Anthropometric Measurements Used To Assess Adiposity In African American Elementary School Children

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ANTHROPOMETRIC MEASUREMENTS USED TO ASSESS ADIPOSITY IN AFRICAN AMERICAN ELEMENTARY SCHOOL CHILDREN

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Over nine million children 6-17 years old are overweight in the United States. They may face the highest risk ever for overweight, obesity, and associated health problems as adults. This study's purpose was to evaluate adiposity measurement methods in children by comparing accuracy, cost effectiveness, ease of use, and practicality. IRB approval, parental consent and student assent were obtained. Data were collected by trained employees at six elementary schools on 789 subjects for boys (n= 391) and girls (n=398) 5-11 years old African American children. Hip and waist circumferences, height, and weight were collected. BMI, Waist to Hip Ratio (WHR), and Waist to Height Ratio (WHTR) were calculated. Upon analysis, weight and hip circumference were correlated (r = .94135) and waist circumference was correlated to BMI (r = .92396). The measures of adiposity were highly correlated indicating that a variety of anthropometric measurements can be used for measuring children.

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CHAPTER I

INTRODUCTION

Obesity has exploded onto the forefront of The United States' health concerns and agenda. This swift rise in concern is due to the rapidly increasing health costs associated with the condition and the ever more apparent realization that the prevalence of this disease continues to rise. Of equal concern is the steadily increasing prevalence of overweight and obesity among America's youth. This concern has been made all the more pressing with the increase in diagnoses of comorbidities previously associated with obesity in adulthood (Fagot-Campagna, 2000; Rosenbloom, 1999). Since 1978 the rate of obesity in the United States has more than tripled for children 6 to 11 years old and now more than 4 million children within this age range are overweight or at risk for overweight (Ogden, 2008; Institute of Medicine, 2005; Hedley, 2004; Ogden, 2002). Without slowing or reversing this trend, American children today will experience the highest risk ever for overweight, obesity and associated health problems in their futures (Ogden, 2008; Wang, 2008; Institute of Medicine).

Overweight or at risk for overweight in children is defined as having a BMI $\geq$ the 85^{th} percentile and $<$ the 95^{th} percentile for age. Overweight is defined as BMI $\geq$ the 95^{th} percentile for age. These percentages come from plotting a distribution of all weights for a given height at a particular age and gender. This classification system creates two major divisions, one for male and another for female. Within these two divisions a specific distribution exists for each age by gender.

Multiple studies have made estimates of the overall costs of obesity in terms of lost time at work, direct medical costs, and social care costs. Economic costs associated with obesity in the United States for 2004 were estimated at $117 billion (Human Health Services, 2004). Additionally, obesity related avoidable medical costs for the same period were estimated at $50 billion (Human Health Services). More recently, Wang and others performed research to approximate future costs and arrived at some alarming although, not totally unexpected figures. They estimate that the economic cost of overweight/obesity will double each decade and by the year 2030 will be between $860-957 billion, an amount equivalent to 16-18% of all US healthcare costs at that time (Wang). By extrapolating backward the amount for 2010 may be approximated at $215-278 billion. The obesity epidemic knows no borders as evidenced by the staggering costs endured by England. The British House of Commons Health Select Committee (HSC) estimated total obesity related costs at $3.3-3.7 billion euro for 2002 with about $991 million to $1.1 billion attributable to direct healthcare costs as a result of obesity and obesity related treatments (House of Commons HSC, 2004).

Another study sought to track the trends of healthcare costs for individuals as they aged. This study grouped the subjects by BMI categories. In order to determine the link between BMI for middle age individuals (ages 33-64) and the coinciding health care costs once the subjects passed into older age groups, researchers at Northwestern compared data from the Chicago Heart Association Detection Project in Industry (held from 1967-1973) with data concerning the same subjects Medicare expenditures from 1984-2002 (Daviglus, 2004). Results agreed with expected outcomes of higher medical costs for subjects with higher BMI at the start of the study.

