Prevalence of Obesity and Trends in the Distribution of Body Mass Index Among US Adults, 1999-2010

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O VERALL TRENDS IN OBESITY in the adult population of the United States can be tracked using national survey data that include measured heights and weights. Based on national survey data, the population prevalence of obesity, defined as a body mass index (BMI) of 30 or greater (calculated as weight in kilograms divided by height in meters squared), showed little change in the period 1960 through 1980, followed by an increase of almost 8 percentage points between the 1976-1980 survey and the 1988-1994 survey, with a similar increase between the 1988-1994 survey and the 1999-2000 survey.[1-3] Over the period 1999-2008, however, there were smaller changes in the prevalence among men than seen previously and no significant change in prevalence among women.[3] Changes in the prevalence of obesity reflect changes in the distribution of BMI in the population. Previous analyses showed increases across almost the entire distribution of BMI with larger changes at higher BMI levels.[4]

Here we report the results from the latest National Health and Nutrition Examination Survey (NHANES) from

Context Between 1980 and 1999, the prevalence of adult obesity (body mass index [BMI] ≥30) increased in the United States and the distribution of BMI changed. More recent data suggested a slowing or leveling off of these trends.

Objective To estimate the prevalence of adult obesity from the 2009-2010 National Health and Nutrition Examination Survey (NHANES) and compare adult obesity and the distribution of BMI with data from 1999-2008.

Design, Setting, and Participants NHANES includes measured heights and weights for 5926 adult men and women from a nationally representative sample of the civilian noninstitutionalized US population in 2009-2010 and for 22 847 men and women in 1999-2008.

Main Outcome Measures The prevalence of obesity and mean BMI.

Results In 2009-2010 the age-adjusted mean BMI was 28.7 (95% CI, 28.3-29.1) for men and also 28.7 (95% CI, 28.4-29.0) for women. Median BMI was 27.8 (interquartile range [IQR], 24.7-31.7) for men and 27.3 (IQR, 23.3-32.7) for women. The age-adjusted prevalence of obesity was 35.5% (95% CI, 31.9%-39.2%) among adult men and 35.8% (95% CI, 34.0%-37.7%) among adult women. Over the 12-year period from 1999 through 2010, obesity showed no significant increase among women overall (age- and race-adjusted annual change in odds ratio [AOR], 1.01; 95% CI, 1.00-1.03; $P = .07$), but increases were statistically significant for non-Hispanic black women ($P = .04$) and Mexican American women ($P = .046$). For men, there was a significant linear trend (AOR, 1.04; 95% CI, 1.02-1.06; $P < .001$) over the 12-year period. For both men and women, the most recent 2 years (2009-2010) did not differ significantly ($P = .08$ for men and $P = .24$ for women) from the previous 6 years (2003-2008). Trends in BMI were similar to obesity trends.

Conclusion In 2009-2010, the prevalence of obesity was 35.5% among adult men and 35.8% among adult women, with no significant change compared with 2003-2008.

2009-2010 regarding population prevalence in obesity and compare the results with previous NHANES data over the 12-year period from 1999 through 2010. We also examine trends in the distribution of BMI in the population.

METHODS

The NHANES program of the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention, includes a series of cross-sectional nationally representative health examination surveys

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Table 1. Unweighted Sample Sizes (and Weighted Percentages of Total) for Adults Aged 20 Years and Older: NHANES 2009-2010

