Trends in Abdominal Obesity Among US Children and Adolescents

WHAT’S KNOWN ON THIS SUBJECT: Previous studies showed that prevalence of abdominal obesity among US children and adolescents increased significantly between 1988–1994 and 2003–2004. However, little is known about recent time trends in abdominal obesity since 2003–2004.

WHAT THIS STUDY ADDS: In 2011–2012, 17.95% of children and adolescents aged 2 to 18 years were abdominally obese defined by waist circumference. The prevalence of abdominal obesity leveled off among US children and adolescents from 2003–2004 to 2011–2012.

abstract

OBJECTIVES: Previous studies showed that prevalence of abdominal obesity among US children and adolescents increased significantly between 1988–1994 and 2003–2004. However, little is known about recent time trends in abdominal obesity since 2003–2004. This study was to provide recent updated national estimates of childhood abdominal obesity and examine the trends in childhood abdominal obesity from 2003 to 2012.

METHODS: Data were from the National Health and Nutrition Examination Survey (NHANES) conducted during 5 time periods (2003–2004, 2005–2006, 2007–2008, 2009–2010, and 2011–2012). A total of 16,801 US children and adolescents aged 2 to 18 years were included. Abdominal obesity is defined as a waist circumference (WC) ≥ gender- and age-specific 90th percentile based on data from NHANES III (1988–1994) and a waist-to-height (WHtR) ≥ 0.5, respectively.

RESULTS: In 2011–2012, 17.95% of children and adolescents aged 2 to 18 years were abdominally obese defined by WC, and 32.93% of those aged 6 to 18 years were abdominally obese defined by WHtR. Mean WC and WHtR and prevalence of abdominal obesity kept stable between 2003–2004 and 2011–2012, independently of gender, age, and race/ethnicity. However, there was a significant decrease in abdominal obesity among children aged 2 to 5 years.


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KEY WORDS
abdominal obesity, waist circumference, waist-to-height ratio, children

ABBREVIATIONS
CI—confidence interval  
CVD—cardiovascular disease  
NHANES—National Health and Nutrition Examination Survey  
OR—odds ratio  
WC—waist circumference  
WHR—waist-to-height ratio

Drs Xi, Mi and Steffen conceptualized and designed the study and drafted the initial manuscript; Drs Zhao and Zhang carried out the initial analyses and reviewed and revised the manuscript; Drs Jia, Li, and Zeng designed the data collection instruments, coordinated data collection, and critically reviewed the manuscript; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Childhood obesity is a serious public health problem worldwide, including in the United States.† BMI is the most widely recognized surrogate of obesity, but it does not provide information about the distribution of body fat.§ Anthropometric measures such as waist circumference (WC) and waist-to-height ratio (WHtR), used for defining abdominal obesity, are better than BMI for predicting risk for hypertension, type 2 diabetes, metabolic syndrome, cardiovascular disease (CVD), and all-cause mortality.|| Importantly, the US National Institutes of Health recommends screening of WC for health risk, especially in overweight or obese adults (BMI ≥25.0 kg/m²).5

To prevent and control an epidemic of obesity, it is necessary to monitor secular trends in obesity through population surveillance. Abdominal obesity among US children and adolescents increased dramatically from 1988–1994 to 1999–2004 according to the National Health and Nutrition Examination Survey (NHANES) III and the continuous NHANES 1999–2004.6 However, it is unclear whether abdominal obesity has continued to increase since 2004. Using the most recent national data from NHANES since 2004, we examined the secular trends of WC, WHtR, and abdominal obesity among children and adolescents aged 2 to 18 years in the United States.

METHODS

Design and Subjects

The NHANES population is a complex, multistage probability sample of US civilian, non-institutionalized adults and children; details have been described elsewhere.† The NHANES since 1999 has been conducted annually by the National Center for Health Statistics of the Centers for Disease Control and Prevention. A questionnaire was administered during the home interview, and physical measurements including weight, height, and WC were measured at the mobile examination center. Written informed consent was obtained from parents and/or children aged 2 to 18 years. The NHANES was approved by the National Center for Health Statistics Ethics Review Board.

