

The Continuing Epidemics of Obesity and Diabetes in the United States

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OBESITY AND DIABETES ARE major causes of morbidity and mortality in the United States.^{1,2} Evidence from several studies indicates that obesity and weight gain are associated with an increased risk of diabetes.^{3,4} Each year, an estimated 300 000 US adults die of causes related to obesity.⁵ Obesity also substantially increases morbidity and impairs quality of life.⁶⁻⁸ Overall, the direct costs of obesity and physical inactivity account for approximately 9.4% of US health care expenditures.⁹ The direct and indirect costs of health care associated with diabetes in 1997 were an estimated \$98 billion.¹⁰

We recently reported that the prevalence of obesity among US adults (body mass index [BMI]; calculated as weight in kilograms divided by the square of height in meters) ≥ 30 kg/m², based on self-reported weight and height, increased from 1991 to 1999, and that the prevalence of diagnosed diabetes based on self-reported data increased from 1990 to 1999.¹¹⁻¹⁴ We used data from the Behavioral Risk Factor Surveillance System (BRFSS) in 2000 to examine whether these increases in obesity and diabetes are continuing, the prevalence of attempting to lose or maintain weight, and the strategies used by the US adults to lose or maintain weight.

Context Recent reports show that obesity and diabetes have increased in the United States in the past decade.

Objective To estimate the prevalence of obesity, diabetes, and use of weight control strategies among US adults in 2000.

Design, Setting, and Participants The Behavioral Risk Factor Surveillance System, a random-digit telephone survey conducted in all states in 2000, with 184 450 adults aged 18 years or older.

Main Outcome Measures Body mass index (BMI), calculated from self-reported weight and height; self-reported diabetes; prevalence of weight loss or maintenance attempts; and weight control strategies used.

Results In 2000, the prevalence of obesity (BMI ≥ 30 kg/m²) was 19.8%, the prevalence of diabetes was 7.3%, and the prevalence of both combined was 2.9%. Mississippi had the highest rates of obesity (24.3%) and of diabetes (8.8%); Colorado had the lowest rate of obesity (13.8%); and Alaska had the lowest rate of diabetes (4.4%). Twenty-seven percent of US adults did not engage in any physical activity, and another 28.2% were not regularly active. Only 24.4% of US adults consumed fruits and vegetables 5 or more times daily. Among obese participants who had had a routine checkup during the past year, 42.8% had been advised by a health care professional to lose weight. Among participants trying to lose or maintain weight, 17.5% were following recommendations to eat fewer calories and increase physical activity to more than 150 min/wk.

Conclusions The prevalence of obesity and diabetes continues to increase among US adults. Interventions are needed to improve physical activity and diet in communities nationwide.

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METHODS

The BRFSS is a cross-sectional telephone survey conducted by the Centers for Disease Control and Prevention and state health departments. The BRFSS questionnaire consists primarily of questions about personal behaviors that increase risk for 1 or more of the 10 leading causes of death in the United States. The BRFSS uses a multistage cluster design based on random-digit dialing methods of sampling to select a representative sample from each state's noninstitutionalized civilian residents aged 18 years or older. Data collected from each state are pooled to produce nationally representative estimates. A detailed descrip-

tion of the survey methods has been previously published.^{15,16}

We used data on self-reported weight and height to calculate BMI. Participants were classified as obese if their BMI was 30 kg/m² or more.¹⁷ Extreme obesity (obesity class III) was classified as a BMI of 40 kg/m² or more.¹⁸ Self-

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reported weight and height were assessed by asking respondents, "About how much do you weigh without shoes?" and "About how tall are you without

shoes?" Diagnosed diabetes was assessed by asking respondents, "Have you ever been told by a doctor that you have diabetes?" The answer was coded "yes" or "no," to parallel the methods in our previous reports, respondents who answered yes include those with gestational diabetes. Classification of diabetes (type 1 or type 2) was not assessed. The questions on self-reported weight and height and self-reported diabetes did not change from 1991 to 2000.

