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Prevalence of Overweight and At Risk of Overweight in Fourth-Grade Children across Five School-Based Studies Conducted during Four School Years

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Abstract

Purpose/Objectives—This article discusses differences by ethnicity (Black, White), gender, and time (season/year) in body mass index (BMI)-for-age percentiles, and prevalence of overweight and at risk of overweight, in fourth-grade children across five studies conducted during four school years. These five studies concerned either the accuracy of children's dietary recalls or children's social desirability, so weight and height measurements were secondary rather than primary aims.

Methods—Across five studies, 1,696 fourth-grade children (54% Black, 46% White; 51% girls) from a total of 14 public elementary schools in one school district were measured. Each child's BMI-for-age percentile was determined using the Centers for Disease Control and Prevention's gender-specific BMI-for-age growth charts.

Results—Across all five studies, 20 children (1.2%) were underweight (<5th percentile), 989 children (58.3%) were at a healthy weight (≥5th and <85th percentiles), 281 children (16.6%) were at risk of overweight (≥85th and <95th percentiles), and 406 children (23.9%) were overweight (≥95th percentile). The mean gender-specific BMI-for-age percentile across all children was high (70.1%) and greater for Black children (72.0%) than White children (67.8%) (p=0.02; analysis of covariance). A higher percentage of Black children (26.5%) compared to White children (21.0%) were overweight (p=0.01; chi-square). No differences were found by gender or time in the prevalence of children who were overweight; likewise, no differences were found by ethnicity, gender, or time in the prevalence of children who were at risk of overweight.

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Applications to Child Nutrition Professionals—Schools provide an excellent venue for measuring children’s weight and height annually to determine BMI-for-age percentiles. This information can be used to track changes over time, and linked to computerized administrative records of children’s daily participation in school meals from one school year to the next to increase knowledge of a relationship between childhood obesity and daily participation in school meals.

INTRODUCTION

The health consequences of overweight and obesity are public health issues that are among the most burdensome faced by the nation (Office of the Surgeon General, 2001). Overweight youth are at increased risk for adverse levels of several cardiovascular disease risk factors (Freedman et al., 1999); in addition, type two diabetes, early maturation, and orthopedic problems are exhibited more frequently in overweight youth (Office of the Surgeon General, 2001). Furthermore, youth with high body mass index (BMI)-for-age percentiles have high risks of being overweight or obese in adulthood (Guo et al., 2002).

The use of BMI (kg/m^2) is recommended to identify youth who are overweight or at risk of becoming overweight (Centers for Disease Control and Prevention [CDC], 2006a). Based on the CDC’s gender-specific BMI-for-age growth charts for ages two to 20 years, youth with a BMI-for-age percentile below the fifth percentile are categorized as *underweight*, youth at or above the fifth percentile and up to the 85th percentile are categorized as *healthy weight*, youth at or above the 85th percentile and up to the 95th percentile are categorized as *at risk of overweight*, and youth at or above the 95th percentile are categorized as *overweight* (CDC, 2006b).

National survey data have shown an increase in the prevalence of overweight among youth in the U.S. (CDC, 2006a). In the National Health and Nutrition Examination Survey (NHANES) III conducted in 1988 to 1994, rates of overweight were 11% for all youth ages six to 19 years; rates rose to 16% in NHANES 1999–2002 for all youth ages six to 19 years (CDC, 2006a). Therefore, over a period of approximately 10 years, there was a five percent increase in the rate of overweight among youth. Although there have been continuing increases in overweight among youth, the overall prevalence of overweight in youth showed no change between NHANES 1999–2000 and NHANES 2001–2002 (Hedley et al., 2004). Studies have found differences in overweight prevalence among youth by ethnicity (Hedley et al., 2004; Kimm et al., 2002; Melnik et al., 1998; Ogden et al., 2002), gender (Hedley et al., 2004; Melnik et al., 1998), and socioeconomic status (SES) (Moore et al., 2002; Wolfe et al., 1994).

This article discusses differences by ethnicity (Black, White), gender, and time (season/year) in BMI-for-age percentiles, and prevalence of overweight and at risk of overweight, in fourth-grade children (approximately nine to 10 years of age) across five school-based studies conducted during four school years between Spring 2000 (Study One) and Fall 2002 (Study Five). These studies concerned either the accuracy of children’s dietary recalls or children’s social desirability; thus, weight and height measurements were secondary rather than primary aims. Results concerning the accuracy of children’s dietary recalls (Baxter et al., 2004b; Baxter et al., 2002; Baxter et al., 2003a; Baxter et al., 2003b) and children’s social desirability (Baxter et al., 2004a) are reported elsewhere.

