

Health Characteristics of U.S. Adults by Body Mass Index Category: Results from NHANES 1999–2002

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SYNOPSIS

Objectives. We examined self-reported health characteristics, health care utilization, activity patterns, and demographic characteristics of U.S. adults 20 years and over by body mass index (BMI) category. We hypothesized that overweight and obese adults would report fair/poor health more often, report more health provider visits annually, experience more joint pain, report greater limitations in their daily activities, and report more hours of sedentary leisure-time activity than normal-weight adults.

Methods. Self-reported health characteristics of U.S. adults from the National Health and Nutrition Examination Survey (NHANES) 1999–2002 were examined for three BMI categories: normal weight (BMI 18.5–24.9), overweight (BMI 25.0–29.9), and obese (BMI \geq 30.0). Covariates included gender, race/ethnicity, cigarette smoking, and educational attainment. We examined BMI group differences using descriptive and regression methods.

Results. Compared to normal-weight individuals, overweight individuals reported fair/poor health more often, more limitations in daily activities, and more health provider contacts. Overweight and obese subjects reported more hours of television watching and video game use compared to normal-weight subjects.

Conclusion. Our findings are useful to describe the health characteristics of U.S. adults and may be used to anticipate future demand for health services and to support intervention programs that help individuals achieve desirable weight status.

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National health examination surveys conducted by the National Center for Health Statistics (NCHS) have documented the rising prevalences of overweight and obesity among U.S. adults.¹ The National Health and Nutrition Examination Survey (NHANES) 1999–2002 age-adjusted prevalence estimates for overweight and obesity among U.S. adults 20 years of age and over were 64.5% for overweight or obese and 30.5% for obesity.¹ Higher prevalences of overweight and obesity occurred among males, females, and oversampled race/ethnicity groups during NHANES 1999–2002 compared to NHANES III, 1988–1994. Overweight and obesity constitute a major public health problem, with enormous financial and economic consequences.^{2,3}

The economic impacts of overweight include reduced worker productivity,⁴ higher rates of work absenteeism,^{4,5} and higher health care utilization and expenditures.^{6–8} In 1998, aggregate overweight- and obesity-attributable spending accounted for an estimated \$78.5 billion or approximately 9.1% of total U.S. health care expenditures; today this figure is closer to \$90 billion.⁶ Health expenditures associated with overweight and obesity vary according to race/ethnicity and age with the strongest relationship between health care costs and higher BMI occurring among non-Hispanic whites and older adults.⁹ From a public health perspective, obesity is also a major contributor to mortality among U.S. adults. Obesity contributes to lower life expectancy, particularly among younger adults aged 20–30 years compared to adults over 60 years of age.¹⁰

The adverse health outcomes associated with overweight and obesity include increased risk of cardiovascular disease, type 2 diabetes, sleep apnea, gallbladder disease, and some types of cancer.^{11,12} Previous research examined the associations between overweight and obesity and health-related quality of life (HRQOL), a measure of the impact of illness and treatment on functional status, mental health, and general well-being.^{13–17} Data from the 2000 Behavioral Risk Factor Surveillance System (BRFSS) for adults 18 years and over showed that obesity, but not overweight, was associated with lower HRQOL scores, more activity limitations, and unhealthy days for physical and mental health.¹⁵ Results from a large community-based study of treatment-seeking and non-seeking overweight/obese adults 19–90 years reported greater impairment with increasing BMI.¹⁴ Although information about pain was not collected in the study, the authors hypothesized that pain conditions influenced the degree of impairment as reported elsewhere.¹⁸ The NHANES provides a rich data source to examine conditions related to overweight and obesity. The survey collects population-based, cross-sectional data on measured and self-reported health characteristics of the

general population and major subgroups such as non-Hispanic blacks and Mexican Americans as well as extensive information on comorbid conditions and pain.

Our analysis examined self-reported health and lifestyle characteristics of U.S. adults by BMI category. We hypothesized that overweight and obese adults have a higher prevalence of fair/poor health, utilize health care services more often, experience more joint pain, and report greater limitations in their daily activities than normal-weight adults. We hypothesized that sedentary lifestyle is associated with overweight and obesity and that differences in sedentary behavior among the BMI groups would be observed.