Participants were asked to report the type, duration, and frequency of the 2 leisure-time physical activities they had participated in most frequently in the past month. These questions were used to create a leisure-time physical activity score: (1) inactive; (2) irregularly active; (3) regular, not intense; and (4) regular, intense.¹⁹

Respondents were asked, "Are you trying to lose weight?" Those who responded "no" were asked, "Are you trying to maintain weight?" Respondents who answered "yes" to either question were asked the following: (1) "Are you trying to eat fewer calories or less fat to lose weight?", (2) "Are you using physical activity or exercise to lose weight or keep from gaining weight?", and (3) "In the past 12 months, has a doctor, nurse, or health professional given you advice about your weight?"

The 2000 BRFSS questionnaire included the fruit and vegetable module. We used these questions to classify participants into 4 groups based on fruit and vegetable daily consumption: (1) less than once or not at all, (2) 1 to less than 3 times, (3) 3 to less than 5 times, and (4) 5 or more times.

To account for the complex sampling design, SAS and SUDAAN software programs were used in the analyses.^{20,21}

RESULTS

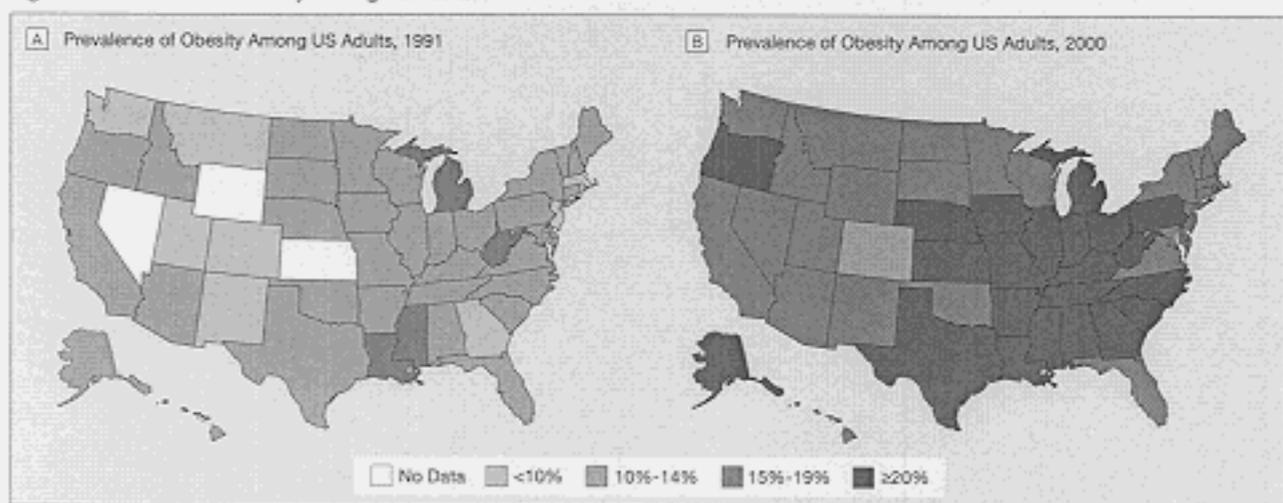
The 2000 BRFSS is based on responses from 184 450 participants in 50 states. In 2000, the prevalence of obesity was 19.8% among US adults (TABLE 1), which reflects a 61% increase since 1991.¹¹ A total of 38.8 million US adults were obese (19.6 million men and 19.2 million women), and approximately 2.1% (1.5% of men and 2.8% of women) of all participants had a BMI of 40 kg/m² or more, compared with 0.9% in 1991 (data available from the author). In 2000, most US adults—approximately 56.4% (65.5% of men and 47.6% of women) of all participants—were overweight (BMI \geq 25 kg/m²), compared with 45% in 1991 (data available from the author).