METHODOLOGY

An Institutional Review Board approved each study, and child assent and parental consent were obtained in writing prior to data collection. Children were recruited from all fourth-

grade classes from a total of 14 public elementary schools in Richmond County, Georgia. The schools were selected based on high participation in school meals (breakfast, lunch) because four of the five studies used observation of school meals to validate these parts of children's dietary recalls. Table 1 provides details by study including the number of schools, eligibility for free or reduced-price school meals, agreed participation rates, number of children measured by ethnicity and gender, and month, year, and time of day of measurements. Information concerning children's ethnicity, gender, and date of birth was obtained from schools.

Weight and height were measured by research staff in a private location at school. Children removed their shoes and heavy jackets prior to being measured. Weights were measured using digital scales (calibrated daily) according to a written protocol and recorded to the nearest tenth of a pound; heights were measured using portable stadiometers according to standardized procedures and recorded to the nearest eighth of an inch (Lohman et al., 1988; U.S. Department of Health and Human Services, n.d.). Weight and height were measured once per child for Study One and twice per child for Studies Two through Five. If the two weight or height measurements per child were not within a tenth of a pound, or a quarter of an inch, respectively, then a third weight or height was measured. If three weight and/or height measurements were obtained per child, then the average of the closest two was used for the child's weight and/or height, respectively.

Because measurements were obtained by more than one research team member for each study, inter-rater reliability was assessed. For training purposes, research team members measured adults at the research office. While measuring children in schools, inter-rater reliability was assessed across pairs of research team members; on a daily basis, approximately 10% of all children measured were randomly selected and measured by each research team member in the pair. Results from inter-rater reliability showed that for all five studies, the intraclass correlation reliability was >0.99 for weight and for height; these inter-rater reliability results indicate that there was good agreement on weight and height measurements for the randomly selected children.

The child's age at the time of measurement was calculated by subtracting the date of birth from the date of measurement. The CDC's gender-specific BMI-for-age growth charts for youth aged two to 20 years were used to determine each child's BMI-for-age percentile (Kuczmarski et al., 2002).

The primary dependent variable was the child's BMI-for-age percentile. Analysis of covariance was used to compare BMI-for-age percentiles by ethnicity (Black, White) and gender and across study times. Due to differences in the timing of data collection for the five studies, for analysis, time codes were assigned as follows to reflect the season and year of measurement of the four school years: 1 = Spring, 2000; 2 = Spring, 2001; 3 = Spring, 2002; and 3.5 = Fall, 2002. Percentile data were rank-transformed due to asymmetry of the sample distributions.

Children were categorized as underweight, healthy weight, at risk of overweight, or overweight according to their BMI-for-age percentile. Percentages of children in the overweight category, and the category for at risk of overweight, were compared by ethnicity and gender using Pearson's chi-square statistic, and across times using the Mantel-Haenszel chi-square test for trend. To maintain an overall alpha level of 0.05, a Bonferroni adjustment for multiple comparisons was used.

Children of other ethnic groups ($n=73$) were excluded from analysis due to the small number. Because eight children who repeated fourth grade had participated in more than one of the five studies, only measurements from the first study in which an individual child

participated were used for data analysis. Analyses were conducted using SAS® (Release 8.02 [TS2M0], SAS Institute, Inc, Cary, NC). Child was the unit of analysis.

RESULTS AND DISCUSSION

Across all five studies, 1,696 children (54% Black, 46% White; 51% girls) were measured. Table 2 shows the percent and number of children in each BMI category overall and by ethnicity and gender. Across all five studies, 1.2% of children were underweight, 58.3% were at a healthy weight, 16.6% were at risk of overweight, and 23.9% were overweight.

The mean BMI-for-age percentile was 70.1%. It was greater for Black (72.0%) than White (67.8%) children ($p=0.02$, analysis of covariance); however, given the large sample of 1,696 and p -value 0.02, the means are actually quite close. What is of more interest is that the mean BMI-for-age percentiles are considerably larger than the 50% that would be expected if the population from which we sampled was like the one on which the norms were based. None of the two- or three-way interactions in the analysis of covariance were significant (p 's <0.27).

A higher percentage of Black (26.5%) compared to White children (21.0%) were overweight ($p=0.01$, chi-square). No differences were found in the prevalence of overweight by gender ($p=0.29$, chi-square; girls=22.9%, boys=25.1%) or time ($p=0.56$, chi-square; Time 1=24.6%, Time 2=22.6%, Time 3=23.0%, Time 3.5=27.7%).

