Original Investigation

Trends in Obesity Among Adults in the United States, 2005 to 2014

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IMPORTANCE Between 1980 and 2000, the prevalence of obesity increased significantly among adult men and women in the United States; further significant increases were observed through 2003-2004 for men but not women. Subsequent comparisons of data from 2003-2004 with data through 2011-2012 showed no significant increases for men or women.

OBJECTIVE To examine obesity prevalence for 2013-2014 and trends over the decade from 2005 through 2014 adjusting for sex, age, race/Hispanic origin, smoking status, and education.

DESIGN, SETTING, AND PARTICIPANTS Analysis of data obtained from the National Health and Nutrition Examination Survey (NHANES), a cross-sectional, nationally representative health examination survey of the US civilian noninstitutionalized population that includes measured weight and height.

EXPOSURES Survey period.

MAIN OUTCOMES AND MEASURES Prevalence of obesity (body mass index ≥30) and class 3 obesity (body mass index ≥40).

RESULTS This report is based on data from 2638 adult men (mean age, 46.8 years) and 2817 women (mean age, 48.4 years) from the most recent 2 years (2013-2014) of NHANES and data from 21 013 participants in previous NHANES surveys from 2005 through 2012. For the years 2013-2014, the overall age-adjusted prevalence of obesity was 37.7% (95% CI, 35.8%-39.7%); among men, it was 35.0% (95% CI, 32.8%-37.3%); and among women, it was 40.4% (95% CI, 37.6%-43.3%). The corresponding prevalence of class 3 obesity overall was 7.7% (95% CI, 6.2%-9.3%); among men, it was 5.5% (95% CI, 4.0%-7.2%); and among women, it was 9.9% (95% CI, 7.5%-12.3%). Analyses of changes over the decade from 2005 through 2014, adjusted for age, race/Hispanic origin, smoking status, and education, showed significant increasing linear trends among women for overall obesity (P = .004) and for class 3 obesity (P = .01) but not among men (P = .30 for overall obesity; P = .14 for class 3 obesity).

CONCLUSIONS AND RELEVANCE In this nationally representative survey of adults in the United States, the age-adjusted prevalence of obesity in 2013-2014 was 35.0% among men and 40.4% among women. The corresponding values for class 3 obesity were 5.5% for men and 9.9% for women. For women, the prevalence of overall obesity and of class 3 obesity showed significant linear trends for increase between 2005 and 2014; there were no significant trends for men. Other studies are needed to determine the reasons for these trends.

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JAMA. 2016;315(21):2284-2291. doi:10.1001/jama.2016.6458

National health examination survey data, based on measured weight and height, provide the best opportunity to estimate the prevalence of obesity in the United States. Results from the National Health and Nutrition Examination Survey (NHANES) have shown that obesity prevalence varied by sex, age, and race/Hispanic origin.[1-7] The prevalence of obesity has also been shown to vary by socioeconomic and cigarette smoking status.[8,9]

Previous research has included comparisons of obesity prevalence estimates from 1999-2000 with those from NHANES III (1988-1994),[4] of 2001-2002 with 1999-2000,[5] of 2003-2004 with 1999-2002,[10] and of 2007-2008,[3] 2009-2010,[1] and 2011-2012[7] with 2003-2004.[11] Previous NHANES data showed little change in obesity prevalence among adults in the United States from 1960 through 1980.[2] However, between NHANES II (1976-1980) and NHANES III (1988-1994), there was a significant increase in the prevalence of obesity.[2,6] The reasons for these and subsequent increases are unclear. Data from NHANES 1999-2000 showed further increases for men and women and all age groups.[4] Analyses for 2001-2002[5] and 2003-2004[10] showed that these trends continued to increase for men. For women, however, the prevalence of obesity showed no increases between 1999 and 2004. Previous analyses of age-adjusted prevalence also showed no significant changes from 2003-2004 through 2011-2012 for men or women.[7]

To get a more comprehensive understanding of the trends in obesity in the United States over the decade from 2005 through 2014, this analysis presents new data for 2013-2014. Age-adjusted and crude estimates of the prevalence of obesity from the combined 4 years of NHANES 2011-2014 have been previously reported.[12] Here we extend those observations by providing sex-specific estimates for overall obesity (body mass index [BMI] ≥30) and class 3 obesity (BMI ≥40) (BMI is calculated as weight in kilograms divided by height in meters squared).[13,14] In addition, we modeled the association of overall obesity and class 3 obesity with age, race/Hispanic origin, smoking, and education. We also examined sex-specific trends from 2005 through 2014, adjusting for the same factors.

