic groups in 1988-1994 (11.6% of non-Hispanic whites, 10.7% of non-Hispanic blacks, and 14.1% of Mexican Americans were overweight), whereas in 1999-2000, 12.8% of non-Hispanic whites, 20.7% of non-Hispanic blacks, and 27.5% of

Mexican-American adolescent boys were overweight.

Analyses based on the adult definition of obesity indicated that 11.2% of 12- through 19-year-olds had a BMI of 30 or higher. Approximately 10% of non-Hispanic white females, 20% of non-Hispanic black females, and 16% of Mexican-American females exceeded the adult definition for obesity. The difference between non-Hispanic white girls and non-Hispanic black girls was significant ($P = .003$). In 1988-1994, the corresponding prevalences were 7.4%, 13.2%, and 9.2%. The 95th percentile of the BMI for age charts is greater than 30 for males aged 19.5 years or older and females aged 17.5 years or older.

COMMENT

The prevalence of overweight among US children is continuing to increase. In 1999-2000, more than 15% of 6-through 19-year-olds were overweight and more than 10% of 2-through 5-year-olds were overweight. The increase in the prevalence of overweight between 1988-1994 and 1999-2000 is similar to that seen between 1976-1980 and 1988-1994. The current increase is particularly evident among non-Hispanic black and Mexican-American adolescents. The prevalence in these groups increased more

Table 4. Trends in Overweight for Children Birth Through 19 Years by Sex and Age Group*

	NHES 2 (1963-1965)	NHES 3 (1966-1970)	NHANES I (1971-1974)	NHANES II (1976-1980)	NHANES III (1988-1994)	NHANES 1999-2000	P Values for NHANES III vs NHANES 1999-2000
6-23 mo†							
Total				7.2 (1.0)	8.9 (0.7)	11.6 (1.9)	.09
Male				8.2 (1.4)	9.9 (0.8)	9.8 (2.2)	.48
Female				6.1 (1.3)	7.9 (1.0)	14.3 (3.5)	.04
2-5 y‡							
Total			5.0 (0.6)	5.0 (0.6)	7.2 (0.7)	10.4 (1.7)	.04
Boys			5.0 (0.9)	4.7 (0.6)	6.1 (0.8)	9.9 (2.2)	.06
Girls			4.9 (0.8)	5.3 (1.0)	8.2 (1.1)	11.0 (2.5)	.16
6-11 y‡							
Total	4.2 (0.4)		4.0 (0.5)	6.5 (0.6)	11.3 (1.0)	15.3 (1.7)	.02
Boys	4.0 (0.4)		4.3 (0.8)	6.6 (0.8)	11.6 (1.3)	16.0 (2.3)	.05
Girls	4.5 (0.6)		3.6 (0.6)	6.4 (1.0)	11.0 (1.4)	14.5 (2.5)	.11
12-19 y‡							
Total		4.6 (0.3)	6.1 (0.6)	5.0 (0.5)	10.5 (0.9)	15.5 (1.2)	<.001
Adolescent boys		4.5 (0.4)	6.1 (0.8)	4.8 (0.5)	11.3 (1.3)	15.5 (1.6)	.02
Adolescent girls		4.7 (0.3)	6.2 (0.8)	5.3 (0.8)	9.7 (1.1)	15.5 (1.6)	.002

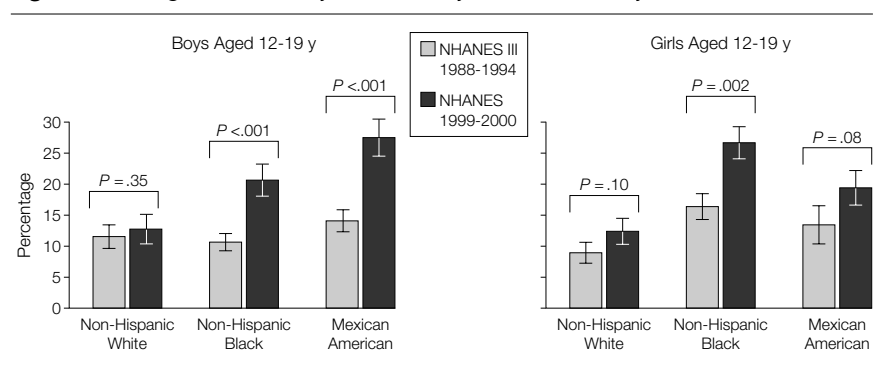
*Values are expressed as percentage (SE).