Measurements and Definitions

Height, weight, and WC were obtained using standardized protocols and calibrated equipment.1,6 Height was measured to the nearest 0.1 cm without shoes using a portable stadiometer.1 WC was measured by using a steel measuring tape to the nearest 0.1 cm at the high point of the iliac crest at minimal respiration when the participant was in a standing position.6 Abdominal obesity is defined as WC equal to or above the gender- and age-specific 90th percentile based on data from NHANES III (1988–1994).7 In addition, a WHtR ≥0.5 defined abdominal obesity for youth aged 6 to 18 years, because this cutoff may overestimate the prevalence of abdominal obesity in children aged 2 to 5 years.6

Statistical Analysis

Differences in distributions of gender, age, and race/ethnicity between 5 cycle surveys were tested by using a χ² test. Time trends in mean WC and WHtR and prevalence of abdominal obesity from 2003–2004 to 2011–2012 were examined by using multiple linear regression or logistical regression model, respectively, with consideration of age, gender, and race/ethnicity, when applicable. Multiple logistical regression analysis was also used to assess the effect of survey years, age, gender, and race/ethnicity on risk for abdominal obesity. P < .05 was considered statistically significant. Statistical analysis was performed by using SPSS version 13.0 (SPSS, Inc, Chicago, IL).

RESULTS

Characteristics of the Study Population

Table 1 shows the characteristics of study population between 5 survey periods (2003–2004, 2005–2006, 2007–2008, 2009–2010, and 2011–2012). The distribution of gender was homogeneous between 5 periods (P > .05) but there were significant differences in the proportions of age- and race/ethnic groups (both P < .001).

Trends in Mean WC and WHtR Among US Children and Adolescents

Mean WC and WHtR remained stable among US children and adolescents from 2003–2004 to 2011–2012 for each survey and by age, gender, and race/ethnic group, except for non-Hispanic blacks, whose WC marginally increased (Table 2).
In 2011–2012, 17.95% of children and adolescents aged 2 to 18 years were abdominally obese (defined by WC); 32.93% of those aged 6 to 18 years were abdominally obese (defined by WHtR). Compared with 2003–2004, the prevalence of abdominal obesity in 2011–2012, as defined by WC and WHtR, did not change in the total population or by age, gender, and race/ethnic group, except for children aged 2 to 5 years (Table 3).

**Influence of Demographic Factors on Abdominal Obesity Among US Children and Adolescents**

As shown in Table 4, compared with children aged 2 to 5 years, those aged 6 to 11 years (odds ratio [OR], 1.79; 95% confidence interval [CI], 1.60–1.99) and 12 to 18 years (OR, 1.48; 95% CI, 1.33–1.65) were more likely to be abdominally obese defined by WC. In addition, girls (boys as referent: OR, 1.15; 95% CI, 1.06–1.24) and Mexican American (non-Hispanic white as referent: OR, 1.38; 95% CI, 1.25–1.53) were more likely to have abdominal obesity. Similar results were found when using WHtR $\geq 0.5$ to define abdominal obesity (Table 4).

**DISCUSSION**

In the current study, trends in mean WC and WHtR and the prevalence of abdominal obesity remained stable among US children and adolescents from 2003–2004 to 2011–2012, which is consistent with the level trends in obesity (defined by BMI) from 2003–2004 to 2011–2012 in this young population.¹ Our findings have important public health implications, because abdominal obesity is a better indicator of many chronic diseases such as hypertension, diabetes, CVD, and death than general obesity. Although the prevalence of abdominal obesity leveled off over the past nine years among US children and adolescents, it is still high, being nearly 18% (defined by WC) in participants aged 2 to 18 years, suggesting an urgent need for lifestyle modifications to lower abdominal obesity.