No differences were found in the prevalence of at risk of overweight by ethnicity ($p=0.23$, chi-square; Black=17.6%, White=15.4%), gender ($p=0.04$, chi-square [not significant after adjustment for multiple comparisons]; girls=18.4%, boys=14.7%), or time ($p=0.37$, chi-square; Time 1=15.2%, Time 2=16.2%, Time 3=17.8%, Time 3.5=16.8%).

The rate of overweight among this sample of fourth-grade children in Richmond County, Georgia at 23.9% between Spring, 2000 and Fall, 2002, is higher than the national rate of 16% reported in NHANES 1999–2002 for youth ages six to 19 years (CDC, 2006a). Data collected elsewhere in Georgia also indicate greater percentages of overweight children than the national rate. For example, the Georgia Center on Obesity and Related Disorders conducted the Washington-Wilkes Health Study in late Spring, 2002 (Davis et al., 2005). (Washington-Wilkes, Georgia is approximately 50 miles west of where the five studies for the current article were conducted.) Results from the Washington-Wilkes Health Study, with 211 youth in grades two, four, six, eight, 10, and 11, showed that 20.9% were at risk of overweight and 27.5% were overweight (Davis et al., 2005). For the 38 fourth-grade children measured, 61% were at risk of overweight. Thus, the prevalence of youth who were overweight or at risk of overweight in a nearby rural community was slightly higher than that in our sample. However, the participation rate in their study was 37% (Davis et al., 2005), while participation rates in our five studies were higher and ranged from 57% to 73% (Table 1).

Our finding that more Black than White children were overweight is similar to findings of Kimm et al. (2002) and Hedley et al. (2004), but different from Melnik et al. (1998), Ogden et al. (2002), and Davis et al. (2005). Among 2,379 girls enrolled at ages nine to 10 years in 1987–1988 in the National Heart, Lung, and Blood Institute Growth and Health Study, Kimm et al. (2002) reported that the prevalence of obesity (defined as $\geq 95^{\text{th}}$ percentile for BMI-for-age from CDC) at age nine was 17.7% for Black girls and 7.7% for White girls, and at age 10 was 18.5% for Black girls and 9.4% for White girls. For 2,214 children ages six through 11 years in NHANES 1999–2002, Hedley et al. (2004) reported that the prevalence of overweight (defined as $\geq 95^{\text{th}}$ percentile for BMI-for-age based on CDC growth charts) among non-Hispanic Whites (13.5%) was less than that of non-Hispanic

Blacks (19.8%) and Mexican Americans (21.8%). For 692 second- and 704 fifth-grade children in New York City during the 1989–1990 school year, Melnik et al. (1998) found that, for fifth-grade children, more Hispanics were $\geq 85^{\text{th}}$ percentile (40.2%) compared to White (32.0%) and Black (29.5%) non-Hispanics, and more Hispanics were $\geq 95^{\text{th}}$ percentile (23.9%) compared to White (19.5%) and Black (16.0%) non-Hispanics, but no differences were reported between White and Black non-Hispanics. For 1,054 children ages six to 11 years in 1999–2000 NHANES, Ogden et al. (2002) reported that more Mexican-Americans (23.7%) were overweight (defined as $\geq 95^{\text{th}}$ percentile of BMI-for-age based on CDC growth charts) compared to Non-Hispanic Whites (11.8%), but no differences were reported between Whites and non-Hispanic Blacks. For 211 youth in grades two through 11 in Washington-Wilkes, Georgia in Spring, 2002, Davis et al. (2005) did not find differences in the percent of White and Black youth with BMI $\geq 85^{\text{th}}$ percentile.

We did not find a difference by gender in the prevalence of children who were overweight or at risk of overweight. In the Melnik et al. (1998) study, there was not a gender difference at the 85^{th} percentile cutoff, but more fifth-grade boys (21.8%) than girls (14.6%) were $\geq 95^{\text{th}}$ percentile. For children ages six through 11 years in NHANES 1999–2002, Hedley et al. (2004) found that among boys, the prevalence of overweight was lower among non-Hispanic Whites (14.0%) and non-Hispanic Blacks (17.0%) compared to Mexican Americans (26.5%); however, among girls, the prevalence of overweight was lower among non-Hispanic Whites (13.1%) compared to non-Hispanic Blacks (22.8%), but neither of these differed from Mexican Americans (17.1%). For the Washington-Wilkes Health Study, Davis et al. (2005) did not find a gender difference in the prevalence of overweight or at risk of overweight. For NHANES 1999–2000, Ogden et al. (2002) did not find a gender difference in the prevalence of overweight among children ages six to 11 years.