	Unweighted No. (Weighted %)				
	All Race/Ethnicity Groups[a]	Non-Hispanic White	Non-Hispanic Black	Hispanic[b]	Mexican American
Both sexes	5926 (100)	2842 (68.8)	1074 (11.4)	1682 (13.6)	1076 (8.5)
Men					
≥20 y	2889 (48.7)	1395 (33.2)	537 (5.2)	802 (7.1)	530 (4.6)
20-39 y	946 (18.7)	413 (11.0)	169 (2.3)	298 (3.8)	191 (2.4)
40-59 y	986 (19.0)	442 (13.5)	200 (2.0)	301 (2.4)	207 (1.6)
≥60 y	957 (11.0)	540 (8.7)	168 (0.9)	203 (0.8)	132 (0.5)
Women					
≥20 y	3037 (51.3)	1447 (34.9)	537 (6.2)	880 (6.2)	546 (3.9)
20-39 y	1011 (17.8)	448 (10.6)	181 (2.5)	312 (3.1)	197 (1.9)
40-59 y	1019 (19.8)	459 (13.4)	185 (2.5)	309 (2.4)	189 (1.4)
≥60 y	1007 (13.8)	540 (10.9)	171 (1.3)	259 (1.0)	160 (0.6)

Abbreviation: NHANES, National Health and Nutrition Examination Survey.
[a] Includes race/ethnicity groups not shown separately.
[b] Includes Mexican American participants.

beginning in 1960. In each survey, a nationally representative sample of the US civilian noninstitutionalized population was selected using a complex, stratified, multistage probability cluster sampling design. Beginning in 1999, NHANES became a continuous survey with data released in 2-year cycles. For this study, we estimated obesity prevalence for data from 2009-2010 and examined trends since 1999 using data from 2-year cycles beginning in 1999-2000. Details of the 1999-2008 data on obesity, including sample sizes and prevalence estimates, have been previously published.[3] NHANES 1999-2010 underwent NCHS institutional review board/research ethics review board approval and included written informed consent from the participants.

Weight and height were measured in a mobile examination center using standardized techniques and equipment. Body mass index was calculated as weight in kilograms divided by height in meters squared and rounded to the nearest tenth. Following current recommendations, overweight was defined as a BMI of 25.0 to 29.9 and obesity as a BMI of 30.0 or higher.[5] Obesity can be further subdivided into grade 1 (BMI 30-<35), grade 2 (BMI 35-<40), and grade 3 (BMI ≥40).

Age was based on age at the interview and grouped into 20 to 39 years of age, 40 to 59 years of age, and 60 years and older. Race and ethnicity were self-reported and for purposes of this report were classified as non-Hispanic white, non-Hispanic black, Mexican American, other Hispanic, and other. Data for 2009-2010 were analyzed overall, including all race/ethnicity groups, and separately for non-Hispanic white, non-Hispanic black, all Hispanic participants (including both Mexican American and other Hispanic participants), and Mexican American participants.

Statistical analyses were carried out using SAS for Windows version 9.2 (SAS Institute) and SUDAAN version 10.0 (RTI). Approximate power calculations were performed using POWER version 3 (National Cancer Institute), assuming a survey design effect of 1.5. The sample sizes were sufficient to detect an annual increase of 0.5 percentage points with more than 90% power and an increase of 0.4 percentage points with more than 80% power. For each 2-year survey cycle, we used the standard sampling weights provided by NCHS for that cycle that took into account unequal probabilities of selection resulting from the sample design, nonresponse, and noncoverage. All analyses took into account differential probabilities of selection and the complex sample design. Standard errors

were calculated with SUDAAN using Taylor series linearization. Age-adjusted values were adjusted by the direct method to the year 2000 US Census population using the age groups 20 to 39 years, 40 to 59 years, and 60 years and older.

Linear trends in the prevalence of obesity over the six 2-year survey cycles overall and by race/ethnicity were assessed with sex-specific logistic regression models with 2-year survey cycle treated as a continuous variable. For convenience, the odds ratios (ORs) for the 2-year cycles were re-expressed as the equivalent OR for a 1-year change. In surveys from 1999 through 2006, Mexican American individuals but not all other Hispanic individuals were oversampled, so trends were examined for Mexican American individuals rather than for all Hispanic individuals. The prevalence of obesity was compared between men and women using a t test.