**TABLE 2** Trends in Mean WC (SE) and WHtR (SE) Among US Children and Adolescents Aged 2 to 18 Years, NHANES 2003–2004 to 2011–2012

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Time trends in mean WC and WHtR from 2003–2004 to 2011–2012 were examined by using multiple linear regression model, with adjustment for age, gender, and race/ethnicity, when applicable.
gender, and race/ethnic group, except for children aged 2 to 5 years, in whom a decreasing trend was observed. Notably, girls, adolescents, and Mexican American youth were more abdominally obese than boys, children, and non-Hispanic whites, respectively. The youth in specific subgroups should be targeted as high priority for intervention efforts to reduce abdominal obesity.

Data on recent trends of abdominal obesity are few in children and adolescents. A previous NHANES study showed that WC and the prevalence of abdominal obesity in US children aged 6 to 11 years significantly increased from 1988–1994 to 1999–2002.9 The increasing trends were further extended when NHANES 2003–2004 data were also examined.6 The Australia national surveys conducted in 1985, 1995, and 2007 showed that abdominal obesity in children increased at a faster rate than obesity defined by BMI during the past 2 decades.10 Liang et al found significantly increased obesity and abdominal obesity in Chinese school-aged children enrolled in the China Health and Nutrition Survey from 1993 to 2009.11 Notably, data from Korean Nutrition Health and Nutrition Examination Survey indicated that abdominal obesity leveled off in boys but decreased in girls aged 10 to 19 years between 2001 and 2005.12

It is well accepted that eating foods rich in energy, intake of sweetened beverage, lack of physical activity, and more time spent in sedentary behaviors (TV/video viewing, computer use) are main risk factors for obesity. Notably, during the periods of 2001–2010, time of TV viewing and consumption of sweets and sweetened beverages decreased, and days with at least 1 hour of physical activity, intake of fruits and vegetables, and frequency of eating breakfast significantly increased among US adolescents aged 11 to 16 years.13 These findings may in part explain why the prevalence of abdominal obesity did not increase but remained stable between 2003–2004 and 2011–2012.

The prevalence of abdominal obesity (WC ≥90th percentile for age and gender in NHANES III) was 18% among US children and adolescents aged 2 to 18 years in 2011–2012, which was similar to the prevalence of obesity.
(BMI ≥95th percentile for age and gender according to the Centers for Disease Control and Prevention growth charts) in the same period (17%). To date, there is not a general consensus defining abdominal obesity at the national level. Thus, we were unable to compare our results to those in other countries. In addition, the prevalence of abdominal obesity (WHR ≥0.5) was 33% among adolescents aged 6 to 18 years in 2011–2012, which was comparable to the prevalence of overweight in the same period (34%). WHR is a simple measure of abdominal obesity, independent of age and gender. Based on results for the association between WHR and cardiometabolic risk in adults, a cutoff for WHR of 0.5 is recommended. Indeed, WHR has been reported as a better indicator of risk for CVD than BMI or WC. Moreover, the message of “keep your waist to less than half your height” is attractive for public health policy.

The current study has 3 strengths. First, we used national data that are representative of US children and adolescents. Second, the data collectors were trained using standard procedures, and quality control measures guaranteed the reliability of study results. Third, although the trends for abdominal obesity in NHANES 1999–2004 was previously reported, we reported the trends for 4 additional survey cycles (2005–2006, 2007–2008, 2009–2010, and 2011–2012). However, 2 limitations should be noted. First, WC ≥90th percentile for age and gender in NHANES III was used to define abdominal obesity, which impeded our ability to compare our results with those of other studies. Second, we did not analyze the influencing factors including dietary and lifestyle habits that may affect the trends in abdominal obesity, and further studies are warranted to examine the trends of environmental factors and whether they influence abdominal obesity.

**CONCLUSIONS**

The prevalence of abdominal obesity leveled off among US children and adolescents from 2003–2004 to 2011–2012, independent of age, gender, and race/ethnicity. However, the prevalence of abdominal obesity is high; therefore, appropriate dietary intake and physical activity should be further emphasized to combat the obesity epidemics.

**ACKNOWLEDGMENTS**

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