Hedley et al. (2004) found no change in the overall prevalence of overweight in youth between NHANES 1999–2000 and NHANES 2001–2002. Our results are similar because we found no differences in the percent overweight and at risk of overweight from Spring, 2000 to Fall, 2002.

In a study reported by Moore et al. (2002), 121 Black and 132 White children were measured at an initial visit (mean age 8.8 ± 2.0 years) and again seven years later; children were classified as overweight if BMI was $> 85^{\text{th}}$ percentile, which differs from definitions used for this article. Moore et al. (2002) found an increase in the prevalence of overweight (30.8% to 40.3%) for all children across seven years. The increase differed by SES, but not by ethnicity or gender: Lower SES youths exhibited the greatest increases in percent overweight (Moore et al., 2002). In a study with ~1,800 second- and fifth-grade children in New York state between Spring, 1987 and Spring, 1988, Wolfe et al. (1994) found that children who tended to be fatter were members of low-SES, two-parent households. For our five studies, we only had SES information at the school-level (Table 1), so we could not analyze our data by SES at the individual child level. We did not analyze our data by school because the number of schools differed for each time period, and only two of the 14 schools (B and E) were used during all four time periods for the five studies (Table 1).

There are several limitations. These five studies were not designed to assess the prevalence of overweight or at risk of overweight. Analyses were performed on cross-sectional, not longitudinal, data. There were not enough Hispanic students to analyze their data. Most (64%) of our sample came from times two and three (Studies Two through Four).

These limitations are offset by two strengths. First, measurements were obtained by research staff instead of being self-reported by children; studies have shown that youth ages 11 through 20 years underreport weight (Fortenberry, 1992; Himes & Story, 1992; Shannon et

al., 1991; Tienboon et al., 1992) and overreport height (Fortenberry, 1992; Tienboon et al., 1992). Second, inter-rater reliability of measurements was assessed throughout data collection for each of our five studies. Publications of studies by Kimm et al. (2002), Moore et al. (2002), and Hedley et al. (2004) failed to mention assessment of inter-rater reliability. Wolfe et al. (1994) reported inter-rater reliability ranging from 96% to 100%. Melnik et al. (1998) reported that “periodic retraining of the field team...was conducted throughout the course of the data collection phase”, however, inter-rater reliability was not specifically reported.

CONCLUSIONS AND APPLICATION

The overall rate for overweight of 23.9% in this Georgia sample was 1.5 times higher than the national rate of 16%, and both are higher than the rate set forth by the Healthy People 2010 objective, which is to reduce the proportion of overweight children to no more than 5% (U.S. Department of Health and Human Services, 2000). Our findings of high prevalence of overweight and at risk of overweight in youth are of concern considering that Richmond County has cardiovascular disease death rates that are in the top 25 of 159 counties in Georgia (Rowe et al., 1999) and overweight youth are at increased risk for future cardiovascular disease (Georgia Department of Human Resources, 2000).

In 2003, the American Academy of Pediatrics Committee on Nutrition issued a policy statement concerning the prevention of pediatric overweight and obesity and recommended that 1) children’s BMI be calculated and plotted once a year, 2) parents and caregivers promote healthy eating patterns by offering nutritious foods, and 3) policy makers from local, state, and national organizations and schools be enlisted to support healthful lifestyles for all children (Committee on Nutrition, 2003). In Arkansas, Act 1220 of 2003 mandated schools to weigh and measure students and to provide parents with an annual BMI percentile (Arkansas General Assembly, 2003). According to a study by Chomitz et al. (2003) that evaluated a school-based health report card on family awareness of, and concerns about, children’s weight status, parents of overweight children who received health and fitness reports were more aware of their child’s weight status than those who did not receive any information; in addition, these parents were more likely to report initiating or intending to initiate activities related to weight control. Examples of strategies being implemented in many schools, as well as types of legislation under consideration by several states to improve children’s nutrition, are provided by the dietary recommendations for children and adolescents from the American Heart Association and the American Academy of Pediatrics (Gidding et al., 2005).