In 1991, 4 of the participating states had obesity rates of 15% or greater, whereas by 2000, all participating states

Table 1. Obesity and Diabetes Prevalence Among US Adults, by Selected Characteristics, Behavioral Risk Factor Surveillance System, 2000

	Obesity, % (SE)	Diabetes, % (SE)
Total	19.8 (0.17)	7.3 (0.12)
Sex		
Male	20.2 (0.26)	6.5 (0.18)
Female	19.4 (0.21)	8.2 (0.15)
Age groups, y		
18 - 29	13.5 (0.33)	1.9 (0.13)
30 - 39	20.2 (0.36)	3.8 (0.18)
40 - 49	22.9 (0.41)	5.8 (0.27)
50 - 59	25.6 (0.47)	10.9 (0.37)
60 - 69	22.9 (0.50)	14.5 (0.44)
\geq 70	15.5 (0.41)	14.9 (0.42)
Race		
White	18.5 (0.17)	6.6 (0.11)
Black	29.3 (0.59)	11.1 (0.39)
Hispanic	23.4 (0.77)	8.9 (0.59)
Other	12.0 (0.68)	6.7 (0.65)
Education levels		
Less than high school	26.1 (0.62)	12.9 (0.51)
High school	21.7 (0.30)	7.6 (0.19)
Some college	19.5 (0.31)	6.7 (0.20)
College degree and higher	15.2 (0.26)	5.2 (0.17)
Smoking status		
Never	19.9 (0.23)	6.6 (0.15)
Ex-smoker	22.7 (0.35)	10.2 (0.26)
Current	16.3 (0.35)	5.9 (0.27)

Figure 1. Prevalence of Obesity Among US Adults



except Colorado had rates of obesity of 15% or greater (FIGURE 1 and TABLE 2). In 1991, none of the participating states had obesity rates of 20% or greater; however, by 2000, 22 of the participating states had rates of obesity of 20% or greater. In 2000, Mississippi had the highest (24.3%) and Colorado had the lowest (13.8%) rate of obesity. Among races, blacks had the highest rate of obesity (29.3%) (Table 1).

The prevalence of a self-report of diagnosed diabetes increased from 4.9% in 1990¹³ to 7.3% in 2000 (Table 1), a 49% increase. In 2000, approximately 15 million US adults aged 18 years or older had diagnosed diabetes (6.3 million men and 8.7 million women). In 1990, 4 states had diabetes rates of 6% or greater, whereas by 2000, 43 of the 50 participating states had diabetes rates of 6% or greater (FIGURE 2). In 2000, Mississippi had the highest rate (8.8%) and Alaska had the lowest rate (4.4%) of diagnosed diabetes. Blacks had the highest rate of diagnosed diabetes (11.1%) among all race groups, and participants with less than a high school education had the highest rate (12.9%) among the educational levels (Table 1). In 2000, 2.9% of US adults both were obese and had diabetes, compared with 1.4% in 1991 (data available from the author).

Weight control practices varied by BMI. While most participants were trying to lose or maintain weight, 20.1% of overweight participants and 13.5% of obese participants were not trying to lose or maintain weight (TABLE 3). About 27% of US adults did not engage in any physical activity, and another 28.2% were not regularly active. Only 24.4% of US adults ate fruits and vegetables at least 5 times a day. Among obese participants who were trying to lose weight, only 42.8% had been advised to lose weight by a health professional, and 15.6% of overweight participants had received such advice.

Among participants who were trying to lose or maintain weight, 72.9% reported dieting, and 59.5% were increasing physical activity (TABLE 4).

However, among participants attempting to lose or maintain weight, only 17.5% were following the 2 key recommendations: to eat fewer calories and to increase physical activity. Similarly, only 24.9% of these participants were consuming the recommended 5 servings of fruits and vegetables, while 40.6% were achieving the recommended physical activity levels (30 minutes of moderate activity 5 times/wk).

