Overweight and Obesity Prevalence Rates among Youth in the Carolinas

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Abstract

Overweight and obesity have become major public health concerns in the United States, reaching epidemic proportions among adults and children in recent years. According to the most recent national surveys, American adults have experienced a 50% increase in the prevalence of overweight and obesity. Moreover, an alarming 100% increase has been observed among children and adolescents since the 1970s. To assess the status of overweight and obesity prevalence among youth in the Carolinas, weight, height, waist, and hip circumferences were monitored during routine cholesterol screenings among 11- to14-year-olds in two school districts. Of the twelve hundred students screened, 32.4% percent were overweight and 16.4% were obese, exceeding national averages of 22% and 11%, respectively. The overweight and obesity prevalence rates were even more dramatic when broken down by gender and ethnic/racial groups. For instance, 54% of black girls and 45% of black boys were overweight, and better than half of these students were obese. Overweight and obesity prevalence rates among black girls were nearly twice the rates observed for white girls. Ethnic differences in percentage of overweight and obese boys were not as great as those observed among girls.

A number of factors may contribute to the unprecedented levels of overweight and obesity observed among American youth, including physical inactivity, poor nutritional habits (i.e., high-fat meals and snacks, and super-sizing), economic, and social factors. Consequently, the coordinated efforts of physicians, school nurses, teachers, parents, and students will be necessary to effectively address the growing problem of childhood obesity.

Keywords*: Overweight, obesity, gender, ethnicity, children, youth*

OVERWEIGHT AND OBESITY have become major health concerns in the United States, affecting women—particularly black women—more often than men.[1] According to data from the most recent National Health and Nutrition Examination Survey (NHANES III, 1988-1991), 32% of black and white men, 33.5% of white women, and 49% of black women are overweight, as defined by the sex-specific 85th percentile values of body mass index (BMI; > 27.8 kg/m^2 for men and > 27.3 kg/m^2 for women) from NHANES II (1976 - 1980).[2] The 85th percentile values correspond roughly to 24% over ideal weight for men of average height and 20% over ideal weight for women of average height based on the 1983 Metropolitan Life tables.[3] Obesity, on the other hand, a term often used interchangeably with overweight, has been associated with the sex-specific 95th percentile values of body mass index (BMI of > 30 kg/m^2 for men and 28.7 kg/m^2 for women), which corresponds to better than 30% over ideal body weight. Among overweight adults, approximately 21% of men and white women and 37% of black women are actually obese.[4] The prevalence of overweight among American adults has increased from 24.3% to 33.4% between 1960 and 1991,[2] while the prevalence of obesity increased from 12.8% to 22.5%.[4] In both cases, trend analyses revealed on average a 9% increase in prevalence since the initial National Health Evaluation Study (NHES I; 1960-62), with most of this increase, 8%, occurring between NHANES II (1976-1980) and NHANES III (1988 – 1994).[2, 4]

More recently, however, a BMI of 25 has been associated with increased health risks.[6-7] Consequently, the World Health Organization and others have recommended that overweight be defined as a BMI > 25 kg/m^2 and obesity as a BMI > 30 kg/m^2.[6-7] Using the latter criteria, better than 50% of American adults are reported to be overweight.[4] Mokdat and colleagues demonstrated, perhaps most effectively, the epidemic increase in obesity prevalence rates that has spread

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across the country.[5] In 1991, they reported that only 4 of 45 states had an obesity prevalence rate of 15% or greater; in 1998 this was true for 37 of the 45 states participating in the Behavioral Risk Factor Surveillance Survey.[5]

Similar increases in overweight and obesity prevalence have been observed among children .[8] However, changes in body composition that accompany growth and development often render these measures difficult to establish in this population.[8-9] Given the static nature of height during childhood, weight—and hence BMI—is a less reliable measure of fatness for children and adolescents than for adults.[9-10] Nonetheless, when the overweight and obesity criteria are based on age- and sex-specific values, BMI is typically the measure of choice.[10] Consequently, age- and sex-specific 85th and 95th percentiles values of BMI derived from national surveys are traditionally used to define children at risk of overweight and obesity, respectively.[8-9, 11-12.] In fact, the 85th percentile cutpoints of NHANES II are used to define overweight for the year 2000 national health objective. [13]