The Child Nutrition and WIC Reauthorization Act of 2004 requires local education agencies that sponsor school meal programs to establish local school wellness policies addressing childhood obesity by the beginning of the 2006–07 school year (U.S. Congress, 2004). Results from focus groups conducted with school foodservice directors in Pennsylvania in June, 2005, indicated that although the majority anticipated they would play a lead role in the development of the required local wellness policies, varying degrees of comfort with this role were expressed (McDonnell et al., 2006).

In a joint position statement, the American Dietetic Association, the Society for Nutrition Education, and the American School Food Service Association [now the School Nutrition Association] (2003) asserted that “...*comprehensive nutrition services must be provided to all of the nation’s preschool through grade twelve students. These nutrition services shall be integrated with a coordinated, comprehensive, school health program and implemented through a school nutrition policy. The policy should link comprehensive, sequential nutrition education; access to and promotion of child nutrition programs providing nutritious meals*

and snacks in the school environment; and family, community, and health services' partnerships supporting positive health outcomes for all children."

The position of the American Dietetic Association (2006) is that *"schools and the community have a shared responsibility to provide all students with access to high-quality foods and school-based nutrition services as an integral part of the total education program. Educational goals, including the nutrition goals of the National School Lunch Program and School Breakfast Program, should be supported and extended through school district wellness policies that create overall school environments that promote access to healthful school meals and physical activity and provide learning experiences that enable students to develop lifelong healthful eating habits."*

Large and extra-large portion sizes have been implicated as an environmental contribution to the obesity epidemic (Hill & Peters, 1998). School meal programs provide age-appropriate serving sizes to the millions of children who participate in school breakfast, school lunch, and/or school snacks on a daily basis. Thus, school foodservice directors may want to use serving sizes provided for school meals and snacks to help educate children, teachers, and parents about age-appropriate serving sizes.

Because food assistance programs serve many individuals who are obese, there is concern that participation in food assistance programs may precipitate the growing problems of obesity (Hofferth & Curtain, 2005; U.S. Department of Agriculture, 2005). However, an Expert Panel convened in March, 2004, to identify scientific evidence about this topic found no published research providing evidence of a consistent relationship between childhood obesity and participation in the School Breakfast Program and National School Lunch Program (U.S. Department of Agriculture, 2005). Research to date about this relationship has been limited by 1) categorizing children as "fed" or "non-fed" based on administrative records of children's participation in school lunch during the previous school year (Paige, 1971); 2) parent's reports of children's average weekly participation in school breakfast and school lunch (Vermeersch et al., 1984); 3) parent's "yes" or "no" reports of children's participation in school lunch (Melnik et al., 1998; Wolfe et al., 1994); and 4) parent's "yes" or "no" reports of children's participation in school breakfast and school lunch within the previous year (Hofferth & Curtain, 2005; Jones et al., 2003). To our knowledge, no study has investigated the relationship between childhood obesity and *daily* participation in school meals (when daily participation is a continuous variable). Although we included weight and height measurements as secondary aims in our five studies, unfortunately, we did not obtain parental permission for the school nutrition program to release information to us about children's daily participation in school meals.

Although it is encouraging that more schools are obtaining annual weight and height measurements, certain methodological aspects deserve consideration. First, the time of day of measurements should be standardized from one year to the next when tracking individual children's annual BMI. Second, measurers should be properly trained, and inter-rater reliability should be performed throughout data collection to ascertain that measurements do not vary based on which measurer obtained them. Height can be especially challenging to measure, and differences of one inch can change a child's BMI category. For example, using the "Child and Teen BMI Calculator" (CDC, 2006b), a girl who weighs 75 pounds at age 9 years and 1 month is categorized as having a healthy weight if her measured height is 53 inches, but at risk of overweight if her measured height is 52 inches. Third, obtaining measurements in a private location at school is important to help relieve concerns that some children may have about other children knowing their weight.

Schools provide an excellent venue for measuring children's weight and height annually to determine BMI-for-age percentiles. This information can be used to track changes over time, which can help schools determine whether the wellness policies implemented are effective and provide ongoing information about the health status of the school population (Crawford et al., n.d.). Future research could link children's annual BMI-for-age percentiles to computerized administrative records of children's daily participation in school meals from one year to the next to increase knowledge of a relationship between childhood obesity and daily participation in school meals.