COMMENT

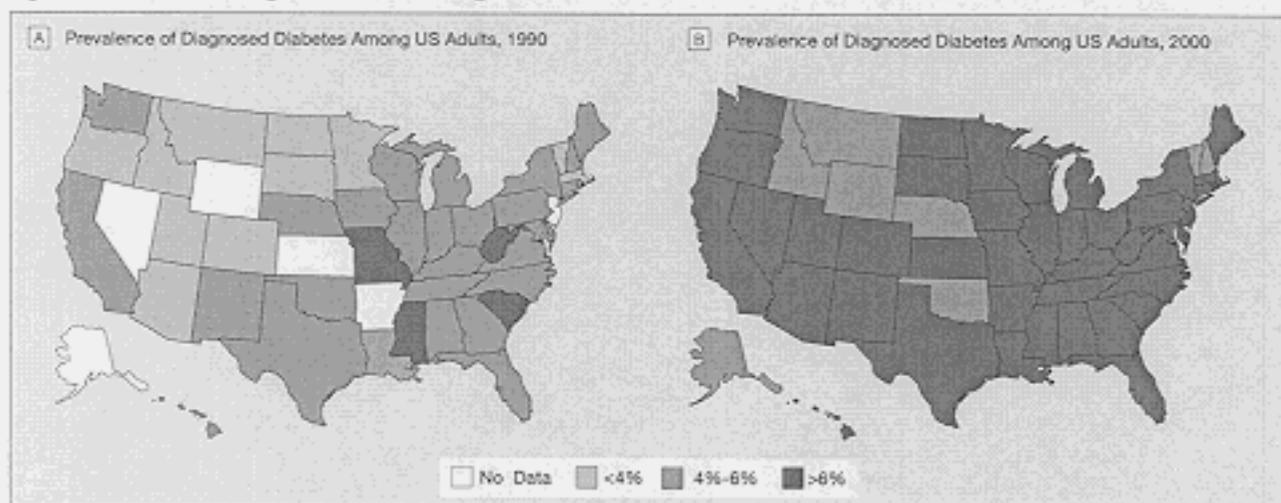
During the 1990s, epidemics of obesity and diabetes developed among US adults. Our current findings indicate that most US adults (>56%) are overweight, about 1 in 5 is obese, and 7.3% have diabetes. However, if undiagnosed diabetes is considered, it is likely that almost 10% of US adults have diabetes based on a previous report that estimated the prevalence of diagnosed diabetes in 1988-1994 to be 5.1% for US adults aged 20 years or older; in this study, the prevalence of undiagnosed diabetes was 2.7%.²²

Our estimates of the extent of the 2 epidemics of obesity and diabetes in US adults are conservative. In validation studies of self-reported weight and height, overweight subjects tend to underestimate their weight, and all participants tend to overestimate their height.²³⁻²⁵ Moreover, persons without telephones are likely to be of lower socioeconomic status, a factor associated with increased risk for both obesity and diabetes.^{22,26}

Both BMI and weight gain are major risk factors for diabetes.^{27,28} Body mass index is one of the strongest predictors of diabetes, and previous studies have shown that changes in BMI at the population level foreshadow changes in diabetes.^{3,4,29-32} For every 1-kg increase in measured weight, the risk of diabetes increased by 4.5% in a national sample of adults.³ In our previous BRFSS analysis for 1991-1998, every 1-kg increase in average self-reported weight was associated with a 9% increase in the prevalence of diabetes.¹³ From 1999 to 2000, the average weight of US adults increased by 0.5

Table 2. Obesity and Diabetes Prevalence Among US Adults, by State, Behavioral Risk Factor Surveillance System, 2000