According to data from the most recent national survey (NHANES III; 1988-1994), 22% of youth in the U.S. are overweight and 11% are obese, reflecting percentage point increases of 7 and 5.5, respectively, since the mid 1960s. As for adults, much of the increase in excess weight occurred between NHANES II and NHANES III. More specifically, 5 of the 7 percentage point increase in overweight and 4 of the 5.5 percentage point increase in obesity occurred between the 1976 to 1980 and the 1988 to 1994 surveys. Also as observed among adults, ethnic and gender differences exit in the prevalence of excess weight. Overweight and obesity rates are greatest for black girls (31% and 15.6%, respectively) and Hispanic boys (30% and 15%, respectively).[9]

Adults in North Carolina and South Carolina experienced a 46% and 47% increase in obesity prevalence; respectively, between 1991 and 1998.[5] To assess the status of overweight and obesity prevalence rates among youth in these states, weight, height, waist, and hip circumferences were monitored during routine cholesterol screenings among 11- to14-year-olds in Cabarrus County, North Carolina, and Cherokee County, South Carolina. Here we present gender and ethnic differences in overweight and obesity prevalence rates among youth in two school districts in the Carolinas.

Methods

Subjects. Written parental consent was obtained for 1200 students (11- to 14-year-olds) to participate in cholesterol screenings conducted at several middle schools located in Cabarrus County, North Carolina, and elementary schools in Cherokee County, South Carolina, during the 1998-1999 school year. Students who failed to return a consent form to their schools signed by one or both parents were not eligible to participate in the screenings.

The Cabarrus County School District is located in the semirural town of Concord, NC, and lies on the eastern border of Mecklenburg County in the southwestern Piedmont of North Carolina. Concord has approximately 56,000 residents. About 79% of the residents aged 25 years and over are high school graduates, and 23% are also college graduates. The median family income in 1999 was $53,571; however, 10% of children under 18 lived below the poverty level. The Cherokee County School District is located in the rural town of Gaffney, SC, approximately 45 miles south of Charlotte, NC, and 45 miles north of Greenville, SC. Gaffney has a population of approximately 13,000 residents, with 70% of those over 25 years of age classified as high school graduates and 17% classified as college graduates. The median family income in 1999 was $38,449, and 18% of children under 18 years old lived below the poverty level. Concord exceeded state indices for income and educational attainment, with fewer children living in poverty. Gaffney, on the other hand, fell below state averages on all three indices. In North Carolina, 78% of residents over 18 graduated from high school and 22.5% of them received a college degree; comparable numbers for South Carolina were 76% and 20%, respectively. The median family income for residents of North Carolina in 1999 was $46,335, with 13.3% of children under 18 below the poverty level; comparable numbers for South Carolina were $44,227 and 17%.

Anthropometry. All height and weight measurements were obtained by the author and standardized across schools. Measurements were made with students' shoes and heavy outerwear removed. A Detecto Physician Scale was used to measure height to the nearest 0.1 cm and weight to the nearest 0.5 lb. Body mass index (weight in kilograms divided by height in meters squared) was used as the index of obesity. Overweight and obesity were defined according to the age- and sex-specific (races combined) 85th and 95th percentile values of BMI compiled by Rosner (1998)[11] and Frisancho.[14]

Results

Demographic Characteristics. More than 80% of the 6th grade students in South Carolina (555/690) participated in the cholesterol screenings, whereas only 50% of the 8th grade students (439/878) and 20% of 9th grade students (200/1000) in North Carolina volunteered for the screenings. Although males and females participated in the screenings at roughly equivalent rates (45% males, 55% females), White students constituted 78% of the sample. Approximately 11% of the students screened in Cabarrus County schools were black, whereas 35% of those from Cherokee County were black. Twelve Hispanic students, two Asian-American, and two Native-American students participated in the screenings. Data collected from Hispanic, Asian-American, and native-American students are not included in subsequent analyses

Table 1. Mean (standard error) weight, height, body mass index, overweight and obesity prevalence as a function of age