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REFERENCES

- American Dietetic Association. Position of the American Dietetic Association, Society for Nutrition Education, and American School Food Service Association – Nutrition services: An essential component of comprehensive school health programs. *Journal of the American Dietetic Association* 2003;103:505–514. [PubMed: 12669016]
- American Dietetic Association. Position of the American Dietetic Association: Local support for nutrition integrity in schools. *Journal of the American Dietetic Association* 2006;106:122–133. [PubMed: 16390677]
- Arkansas General Assembly. An act to create a Child Health Advisory Committee, Act 1220 of 2003. 2003 Apr. Retrieved December 17, 2006, from http://www.healthyearkansas.com/advisory_committee/pdf/act1220.pdf.
- Baxter SD, Smith AF, Litaker MS, Baglio ML, Guinn CH, Shaffer NM. Children's social desirability and dietary reports. *Journal of Nutrition Education and Behavior* 2004a;36:84–89. [PubMed: 15068757]
- Baxter SD, Smith AF, Litaker MS, Guinn CH, Shaffer NM, Baglio ML, Frye FHA. Recency affects reporting accuracy of children's dietary recalls. *Annals of Epidemiology* 2004b;14:385–390. [PubMed: 15246326]
- Baxter SD, Thompson WO, Litaker MS, Frye FHA, Guinn CH. Low accuracy and low consistency of fourth-graders' school breakfast and school lunch recalls. *Journal of the American Dietetic Association* 2002;102:386–395. [PubMed: 11905461]
- Baxter SD, Thompson WO, Litaker MS, Guinn CH, Frye FHA, Baglio ML, Shaffer NM. Accuracy of fourth-graders' dietary recalls of school breakfast and school lunch validated with observations: In-person versus telephone interviews. *Journal of Nutrition Education and Behavior* 2003a;35:124–134. [PubMed: 12773283]
- Baxter SD, Thompson WO, Smith AF, Litaker MS, Yin Z, Frye FHA, Guinn CH, Baglio ML, Shaffer NM. Reverse versus forward order reporting and the accuracy of fourth-graders' recalls of school breakfast and school lunch. *Preventive Medicine* 2003b;36:601–614. [PubMed: 12689806]
- Centers for Disease Control and Prevention, National Center for Health Statistics. Prevalence of overweight among children and adolescents: United States, 1999–2002. 2006a Oct. Retrieved December 17, 2006 from <http://www.cdc.gov/nchs/products/pubs/pubd/hestats/overwght99.htm>.
- Centers for Disease Control and Prevention. BMI - Body mass index: About BMI for children and teens. 2006b Aug. Retrieved December 17, 2006, from www.cdc.gov/nccdphp/dnpa/bmi/childrens_BMI/about_childrens_BMI.htm.