Methods

The NHANES program of the National Center for Health Statistics, Centers for Disease Control and Prevention includes a series of cross-sectional nationally representative health examination surveys beginning in 1960. In each survey cycle, a nationally representative sample of the US civilian noninstitutionalized population is selected using a complex, stratified, multistage probability cluster sampling design. Beginning in 1999, NHANES became a continuous survey without a break between cycles.[11] NHANES was approved by the National Center for Health Statistics Research Ethics Review Board. Written consent was obtained for all adult participants.

For all surveys, weight and height were measured in a mobile examination center using standardized techniques and equipment. BMI was rounded to 1 decimal place. For adults aged 20 years or older, obesity was defined according to clinical guidelines.[13,14] Pregnant women were excluded from analysis. Participant age was grouped into categories of 20 to 39 years, 40 to 59 years, and 60 years and older.

Race/Hispanic origin group was defined on the basis of self-reported responses to specific interview questions. To examine current prevalence, race/Hispanic origin groups were categorized as non-Hispanic white, non-Hispanic black, non-Hispanic Asian, Hispanic, and other. The non-Hispanic Asian category includes predominantly individuals of Chinese, South Asian, Filipino, Vietnamese, and Japanese origin. Non-Hispanic participants who reported a multiracial background were categorized as other. For analyses of trends over time, race/Hispanic origin was categorized as non-Hispanic white, non-Hispanic black, Mexican American, and other. These categories follow the analytic guidelines for analyses that include data from the 2005-2006 NHANES cycle.[15]

Self-reported smoking status was categorized as never-smokers, former smokers, and current smokers. Never-smokers were defined as those who reported that they had not smoked as many as 100 cigarettes in their lifetime. Former smokers were defined as those who had smoked as many as 100 cigarettes but did not smoke cigarettes currently. Current smokers were defined as those who reported that they currently smoked cigarettes every day or some days. Self-reported education was defined using 3 categories: less than a high school education, high school graduate, and education beyond high school. The sample distributions of smoking status and educational categories are shown by sex and survey cycle in eTable 1 and eTable 2 in the Supplement.

Statistical Analyses

Statistical analyses were conducted using SAS version 9.3 (SAS Institute) and SUDAAN version 11.01 (RTI International). For all surveys, sampling weights accounted for unequal probabilities of selection (resulting from the sample design and planned oversampling of certain subgroups) and were adjusted for nonresponse. All analyses used the examination sampling weights and accounted for differential probabilities of selection and the complex sample design. Standard errors were estimated with SUDAAN using Taylor series linearization. Statistical significance was determined (2-sided test, $P < .05$) using the Satterthwaite F statistic. Age-adjusted estimates were adjusted by the direct method to the 2000 US Census population using the age groups 20 to 39 years, 40 to 59 years, and 60 years and older. Confidence intervals were estimated using the method described by Korn and Graubard.[16,17]

Sex-specific logistic regression models were used to assess the associations of age group, race/Hispanic origin, smoking status, and education with obesity prevalence. To examine trends over a decade, data from 5 discrete 2-year cycles of the continuous NHANES (2005-2006, 2007-2008, 2009-2010, 2011-2012, and 2013-2014) survey were used. Survey cycle was treated as a categorical variable, and obesity prevalence was modeled as a function of survey cycle, first adjusting for age group and then with further adjustments for age group, race/Hispanic origin, education, and smoking status. Models initially included all 2-way interactions between the

Table 1. Unweighted Sample Sizes for Adults 20 Years and Older by Sex, Age Group, and Race/Hispanic Origin: NHANES 2013-2014

	No. of Participants by Race/Hispanic Origin				
		Non-Hispanic			
Age Groups,y	All Groups[a]	White	Black	Asian	Hispanic
All participants					
20-39	1810	734	362	216	412
40-59	1896	759	383	251	449
≥60	1749	850	370	156	353
Men					
20-39	909	386	182	106	189
40-59	897	360	179	120	215
≥60	832	384	195	74	169
Women					
20-39	901	348	180	110	223
40-59	999	399	204	131	234
≥60	917	466	175	82	184

Abbreviation: NHANES, National Health and Nutrition Examination Survey.

[a] Includes race/Hispanic origin groups not shown separately.

adjustment factors, and nonsignificant interactions were deleted from the models. Models were fit for the overall sample with adjustment for sex and also separately for men and women. For each model, predicted margins were calculated to show prevalence standardized to the distribution of the model covariates within the full sample.[17] Predicted margins provide prevalence estimates that are standardized to the sample distribution of the model covariates but not to an external standard distribution. Thus, the standardization is specific to a given model and sample, and it is not comparable between models. The predicted margins show the findings of the model by adjusting the estimate from each survey cycle to the joint distribution of all the variables in the model, thereby allowing comparison of the estimates for different survey cycles from a given model. Single *df* linear contrasts in logistic regression models were used to test for linear and quadratic trends across survey cycles. For women, additional subgroup analyses of linear trends were performed separately by age group with adjustment for race/Hispanic origin, education, and smoking status; by race/Hispanic origin with adjustment for age group, education, and smoking status; and by smoking status with adjustment for age group, education, and race/Hispanic origin.