Much of the medical costs associated with obesity are for treatment of its comorbidities. There are several studies which indicate that obesity in childhood is linked to multiple chronic diseases such as asthma, impaired glucose homeostasis, hypertension, and sleep apnea (Yanovski, 2001; Freedman, 1999; Must, 1999). Yanovski also linked other diseases including: "problems unique to childhood and adolescence, including accelerated pubertal[12] and skeletal[13] development and orthopedic disorders, such as slipped capital femoral epiphysis." Additionally, research has shown evidence that childhood obesity leads to adult obesity in many cases (Pietrobelli, 2008; Power, 1997; Whitaker, 1997). Other studies have found a link between the disease and lowered levels of self esteem in children (Strauss, 2000; Dietz, 1998; French, 1995). Considering the current situation of children's health in the United States, it is important that researchers, policy makers, parents, and schools unify to provide comprehensive, evidence based prevention and intervention efforts.

The current high prevalence of at risk for overweight and overweight in children is caused by a combination of environmental, lifestyle and genetic factors. Multiple studies have shown evidence that on an individual basis, genetics plays a part in the body's predisposition to amass or prevent fat accumulation (Farooqi, 2006; Maes, 1997). The fact that such a high increase in total overweight and obesity in such a relatively short period has occurred in the U.S. points to environment and lifestyle factors as the major causes rather than genetics (Kipping, 2008; Ogden, 2002). The passing of more time would be required for the gene pool to undergo significant changes. Environmental and behavioral factors which have contributed to the large increase in overweight and obesity include: sedentary lifestyle (reduced levels of physical activity), high levels of screen viewing, sleep habits, diet, and food environment, specifically the proliferation of inexpensive, calorically dense, low nutritive value foods.

Screen Viewing

Excessive television viewing has been concretely linked to childhood obesity. This unbalanced practice has shown a link to a reduction in physical activity, a poorer quality diet, and raised calorie intakes (Dennison, 2008). A recent study found that approximately 17% of US children watch TV for 3 or more hours per day (Singh, 2008). This occurrence is not limited to children, and the three previously mentioned characteristics linked to excessive viewing all push the scale in a heavier direction. In fact, suggesting more physical activity, a better quality diet, and lower calorie intakes is a completely sound prevention or intervention technique in and of itself.

Other non active entertainment such as video games or computer time can have similar effects. African Americans, in particular, watch TV and movies, and play video games more than their white counterparts (Roberts, 2004). This is especially enlightening when viewed alongside the evidence that African American television programming features commercials with elevated levels of commercials for food products and that these commercials contain higher energy density foods than general prime time shows (Henderson, 2005; Tirodkar, 2003).

Physical Activity Levels

Workers in the US that participated in the National Health Interview Surveys between 1997 and 2004 only participated in regular physical activity at a rate of approximately 36 and 31 percent for men and women respectively (Caban-Martinez, 2007), activity levels for US adults between January and September of 2008 was 35.2% for Caucasians, 23.7% for Hispanics and 23.8% for non-Hispanic blacks. For both studies regular physical activity was defined by the report *Healthy People 2010* which suggests a minimum of 30 minutes moderate intensity 5 days a week or 20 minutes vigorous intensity 3 days a week. Current research suggests that the elevated proportion of Hispanics and non-Hispanic blacks living in low socioeconomic status (SES) neighborhoods contributes to these percentages.

A study performed to assess safety and access for physical activity in low SES areas found that "More African Americans (66.5%) than Whites (33.5%) were classified as living in low-SES areas" and they ". . . reported higher perceptions of neighborhood crime, unattended dogs, unpleasantness of neighborhoods, untrustworthy neighbors, and less access to public recreation facilities" (Wilson, 2004). Overall data suggests that all ethnicities and SES classifications are in need of increasing their levels of physical activity, however, minorities, low SES persons, and especially minorities of low SES endure greater barriers to attaining those goals (Wilson).

Diet/Food Environment

By 1990, the food industry in the U.S. produced more than 3,700 calories of food for every man, woman, and child in the country every day (Pi-Sunyer, 1991). This level of production outweighs caloric needs. In addition; "Sophisticated marketing of high fat, high sugar, high calorie foods and beverages is increasingly being targeted to children and adolescents. These advertisements have been shown to affect children's preferences, requests, and short-term consumption of foods and beverages. . . " (Dennison). This increase in targeting children and adolescents contributes to their food choices and overall diet.

Changes in the workforce such as specialization and the need for two working parents to support a family have also contributed to the current situation. These changes reduce the capabilities of individuals to feed themselves through subsistence farming, or in many cases having enough time to prepare meals.