From sex-specific logistic regression models with 2-year survey cycle treated as a categorical variable, linear contrasts were used to compare prevalence estimates from 2009-2010 with the joint effect of survey cycles for 2003-2004, 2005-2006, and 2007-2008. Trends in log-transformed BMI were assessed using linear regression. Statistical significance was determined as a 2-sided $P < .05$. To further examine trends in BMI, selected percentiles were graphed. The smoothed distribution of BMI by sex and age in NHANES 1999-2002 and NHANES 2007-2010 with the 90th percentile indicated were also graphed, and data from NHANES III, conducted from 1988-1994, were included for comparative purposes. NHANES III has been described fully elsewhere.[1,6,7]

RESULTS

In 2009-2010, the adult sample consisted of 8397 men and women aged 20 years and older of whom 74.1% (n=6218) were interviewed and 72.2% (n=6059) were interviewed and examined. Of those examined, 65 were excluded from analysis because of miss-

ing weight or height, and an additional 68 women were excluded because they were pregnant at the time of the examination. This report is based on data for 2889 adult men and 3037 nonpregnant adult women with measured weights and heights from the most recent 2 years of the continuous NHANES (2009-2010) in addition to previously described data on 22847 men and women from NHANES 1999-2008. Response rates were similar across all cycles of the study.

Sample sizes for analyses from 2009-2010 are shown in TABLE 1.

Detailed information on the prevalence of obesity (BMI ≥30) and of overweight and obesity combined (BMI ≥25), both overall and by age, sex, and race/ethnicity, from NHANES 2009-2010 is shown in TABLE 2. Overall, the age-adjusted obesity prevalence was 35.7% (95% CI, 33.8%-37.7%). Among men, age-adjusted obesity prevalence was 35.5% (95% CI, 31.9%-39.2%) overall, and within race/ethnicity groups, prevalence ranged from 36.2% (95% CI, 31.8%-40.8%) among non-Hispanic white men to 38.8% (95%

CI, 33.9%-43.9%) among non-Hispanic black men. For women, the age-adjusted prevalence was 35.8% (95% CI, 34.0%-37.7%), and the range was from 32.2% (95% CI, 29.2%-35.3%) among non-Hispanic white women to 58.5% (95% CI, 52.4%-64.3%) among non-Hispanic black women. The overall prevalence of obesity did not differ significantly between men and women (P=.86). The age-adjusted prevalence of overweight and obesity combined (BMI ≥25) was 68.8% (95% CI, 65.9%-71.5%) overall, 73.9% (95% CI,

Table 2. Prevalence of Obesity (BMI ≥30) and of Overweight and Obesity Combined (BMI ≥25) for Adults Aged 20 Years and Older: NHANES 2009-2010