Results

This report includes data from 5455 adults (2638 men, mean age 46.8 years; and 2817 women, mean age 48.4 years) from the most recent 2 years of the continuous NHANES survey (2013-2014). The sample sizes by sex, age group, and race/Hispanic origin are shown in **Table 1**. The examination response rate for adults in 2013-2014 was 64%.[18] Data from 21 013 participants in NHANES 2005-2006, 2007-2008, 2009-2010, and 2011-2012 were also included to examine changes in obesity prevalence over the decade. Information about sample sizes and response rates for the earlier data used in these analyses is provided in previous reports.[1,3,7,18,19]

Obesity Prevalence in 2013-2014

The estimated prevalence of obesity in 2013-2014 overall and by sex, age group, and race/Hispanic origin is shown in **Table 2**. The overall crude prevalence of obesity was 37.9% (95% CI, 36.1%-39.8%); among men, it was 35.2% (95% CI, 33.0%-37.4%); and among women, it was 40.5% (95% CI, 37.6%-43.4%). The overall age-adjusted prevalence of obesity was 37.7% (95% CI, 35.8%-39.7%); for men, it was 35.0% (95% CI, 32.8%-37.3%); and for women, it was 40.4% (95% CI, 37.6%-43.3%).

The estimated prevalence of class 3 obesity in 2013-2014 overall and by sex, age group, and race/Hispanic origin is also shown in Table 2. The overall crude prevalence of class 3 obesity was 7.7% (95% CI, 6.2%-9.3%); among men, it was 5.5% (95% CI, 4.2%-7.0%); and among women, it was 9.7% (95% CI, 7.9%-11.9%). The overall age-adjusted prevalence of class 3 obesity was 7.7% (95% CI, 6.2%-9.3%); among men, it was 5.5% (95% CI, 4.0%-7.2%); and among women, it was 9.9% (95% CI, 7.5%-12.3%).

Odds ratios (ORs) for logistic regression models that adjusted simultaneously for race/Hispanic origin, age group, smoking status, and education for obesity and class 3 obesity are shown in **Table 3** (for overall *P* values for each variable see eTable 3 in the Supplement). The prevalence of obesity in 2013-2014 among men differed significantly by race/Hispanic origin and by smoking status but not by age group or education. The prevalence of obesity among non-Hispanic Asian men was significantly lower than among non-Hispanic white men (OR, 0.27 [95% CI, 0.20-0.38]). Among women, the prevalence of obesity in 2013-2014 varied significantly by age group, race/Hispanic origin, and education but not by smoking status. The prevalence of class 3 obesity among men did not differ by age group, race/Hispanic origin, smoking status, or education. The prevalence of class 3 obesity among women differed by age and race/Hispanic origin but not by smoking status or education.

Trend Analyses

Graphical representations of the changes in the distribution of BMI by survey and sex are shown in the **Figure**, which dis-

Table 2. Weighted Prevalence of Obesity and Class 3 Obesity by Sex, Age Group, and Race/Hispanic Origin: NHANES 2013-2014