Preventions and Interventions

A wealth of research and information currently exists about techniques for preventing and intervening with the condition of obesity. A review of existing scientific literature on the subject reveals that:

1) Recent improvements in researchers' understanding of the causes of the current obesity epidemic are helping to shape more highly focused and effective efforts

2) Prevention and Intervention efforts which recognize and account for the interconnectedness of causative factors and curative measures are more successful

3) At least some level of future public policy creation and implementation will be necessary to ensure success in the fight against obesity

4) There are several risk factors linked to obesity, however, not all are modifiable.

As the body of obesity research has grown the development of researchers understanding of trends, causes, and how to achieve successful outcomes has risen. Through objective review and analysis of the bulk of the body of obesity intervention research, it is evident that more integrated and comprehensive prevention and intervention efforts achieve the most consistent positive results. Involving multiple stakeholders and accounting for the multiple stages in a subject's life such as school, home, work or chores, and others is one method discovered which helps create a barrier to prevent behaviors conducive to obesity creation. Since education alone has been met with limited success in the fight against obesity, it is now apparent that some form of support from public policy change will be necessary to help shift environmental factors which are currently adding to the problem.

A study performed by Procter and others in 2008 found evidence to support the need for small scale analysis in the search for answers to the obesity. The ultimate goal of this "micro-analysis" would be individualizing intervention and/or prevention techniques in order to ensure the highest probability of success. This perspective acknowledges the individuality which plays a role in the development of the condition. Science tends to generalize in order to spot trends in statistical analysis, however, it is individuals which must overcome the disease and each one is different. The combination of comprehensive and more specifically tailored interventions and prevention tactics may be all that is needed to turn the tide against this alarming trend.

Role of Schools

School systems and environments present a great opportunity for obesity prevention and intervention. As listed in the 2004 publication "The Role of Schools in Preventing Childhood Obesity" by Wechsler:

1) Over 95 percent of young people are enrolled in schools (National Center for Education Statistics, 2001).

2) Part of schools traditional roles includes promotion of physical activity and healthy eating.

3) Research indicates that school programs can be successful at reducing TV viewing time, and promoting healthy eating and physical activity (Robinson, 1999; Gortmaker, 1999; CDC, 1997; CDC, 1996).

One key question moving forward will be how to maximize efficiency of school based programs in terms of economic costs, prevention and intervention success, and psychological and emotional stability for subjects.

Several school based research projects with the goal of establishing successful and reproducible results have been carried out. In one study examining a wellness-based prevention program, student eating behaviors and attitudes were measured to discover differences in effectiveness of using different combinations of stakeholders. Ten groups were formed with the control using no intervention, and the other groups using combinations of participants such as parent and teacher or student, parent and teacher. The results indicated that this type of wellness-based intervention could be more effective when parents and teachers take part (Russel-Mayhew, 2007).

Mississippi ranks highest in prevalence of obesity in the US; 31.4% of Mississippians are classified as obese compared to 25.1% nationwide (CDC). Additionally, only 40% of Mississippians met the recommended guidelines for moderate physical activity, compared to 49.1% nationwide (CDC). The poverty rate in Mississippi exceeds the national average, with 19.3% of Mississippians living in poverty in 2004 (US Census Bureau, 2004), compared to 12.6% nationwide (DeNavas). Furthermore, in the three counties selected for this project, 31.6% of residents (LeFlore County) 29.5% of residents (Washington County), and 34.3% of residents (Sunflower County), were below the poverty line (US Census Bureau, 2004). There is also a high concentration of African Americans in the Mississippi Delta, who experience greater risk for overweight (Ogden, 2002). In 2005, 12.8% of Americans were African American (US Census Bureau), compared to 36.9% of Mississippians (US Census Bureau). Furthermore, in the three counties selected for this study, approximately 70.6% of the population is comprised of African Americans (US Census Bureau).

This descriptive study will analyze anthropometric data for elementary school children in the Mississippi Delta. The analysis and a review of current obesity literature will be used to support the following statement of purpose: Determining the best method for measuring adiposity in children through a comparison of accuracy, cost effectiveness, ease of use, and practicality.