	Obesity, % (SE)	Diabetes, % (SE)
Total	19.8 (0.17)	7.3 (0.12)
State		
Alabama	23.5 (1.09)	8.0 (0.64)
Alaska	20.5 (1.26)	4.4 (0.68)
Arizona	18.8 (1.50)	7.4 (1.14)
Arkansas	22.6 (0.90)	6.9 (0.52)
California	19.2 (0.79)	8.4 (0.63)
Colorado	13.8 (0.89)	6.0 (0.64)
Connecticut	16.9 (0.71)	6.3 (0.42)
Delaware	16.2 (0.90)	6.9 (0.66)
District of Columbia	21.2 (1.13)	7.3 (0.72)
Florida	18.1 (0.63)	7.9 (0.42)
Georgia	20.9 (0.81)	7.7 (0.48)
Hawaii	15.1 (0.69)	6.4 (0.40)
Idaho	18.4 (0.65)	5.7 (0.38)
Illinois	20.9 (0.78)	7.3 (0.49)
Indiana	21.3 (0.87)	6.9 (0.50)
Iowa	20.8 (0.82)	6.7 (0.48)
Kansas	20.1 (0.71)	6.9 (0.44)
Kentucky	22.3 (0.76)	6.9 (0.42)
Louisiana	22.8 (0.70)	7.4 (0.41)
Maine	19.7 (1.00)	6.9 (0.61)
Maryland	19.5 (0.76)	8.0 (0.51)
Massachusetts	16.4 (0.52)	7.3 (0.35)
Michigan	21.8 (0.93)	7.6 (0.54)
Minnesota	16.8 (0.80)	6.1 (0.50)
Mississippi	24.3 (1.10)	8.8 (0.65)
Missouri	21.6 (0.92)	7.2 (0.55)
Montana	15.2 (0.83)	5.5 (0.50)
Nebraska	20.6 (0.87)	5.4 (0.47)
Nevada	17.2 (1.29)	7.1 (1.04)
New Hampshire	17.1 (1.04)	5.0 (0.53)
New Jersey	17.6 (0.75)	6.7 (0.44)
New Mexico	18.8 (0.77)	7.1 (0.52)
New York	17.2 (0.76)	7.7 (0.54)
North Carolina	21.3 (0.87)	7.3 (0.49)
North Dakota	19.8 (1.04)	6.3 (0.62)
Ohio	21.0 (1.04)	7.5 (0.64)
Oklahoma	19.0 (0.75)	5.8 (0.42)
Oregon	21.0 (0.79)	6.9 (0.48)
Pennsylvania	20.7 (0.81)	7.6 (0.53)
Rhode Island	16.8 (0.72)	7.4 (0.49)
South Carolina	21.5 (0.82)	8.5 (0.56)
South Dakota	19.2 (0.65)	6.3 (0.38)
Tennessee	22.7 (0.92)	7.6 (0.57)
Texas	22.7 (0.72)	7.1 (0.40)
Utah	18.5 (0.99)	6.7 (0.61)
Vermont	17.7 (0.71)	5.6 (0.44)
Virginia	17.5 (0.97)	6.6 (0.74)
Washington	18.5 (0.74)	6.1 (0.43)
West Virginia	22.8 (0.96)	7.9 (0.57)
Wisconsin	19.4 (0.86)	6.2 (0.52)
Wyoming	17.6 (0.90)	5.5 (0.52)

Figure 2. Prevalence of Diagnosed Diabetes Among US Adults**Table 3.** Percentage of US Adults Who Use Specific Weight Control Practices by Body Mass Index, Behavioral Risk Factor Surveillance System, 2000*

	Total, % (SE)	Body Mass Index, % (SE)		
		Normal	Overweight (≥ 25 kg/m ²)	Obese (≥ 30 kg/m ²)
Weight control practices				
Trying to lose weight	38.5 (0.21)	20.7 (0.25)	45.0 (0.36)	65.7 (0.46)
Trying to maintain weight	35.9 (0.20)	43.6 (0.31)	34.9 (0.34)	20.8 (0.38)
Neither	25.6 (0.19)	35.7 (0.30)	20.1 (0.29)	13.5 (0.35)
Physical activity				
Inactive	27.0 (0.19)	23.8 (0.27)	26.0 (0.33)	35.6 (0.47)
Irregularly active	28.2 (0.19)	27.8 (0.28)	28.7 (0.32)	28.1 (0.43)
Regular, not intense	30.5 (0.19)	31.6 (0.29)	31.1 (0.33)	27.2 (0.42)
Regular, intense	14.3 (0.14)	16.8 (0.23)	14.2 (0.25)	9.1 (0.27)
Fruit and vegetable intake, No. of servings/d				
<1	4.0 (0.09)	3.9 (0.13)	3.5 (0.13)	5.2 (0.29)
1 to <3	33.1 (0.20)	31.0 (0.29)	34.1 (0.34)	35.7 (0.45)
3 to <5	38.5 (0.20)	38.3 (0.30)	39.1 (0.35)	38.0 (0.46)
≥ 5	24.4 (0.18)	26.8 (0.28)	23.3 (0.30)	21.1 (0.38)
Professional advice on weight*				
Loss	17.3 (0.21)	3.3 (0.16)	15.6 (0.34)	42.8 (0.57)
Gain	1.0 (0.06)	1.7 (0.12)	0.6 (0.08)	0.4 (0.09)
Maintain	2.7 (0.10)	3.2 (0.16)	2.8 (0.17)	1.9 (0.14)
None	79.0 (0.23)	91.8 (0.25)	81.0 (0.37)	54.9 (0.57)