	Overall, % (95% CI)		By Age, % (95% CI)		
	Unadjusted	Age-Adjusted	20-39 y	40-59 y	≥ 60 y
Obese[a]					
Both sexes					
All race/Hispanic origins[b]	37.9 (36.1-39.8)	37.7 (35.8-39.7)	34.3 (31.1-37.6)	41.0 (36.5-45.5)	38.5 (35.0-42.1)
Non-Hispanic white	37.1 (34.8-39.4)	36.4 (34.1-38.8)	31.2 (27.4-35.2)	40.3 (34.1-46.7)	39.1 (34.7-43.6)
Non-Hispanic black	48.5 (44.2-52.8)	48.4 (44.1-52.7)	45.2 (38.5-51.9)	52.1 (44.2-59.9)	47.9 (41.0-54.9)
Non-Hispanic Asian	12.7 (10.1-15.6)	12.6 (10.0-15.7)	16.4 (11.6-22.2)	11.2 (7.5-15.8)	8.5 (4.3-14.6)
Hispanic	42.7 (38.0-47.4)	42.6 (38.1-47.1)	41.2 (35.1-47.5)	46.3 (41.2-51.5)	38.9 (32.0-46.1)
Men					
All race/Hispanic origins[b]	35.2 (33.0-37.4)	35.0 (32.8-37.3)	31.6 (27.1-36.4)	37.2 (32.1-42.5)	37.5 (31.0-44.4)
Non-Hispanic white	35.4 (32.2-38.7)	34.7 (31.3-38.1)	29.3 (22.1-37.4)	37.0 (29.2-45.3)	40.1 (32.5-48.0)
Non-Hispanic black	38.2 (32.8-43.8)	38.0 (32.7-43.5)	33.1 (24.6-42.4)	45.7 (35.4-56.2)	34.3 (25.3-44.1)
Non-Hispanic Asian	13.0 (9.40-17.4)	12.6 (9.1-16.9)	23.4 (15.7-32.6)	6.2 (2.6-12.2)	4.4 (0.5-15.8)
Hispanic	38.8 (32.8-45.0)	37.9 (32.0-44.1)	39.3 (31.8-47.1)	41.5 (34.4-48.8)	29.8 (20.1-41.0)
Women					
All race/Hispanic origins[b]	40.5 (37.6-43.4)	40.4 (37.6-43.3)	37.0 (33.9-40.3)	44.6 (39.0-50.3)	39.4 (35.4-43.5)
Non-Hispanic white	38.7 (35.3-42.2)	38.2 (34.8-41.6)	33.2 (28.2-38.4)	43.5 (36.3-51.0)	38.2 (33.1-43.5)
Non-Hispanic black	57.2 (53.0-61.3)	57.2 (52.9-61.3)	56.7 (48.6-64.6)	57.5 (48.5-66.1)	57.5 (48.3-66.3)
Non-Hispanic Asian	12.4 (8.20-17.7)	12.4 (8.2-17.6)	10.0 (4.4-19.0)	15.4 (9.7-22.7)	11.5 (4.4-23.1)
Hispanic	46.6 (40.1-53.1)	46.9 (41.1-52.7)	43.3 (33.4-53.7)	51.1 (43.7-58.5)	46.3 (38.9-53.8)
Class 3 Obesity[a]					
Both sexes					
All race/Hispanic origins[b]	7.7 (6.2-9.3)	7.7 (6.2-9.3)	8.0 (6.3-10.0)	8.6 (6.2-11.6)	5.8 (4.2-7.7)
Non-Hispanic white	7.4 (5.6-9.6)	7.6 (5.1-10.5)	8.0 (5.2-11.7)	8.5 (5.4-12.5)	5.6 (3.7-8.0)
Non-Hispanic black	12.5 (9.5-16.0)	12.4 (7.4-17.8)	11.5 (7.6-16.4)	14.4 (8.7-21.9)	10.8 (7.0-15.6)
Non-Hispanic Asian[c]					
Hispanic	7.3 (4.9-10.4)	7.1 (4.4-10.4)	7.5 (3.7-13.4)	8.0 (5.4-11.2)	5.0 (3.0-7.8)
Men					
All race/Hispanic origins[b]	5.5 (4.2-7.0)	5.5 (4.0-7.2)	6.0 (3.6-9.3)	5.2 (3.1-8.2)	5.0 (2.7-8.4)
Non-Hispanic white	5.5 (3.9-7.5)	5.6 (3.1-8.7)	6.1 (2.7-11.5)	5.2 (2.4-9.4)	5.3 (2.5-9.8)
Non-Hispanic black	7.3 (4.5-10.9)	7.2 (3.4-12.5)	6.6 (3.4-11.2)	8.5 (4.4-14.5)	6.3 (2.7-12.3)
Non-Hispanic Asian[c]					
Hispanic	5.8 (2.6-11.0)	5.4 (1.8-11.5)	6.3 (1.6-16.0)	6.0 (3.0-10.6)	3.2 (1.1-7.1)
Women					
All race/Hispanic origins[b]	9.7 (7.9-11.9)	9.9 (7.5-12.3)	10.1 (8.1-12.5)	11.9 (8.6-16.0)	6.4 (4.5-8.9)
Non-Hispanic white	9.3 (6.9-12.1)	9.7 (5.9-13.9)	10.0 (6.3-14.8)	11.7 (7.3-17.5)	5.8 (3.8-8.5)
Non-Hispanic black	16.9 (13.1-21.2)	16.8 (9.0-24.9)	16.2 (9.9-24.4)	19.4 (12.3-28.2)	13.9 (7.0-23.9)
Non-Hispanic Asian[c]					
Hispanic	8.9 (6.5-11.8)	8.7 (5.4-12.5)	8.9 (4.3-15.9)	9.9 (6.4-14.5)	6.5 (3.2-11.4)

Abbreviations: BMI, body mass index; NHANES, National Health and Nutrition Examination Survey.