METHODS

Study design

The NHANES is conducted to assess the health and nutritional status of the civilian, noninstitutionalized U.S. population.¹⁹ Prior to 1999, the NHANES was conducted periodically; the survey became a continuous program in 1999. Nationally representative samples are selected annually using a complex, stratified, multistage probability cluster sampling design; public data files are released biannually.²⁰ Non-Hispanic blacks, Mexican Americans, adolescents 12–19 years of age, adults 60 years of age and over, pregnant women, and people with low incomes were oversampled to obtain more reliable statistical estimates.

Detailed descriptions of the sample design, data collection methods, and protocols are posted on the NHANES website.²⁰ Standardized household interview and health examination methods were used to collect all data. The NCHS Ethics Review Board approved the survey protocols and informed consent was obtained from all subjects.

Subjects

The data used in this study were collected between 1999 and 2002. A total of 10,291 subjects 20 years and over completed the household interview component; of these, 9,471 (92%) were examined in the NHANES mobile examination centers. Pregnant women ($n=582$), subjects who did not have measured body mass index (BMI) data ($n=384$), and subjects defined as underweight using a BMI criterion of $<18.5 \text{ kg/m}^2$ ($n=144$) were excluded from the analysis. The final analytic sample consisted of 8,361 subjects.

Variables

The analytic covariates included the demographic variables of age, gender, race/ethnicity, and educational attainment. Subjects were categorized into four race/

ethnicity groups: non-Hispanic white, non-Hispanic black, Mexican-American, and other races.²⁰ The “other” race category included American Indians, Alaskan Natives, Asians, Pacific Islanders, and Hispanics who were not of Mexican American origin; separate results for this group are not shown. Educational attainment was categorized using the same categories used to report educational attainment information in NHANES 1999–2002: less than high school education, high school diploma/GED, or more than high school.¹⁹ Income information was not available for approximately 10% of the analytic sample. Educational attainment is associated with family income and was used in place of income in this analysis.²¹ Subjects were placed in three age groups: 20 to 39 years, 40 to 59 years, and 60 years and over. The age groups are consistent with the NHANES 1999–2002 sample design and analytic guideline recommendations.²² BMI (kg/m^2) was calculated from measured height and weight. A BMI of 18.5–24.9 was defined as normal, 25.0–29.9 was defined as overweight, and 30.0 or more was considered obese.³

Health-related covariates were taken from the household interview component. We included cigarette smoking status because smoking status is related to BMI status in adults and because tobacco use is associated with poorer quality health status.²³ A current cigarette smoker was defined as anyone who reported smoking at least 100 cigarettes in their lifetime and currently smokes cigarettes. A former smoker was defined as anyone smoking at least 100 cigarettes in their lifetime who reported that they no longer smoked cigarettes.

Self-reported health status and use of health care services were also obtained from the household interview. Subjects were asked about their overall health during the past 12 months. The response choices “excellent” and “very good” were combined, as were the responses given as “fair” or “poor.” Health care utilization was defined as the number of times the subject had seen a doctor or other health care professional in the past 12 months. We recoded the “no visit” and “1 visit” response categories in the original question as 1 or fewer visits and 10–12 and 13 or more visits as 10 or more times, based on preliminary analyses showing insignificant differences in the categories and the desire to have sufficient sample sizes in each group.

Sedentary behavior was assessed using self-reported interview information. Subjects estimated the number of hours per day spent watching television and the number of hours of computer and computer game use (outside of work) during the past 30 days. The combined total hours spent in these activities were recoded in two categories: 0–2 hours or 3 or more hours per day.

A categorical variable for limitation in daily activities was derived from responses to two questions. The first question asked whether any physical, mental, or emotional problem(s) kept the subject from working at a job or business, and the second question asked whether the subject was limited in any way because of a physical, mental, or emotional problem. A subject who answered affirmatively to either or both questions was classified as having a limitation in their daily activities. A subject who answered both questions negatively was considered not to have a limitation. The survey questionnaire includes a series of questions on joint pain, aching, and stiffness, and separate questions on low back pain. The percentages of individuals with joint pain, aching, or stiffness (any type), and with low back pain were compared by BMI group. Self-reported breathing problems associated with walking at an ordinary pace and while walking on an incline were assessed. Percentages of persons reporting shortness of breath for both scenarios were compared by BMI group.

