CLINICAL RESEARCH STUDY

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Obesity, Abdominal Obesity, Physical Activity, and Caloric Intake in US Adults: 1988 to 2010

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ABSTRACT

BACKGROUND: Obesity and abdominal obesity are associated independently with morbidity and mortality. Physical activity attenuates these risks. We examined trends in obesity, abdominal obesity, physical activity, and caloric intake in US adults from 1988 to 2010.

METHODS: Univariate and multivariate analyses were performed using National Health and Nutrition Examination Survey data.

RESULTS: Average body mass index (BMI) increased by 0.37% (95% confidence interval [CI], 0.30-0.44) per year in both women and men. Average waist circumference increased by 0.37% (95% CI, 0.30-0.43) and 0.27% (95% CI, 0.22-0.32) per year in women and men, respectively. The prevalence of obesity and abdominal obesity increased substantially, as did the prevalence of abdominal obesity among overweight adults. Younger women experienced the greatest increases. The proportion of adults who reported no leisure-time physical activity increased from 19.1% (95% CI, 17.3-21.0) to 51.7% (95% CI, 48.9-54.5) in women, and from 11.4% (95% CI, 10.0-12.8) to 43.5% (95% CI, 40.7-46.3) in men. Average daily caloric intake did not change significantly. BMI and waist circumference trends were associated with physical activity level but not caloric intake. The associated changes in adjusted BMIs were 8.3% (95% CI, 6.9-9.6) higher among women and 1.7% (95% CI, 0.68-2.8) higher among men with no leisure-time physical activity compared with those with an ideal level of leisure-time physical activity.

CONCLUSIONS: Our analyses highlight important dimensions of the public health problem of obesity, including trends in younger women and in abdominal obesity, and lend support to the emphasis placed on physical activity by the Institute of Medicine.

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KEYWORDS: Abdominal obesity; Adiposity; Body mass index; Calories; Diet; Exercise; Obesity; Physical activity; Waist circumference; Weight

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The Institute of Medicine (IOM) identifies obesity as a health issue of monumental importance to the nation.[1] Obesity, defined as a body mass index (BMI) of $\geq$30 kg/m^2, is associated with multiple comorbidities, including cardiovascular disease and cancer, and a higher risk of all-cause mortality.[1,2] Overweight, defined as a BMI of 25.0 to 29.9 kg/m^2, has been associated with an increased risk of death in several studies.[2-4] More than two thirds of US adults are considered obese or overweight.[5,6] The cost of obesity-related illness approximates 20% of annual US health care spending.[1] Life expectancy could decline because of the effects of obesity.[7]

Increased waist circumference is an independent predictor of morbidity and mortality, even in persons with a normal BMI.[8-11] The National Institutes of Health recommends measuring waist circumference in addition to weight and height in primary care practice to help guide weight management.[12]

The causes of obesity are multifactorial and reflect the balance between energy intake and expenditure.[1,13] Physical

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activity is a key component of weight management.[12] Of the IOM's 5 recommendations to address the national obesity epidemic, the first is to make physical activity an integral and routine part of life.[1]

Our aims were to characterize trends in and associations among overweight and obesity, abdominal obesity, physical activity, and caloric intake in US adults in the last 2 decades. We explored trends in the prevalence of abdominal obesity within strata defined by BMI, given the health risks of increased waist circumference independent of BMI, and we explored the relationships between measures of obesity and levels of physical activity and caloric intake.

CLINICAL SIGNIFICANCE

- Average body mass index and waist circumference, obesity and abdominal obesity prevalence, and the population fraction reporting no leisure-time physical activity increased substantially in US adults from 1988 to 2010.
- Body mass index and waist circumference trends were associated with physical activity level but not daily caloric intake.
- Although US obesity rates may be stabilizing, our results lend support to the emphasis placed on physical activity in the Institute of Medicine report on obesity.

METHODS

Data Source

We used data from the National Health and Nutrition Examination Survey (NHANES), beginning with NHANES-III (1988-1994) and including the continuous NHANES 2-year survey cycles from 1999-2000 to 2009-2010.[14] The samples in each cycle were selected using a stratified, multistage, clustered probability sampling design, described in detail before.[15,16]

Study Population

All examined participants aged ≥18 years, except pregnant women, were included. For the caloric intake analyses, only eligible participants who had reliable and complete 24-hour dietary recall data were included. Subgroup analyses were performed for subgroups of self-identified race/ethnicity with sufficiently large samples: non-Hispanic white, non-Hispanic black, and Mexican-American.[14]

Definition of Anthropometric Measures

During the examination component of NHANES, height, weight, and waist circumference were measured. On the basis of BMI, individuals were categorized as normal weight (18.5-24.99 kg/m^2), overweight (25.0-29.99 kg/m^2), or obese (≥30 kg/m^2).[8] Abdominal obesity was defined on the basis of a waist circumference of >88 cm for women and >102 cm for men.[8,17]

Definition of Leisure-time Physical Activity Levels

Participants were grouped into 3 levels of leisure-time physical activity: ideal, intermediate, and none. This was accomplished by following the methods and definitions of the specific NHANES surveys (Appendix, online).

Definition of Dietary Measures

Total caloric intake per day was estimated on the basis of the total energy intake (kcal, or calories) reported in the first 24-hour recall data set. These data were obtained during the examination component of NHANES by trained dietary interviewers using an automated dietary interview system.[15,16]

Statistical Analyses

Analyses were performed for all adults and after stratification by gender; predefined age strata of 18 to 39 years, 40 to 64 years, and ≥65 years; and race/ethnicity. Data from each cycle were considered to be from the midpoint of each period.

To examine trends in BMI, waist circumference, and daily energy intake, we calculated national estimates of age-adjusted averages and 95% confidence intervals (CIs) for each survey cycle. We used linear regression to assess trends in log-transformed BMI, waist circumference, and daily energy intake by including the midpoints of each survey cycle as a continuous variable. To address possible changes in BMI trends over time, we used joinpoint analysis (Appendix, online).[18] The results are expressed as annual percentage change.

To examine trends in the prevalence of obesity and abdominal obesity, and the levels of physical activity, we calculated national estimates of age-adjusted proportions and 95% CIs for each survey cycle. We assessed changes over time using logistic regression analysis by including the midpoints of each survey cycle as a continuous variable. We present odds ratios and 95% CIs reflecting the odds of fulfilling criteria for a specific category in a given year versus the previous year. We performed separate analyses to examine trends in abdominal obesity for overweight and obese adults, defined by BMI.

Analyses stratified by 3 prespecified levels of leisure-time physical activity were performed for trends in the measures of obesity and daily energy intake. To examine the independent effects of physical activity and daily energy intake, we performed multivariate regression analysis with log-transformed BMI and waist circumference as response variables, and year, physical activity level, and daily energy intake as explanatory variables, adjusted for age, age squared, and gender. For sensitivity analyses, we first used only the continuous NHANES data, in which total minutes spent on physical activity can be estimated; and second, we used only data from 1999-2000 to 2005-2006, including activity related to transportation and domestic work, because the physical activity questionnaire was consistent in these cycles (Appendix).