- Chomitz VR, Collins J, Kim J, Kramer E, McGowan R. Promoting healthy weight among elementary school children via a health report card approach. *Archives of Pediatrics and Adolescent Medicine* 2003;157:765–772. [PubMed: 12912782]
- Committee on Nutrition. American Academy of Pediatrics Policy Statement: Prevention of pediatric overweight and obesity. *Pediatrics* 2003;112:424–430. [PubMed: 12897303]
- Crawford, P.; Woodward-Lopez, G.; Ikeda, J. Weighing the risks and benefits of BMI reporting in the school setting. Berkeley: Center for Weight and Health, University of California; n.d. Retrieved December 17, 2006 from http://nature.berkeley.edu/cwh/PDFs/BMI_report_cards.pdf.
- Davis CL, Flickinger B, Moore D, Bassali R, Baxter SD, Yin Z. Prevalence of cardiovascular risk factors in schoolchildren in a rural Georgia community. *The American Journal of the Medical Sciences* 2005;330:53–59. [PubMed: 16103784]
- Fortenberry JD. Reliability of adolescents' reports of height and weight. *Journal of Adolescent Health* 1992;13:114–117. [PubMed: 1627577]
- Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: The Bogalusa Heart Study. *Pediatrics* 1999;103:1175–1182. [PubMed: 10353925]
- Georgia Department of Human Resources, Division of Public Health, Family Health Branch, Nutrition Section. Status of obesity in Georgia, 2000. 2000 Retrieved December 17, 2006 from <http://health.state.ga.us/pdfs/familyhealth/nutrition/obesity2000.pdf>.
- Gidding SS, Dennison BA, Birch LL, Daniels SR, Gilman MW, Lichtenstein AH, Rattay KT, Steinberger J, Stettler N, Van Horn L. Dietary recommendations for children and adolescents: A guide for practitioners. Consensus statement from the American Heart Association; endorsed by the American Academy of Pediatrics. *Circulation* 2005;112:2061–2075. [PubMed: 16186441]
- Guo SS, Wu W, Chumlea WC, Roche AF. Predicting overweight and obesity in adulthood from body mass index values in childhood and adolescence. *American Journal of Clinical Nutrition* 2002;76:653–658. [PubMed: 12198014]
- Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM. Prevalence of overweight and obesity among US children, adolescents, and adults, 1999–2002. *Journal of the American Medical Association* 2004;291:2847–2850. [PubMed: 15199035]
- Hill JO, Peters JC. Environmental contributions to the obesity epidemic. *Science* 1998;280:1371–1374. [PubMed: 9603719]
- Himes JH, Story M. Validity of self-reported weight and stature of American Indian youth. *Journal of Adolescent Health* 1992;13:118–120. [PubMed: 1627578]
- Hofferth SL, Curtin S. Poverty, food programs, and childhood obesity. *Journal of Policy Analysis and Management* 2005;24:703–726. [PubMed: 16201056]
- Jones SJ, Jahns L, Laraia BA, Haughton B. Lower risk of overweight in school-aged food insecure girls who participate in food assistance. *Archives of Pediatric and Adolescent Medicine* 2003;157:780–784.
- Kimm, SYS.; Barton, BA.; Obarzanek, E.; McMahon, RP.; Kronsberg, SS.; Waclawiw, MA.; Morrison, JA.; Schreiber, GB.; Sabry, ZI.; Daniels, SR. Obesity development during adolescence in a biracial cohort: The NHLBI Growth and Health Study; *Pediatrics*. 2002. p. e54 Retrieved December 17, 2006 from <http://www.pediatrics.org/cgi/content/full/110/5/e54>.
- Kuczmariski, RJ.; Ogden, CL.; Guo, SS.; Bogus, CH. 2000 CDC growth charts for the United States: Methods and development (pp. Vital Health Stat 11(246)). National Center for Health Statistics; 2002.
- Lohman, TG.; Roche, AF.; Martorell, R. Anthropometric standardization reference manual. Champaign, IL: Human Kinetics Books; 1988.
- McDonnell E, Probart C, Weirich JE. School foodservice directors' perceptions and concerns about local wellness policy development, implementation, and enforcement. *Journal of Child Nutrition & Management*, 1. 2006 Retrieved December 17, 2006 from <http://docs.schoolnutrition.org/newsroom/jcnm/06spring/mcdonnell/index.asp>.
- Melnik TA, Rhoades SJ, Wales KR, Cowell C, Wolfe WS. Overweight school children in New York City: Prevalence estimates and characteristics. *International Journal of Obesity* 1998;22:7–13. [PubMed: 9481594]

- Moore DB, Howell PB, Treiber FA. Changes in overweight in youth over a period of 7 years: Impact of ethnicity, gender and socioeconomic status. *Ethnicity and Disease* 2002;12:S1-83-S81-86. [PubMed: 11913626]
- Office of the Surgeon General. The Surgeon General's call to action to prevent and decrease overweight and obesity. 2001. Retrieved on December 17, 2006 from <http://www.surgeongeneral.gov/topics/obesity/>.
- Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999–2000. *Journal of the American Medical Association* 2002;288:1728–1732. [PubMed: 12365956]
- Paige DM. The school feeding program: An underachiever. *Journal of School Health* 1972;42:392–395. [PubMed: 4483997]
- Rowe, AK.; Powell, KE.; Hall, V. The 1999 Georgia State of the Heart Report. 1999 Feb. Retrieved December 17, 2006 from Georgia Department of Human Resources, Division of Public Health, Cardiovascular Health Section, and the American Heart Association, Southeast Affiliate: <http://health.state.ga.us/pdfs/chronic/stateheart1999.pdf>.
- Shannon B, Smiciklas-Wright H, Wang MQ. Inaccuracies in self-reported weights and heights of a sample of sixth-grade children. *Journal of the American Dietetic Association* 1991;91:675–678. [PubMed: 2040781]
- Tienboon P, Wahlqvist ML, Rutishauser IHE. Self-reported weight and height in adolescents and their parents. *Journal of Adolescent Health* 1992;13:528–532. [PubMed: 1390822]
- U. S. Congress. Child Nutrition and WIC Reauthorization Act of 2004. 2004 Jun. Retrieved December 17, 2006 from http://www.fns.usda.gov/cnd/Governance/Legislation/Historical/PL_108-265.pdf.
- U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition, and Evaluation. Report No. FSP-04-PO. Obesity, poverty, and participation in nutrition assistance programs: Summary. 2005 Feb. Retrieved on December 17, 2006 from <http://www.fns.usda.gov/oane/MENU/Published/NutritionEducation/Files/ObesityPovertySum.pdf>.
- U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. Accurately weighing & measuring: Technique. n.d.. Retrieved December 17, 2006 from <http://depts.washington.edu/growth/module5/text/intro.htm>.
- U.S. Department of Health and Human Services. Healthy People 2010: Volume II (second edition) objectives for improving health (Part B: Focus Areas 15 - 28). 2000 Nov. Retrieved on December 17, 2006 from <http://www.healthypeople.gov/Publications/>.
- Vermeersch J, Hanes S, Gale S. The National Evaluation of School Nutrition Programs: Program impact on anthropometric measures. *American Journal of Clinical Nutrition* 1984;40:414–424. [PubMed: 6465073]
- Wolfe WS, Campbell CC, Frongillo EA Jr, Haas JE, Melnik TA. Overweight schoolchildren in New York State: Prevalence and characteristics. *American Journal of Public Health* 1994;84:807–813. [PubMed: 8179053]