Age (years)	N	Weight (lbs)	Height (inches)	Body Mass Index (kg/m^2)	OWT %	Obese %	Percentile Cutpoints[11] 85th Girls	85th Boys	95th Girls	95th Boys
11	382	113.8 (1.7)	59.7 (0.2)	21.8 (0.3)	38.9	21.3	22.5	21.8	26.0	25.6
12	170	120.7 (2.9)	60.6 (0.5)	22.5 (0.5)	36.2	18.8	23.5	22.5	27.4	26.4
13	344	130.4 (2.3)	63.6 (0.2)	22.0 (0.3)	27.3	11.8	24.3	23.1	28.5	27.0
14	298	138.5 (2.2)	65.1 (0.2)	22.5 (0.3)	26.2	12.7	24.8	23.6	29.2	27.7

OWT – Overweight prevalence as defined by age- and sex-specific 85th percentile[11]
Obese – Obesity prevalence as defined by age- and sex-specific 95th percentile[11]

because of their low rates of participation in the screenings and their low representation in the respective school districts.

Table 1 presents means and standard errors for demographic characteristics of the study population as a function of age. As expected, mean weight and height increased with age. Overweight and obesity prevalence rates among 11-and 12-year-olds were slightly higher than the overall sample prevalence rates of 32.4% and 16.4%, respectively. Prevalence rates among 13- and 14-year-olds were slightly lower than those for the overall sample. Because of the limited number of minority students, subsequent analyses were not conducted by age but instead as a function of ethnicity and gender collapsed across age.

Table 2 presents means and standard errors for demographic characteristics of the study population by gender and ethnic groups. Separate 2 (black vs white) x 2 (female vs male) ANOVAs for age, weight, height, and BMI revealed several ethnicity main effects and ethnicity by gender interactions. More specifically, race main effects were observed for both age and height. White students were older ($F(1, 1196) = 77.8$; $p < 0.0001$) and taller ($F(1, 1023) = 140.1$; $p < 0.003$) than black students. However, the race main effect for height was qualified by a significant race-by-gender interaction ($F(1, 1023) = 6.4$; $p < 0.01$). Subsequent post-hoc analyses (Tukey's HSD) revealed that white males were taller than black males and females of both ethnic groups ($p < 0.05$). Females, on the other hand, did not differ in height as a function of ethnicity ($p > 0.10$). Similarly, the race and gender main effects observed for BMI ($F(1, 1023) > 10.2$; $ps < 0.002$), and the race main effect for weight ($F(1, 1023) = 3.8$; $p < 0.05$) were qualified by significant race-by-gender interactions ($F(1,1023) > 5.0$; $p < 0.03$). Although blacks were heavier and had larger BMI values than their white counterparts, post-hoc analyses revealed that this was true for black females but not black males. In fact, black females were heavier and had a larger mean BMI than all other race-gender groups.

Overweight and Obesity Prevalence

Height and weight measurements were obtained for 85% of the students (1024 of 1200) who participated in the cholesterol screenings. Prevalence estimates for overweight and obesity as defined by the 85th and 95th percentile values of BMI derived from Rosner's cutpoints are presented in Table 3. The mean BMI as a function of weight status and the number of overweight and obese students in each race-gender category are also presented in Table 3. Overall, 32.4% of the students screened were overweight and 16.4% were actually obese. The overweight and obesity prevalence estimates were even greater among black students. Nearly 50% of black females (48.6%) had a BMI above the 85th percentile and 25.7% had a BMI above the 95th percentile, comparable overweight and obesity estimates for black males were 41.5 % and 25.5 %, respectively. Among both normal weight and overweight students, females had greater mean BMI values than males ($p = 0.0001$).

Overall overweight and obesity prevalence rates of 36.4% and 18.2%, respectively, were obtained using BMI cutpoints provided by Frisancho (1990). For both black females and males the overweight prevalence was three times that expected by definition at the 85th percentile (53.6% and 44.7%, respectively), and the obesity prevalence rates were nearly six times what was expected at the 95th percentile (27.1 % and 29.8%, respectively). Among white students, the overweight and obesity prevalence rates were 27.6% and 13.4% for females and 37.8% and 16.9 % for males (exceeding two to

Table 2. Mean age, weight, height, and body mass index (standard error) as a function of ethnicity and gender.