	% (95% CI)				
	All Race/Ethnicity Groups[a]	Non-Hispanic White	Non-Hispanic Black	Hispanic[b]	Mexican American
Body Mass Index ≥30[c]					
All					
≥20 y	35.9 (34.0-37.9)	34.9 (32.4-37.4)	49.6 (44.5-54.8)	37.9 (33.7-42.3)	39.6 (35.7-43.6)
Age adjusted ≥20 y[d]	35.7 (33.8-37.7)	34.3 (31.8-36.8)	49.5 (44.7-54.5)	39.1 (35.2-43.1)	40.4 (36.6-44.3)
Men					
≥20 y	35.5 (32.0-39.2)	36.4 (32.1-40.9)	38.8 (33.5-44.3)	35.3 (30.1-40.9)	35.6 (30.1-41.5)
Age adjusted ≥20 y[d]	35.5 (31.9-39.2)	36.2 (31.8-40.8)	38.8 (33.9-43.9)	37.0 (32.5-41.7)	36.6 (31.7-41.8)
20-39 y	33.2 (27.7-39.2)	34.5 (27.3-42.6)	35.8 (26.8-45.9)	30.8 (24.4-38.0)	32.7 (25.4-41.1)
40-59 y	37.2 (33.4-41.2)	37.4 (33.0-42.0)	42.6 (35.2-50.3)	40.0 (33.3-47.2)	38.1 (30.7-46.2)
≥60 y	36.6 (31.7-41.8)	37.1 (31.1-43.4)	37.8 (30.4-45.8)	42.6 (37.1-48.4)	40.7 (29.3-53.2)
Women					
≥20 y	36.3 (34.3-38.3)	33.4 (30.3-36.6)	58.6 (52.5-64.5)	40.7 (36.7-44.8)	44.3 (41.1-47.5)
Age adjusted ≥20 y[d]	35.8 (34.0-37.7)	32.2 (29.2-35.3)	58.5 (52.4-64.3)	41.4 (37.4-45.6)	44.9 (41.5-48.3)
20-39 y	31.9 (28.6-35.5)	26.9 (23.0-31.3)	56.2 (44.3-67.5)	34.4 (30.9-38.2)	37.8 (33.2-42.7)
40-59 y	36.0 (32.5-39.6)	31.8 (27.2-36.7)	62.7 (55.0-69.8)	48.0 (39.4-56.7)	53.9 (44.8-62.7)
≥60 y	42.3 (38.3-46.3)	41.8 (37.7-46.0)	55.5 (47.6-63.1)	42.8 (37.5-48.3)	42.5 (33.9-51.6)
Body Mass Index ≥25[c]					
All					
≥20 y	69.2 (66.3-71.9)	68.0 (64.5-71.3)	76.6 (72.8-80.0)	77.3 (74.3-80.0)	80.0 (76.3-83.3)
Age adjusted ≥20 y[d]	68.8 (65.9-71.5)	66.7 (63.1-70.2)	76.7 (73.3-79.7)	78.8 (76.2-81.3)	81.2 (78.0-84.1)
Men					
≥20 y	74.1 (70.0-77.8)	75.0 (70.1-79.4)	69.9 (66.0-73.5)	79.9 (75.5-83.7)	81.3 (76.0-85.6)
Age adjusted ≥20 y[d]	73.9 (70.0-77.5)	74.0 (69.2-78.3)	69.9 (66.4-73.3)	81.7 (77.8-85.0)	82.4 (77.6-86.4)
20-39 y	67.1 (61.2-72.6)	65.0 (57.1-72.2)	64.5 (57.6-70.9)	74.5 (67.7-80.2)	76.9 (68.4-83.6)
40-59 y	79.5 (73.8-84.2)	80.8 (73.2-86.6)	75.8 (68.3-82.0)	86.3 (82.9-89.1)	86.3 (82.6-89.3)
≥60 y	76.5 (72.1-80.4)	78.6 (75.1-81.8)	69.8 (63.7-75.3)	86.6 (79.7-91.5)	85.8 (75.8-92.1)
Women					
≥20 y	64.5 (61.8-67.1)	61.3 (57.8-64.7)	82.1 (77.5-86.0)	74.4 (71.0-77.5)	78.5 (74.9-81.7)
Age adjusted ≥20 y[d]	63.7 (60.9-66.4)	59.5 (55.5-63.3)	82.1 (77.9-85.6)	75.7 (72.6-78.6)	79.8 (76.9-82.4)
20-39 y	55.8 (49.6-61.9)	50.7 (43.1-58.2)	74.2 (65.9-81.1)	65.4 (59.9-70.5)	68.8 (62.1-74.8)
40-59 y	66.0 (61.9-69.8)	61.3 (55.9-66.5)	87.7 (80.8-92.4)	83.3 (79.4-86.5)	89.7 (83.9-93.5)
≥60 y	73.5 (70.4-76.4)	71.6 (68.1-74.9)	86.4 (77.9-92.0)	81.2 (77.9-84.1)	82.8 (78.0-86.7)

Abbreviations: BMI, body mass index; NHANES, National Health and Nutrition Examination Survey.
[a] Includes race/ethnicity groups not shown separately.
[b] Includes Mexican American participants.
[c] Calculated as weight in kilograms divided by height in meters squared.
[d] Age adjusted by the direct method to the year 2000 Census population using the age groups 20-39 years, 40-59 years, and 60 years and older.

70.0%-77.8%) among men, and 63.7% (95% CI, 60.9%-66.4%) among women.