Statistical analysis

SAS computer software²⁴ was used for data management and SUDAAN²⁵ was used for the statistical analyses. All estimates were weighted using the examination sample weights, which account for unequal probabilities of selection, person-level non-response, and a post-stratification adjustment to the estimated U.S. population. Standard errors were calculated using SUDAAN by the Taylor series linearization method.^{25,26} A survey design-consistent chi-square method was used for testing hypothesis of no association between the categorical variables and BMI groups and *p*-values for the chi-squares were examined to determine statistical significance. Crude and adjusted odds ratios were used to examine the relationship between health outcomes and BMI category. Logistic regression was used to compute the adjusted odds ratio; a generalized multinomial logit model was used for dependent variables with more than two outcomes. The logistic models controlled for age, gender, race-ethnicity, education level, and cigarette smoking. A *p*-value of <0.05 was used to define statistical significance.

RESULTS

Sample sizes and weighted sample characteristics are shown in Table 1. Chi-square analyses revealed that higher percentages of males were overweight compared to females (41.8% vs. 29.3%; $p<0.001$). Overall, significantly higher percentages of female subjects were obese compared to male subjects (34.0% vs. 27.2%; $p<0.001$). The prevalence of overweight increased with

Table 1. Demographic characteristics by body mass index category for U.S. adults 20 years and over, NHANES 1999–2002

	n	Body mass index (kg/m ²) category			p-value
		18.5–24.9	25.0–29.9	≥30.0	
Total	8,361	33.9 (0.8)	35.4 (0.8)	30.6 (0.9)	
Gender					<0.001
Male	4,209	31.1 (0.9)	41.8 (1.0)	27.2 (0.9)	
Female	4,152	36.7 (1.2)	29.3 (1.2)	34.0 (1.2)	
Age group					<0.001
20–39	2,697	41.1 (1.1)	32.7 (1.3)	26.2 (1.0)	
40–59	2,712	30.1 (1.4)	36.1 (1.0)	33.8 (1.6)	
60 and over	2,952	28.3 (1.2)	39.0 (1.3)	32.7 (1.2)	
Race/ethnicity ^a					<0.001
Non-Hispanic white	4,061	35.0 (1.1)	34.9 (0.9)	30.0 (1.1)	
Non-Hispanic black	1,647	28.8 (1.0)	31.8 (1.4)	39.4 (1.3)	
Mexican American	2,014	29.9 (1.7)	39.1 (1.1)	31.0 (1.7)	
Education					<0.001
Less than high school	2,888	28.5 (1.4)	38.5 (1.4)	33.0 (1.5)	
High school	1,931	32.7 (1.5)	34.0 (1.5)	33.3 (1.3)	
More than high school	3,526	36.8 (1.1)	34.8 (1.1)	28.4 (1.2)	

^aOther races excluded

age; differences were observed in the prevalence of overweight between subjects 20–29 years and those 60 years and over (32.7% vs. 30.0%; $p<0.001$). The percentage of obese adults increased between ages 20–39 years and 40–59 years; 20–39 year olds differed from the other two age groups ($p<0.001$). Overall, Mexican Americans had the highest percentage of overweight subjects (39.1%) while non-Hispanic blacks had the highest prevalence of obesity (39.4%).

Chi-square analysis demonstrated statistically significant differences in all self-reported health, lifestyle characteristics, health symptoms, and health care utilization among the BMI categories (Table 2). For example, in the normal-weight group, 63.1% reported excellent/very good health compared to 39.8% of obese subjects ($p<0.001$). Cigarette smoking was more prevalent in the normal-weight group (29%) compared to the overweight (23.2%) and obese (20.3%) groups ($p<0.001$). Approximately 54% of obese subjects reported joint pain and stiffness symptoms as compared to 37% in the normal-weight group. Low back pain was reported by 44.5% of obese subjects compared to 33.4% of normal-weight subjects. Responses to a general question about limitations in daily activities revealed that approximately 24% of obese subjects experienced limitations in the daily activities compared to 13.2% of normal-weight and 14.7% of overweight subjects.