*Questions were asked only to participants trying to lose or maintain weight; percentages are for persons who had had a routine checkup in the previous 12 months.

kg (data available from the author), and the prevalence of diagnosed diabetes increased by about 6%.³⁴

Both obesity and diabetes are largely preventable. Previous studies have demonstrated that changes in lifestyle are effective in preventing diabetes and obesity in selected groups of

adults who are at high risk.³³⁻³⁵ In a recent clinical trial from Finland, lifestyle changes significantly reduced the risk of diabetes in middle-aged, overweight subjects.³⁵ After a modest (4.7%) weight loss, those in the intervention group had a 58% reduction in incidence of diabetes over 4 years.³⁵

Moreover, blood pressure, triglycerides, and high-density lipoprotein cholesterol levels also improved significantly.³⁵ Therefore, increasing physical activity, improving diet, and sustaining these lifestyle changes can reduce the risk of both diabetes and increased weight.

The weight-related behaviors of US adults are clearly linked to these continuing epidemics. We found that 27.0% of US adults in 2000 did not engage in any leisure-time physical activity, and another 28.2% were not regularly active. These rates are similar to those reported for 1998 (28.6% inactive and 28.2% irregularly active).¹¹ In 2000, 38.5% of US adults were trying to lose weight, 35.9% were trying to maintain weight, and 25.6% were doing neither. In 1996, these rates were 36.6%, 34.4%, and 29.0%.³⁶ Furthermore, only 24.4% of US adults met recommendations for fruit and vegetable consumption in 2000 vs 22.7% in our previous report on BRFSS participants from 16 states in 1996.³⁷

Strategies that US adults use to lose or maintain weight contribute to their failure to achieve their weight control objectives. In 2000, 72.9% of US adults reported that they had changed their diet to achieve their weight goal, and 59.5% reported that they had increased their physical activity.³⁶

These rates have not changed substantially since 1996. Furthermore, in the year 2000, only 17.5% of US adults were following guidelines for increasing physical activity and lowering energy intake. Although this percentage has increased from 15.0% in 1996, it is still far below what will be needed to attain goals for healthy weight.

Our finding that only 42.8% of obese persons who had had a routine checkup in the past year had been advised by health care professionals to lose weight is disturbing. In 1996, this percentage was 42.4%, which prompted a call for physicians to be more involved in weight counseling.^{38,39} Persons who receive advice from a health care professional to lose weight are more likely to attempt to lose weight than those who do not receive this advice.³⁸ Health care

professionals should assess overweight and obesity and recommend weight loss (using the combination of a low-calorie diet and increased physical activity) to overweight and obese patients and weight maintenance to patients with normal weight.¹⁸

While overweight and obese individuals need to reduce their energy intake and increase their physical activity, many others must play a role to help these individuals and to prevent further increases in obesity and diabetes. That is, health care professionals must counsel their overweight and obese patients; workplaces must offer healthy food choices in their cafeterias and provide opportunities for employees to be physically active on site; schools must offer more physical education that encourages lifelong physical activity; urban policymakers

must provide more sidewalks, bike paths, and other alternatives to cars; and parents need to reduce their children's television and computer time and encourage active play. In general, restoring physical activity to our daily routines is crucial to the future reduction of diabetes and obesity in the US population.

Unfortunately, the prevalence of obesity and diabetes has increased despite previous calls for action⁴⁰; it is likely to continue to increase in the years ahead unless effective interventions are implemented. In the past 25 years, several promising approaches have been identified as targets for clinical and public health action. To control these dual epidemics, now is the time for implementing multicomponent interventions for weight control, healthy eating, and physical activity.