[a] BMI was calculated as weight in kilograms divided by height in meters squared. Obese was defined as participants with a BMI of 30 or greater. Class 3 obesity was defined as participants with a BMI of 40 or greater.

[b] Includes race/Hispanic origin groups not shown separately.

[c] Data are not shown because category included only 2 participants.

plays selected percentiles over survey cycles. Sex-specific and overall age-adjusted prevalence estimates for obesity and class 3 obesity by survey cycle are displayed in eTable 4 in the Supplement. The age-adjusted overall prevalence of obesity was 34.3% (95% CI, 31.4%-37.2%) in 2005-2006 and 37.7% (35.8-39.7) in 2013-2014. Trend analyses for the prevalence of obesity were performed with adjustments for age group, sex, race/Hispanic origin, smoking status, and education. The ORs and predicted margins (standardized prevalence values) from these models are shown in **Table 4**. Predicted margins show the predicted prevalence by survey cycle (based on the model coefficients and standardized to the distribution of the model covariates within the combined analytic sample).[17]

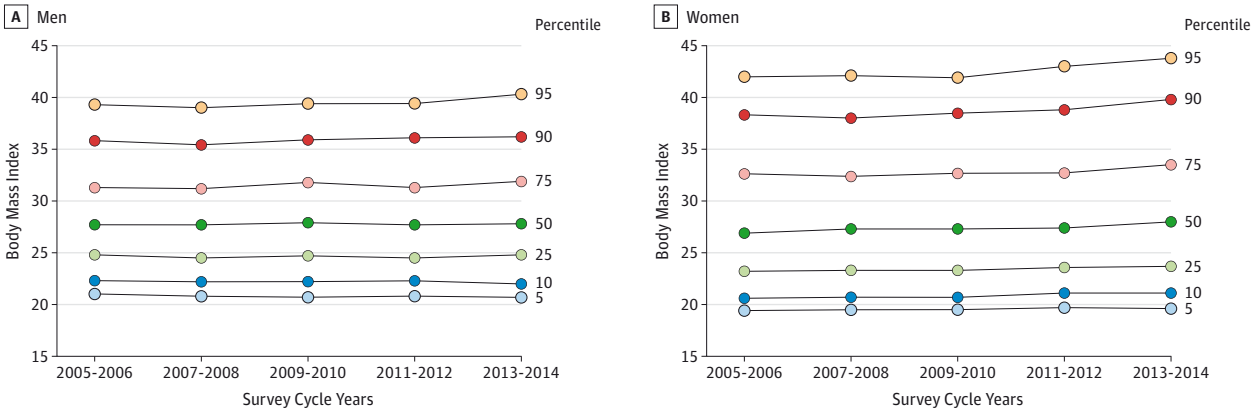
In the model adjusted only for sex and age group, there was a significant positive linear trend by survey cycle (P = .04) but not a significant quadratic trend (P = .32). In sex-specific

Table 3. Weighted Logistic Regression Models Adjusted for Race/Hispanic Origin, Age Group, Smoking Status, and Education for Obesity and Class 3 Obesity

	Odds Ratio (95% CI)			
	Men		Women	
	Obese, All Grades[a]	Class 3 Obesity[a]	Obese, All Grades[a]	Class 3 Obesity[a]
Age group, y				
20-39	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
40-59	1.28 (0.92-1.78)	0.86 (0.50-1.46)	1.37 (1.10-1.71)	1.15 (0.74-1.77)
≥60	1.19 (0.74-1.91)	0.78 (0.29-2.07)	1.05 (0.84-1.32)	0.56 (0.38-0.82)
Race/Hispanic origin group				
Non-Hispanic white	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Non-Hispanic black	1.23 (0.90-1.68)	1.40 (0.82-2.39)	2.10 (1.77-2.50)	1.98 (1.38-2.85)
Non-Hispanic Asian	0.27 (0.20-0.38)	0.07 (0.01-0.59)	0.23 (0.16-0.35)	0.02 (0.00-0.18)
Hispanic	1.21 (0.85-1.74)	1.05 (0.39-2.81)	1.33 (0.95-1.86)	0.92 (0.50-1.70)
Other	1.23 (0.64-2.36)	0.91 (0.35-2.36)	1.01 (0.60-1.69)	1.58 (0.80-3.14)
Smoking status				
Never smoker	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Former smoker	1.25 (0.93-1.67)	1.08 (0.60-1.95)	1.28 (0.95-1.73)	1.46 (0.95-2.25)
Current smoker	0.71 (0.54-0.93)	0.72 (0.35-1.50)	0.95 (0.59-1.53)	1.05 (0.78-1.43)
Education				
High school	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
<High school	0.92 (0.65-1.31)	0.74 (0.37-1.46)	0.91 (0.67-1.24)	0.88 (0.58-1.35)
>High school	0.96 (0.70-1.31)	0.89 (0.60-1.32)	0.68 (0.54-0.87)	0.90 (0.57-1.41)