Age-stratified results on general health status and joint pain, aching, and swelling showed the preva-

lence of excellent/very good health decreased with increased age and BMI (Figure 1). Obese subjects consistently reported overall excellent or very good health less often than their normal- or overweight counterparts. Joint pain symptoms were also associated with age and BMI (Figure 2). Within age groups, lower percentages of obese subjects were symptom-free compared to overweight and normal-weight subjects.

The logistic regression analyses examined the odds of specific outcomes by BMI category; the normal BMI group served as the reference group. Table 3 includes unadjusted and adjusted odds ratios for self-reported and measured health characteristics. The adjusted model controlled for gender, age group, race/ethnicity, education, and cigarette smoking. The odds of excellent/very good health vs. fair/poor health among obese adults was about 0.3 that of normal-weight persons ($p<0.001$; 95% confidence interval [CI] 0.3, 0.4). Limitations in daily activities were 1.9 times more likely among obese adults compared to normal-weight adults ($p<0.001$; 95% CI 1.5, 2.3) and the likelihood of having 10 or more health provider visits vs. one or fewer was 0.6 times that of normal-weight persons ($p<0.001$; 95% CI 0.4, 0.8).

DISCUSSION

Increasing BMI was associated with decreased likelihood of self-reported excellent/very good general health among adults, particularly in adults 60 years of

Table 2. Self-reported health characteristics by body mass index category, U.S. adults 20 years and over, NHANES 1999–2002

	n	Body mass index (kg/m ²) category			p-value
		18.5–24.9	25.0–29.9	≥30.0	
		Percent (standard error)			
Cigarette smoking status					<0.001
Never smoked	4,277	50.3 (1.6)	49.0 (1.5)	52.1 (1.7)	
Former smoker	2,238	20.8 (1.0)	27.8 (1.3)	27.6 (1.3)	
Current smoker	1,833	29.0 (1.5)	23.2 (1.0)	20.3 (1.1)	
Self-reported health					<0.001
Excellent/very good	3,775	63.1 (1.3)	57.2 (1.6)	39.8 (1.0)	
Good	2,664	25.0 (1.1)	28.5 (1.1)	36.6 (1.1)	
Fair/poor	1,915	11.9 (0.7)	14.3 (0.9)	23.5 (1.0)	
Health care utilization (number of visits)					<0.001
0–1	3,003	39.9 (1.2)	40.7 (1.2)	30.6 (1.3)	
2–3	2,232	28.9 (1.1)	27.1 (0.8)	26.7 (1.2)	
4–9	1,975	20.1 (1.1)	20.4 (1.1)	27.4 (1.1)	
≥10	1,145	11.1 (0.8)	11.8 (0.7)	15.2 (1.2)	
Limitation in daily activities?					<0.001
Yes	1,491	13.2 (1.1)	14.7 (0.8)	24.1 (1.0)	
No	6,534	86.8 (1.1)	85.3 (0.8)	75.9 (1.0)	
Joint pain/aching/stiffness (past year)?					<0.001
Yes	3,665	37.1 (1.0)	43.6 (1.3)	54.3 (1.0)	
No	4,692	62.9 (1.1)	56.4 (1.3)	45.7 (1.0)	
Shortness of breath on walking on an incline? ^a					<0.001
Yes	1,976	25.4 (1.8)	29.2 (1.5)	46.9 (1.8)	
No	3,674	74.6 (1.8)	70.8 (1.5)	53.1 (1.8)	
Low back pain (past 3 months)?					<0.001
Yes	3,122	33.4 (0.9)	39.0 (0.9)	44.5 (1.5)	
No	5,237	66.6 (0.9)	61.0 (0.9)	55.5 (1.5)	
Number hours of TV or video games per day					<0.001
Less than 3	4,613	62.9 (1.2)	58.2 (1.1)	48.6 (1.3)	
3 or more	3,736	37.1 (1.2)	41.8 (1.1)	51.4 (1.3)	