Table 1

Details concerning each of the five studies

| | Study One | Study Two | Study Three | Study Four | Study Five |
|--|----------------------------------|---|--|-------------------|----------------------------------|
| Number of Schools | 6 | 11 | 10 | 3 | 6 |
| School codes * | A,B,C,D,E,F | A,B,C,D,E,G,H,I,J,K,L | A,B,C,D,E,G,H,I,J,K | F,M,N | B,E,F,G,K,M |
| Percent of children (from most to least) across all grades in a school who were eligible to receive free or reduced-price school meals during the school year of data collection | 91%, 83%, 71%, 68%, 66%, and 36% | 74%, 73%, 72%, 69%, 66%, 64%, 59%, 57%, 50%, 40%, and 33% | 79%, 72%, 71%, 67%, 61%, 60%, 59%, 46%, 45%, and 27% | 96%, 91%, and 69% | 82%, 79%, 75%, 73%, 70%, and 60% |
| Number (%) who agreed to participate (1,897 total) | 376 (72%) | 635 (73%) | 432 (57%) | 158 (66%) | 296 (71%) |
| Number measured ** (1,696 total) | 330 | 575 | 363 | 154 | 274 |
| Number of Black boys (435 total) | 70 | 144 | 81 | 59 | 81 |
| Number of Black girls (475 total) | 73 | 147 | 90 | 69 | 96 |
| Number of White boys (395 total) | 88 | 133 | 104 | 16 | 54 |
| Number of White girls (391 total) | 99 | 151 | 88 | 10 | 43 |
| Month and year of measurements | March, 2000 | March, 2001 | March, 2002 | April/May, 2002 | November 2002 |
| Time of day of measurements | Afternoon | Afternoon | Afternoon | Afternoon | Morning |
| Time code for analysis *** | Time 1 | Time 2 | Time 3 | Time 3 | Time 3.5 |

* Although a total of 14 schools participated in the five studies, no school participated in each of the five studies; thus, school codes are provided to indicate which of the 14 schools were included in which study (or studies).

** Not all of the children who agreed to participate in each study were measured; this was primarily due to withdrawal from school after child assent and parental consent were obtained and before the measurement date, or due to absence from school at the time of measurement. Because eight children who repeated fourth grade had participated in more than one of the five studies, only measurements from the first study in which an individual child participated were used for data analysis.

*** Data collection for Studies One through Three occurred in March in three consecutive years, while data collection for Study Four occurred in April/May in the same year as Study Three, and data collection for Study Five occurred in the fall of the same year as Studies Three and Four. Due to differences in the timing of data collection for the five studies, for analysis, time codes were assigned to reflect the season and year of measurement for the four school years.

Percent and number of children in gender-specific BMI categories (as defined by the Centers for Disease Control and Prevention, 2006) overall and by ethnicity and gender

Table 2

| BMI Category | % (n) | | | |
|---|-----------------|--------------------|---------------------|---------------------|
| | Total (n=1,696) | Black boys (n=435) | Black girls (n=475) | White girls (n=391) |
| Underweight (< 5 th percentile) | 1.2% (20) | 0.7% (3) | 1.5% (7) | 1.3% (5) |
| Healthy weight (≥5 th and <85 th percentiles) | 58.3% (989) | 57.0% (248) | 52.8% (251) | 62.9% (246) |
| At risk of overweight (≥85 th and <95 th percentiles) | 16.6% (281) | 15.9% (69) | 19.2% (91) | 17.4% (68) |
| Overweight (≥95 th percentile) | 23.9% (406) | 26.4% (115) | 26.5% (126) | 18.4% (72) |