Additional information on the prevalence of grade 2 and grade 3 obesity (BMI ≥35) and of grade 3 obesity (BMI ≥40) by age, sex, and race/ethnicity from NHANES 2009-2010 is shown in TABLE 3. The age-adjusted values for BMI of 35 or greater ranged from 11.4% (95% CI, 8.8%-14.6%) among Mexican American men to 20.0% (95% CI, 16.4%-24.3%) for non-Hispanic black men; corresponding ranges for women

were 16.6% (95% CI, 14.7%-18.6%) for non-Hispanic white women to 30.7% (95% CI, 26.4%-35.2%) for non-Hispanic black women. The age-adjusted prevalence of grade 3 obesity (BMIs of ≥40) was 6.3% (95% CI, 5.8%-6.8%) overall, 4.4% (95% CI, 3.7%-5.1%) for men, and 8.1% (95% CI, 7.2%-9.3%) for women, with the highest values among non-Hispanic black women, for whom the prevalence was 17.8% (95% CI, 15.1%-20.8%).

Table 2 and Table 3 show the prevalence of BMI above specified cutoff val-

ues with no upper bound (eg, BMI 30 and above), and thus the estimates are not mutually exclusive. Estimates of the prevalence of BMI values between specified cutoff values of overweight (BMI 25-<30), grade 1 obesity (BMI 30-<35), and grade 2 obesity (BMI 35-<40) are shown in the eTable (available at http://www.jama.com).

The results of statistical tests for trends in obesity over the 12 years of survey cycles from 1999 through 2010, shown in TABLE 4, are expressed as annualized ORs, indicating the estimated increase per year in the odds of

Table 3. Prevalence of Grade 2 and Grade 3 Obesity Combined (BMI ≥35) and of Grade 3 Obesity (BMI ≥40) for Adults Aged 20 Years and Older: NHANES 2009-2010