[a] Body mass index was calculated as weight in kilograms divided by height in meters squared. Obese was defined as participants with a body mass index of 30 or greater. Class 3 obesity was defined as participants with a body mass index of 40 or greater.

Figure. Selected Weighted Percentiles of Body Mass Index by Survey Cycle: NHANES 2005-2014



models adjusted for age group, there was no significant positive linear trend (P = .34) or quadratic trend (P = .95) for men. For women, there was a significant linear trend (P = .02) but no significant quadratic trend (P = .11).

When the model was additionally adjusted for race/Hispanic origin, smoking status, and education, including any significant 2-way interactions, the overall model showed a significant positive linear trend (P = .02) but no significant quadratic trend (P = .27). In sex-specific models for men, there was no significant linear trend (P = .30) or quadratic trend (P = .95). For women, however, there was a significant positive linear trend (P = .004) and a significant positive quadratic trend (P = .048).

Similar analyses were performed for class 3 obesity (**Table 5**). In models that included only age group, there was a significant linear trend overall (P = .02) and for women (P = .03) but not for men (P = .17). For models that were additionally adjusted for age group, race/Hispanic origin, smoking status, and education, there was a significant linear trend overall (P = .01) and for women (P = .01) but not for men (P = .14).

Limited subgroup analyses were performed to further investigate the trends in obesity among women by stratifying separately for age group, smoking status, or race/Hispanic origin. Adjusting for age group, education, and smoking status, there were significant positive linear trends among non-Hispanic white women (P = .03), non-Hispanic black women (P = .008), and Mexican American women (P = .03). Adjusting for race/Hispanic origin, educational status, and smoking status, there were significant positive linear trends for the age group 20 to 39 years (P = .02) and also for 60 years and older (P = .03) but not for the age group 40 to 59 years (P = .20). Adjusting for age group, education, and race/Hispanic origin, there

Table 4. Weighted Associations of Survey Cycle and Obesity Prevalence: 2005-2014[a]

Survey Cycle	Sample Size	Odds Ratios (95% CI)		Predicted Margins, % (95% CI)	
		Adjusted for Age Group	Adjusted for Age Group, Race/Hispanic Origin Group, Smoking Status, and Educational Category	Adjusted for Age Group	Adjusted for Age Group, Race/Hispanic Origin Group, Smoking Status, and Educational Category
All[b,c]					
2005-2006	4356	1 [Reference]	1 [Reference]	34.6 (31.9-37.4)	34.5 (31.7-37.4)
2007-2008	5550	0.97 (0.83-1.13)	0.96 (0.81-1.14)	33.9 (31.8-36.1)	33.6 (31.3-36.0)
2009-2010	5926	1.06 (0.92-1.22)	1.06 (0.91-1.23)	35.9 (34.1-37.7)	35.8 (34.1-37.5)
2011-2012	5181	1.02 (0.86-1.21)	1.04 (0.87-1.25)	35.1 (32.4-37.9)	35.4 (32.8-38.2)
2013-2014	5455	1.15 (1.00-1.33)	1.18 (1.01-1.37)	37.9 (36.2-39.7)	38.1 (36.3-40.0)
Total	26 468				
Men[d]					
2005-2006	2237	1 [Reference]	1 [Reference]	33.5 (29.5-37.7)	33.4 (29.3-37.7)
2007-2008	2746	0.94 (0.75-1.18)	0.94 (0.74-1.20)	32.2 (29.4-35.1)	32.1 (29.1-35.2)
2009-2010	2889	1.10 (0.87-1.39)	1.09 (0.86-1.38)	35.5 (32.2-39.0)	35.3 (32.2-38.6)
2011-2012	2585	1.01 (0.81-1.25)	1.02 (0.82-1.28)	33.7 (31.1-36.4)	33.9 (31.4-36.6)
2013-2014	2638	1.08 (0.88-1.32)	1.08 (0.87-1.34)	35.2 (33.1-37.3)	35.1 (33.1-37.3)
Total	13 095				
Women[e]					
2005-2006	2119	1 [Reference]	1 [Reference]	35.7 (33.0-38.5)	35.6 (33.0-38.3)
2007-2008	2804	0.99 (0.85-1.16)	0.97 (0.83-1.14)	35.5 (33.4-37.7)	35.0 (32.8-37.3)
2009-2010	3037	1.03 (0.89-1.18)	1.02 (0.88-1.18)	36.3 (34.5-38.1)	36.0 (34.2-37.8)
2011-2012	2596	1.04 (0.85-1.26)	1.06 (0.86-1.31)	36.5 (33.0-40.1)	36.9 (33.3-40.7)
2013-2014	2817	1.23 (1.04-1.45)	1.28 (1.08-1.51)	40.5 (37.9-43.2)	41.1 (38.5-43.7)
Total	13 373				