Table 4. Prevalence of Specific Weight Control Practices by Selected Characteristics Among Persons Trying to Lose or Maintain Weight, Behavioral Risk Factor Surveillance System, 2000*

	Diet	Fruits and Vegetables ≥5 Servings per Day	Physical Activity	Physical Activity (≥150 min/wk)	Diet Plus Physical Activity (≥150 min/wk)
Total	72.9 (0.21)	24.9 (0.21)	59.5 (0.23)	40.6 (0.23)	17.5 (0.18)
Sex					
Male	68.0 (0.36)	20.0 (0.31)	60.8 (0.38)	45.0 (0.38)	17.9 (0.29)
Female	76.8 (0.25)	28.9 (0.28)	58.6 (0.29)	37.0 (0.29)	17.1 (0.23)
Age groups, y					
18-29	66.8 (0.55)	21.4 (0.50)	72.3 (0.52)	45.4 (0.58)	17.3 (0.44)
30-39	71.6 (0.45)	21.1 (0.42)	64.5 (0.49)	40.7 (0.50)	17.4 (0.40)
40-49	75.1 (0.46)	23.4 (0.44)	61.2 (0.51)	38.9 (0.50)	17.5 (0.38)
50-59	77.6 (0.49)	25.7 (0.50)	56.3 (0.58)	39.3 (0.57)	18.9 (0.46)
60-69	77.2 (0.58)	30.0 (0.64)	49.5 (0.69)	40.6 (0.68)	18.4 (0.53)
≥70	70.8 (0.65)	35.2 (0.68)	38.5 (0.69)	36.6 (0.69)	14.7 (0.51)
Race					
White	72.3 (0.23)	24.9 (0.22)	60.4 (0.25)	42.0 (0.25)	18.2 (0.20)
Black	75.0 (0.70)	22.3 (0.66)	57.5 (0.77)	34.7 (0.75)	16.2 (0.62)
Hispanic	76.5 (0.78)	25.3 (0.84)	55.3 (0.95)	36.1 (0.91)	14.9 (0.68)
Other	68.7 (1.40)	30.2 (1.42)	62.0 (1.42)	41.6 (0.18)	15.2 (0.98)
Education levels					
Less than high school	70.7 (0.73)	22.2 (0.69)	42.3 (0.80)	25.8 (0.70)	9.8 (0.47)
High school	73.3 (0.39)	21.4 (0.35)	54.4 (0.43)	35.7 (0.41)	15.2 (0.31)
Some college	73.7 (0.40)	25.6 (0.40)	62.0 (0.43)	43.9 (0.45)	18.9 (0.36)
College degree and higher	72.5 (0.37)	28.8 (0.38)	69.1 (0.38)	48.2 (0.41)	21.3 (0.34)
Weight categories					
Normal BMI	65.1 (0.37)	27.8 (0.35)	61.0 (0.38)	44.8 (0.36)	16.2 (0.29)
Overweight (≥25 kg/m ²)	74.6 (0.36)	23.9 (0.35)	61.2 (0.39)	42.2 (0.40)	18.8 (0.31)
Obese (≥30 kg/m ²)	81.3 (0.39)	21.5 (0.42)	55.7 (0.51)	33.1 (0.48)	17.6 (0.39)
Smoking status					
Never	73.6 (0.29)	26.9 (0.30)	62.3 (0.32)	40.5 (0.32)	17.5 (0.25)
Ex-smoker	75.1 (0.41)	25.9 (0.40)	58.5 (0.46)	43.9 (0.46)	20.0 (0.37)
Current	68.1 (0.50)	18.0 (0.41)	53.1 (0.53)	36.4 (0.51)	14.0 (0.36)

*All values are expressed as percentage (SE).

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Analysis and interpretation of data: Mokdad, Bowman, Ford, Vincoor, Marks, Koplan.

Drafting of the manuscript: Mokdad, Bowman, Ford, Vincoor, Marks, Koplan.

Critical revision of the manuscript for important intellectual content: Mokdad, Bowman, Ford, Vincoor, Marks, Koplan.

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