	All Race/Ethnicity Groups[a]	Non-Hispanic White	Non-Hispanic Black	Hispanic[b]	Mexican American
	% (95% CI)				
Body Mass Index ≥35[c]					
All					
≥20 y	15.5 (14.4-16.6)	14.8 (13.5-16.1)	26.2 (23.9-28.8)	14.6 (12.8-16.7)	14.8 (12.8-17.1)
Age adjusted ≥20 y[d]	15.4 (14.3-16.5)	14.4 (13.2-15.7)	26.0 (23.6-28.5)	14.9 (13.0-17.0)	14.9 (12.9-17.2)
Men					
≥20 y	12.5 (10.9-14.4)	12.4 (10.6-14.6)	20.7 (17.1-24.7)	11.4 (9.3-14.0)	11.1 (8.5-14.3)
Age adjusted ≥20 y[d]	12.5 (10.9-14.2)	12.1 (10.3-14.1)	20.0 (16.4-24.3)	11.9 (9.8-14.3)	11.4 (8.8-14.6)
20-39 y	10.1 (8.0-12.7)	8.6 (5.7-12.8)	23.2 (16.4-31.8)	10.2 (7.1-14.4)	10 (6-16.1)
40-59 y	15.0 (12.2-18.5)	15.4 (11.9-19.6)	21.8 (17.3-27.2)	12.6 (10.5-15.2)	12.2 (9.1-16.2)
≥60 y	12.3 (10.2-14.8)	12.6 (10.1-15.6)	11.8 (6.9-19.4)	13.6 (9.1-20.0)	12.5 (5.2-26.9)
Women					
≥20 y	18.3 (16.8-19.8)	17.0 (15.0-19.2)	30.9 (26.9-35.2)	18.1 (15.8-20.8)	19.3 (16.5-22.4)
Age adjusted ≥20 y[d]	18.1 (16.7-19.7)	16.6 (14.7-18.6)	30.7 (26.4-35.2)	18.1 (15.6-20.9)	19.1 (16.3-22.1)
20-39 y	17.2 (14.2-20.7)	15.3 (12.3-19.0)	27.4 (19.5-37.1)	18.6 (14.8-23.1)	20.1 (14.3-27.5)
40-59 y	17.6 (14.8-20.7)	15.6 (12.3-19.6)	36.4 (32.0-41.1)	17.3 (11.7-24.7)	19.1 (13.2-26.7)
≥60 y	20.6 (17.2-24.6)	20.2 (16.4-24.7)	26.9 (22.4-32.0)	18.8 (14.3-24.3)	17.2 (12.5-23.1)
Body Mass Index ≥40[c]					
All					
≥20 y	6.3 (5.9-6.9)	5.8 (5.1-6.6)	13.3 (11.5-15.3)	5.0 (3.9-6.4)	5.4 (3.9-7.4)
Age adjusted ≥20 y[d]	6.3 (5.8-6.8)	5.7 (5.0-6.5)	13.1 (11.3-15.1)	5.0 (4.0-6.2)	5.4 (4.1-7.2)
Men					
≥20 y	4.4 (3.7-5.2)	4.2 (3.3-5.3)	7.6 (5.8-9.9)	4.1 (2.7-6.0)	4.3 (2.6-7.0)
Age adjusted ≥20 y[d]	4.4 (3.7-5.1)	4.2 (3.3-5.4)	7.4 (5.6-9.8)	4.1 (2.9-5.7)	4.4 (2.9-6.7)
20-39 y	4.3 (2.9-6.3)	4.1 (2.3-7.3)	7.6 (5.6-10.3)	4.6 (2.5-8.5)	5.2 (2.5-10.4)
40-59 y	5.1 (3.5-7.3)	5.1 (3.4-7.6)	8.7 (6.0-12.5)	2.8 (1.5-5.1)	2.3 (1.2-4.1)
≥60 y	3.3 (1.7-6.2)	2.8 (1.2-6.4)	5.0 (2.5-9.5)	5.3 (2.8-9.7)	6.6 (3-13.8)
Women					
≥20 y	8.2 (7.2-9.3)	7.3 (6.2-8.6)	18.0 (15.4-21.0)	6.1 (4.7-7.8)	6.7 (5.1-8.6)
Age adjusted ≥20 y[d]	8.1 (7.2-9.3)	7.1 (6.0-8.3)	17.8 (15.1-20.8)	6.0 (4.7-7.7)	6.6 (5.1-8.5)
20-39 y	7.5 (5.8-9.7)	5.9 (4.1-8.4)	15.7 (11.7-20.7)	7.3 (5.1-10.2)	7 (4.5-10.9)
40-59 y	8.4 (6.8-10.4)	7.3 (5.4-9.7)	23.0 (16.9-30.3)	4.4 (2.2-8.7)	6 (3.2-11.3)
≥60 y	8.8 (6.9-11.0)	8.7 (6.5-11.5)	13.0 (10.8-15.6)	6.3 (4.7-8.5)	6.9 (4.8-9.9)

Abbreviations: BMI, body mass index; NHANES, National Health and Nutrition Examination Survey.
[a] Includes race/ethnicity groups not shown separately.
[b] Includes Mexican American participants.
[c] Calculated as weight in kilograms divided by height in meters squared.
[d] Age adjusted by the direct method to the year 2000 Census population using the age groups 20-39 years, 40-59 years, and 60 years and older.

obesity prevalence. An OR of 1.04 would be approximately equivalent to a yearly increase in obesity prevalence of 0.8 percentage points. For men, there were significant increases over the period 1999-2000 through 2009-2010 (OR, 1.04; 95% CI, 1.02-1.06). For women, there were no significant trends overall in analyses using the 2-year survey cycles. Within race/ethnicity groups, increases were significant for both non-Hispanic black women (P=.04) and Mexican American women (P=.046).

The largest part of the increase for men appeared to be due to differences between estimates in 1999-2002 and later estimates. Previous analyses[3] had shown no difference between estimates for 2007-2008 and the joint effect of estimates for the previous 4 years (2003-2004 and 2005-2006). For both men and women, estimates for 2009-2010 similarly were not significantly different (P=.08 for men and P=.24 for women) from the joint effect of the 3 previous cycles (2003-2004, 2005-2006, and 2007-2008).