†A weight-for-length at the 95th percentile or higher is considered overweight.

‡A body mass index for age at the 95th percentile or higher is considered overweight.

than 10 percentage points between 1988-1994 and 1999-2000. More than 23% of non-Hispanic black and Mexican-American adolescents were overweight in 1999-2000. These results are consistent with data reported from the National Longitudinal Survey of Youth in which 21.5% of black and 21.8% of Hispanic 4- to 12-year-olds were overweight in 1998.²⁰ This study also showed a significant increase in overweight among black, Hispanic, and white children between 1986 and 1998. More recently, self-reported data from the Youth Risk Behavior Surveillance System suggested that 10.5% of high school students were overweight in 2001.²¹ This is considerably less than the 15.5% overweight based on measured weight and height in NHANES 1999-2000.

Overweight is due to an imbalance between dietary intake and energy expenditure, but the exact reason for the imbalance among children is not clear. Although diet and physical activity are difficult to measure, especially in children, poor eating habits are often established during childhood. In 2001, almost 80% of school children did not consume the recommended 5 or more servings of fruits and vegetables per day.²¹ Boys were significantly more

Figure. Overweight Prevalence by Race/Ethnicity for Adolescent Boys and Girls

Error bars represent SEs.

likely than girls to have eaten 5 or more servings per day of fruits and vegetables. This was particularly true for black students. In terms of physical activity, only about half of individuals aged 12 to 21 years reported regular participation in vigorous physical activity and one fourth reported no vigorous physical activity in 1996.²² More females than males and more black females than white females reported being inactive. Moreover, the percentage of high school students who were enrolled in physical education classes and who reported being physically active for at least 20 minutes in physical education classes declined from approxi-

mately 81% to 70% during the first half of the 1990s.²²

Several disorders have been linked to overweight in childhood. Of particular concern has been a potential increase in type 2 diabetes mellitus related to the increase in overweight among children.²³ Until recently, type 2 diabetes mellitus had rarely been seen in children. Although the prevalence of type 2 diabetes mellitus in adolescents is low (<1%),²⁴ cases are now occurring among many population groups in the United States, especially among ethnic minorities.²⁵ In general, children and adolescents diagnosed as having type 2 diabetes mellitus were overweight, had a

family history of type 2 diabetes mellitus, and had signs of insulin resistance. Impaired glucose tolerance has been shown to be highly prevalent among children with severe obesity.²⁶ The increase in type 2 diabetes mellitus has occurred particularly among minority youth in the United States.²⁷ The increase in prevalence of overweight seen in our current analysis also occurred primarily among minority adolescents.

It is not clear what interventions will work most effectively to reduce the high prevalence of overweight among youth. Changes that have contributed to the increase in overweight may relate to increasing food portion sizes, consump-

tion of high-fat, energy-dense fast foods, and an increasingly sedentary lifestyle. These changes will need to be addressed to prevent overweight in childhood.²⁸ Interventions may focus on parental behaviors because parents determine the diet and physical activity practices of their children.²⁹ School-based programs also may help to change diet or reduce sedentary behaviors.³⁰

To address the problem of increasing prevalence of overweight in US children, research will need to focus on reasons for the increase and what interventions will help reduce the prevalence. Overweight is related to dietary intake and physical activity, both of which are

influenced by social, economic, and physical environments. Whatever the causes of the increase in overweight among children, overweight among children in the United States is continuing to increase and the increase in prevalence is highest among Mexican-American and non-Hispanic black adolescents.

Author Contributions: Study concept and design: Ogden, Flegal.

Acquisition of data: Johnson.

Analysis and interpretation of data: Ogden, Flegal, Carroll, Johnson.

Drafting of the manuscript: Ogden.

Critical revision of the manuscript for important intellectual content: Ogden, Flegal, Carroll, Johnson.

Statistical expertise: Ogden, Flegal, Carroll.

Administrative, technical, or material support: Johnson.

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