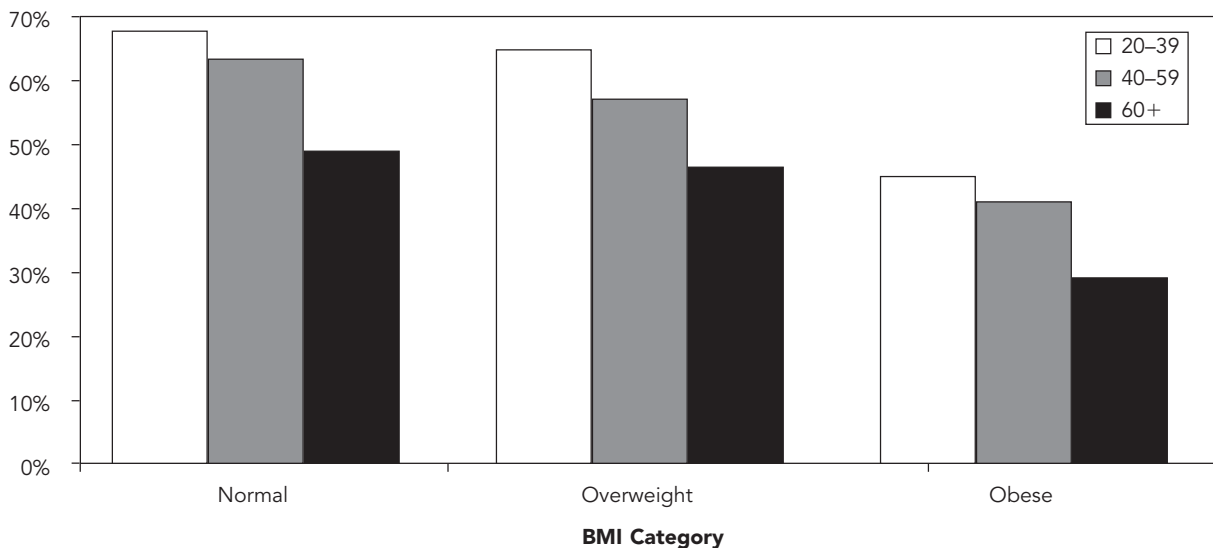
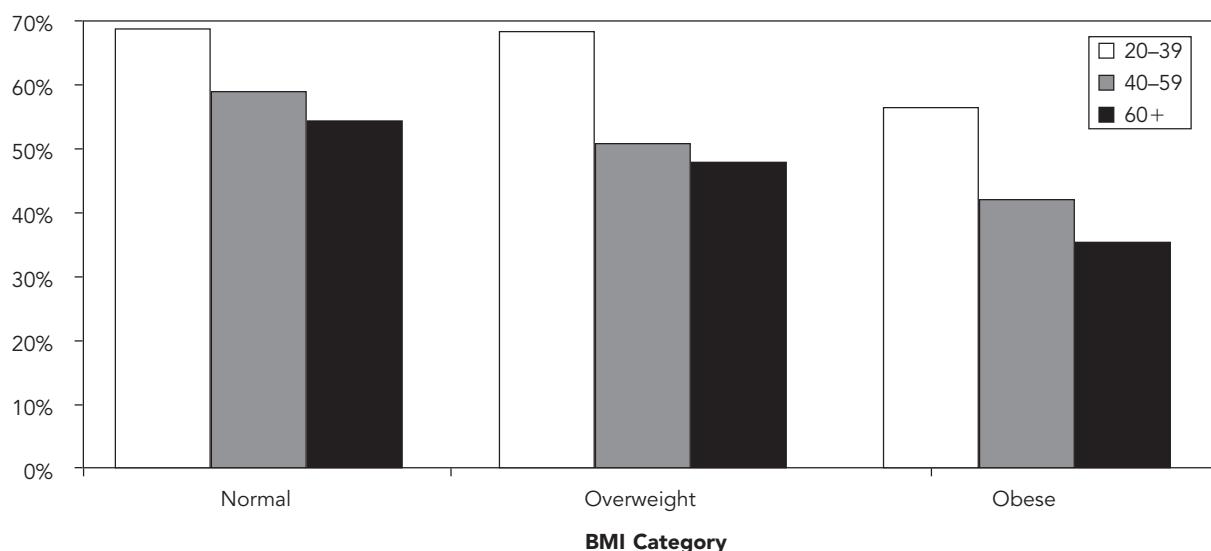
^aSubjects 40 years and over**Figure 1. Percent reporting excellent or very good general health by age group and BMI category, U.S. population 20 years and over, NHANES 1999–2002**