In 2009-2010, the age-adjusted mean BMI was 28.7 (95% CI, 28.3-29.1) for men and 28.7 (95% CI, 28.4-29.0) for women. Tests of trends in log-transformed mean BMI over the 12-year period from 1999 through 2010 showed a significant increase in men (P<.001) and no significant increase in women (P=.06). To describe changes in the dis-

tribution of BMI over the period 1999 through 2010, we calculated selected percentiles, with results shown graphically in the FIGURE. Additional graphs of the distribution of BMI are provided as eFigures 1 through 6. For both men and women, the estimated median BMI (50th percentile) was slightly higher in 2009-2010 than in 1999-2000 within all age groups. For men, the median BMI was 26.8 (interquartile range [IQR], 24.1-30.3) in 1999-2000 and 27.8 (IQR, 24.7-31.7) in 2009-2010. For women, the median BMI was 26.8 (IQR, 23.2-32.1) in 1999-2000 and 27.3 (IQR, 23.3-32.7) in 2009-2010.

COMMENT

The prevalence of BMI-defined obesity in adults in the United States continues to exceed 30% in most sex-age groups. It increased significantly over the 12-year period from 1999 through 2010 for men and for non-Hispanic black and Mexican American women, but did not change between 2003-2008 and 2009-1010 for men or women. These estimates are based on a large sample of data from a nationally representative survey that included measured weight and height obtained through standardized procedures.

The definition is based on BMI, a function of weight and height, and not on body fatness per se. In the NHANES, however, BMI has been found to be

highly correlated with percentage body fat as measured by dual x-ray absorptiometry.[8] For men, the correlation between BMI and percentage body fat ranges from 0.72 to 0.79 within age groups; for women the correlation ranges from 0.72 to 0.84. At a given BMI, black men and women tend to have higher lean mass and lower fat mass than white men and women.[8-11]
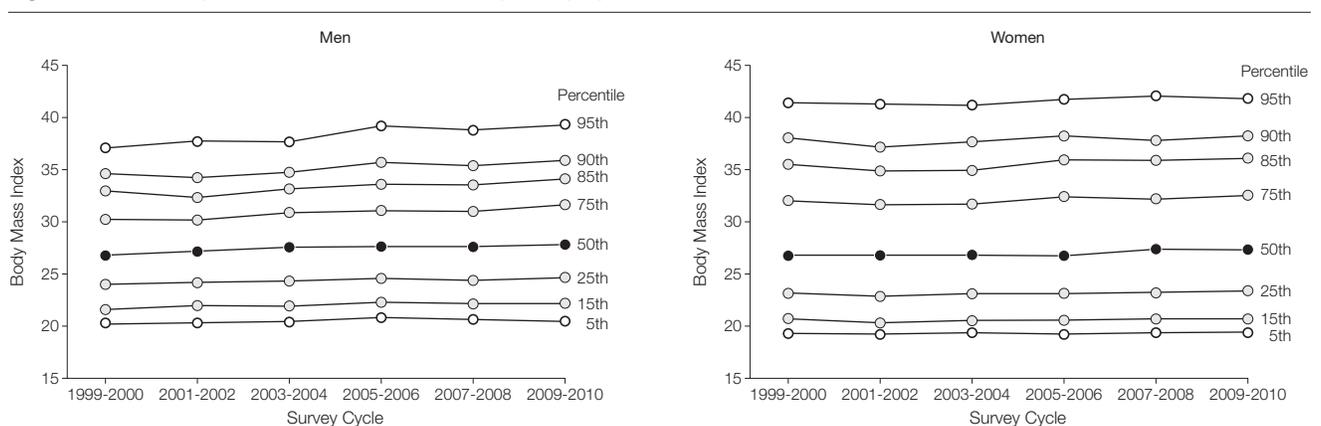
As a result, race/ethnicity differences in the prevalence of obesity as defined by BMI do not always com-

