
Katherine M. Flegal, PhD
Margaret D. Carroll, MS
Cynthia L. Ogden, PhD
Clifford L. Johnson, MSPH

DATA FROM THE THIRD NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY (NHANES III; 1988-1994) showed that the prevalence of obesity, defined as a body mass index (BMI) of 30 or higher, had increased by approximately 8 percentage points in the United States after being relatively stable from 1960 to 1980. Since those data were published, additional reports from other sources have suggested that these trends are continuing. However, those reports from the Behavioral Risk Factor Surveillance System (BRFSS) and the Harris Poll have limitations because they are based on self-reported weight and height. Obesity prevalence estimates based on self-reported data tend to be lower than those based on measured data. For example, the BRFSS showed a prevalence of obesity of 12% to 14.4% during 1991 to 1994; the corresponding NHANES estimate of 22.5% for 1988 to 1994 was more than 50% higher than the BRFSS estimates. National examination survey data based on measured weight and height provide the best opportunity to track trends in weight in the United States. In this article we report the results from the latest NHANES data from 1999-2000 regarding population trends in obesity and in the frequency distribution of BMI.

Context The prevalence of obesity and overweight increased in the United States between 1978 and 1991. More recent reports have suggested continued increases but are based on self-reported data.

Objective To examine trends and prevalences of overweight (body mass index [BMI] ≥25) and obesity (BMI ≥30), using measured height and weight data.

Design, Setting, and Participants Survey of 4115 adult men and women conducted in 1999 and 2000 as part of the National Health and Nutrition Examination Survey (NHANES), a nationally representative sample of the US population.

Main Outcome Measure Age-adjusted prevalence of overweight, obesity, and extreme obesity compared with prior surveys, and sex-, age-, and race/ethnicity-specific estimates.

Results The age-adjusted prevalence of obesity was 30.5% in 1999-2000 compared with 22.9% in NHANES III (1988-1994; P<.001). The prevalence of overweight also increased during this period from 55.9% to 64.9% (P<.001). Extreme obesity (BMI ≥40) also increased significantly in the population, from 2.9% to 4.7% (P=.002). Although not all changes were statistically significant, increases occurred for both men and women in all age groups and for non-Hispanic whites, non-Hispanic blacks, and Mexican Americans. Racial/ethnic groups did not differ significantly in the prevalence of obesity or overweight for men. Among women, obesity and overweight prevalences were highest among non-Hispanic black women. More than half of non-Hispanic black women aged 40 years or older were obese and more than 80% were overweight.

Conclusions The increases in the prevalences of obesity and overweight previously observed continued in 1999-2000. The potential health benefits from reduction in overweight and obesity are of considerable public health importance.

METHODS Surveys

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. Each cross-sectional survey provides a national estimate for the US population at the time of the survey, enabling examination of trends over time in the US population. In each survey a nationally representative sample of the US civilian noninstitutionalized population was selected using a complex, stratified, multistage probability cluster sampling design. Previous national surveys include the first National Health Examination Survey (NHES I, 1960-1962) and the first, second, and third NHANES surveys (NHANES I, 1971-1974; NHANES II, 1976-1980; and NHANES III, 1988-1994). Beginning in 1999, NHANES became a continuous survey without a break between cycles. The procedures followed to select the sample and conduct the interview and examination were similar to those for previous sur-
inadequate sample sizes for subgroup analyses.

**BMI and Obesity**

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 the square of height in meters. For adults, overweight was defined as a BMI of 25.0 or higher, obesity as a BMI of 30.0 or higher, and extreme obesity as a BMI of 40 or higher. These definitions are consistent with those of the National Heart, Lung, and Blood Institute and the World Health Organization.11,12

**Data Analysis and Statistical Methods**

Statistical analyses were carried out using SAS for Windows software (SAS Institute, Cary, NC) and SUDAAN software (RTI, Research Triangle Park, NC). For all surveys, sampling weights had been calculated that took into account unequal probabilities of selection resulting from the sample design, from nonresponse, and from planned oversampling of certain subgroups. All analyses took into account differential probabilities of selection and the complex sample design. Standard errors were calculated with SUDAAN using Taylor series linearization for NHANES III.13 For NHANES 1999-2000, SEs were calculated using the delete 1 jackknife method,13 partitioning the sample into 52 sampling units and forming 52 replicates by deleting one unit at a time. Statistical hypotheses were tested univariately at the .05 level using a t statistic. To adjust for multiple comparisons when 3 racial/ethnic groups were compared, the Bonferroni method was used. For graphical comparison, the frequency distributions of BMI from both surveys were smoothed using a nonparametric smoothing algorithm, based on sequential calculations of running medians for groups of adjacent points.14