Figure 2. Percent reporting no joint pain, aching, stiffness, or swelling in the past year by age group and BMI category, NHANES 1999–2002

age and over. The prevalence of excellent or very good health declined with age in all BMI groups. General health status assessed using self-reported and measured health characteristic data also declined with increasing overweight status. Differences in self-reported current health, limitations in daily activities, joint problems, and health care utilization were observed among the BMI groups after controlling for gender, age group, race/ethnicity, education, and ciga-

rette smoking. We confirmed that sedentary lifestyle behavior is associated with higher BMI levels; overweight and obese adults engaged in more hours of television watching and non-work computer use than the normal BMI group.

The limitations of this analysis include the cross-sectional nature of these data; inferences to causality cannot be made because temporal sequence cannot be established. Potential sources of error for self-

Table 3. Crude and adjusted odds ratios for self-reported and measured health characteristics by BMI category, U.S. adults 20 years and over, NHANES 1999–2002

	Body mass index (kg/m^2) category					
	18.5–24.9 ^a	25.0–29.9	≥ 30.0	18.5–24.9 ^a	25.0–29.9	≥ 30.0
	Odds ratio (95% CI)			Adjusted odds ratio ^b (95% CI)		
Self-reported health						
Excellent/very good vs. fair/poor	—	0.8 (0.6, 0.9)	0.3 (0.3, 0.4)	—	0.9 (0.7, 1.1)	0.3 (0.3, 0.4)
Good vs. fair/poor	—	1.0 (0.8, 1.1)	0.7 (0.7, 0.8)	—	1.1 (0.9, 1.3)	0.8 (0.7, 0.9)
Health care utilization (number of visits)						
≤ 1 vs. 10+	—	1.0 (0.7, 1.3)	0.6 (0.4, 0.7)	—	0.9 (0.7, 1.2)	0.6 (0.4, 0.8)
2–3 vs. 10+	—	0.9 (0.7, 1.2)	0.7 (0.5, 0.9)	—	0.8 (0.6, 1.1)	0.7 (0.5, 0.9)
4–9 vs. 10+	—	1.0 (0.7, 1.3)	1.0 (0.7, 1.4)	—	0.9 (0.7, 1.2)	1.0 (0.7, 1.3)
Limitation in daily activities?						
Yes vs. no	—	1.1 (0.9, 1.4)	2.1 (1.7, 2.5)	—	1.0 (0.8, 1.3)	1.9 (1.5, 2.3)
Joint pain, aching, or stiffness?						
Yes vs. no	—	1.3 (1.1, 1.5)	2.0 (1.8, 2.2)	—	1.3 (1.1, 1.5)	1.9 (1.7, 2.2)

^aReference group

^bAdjusted for gender, age group, race/ethnicity, education, and cigarette smoking

CI = confidence interval

reported interview data include recall bias, misinterpretation of the survey questions, interviewer error, and respondent error.^{27,28} Questionnaire quality control measures included the use of computer-assisted interview methods, standardized questionnaires, intensive interviewer training, and interviewer monitoring.

It is also important to acknowledge that BMI provides an approximation of total body fat as it does not differentiate between persons who have high BMI due to greater lean muscle mass vs. excess body fat.² Body composition data and measures of abdominal adiposity such as waist circumference were not examined in this analysis. Because fluctuations in body weight occur during a person's lifetime, persons in the normal-weight group may have experienced recent weight loss and conversely, adults who are now overweight may have experienced recent weight gain. Future analyses using the NHANES weight history information may be useful to characterize health outcomes using information on the long-term weight gain/loss patterns of U.S. adults.

Our report is useful to inform health practitioners, researchers, and educators who interact with consumers about the impact of overweight and obesity on functional performance and health status. This information should motivate normal-weight individuals to maintain their weight and could also provide an incentive to those who need to improve their weight status. These findings may also be useful to policymakers and health economists who are concerned about the economic burden associated with adult overweight and obesity. There are compelling health and economic reasons for adults to adopt healthy lifestyles to achieve desirable body weight and improve their overall health and functional status.

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