Table 4. Estimated Annual Increase in the Odds of Obesity Prevalence by Sex and by Sex and Race/Ethnicity: Adults Aged 20 Years and Older, United States, 1999-2010

	Odds Ratio (95% CI)	P Value
Men		
All[a]	1.04 (1.02-1.06)	<.001
Non-Hispanic white[b]	1.04 (1.02-1.06)	<.001
Non-Hispanic black[b]	1.06 (1.03-1.08)	<.001
Mexican American[b]	1.04 (1.01-1.08)	.01
Women		
All[a]	1.01 (1.00-1.03)	.07
Non-Hispanic white[b]	1.01 (0.99-1.03)	.20
Non-Hispanic black[b]	1.03 (1.00-1.06)	.04
Mexican American[b]	1.03 (1.00-1.06)	.046

[a] Adjusted for race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, other Hispanic, other race/ethnicity) and age group (20-39 years, 40-59 years, ≥60 years).
[b] Adjusted for age group (20-39 years, 40-59 years, ≥60 years).

Figure. Selected Body Mass Index Percentile Values by Survey Cycle, 1999-2010

Values are weighted estimates.

pletely reflect differences in body fatness. Despite the large overall sample size, precision may be limited for smaller subgroups by age and race/ethnicity categories. Our analyses addressed changes in the population over time and not changes in individuals or changes by birth cohort. Analyses by birth cohort might provide additional perspective on the changes in the population.[12]

Trends

For men, the overall prevalence of obesity showed a significant linear trend over the 12-year period from 1999 through 2010. For women, within race/ethnicity groups, the data suggested slight increases that were statistically significant for non-Hispanic black and Mexican American women but not significant for women overall. For both men and women, estimates for 2009-2010 did not differ significantly from estimates for 2003-2008. These data suggest that the increases in the population prevalence of obesity previously observed[2] may not be continuing at a similar rate, and in fact, the increases appear to be slowing or leveling off. However, we found no indication that the prevalence of obesity is declining in any group.

Relatively little is known about the causes of population trends in body weight. They are likely to have complex roots.[13,14] Some research has addressed the possible effect of environmental endocrine disruptors on obesity.[15,16] Considerations of the forces related to energy imbalance have also included discussions of cultural, economic, and social factors.[17,18] Swinburn and colleagues[19] attribute the trends primarily to the expansion of the global food system and its success in food processing and marketing and in providing available and affordable food.

In part because we know relatively little about the precise causes of the trends previously observed, it is hard to predict the future trends in obesity. Several analyses[20-25] have modeled increasing obesity prevalence as a function of calendar time and then pro-

jected future obesity prevalence from these models. These obesity predictions in effect assume that the causal factors for obesity will continue to rise with time or will have an increasing effect over time, and therefore calendar time itself is a reasonable predictor of future obesity prevalence. However, the results reported here and the apparent slowing of trends suggest these may not be valid assumptions and these predictions may be inaccurate.

Comparisons

International comparisons of BMI and obesity are challenging.[26] Differences in sampling and design make precise comparisons between the United States and other countries difficult. However, for estimates based on measured data, the prevalence of obesity in the United States is higher than that in Canada or in England.[27,28] The phenomenon of slowing or leveling trends may not be limited to the United States. A number of studies in other countries have suggested that trends previously observed in the prevalence of obesity may be slowing or not continuing. Data from the Health Survey for England showed that for men prevalence of obesity was 22.2% in 2005 and 22.1% in 2009; comparable figures for women were 23.0% and 23.9%.[27] Reports from Sweden, Switzerland, and Spain have also suggested a possible degree of leveling.[29-32] Rokholm et al[33] reviewed evidence for a leveling off of trends in obesity since 1999 and found mixed results.

CONCLUSIONS

Obesity prevalence shows little change over the past 12 years, although the data are consistent with the possibility of slight increases. In 2009-2010, the prevalence of obesity was 35.5% among adult men and 35.8% among adult women, with no significant change compared with 2003-2008.

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