**RESULTS**

The prevalence of obesity (BMI ≥ 30) during 1960 to 2000 in the United States by age and sex categories for those aged 20 to 74 years is shown in Table 1. For surveys up through NHANES II, data were available only for respondents younger than 75 years. The prevalence of obesity was relatively constant from 1960 to 1980, then increased as reported by NHANES III in 1988-1994. The most recent data, from NHANES 1999-2000, show further increases for both men and women and in all age groups. The increases from NHANES II to NHANES III were statistically significant in all sex-age groups. Statistically significant increases also occurred from NHANES III to NHANES 1999-2000, except for the increase for men aged 40 to 59 years, which was not statistically significant but showed the same trend. The increases between NHANES III and NHANES 1999-2000 were almost as large as the increases between NHANES II and NHANES III and were not significantly different.

A more detailed examination of trends by age over a broader age range between NHANES III and NHANES 1999-2000 is possible because both surveys had no upper age limit. The prevalence of obesity for both surveys for all adults and by sex and 10-year age groups is shown in Table 2. Increases in the prevalence of obesity occurred for both men and women and in all age groups. Because the SEs are relatively large, particularly for NHANES 1999-2000, the differences are not always statistically significant, but the trends are similar across all subgroups.

The changes in the prevalence of obesity and extreme obesity between NHANES III and NHANES 1999-2000 by sex and racial/ethnic group for 3 groups—non-Hispanic whites, non-Hispanic blacks, and Mexican Americans—are shown in Table 3. In each subgroup the prevalence of both obesity and extreme obesity increased between NHANES III and NHANES 1999-2000. The increases were generally similar across all groups, although there was a nonsignificant trend for a larger

| Table 1. Trends in the Age-Adjusted and Age-Specific Prevalence of Obesity for Adults Aged 20-74 Years, 1960-2000† |
|---|---|---|---|---|---|---|---|---|
| Both sexes | 20-74 | 13.4 | 14.5 | 15.0 | 23.3 | 30.9 | 8.3 (6.6-10.0) | 7.6 (4.2-11.0) |
| | 20-74 | 10.7 | 12.1 | 12.7 | 20.6 | 27.7 | 7.9 (6.0-9.6) | 7.1 (3.4-10.0) |
| | 20-39 | 9.8 | 10.2 | 9.8 | 14.9 | 23.7 | 5.1 (2.9-7.2) | 8.8 (4.8-12.8) |
| | 40-59 | 12.6 | 14.7 | 15.4 | 25.4 | 28.8 | 10.0 (6.9-13.0) | 3.4 (-2.8-9.6) |
| | 60-74 | 8.4 | 10.5 | 13.5 | 23.8 | 35.8 | 10.3 (6.1-13.4) | 12.0 (5.0-19.0) |
| Women | 20-74 | 15.8 | 16.6 | 17.0 | 25.9 | 34.0 | 8.9 (6.5-11.3) | 8.1 (3.7-12.5) |
| | 20-39 | 9.3 | 11.2 | 12.3 | 20.6 | 28.4 | 8.3 (5.2-11.4) | 7.8 (2.5-13.1) |
| | 40-59 | 18.5 | 19.7 | 20.4 | 30.4 | 37.8 | 10.0 (6.1-13.9) | 7.4 (0.5-14.3) |
| | 60-74 | 26.2 | 23.4 | 21.3 | 28.6 | 39.6 | 7.3 (3.9-10.6) | 11.0 (4.6-17.4) |

‡Overall and within each age-sex group, the changes between 1988-1994 and 1999-2000 are not significantly different from the changes between 1976-1980 and 1988-1994.

©2002 American Medical Association. All rights reserved.
increase in non-Hispanic black women. For obesity, the increases were not statistically significant for Mexican Americans, although trends were in the same direction as for the other racial/ethnic groups. For extreme obesity, the increases were significant for men and women overall and for non-Hispanic black women. In other racial/ethnic groups, the increases were not statistically significant, although the trends were in the same direction.