Abbreviation: BMI, body mass index.

[a] BMI was calculated as weight in kilograms divided by height in meters squared. Obese was defined as participants with a BMI of 30 or greater.

[b] All of the models for both sexes combined include sex as a covariate.

[c] Models for both sexes, combined for all covariates, include significant interactions between race/Hispanic origin group and educational category, age group and educational category, race/Hispanic origin group and smoking status, race/Hispanic origin group and sex, educational category and sex, and smoking status and sex.

[d] For men, the model includes an interaction between race/Hispanic origin group and smoking status.

[e] For women, the model includes interactions between age group and educational category, race/Hispanic origin group and educational category, age group and smoking status, and race/Hispanic origin group and smoking status.

were significant positive linear trends for never smokers (P = .03) and for current smokers (P = .01) but not for former smokers (P = .41). Because of the limitations of subgroup analyses,[20,21] these results should be interpreted cautiously.

Discussion

For the years 2013-2014, the unadjusted prevalence of obesity was 35.2% among men and 40.5% among women. Analyses of data from 2013-2014 found that for both sexes, obesity prevalence varied by race/Hispanic origin. For men, obesity prevalence also varied by smoking status, with the prevalence of obesity significantly lower among current smokers than among never smokers. For women, there were no significant differences by smoking status, but those with education beyond high school were significantly less likely to be obese.

In the present analyses, we examined trends in obesity over a decade, beginning with NHANES 2005-2006, and we found no significant effect of survey cycle on the prevalence of obesity among men after adjusting for age group. However, there was a statistically significant positive linear trend in obesity prevalence with survey cycle during this decade among women and after adjustments for age group, race/Hispanic origin, education, and smoking status, there was also a statistically significant quadratic trend. Thus it does not appear that changes in the distribution of these factors explain these trends in obesity prevalence. The increase in obesity prevalence, relative to 2005-2006, was statistically significant in the 2013-2014 data for women. Statistically significant linear trends in the prevalence of class 3 obesity were found for women but not for men after adjustments for age group, race/Hispanic origin, education, and smoking status.

There are several limitations to this study. The definition of obesity used here is based on weight and height and not on measurements of body fatness. Although BMI and body fatness are highly correlated,[22] the trends observed in BMI may not completely parallel trends in body fatness or in health risks. Body fatness at a given BMI may vary by sex, age group, and race-ethnicity.[23] Health risk at a given BMI may also vary by these factors.[24-26] Thus use of different BMI cutoff values for the definitions of risk in Asian populations were recommended in an expert consultation from the World Health Organization.[26] Sample estimates are weighted to reflect

Table 5. Weighted Associations of Survey Cycle and Class 3 Obesity Prevalence: 2005-2014[a]