	N	Age [a] (yrs)	Weight [b] (lbs)	Height [c] (inches)	Body Mass Index [d] (kg/m^2)
Black females	162	11.9 (0.09)	135.4 (3.2)	61.7 (0.3)	24.4 (0.51)
Black males	107	11.9 (0.10)	123.4 (4.3)	61.3 (0.5)	22.2 (0.59)
White females	496	12.6 (0.05)	122.3 (1.6)	61.8 (0.2)	21.9 (0.26)
White males	435	12.6 (0.06)	125.8 (2.0)	63.0 (0.2)	21.6 (0.25)

[a] Ethnicity main effect ($p < 0.003$)
[b,c,d] Ethnicity x gender interaction ($p < 0.03$)

three times what was expected by definition for the 85th and 95th percentiles). The most recent national estimates of overweight and obesity prevalence rates are 22.4% and 10.8% for overweight and obesity prevalence rates, respectively. [9]

Discussion

These results suggest that the obesity epidemic has affected adolescents of two school districts in the Carolinas. In fact, the data suggest that in some cases the epidemic is even worse among adolescents than among adults. For instance, overweight and obesity prevalence rates based on NHANES cutpoints[14] revealed that 36.4% of the adolescents who participated in the cholesterol screenings were overweight and 18.2% were obese. Comparable national prevalence rates among adults are 33.4% and 22.5% for overweight and obesity, respectively. [2,4] Available obesity prevalence rates among adults in North and South Carolina, respectively, are 19.0% and 20.2%. [5]

In accordance with previous reports, overweight and obesity prevalence rates varied as a function of ethnicity and gender. Fifty-four percent of black girls and 45% of black boys were overweight, and better than half of these students were actually obese. Overweight and obesity prevalence rates among black girls were nearly twice the rates observed for white girls. Ethnic differences in percentage of overweight and obese boys were not as great as those observed among girls.

Rosner's cutpoints, which were based on an evaluation of more than 66,000 youths examined in nine large epidemiologic studies (including NHANES II and NHANES III) yield more conservative overweight and obesity estimates because they include data that reflect the increase in overweight observed among youth since 1980. [11] However, to facilitate comparisons across studies, findings were also presented based on BMI cutpoints derived from the NHANES I and II databases compiled by Frisancho. [14] Frisancho's cutpoints, which tend to be used more often to assess risk for overweight and obesity, are less conservative because the reference population data collection predates the markedly increased prevalence in overweight observed between NHANES II and NHANES III (1980 and 1988).

One limitation of the present investigation is the low participation rates among all Cabarrus County students, and among minority students. Although student participation in Cabarrus County (< 50%) was less than that observed in Cherokee County (> 80%), it is probable that overweight and obesity prevalence rates were underestimated for Cabarrus County students. Older, more weight-conscious students in Cabarrus County may have chosen not to participate in the screenings. The prevalence rates among Cherokee County students, on the other hand, were derived from the entire sixth grade population with the exception of those students absent on the day of screening. It should also be noted that the minority participation is reflective of the ethnic composition of the student body in both school districts.

The study findings are also limited by the caution that must be used in extrapolating findings from two school districts to students across the Carolinas. Although Concord, NC, and Gaffney, SC, compare well with their respective states on a number of indices (i.e., educational attainment, median family income, and percentage of children under 18 below the poverty level), caution must be used in interpreting the present findings. It has been suggested that obesity varies as a function of socioeconomic status (SES), with greater levels of obesity evident at lower SES levels.[15] However, this may not hold true among ethnic minority individuals, and may no longer be case for white Americans.[16] In fact, Mokdad and colleagues reported that the greatest magnitude of increase in obesity prevalence was observed among individuals 18 to 29 years of age and among those with some college education.[5]

The obesity epidemic among youth is troubling not

Table 3. Prevalence of overweight by two cutpoint definitions[11] and mean body mass index for normal weight (NWT) and overweight (OWT) students as a function of ethnicity and gender.

		85th Percentile				95th Percentile			
		Mean BMI[a]		% OWT	(N)	Mean BMI[a]		% Obese	(N)
	N	NWT	OWT		OWT	NWT	OWT		OWT
Black females	140	19.8	29.1	46.6%	(68)	21.5	32.3	25.7%	(36)
Black males	94	18.3	27.8	41.5%	(39)	19.5	30.3	25.5%	(24)
White females	417	19.5	29.2	24.9%	(104)	20.3	32.4	13.4%	(56)
White males	373	18.9	27.0	32.4%	(121)	20.1	30.4	13.9%	(52)
Overall				32.4%				16.4%	