More detailed information on the prevalence of overweight and obesity by age, sex, and racial/ethnic group from NHANES 1999-2000 is shown in Table 4. The prevalence of overweight, which was 55.9% in NHANES III, increased to 64.5% (P<.001). The prevalences of overweight and obesity among men varied little by racial/ethnic group and there were no significant differences. Among women, non-Hispanic black women had a higher prevalence of both overweight and obesity than did non-Hispanic white women. For Mexican American women, the prevalence was intermediate between the other 2 groups and was not significantly different from either non-Hispanic white women or non-Hispanic black women. Data on extreme obesity are not shown because the estimates within subgroups were statistically unreliable.

The distribution of BMI in the population was also evaluated. For men aged 60 to 79 years, the distribution of BMI between NHANES III and NHANES 1999-2000 has shifted to the right (Figure), but the shift is greater at the upper percentiles of the distribution, indicating that the distribution has become more skewed. This pattern was also seen for men and women aged 20 to 39 years and 40 to 59 years (data not shown). For women aged 60 to 79 years the shift is more uniform (Figure).

**COMMENT**

These data indicate that the trends in BMI and the prevalence of obesity previously observed between the 1976-1980 NHANES II survey and the 1988-1994 NHANES III survey appear to be...
continuing at a similar level in 1999-2000. Although these increases in obesity observed in NHANES III and NHANES 1999-2000 appear dramatic compared with previous surveys, they may also be viewed as part of a longer-term trend for increases in body size in affluent and well-nourished societies. In the United States, mean BMI appears to have been increasing over a long time, with recent increases perhaps less steep than those earlier. Other developed countries are experiencing similar increases, and less developed countries also show increases in obesity as they become more affluent. As with NHANES III, the increases seen in NHANES 1999-2000 appear to be occurring in both men and women, in all age groups, and in all racial/ethnic groups studied.

The findings also reflect the difference in prevalence estimates based on measured vs self-reported height and weight. The 2000 BRFSS data estimate an obesity prevalence of 19.8% among adults compared with the estimated prevalence of 30.5% in our study. Relatively little is known about the precise causes of these trends. Although they must reflect energy imbalances in the sense that energy intake must exceed energy expenditure for weight to increase, the nature of the imbalances is not clear. Both dietary intake and physical activity are difficult to measure, and trends in these factors are not easy to evaluate. A more fundamental problem is to identify the social, economic, and cultural forces leading to energy imbalance. Advances in technology, changes in work life, the advent of computers, trends in eating out vs food preparation at home, time pressures, fear of crime, decreases in tobacco use, and many other factors have been suggested, but definitive data are lacking that would clearly associate changes in these factors with the increase in obesity on an individual basis.

The decreases in overweight and obesity raise questions about the implications of these trends for health outcomes. Obesity is a risk factor for many chronic conditions including diabetes, hypertension, hypercholesterolemia, stroke, heart disease, certain cancers, and arthritis. Of these conditions,
INCREASING OBESITY IN US ADULTS

Obesity is a complex and multifaceted problem that has significant implications for public health and individual well-being. The prevalence of obesity has increased dramatically in the United States and globally in recent decades. This increase can be attributed to various factors, including changes in dietary patterns, physical activity levels, and the built environment. The increase in obesity prevalence has contributed to a rise in related health conditions such as type 2 diabetes, cardiovascular disease, and certain types of cancer. Addressing obesity requires a multifaceted approach that includes interventions at the individual, community, and societal levels. This involves promoting healthy eating habits, increasing physical activity, and creating supportive environments that facilitate healthy behaviors.

Author Contributions: Study concept and design: Flegal. Acquisition of data: Johnson. Analysis and interpretation of data: Flegal, Carroll, Ogden, Johnson. Drafting of the manuscript: Flegal. Critical revision of the manuscript for important intellectual content: Flegal, Carroll, Ogden, Johnson. Statistical expertise: Flegal, Carroll, Administrative, technical, or material support: Johnson.

REFERENCES


©2002 American Medical Association. All rights reserved.

(Reprinted) JAMA, October 9, 2002—Vol 288, No. 14

Downloaded From: https://jamanetwork.com/ by a Non-Human Traffic (NHT) User on 08/11/2019