		Odds Ratios (95% CI)		Predicted Margins, % (95% CI)	
Survey Cycle	Sample Size	Adjusted for Age Group	Adjusted for Age Group, Race/Hispanic Origin Group, Smoking Status, and Educational Category	Adjusted for Age Group	Adjusted for Age Group, Race/Hispanic Origin Group, Smoking Status, and Educational Category
All[b,c]					
2005-2006	4356	1 [Reference]	1 [Reference]	5.9 (5.1-7.0)	5.9 (5.0-6.9)
2007-2008	5550	0.96 (0.76-1.21)	0.96 (0.75-1.22)	5.7 (5.0-6.6)	5.6 (4.8-6.6)
2009-2010	5926	1.07 (0.89-1.30)	1.08 (0.90-1.30)	6.3 (5.9-6.8)	6.3 (5.9-6.8)
2011-2012	5181	1.08 (0.83-1.41)	1.11 (0.85-1.45)	6.4 (5.3-7.7)	6.5 (5.4-7.8)
2013-2014	5455	1.32 (1.02-1.72)	1.36 (1.05-1.77)	7.7 (6.4-9.2)	7.8 (6.5-9.3)
Total	26 468				
Men[d]					
2005-2006	2237	1 [Reference]	1 [Reference]	4.2 (3.3-5.3)	4.2 (3.3-5.3)
2007-2008	2746	1.00 (0.71-1.40)	0.99 (0.70-1.40)	4.2 (3.3-5.2)	4.1 (3.3-5.2)
2009-2010	2889	1.04 (0.78-1.40)	1.04 (0.77-1.41)	4.4 (3.8-5.1)	4.4 (3.8-5.1)
2011-2012	2585	1.05 (0.62-1.76)	1.08 (0.64-1.82)	4.4 (2.8-6.8)	4.5 (2.9-6.9)
2013-2014	2638	1.32 (0.93-1.87)	1.33 (0.93-1.90)	5.5 (4.3-6.9)	5.5 (4.3-6.9)
Total	13 095				
Women[e]					
2005-2006	2119	1 [Reference]	1 [Reference]	7.6 (6.2-9.2)	7.5 (6.2-9.1)
2007-2008	2804	0.94 (0.72-1.24)	0.93 (0.70-1.25)	7.2 (6.1-8.4)	7.1 (5.9-8.5)
2009-2010	3037	1.09 (0.85-1.40)	1.09 (0.86-1.39)	8.2 (7.3-9.2)	8.2 (7.3-9.1)
2011-2012	2596	1.10 (0.83-1.46)	1.12 (0.86-1.46)	8.3 (7.0-9.8)	8.4 (7.2-9.7)
2013-2014	2817	1.32 (0.98-1.79)	1.37 (1.02-1.84)	9.8 (8.1-11.8)	10.0 (8.3-12.0)
Total	13 373				

Abbreviation: BMI, body mass index.

[a] BMI was calculated as weight in kilograms divided by height in meters squared. Class 3 obesity was defined as participants with a BMI of 40 or greater.

[b] All of the models for both sexes combined include sex as a covariate.

[c] Models for both sexes combined include significant interactions between race/Hispanic origin group and educational status and also between race/Hispanic origin group and smoking status.

[d] For men, the model includes interactions between race/Hispanic origin group and educational status and also between educational status and smoking.

[e] For women, the model includes an interaction between race/Hispanic origin group and smoking status.

the US population at a given time, but demographic changes in the population beyond those included in the models could affect the observed trends. Differential sampling error may affect comparisons over time because each time point represents data from a different cross-sectional sample.

Although there has been considerable speculation about the causes of the increases in obesity prevalence, data are lacking to show the causes of these trends, which have been observed in numerous other countries in addition to the United States. Similarly, there are few data to indicate reasons that these trends might accelerate, stop, or slow. A slowing of increases in obesity prevalence has been observed in other countries[27] and among children as well as adults.[28,29] Historically, increases in body weight have occurred over a relatively long time period, but these increases do not necessarily follow a predictable trajectory.[30] The significant quadratic trend seen in the present data suggest a recent increase in obesity among women, in contrast to the previous findings of no significant increases since 2003-2004.

A number of studies have attempted to examine past trends in obesity and make extrapolations to the future for the United States,[31-33] Canada,[34,35] Australia,[36] the United Kingdom,[37] European populations,[38] and globally.[39] However, the results presented here suggest that attempts to extrapolate from past data to possible future trends in obesity prevalence may not provide valid estimates. These attempts are difficult to validate because many of them make projections for the distant future, and even relatively short-term forecasts are not necessarily high in accuracy. Rokholm et al[40] have reviewed the evidence for leveling off in obesity prevalence. Presumably time itself is not the explanatory factor but some other characteristics that might also change with time; however, there is little known about what those characteristics might be.

Conclusions

In this nationally representative survey of adults in the United States, the age-adjusted prevalence of obesity in 2013-2014 was 35.0% among men and 40.4% among women. The corresponding values for class 3 obesity were 5.5% for men and 9.9% for women. For women, the prevalence of overall and class 3 obesity both showed a significant linear trend between 2005 and 2014; there were no significant trends for men. Other studies are needed to determine the reasons for these trends.

ARTICLE INFORMATION

Author Contributions: Dr Flegal had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Flegal.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Flegal, Kruszon-Moran.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: All authors.

Conflict of Interest Disclosures: All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none were reported.

Disclaimer: The findings and conclusions reported in this article are those of the authors and not necessarily of the US Centers for Disease Control and Prevention (CDC).

Additional Information: The National Center for Health Statistics and the CDC had a role in the design and conduct of the National Health and Nutrition Examination Surveys and in the collection and management of the data; however, the National Center for Health Statistics and the CDC had no role in the analysis and interpretation of the data; in the preparation of the manuscript; or in the decision to submit the manuscript for publication.

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