[a] Weight Status Main effect ($p < 0.0001$)

because of cosmetic issues, but because of the tremendous public health implications. Roughly 60% of overweight 5- to 10-year-olds are reported to have one associated biochemical or clinical cardiovascular disease risk factor, including elevated blood pressure, hyperlipidemia, or increased insulin levels, and 25% have two or more.[17] Research findings suggest that the risk factors observed in childhood often become chronic diseases in adulthood. Approximately 80% of obese adults have diabetes, high blood pressure, high blood cholesterol levels, coronary artery disease, gallbladder disease, osteoarthritis, or obesity related cancer, and almost 40% have two or more comorbid diseases. Only smoking exceeds obesity in its contribution to total mortality rates in the United States.[17]

Although it is commonly assumed that high fat diets and overeating are the primary causes of obesity, recent findings demonstrate that mean energy intake and fat consumption in industrialized countries have declined substantially as obesity rates have escalated.[18-19] Changes in the level of daily activity may account, at least in part, for this apparent discrepancy.[20] Indeed, many attribute the epidemic rise in obesity prevalence to increasingly sedentary lifestyles. For many Americans, leisure time activities are more sedentary, with television watching, video games, and Internet browsing among the most popular pastimes. Furthermore, less energy is spent in activities of daily living, and at work. More than 60% of American adults do not get the recommended amount of physical activity, and nearly half of American youth are not active on a regular basis.[21-22] In fact, America's youth were characterized by the Secretary of Health and Human Services and the Secretary of Education as largely inactive, unfit, and increasingly overweight in their Fall 2000 report to President Clinton entitled, *"Promoting Better Health for Young People Through Physical Activity and Sports."* This report states that physical inactivity not only contributes to the unprecedented epidemic of childhood obesity that is plaguing the United States, but it also threatens to reverse decades of progress made in reducing deaths from cardiovascular diseases. Such a reversal could potentially devastate the nation's health care budget.[23]

As early as 1992, the American Heart Association noted the importance of physical activity to the health and welfare of this country by declaring physical inactivity an independent risk factor for cardiovascular disease.[24] The necessity for physical activity and weight reduction is further highlighted in the *Healthy People 2010* health objectives. Unlike previous sets of national health objectives, *Healthy People 2010* identified a set of leading health indicators. Of the 10 high-priority public health areas pin-pointed for enhanced public attention, physical activity was the first leading health indicator, followed by overweight and obesity, clearly emphasizing the national importance of these issues.[23]

Unfortunately, however, as interest in promoting health through physical activity is increasing, the number of schools investing in quality physical education programs is decreasing.[25] In 1994, only 17% of junior high schools and 2% of high schools required physical education every day of the week. Currently only one state requires daily physical education in every grade, Kindergarten through 12th grade. In addition, too often, students are allowed to be exempt from physical education if they participate in experiences such as ROTC, varsity athletics, or marching band. Although children and adolescents are more physically active than adults, many engage in moderate to vigorous physical activity

less than three days per week.[23] The less than adequate support for physical education by most school districts stems, in part, from the misconception that physical education reduces the much needed instruction time and resources available for core academic subjects.[25] In other words, physical education is often relegated to a low priority. However, contrary to this belief, quality physical education is far from expendable. In addition to its positive health effects, evidence suggests that physical activity enhances performance in reading, math, and science; improves self-image, self-confidence and mood; and decreases anxiety, tension, and behavioral problems. Hence, schools that invest in quality physical education are in a unique position not only to influence public health but also to maximize student performance. In Cabarrus County, we are taking advantage of the opportunity provided by schools to improve the health and welfare of our youth. We are implementing an innovative project entitled *Nurturing-Student Health and Academics with Quality Physical Education* (Project N-SHAPE), which is designed to address the growing problem of childhood obesity. We hope to demonstrate that quality physical education nurtures both student health and fitness and student academic performance, and prepares students for a lifelong commitment to an active, health-conscious lifestyle.

In conclusion, a number of factors may contribute to the unprecedented levels of overweight and obesity observed among American youth, including physical inactivity, poor nutritional habits (i.e., high-fat meals and snacks, and supersizing), and economic and social factors. Consequently, the coordinated efforts of physicians, school nurses, teachers, parents, and students will be necessary to effectively address the growing problem of childhood obesity.

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