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CHAPTER II

ANTHROPOMETRIC MEASUREMENTS USED TO ASSESS ADIPOSITY IN AFRICAN AMERICAN ELEMENTARY SCHOOL CHILDREN

Abstract

Over nine million children 6-17 years old are overweight in the United States. Unless the current trend is modified, American children will face the highest risk ever for overweight, obesity, and associated health problems as adults. Body Mass Index (BMI) is the most common method used to determine adiposity in children. The purpose of this study was to evaluate methods used to measure adiposity in children through a comparison of accuracy, cost effectiveness, ease of use, and practicality. Institutional Review Board approval, parental consent and student assent were obtained. Data were collected by trained employees at six elementary schools on 789 subjects for boys (n= 391) and girls (n=398) 5-11 years old African American children. Hip and waist circumferences, percent body fat, height and weight were collected. BMI, Waist to Hip Ratio (WHR), and Waist to Height Ratio (WHTR) were calculated. Upon analysis, weight and hip circumference were correlated (r = .94135), waist and hip circumferences were also correlated (r = .92826) and waist circumference was correlated to BMI (r = .92396). The measures of adiposity were highly correlated indicating that a variety of anthropometric measurements can be used in addition to BMI for measuring children.

Introduction

Obesity has climbed to the top of The United States' health concerns and agenda. This rising concern is due to heightened health risks linked to the condition and the alarming realization that the prominence of this disease is shifting along an exponential curve. A parallel concern is the steady increase of overweight and obesity among America's youth. Since 1978 the rate of obesity has more than tripled for children ages 6 to 11 and currently over 9 million children within this age range are overweight or at risk for overweight (Ogden, 2008; Institute of Medicine, 2005; Hedley, 2004; Ogden, 2002). Without changing this trend, American children today will experience the highest risk ever for overweight, obesity and associated health problems in their futures (Ogden, 2008; Wang, 2008; Institute of Medicine; Rippe, 1998).

Several studies indicate that obesity in childhood is linked to multiple chronic diseases such as asthma, insulin homeostasis, hypertension, and sleep apnea (Yanovski, 2001; Freedman, 1999; Must, 1999) and other studies support its relationship with cardiovascular disease as well (Baker, 2007). Additionally, there is evidence to support that childhood obesity leads to adult obesity in many cases (Pietrobelli, 2008; Power, 1997; Whitaker, 1997). This preponderance of data maintains the assertion that excess weight and its associated problems are climbing to the top of America's healthcare concerns. Considering the current situation of children's health in the United States, it is important that researchers, policy makers, parents, and schools unify to provide comprehensive, evidence based prevention and intervention efforts.

The current prevalence of pediatric overweight and obesity is elevated in comparison to prevalence rates of previous years and is the result of a combination of environmental, lifestyle and genetic factors. Multiple studies have shown evidence that on an individual basis, genetics plays a part in the body's predisposition to amass or prevent fat accumulation (Farooqi, 2006; Maes, 1997). The fact that such a high increase in total overweight and obesity in such a relatively short period has occurred in the U.S. points to environment and lifestyle factors as the major causes rather than genetics (Kipping, 2008; Ogden, 2002; Hill, 1998). The passing of more time would be required for the gene pool to undergo significant changes. Pertinent factors which have contributed to the large increase in overweight and obesity include genetics, environmental, and behavioral (CDC).

Review of Literature

Overweight Prevalence

Classification of overweight and at risk for overweight is more complicated for children than adults (Kipping). Currently, several classification systems are being used depending on the geographic region (Kipping). This variety of standard causes increased complexity when comparing results of studies using differing systems. For adults there are internationally accepted standards for the categories of obese, overweight, normal, and underweight. However, for children, the differences in developmental progress, gender, and age prevent a standard, simple classification system (Kipping). Many countries currently use age specific BMI which consists of plotting the BMI measurement obtained for a subject against a standard growth chart. In the United States the Centers for Disease Control (CDC) has set governmentally approved, nationally accepted standards based on the 2000 CDC Growth Charts for the United States and expert committee which was commissioned to alter the original 1977 charts (CDC, 2007).

The United States federal government has been collecting overweight prevalence data on its population for over three decades. For this data, BMI measurements were calculated and used to determine overweight and obesity. For children, at risk for overweight is defined as having a BMI ≥ the 85th percentile and < the 95th percentile for age. Overweight is defined as BMI ≥ the 95th percentile for age. These percentages come from plotting a distribution of all weights for a given height at a particular age and gender. Through analysis, a trend of increasing obesity prevalence for children and adolescents in the United States has been established (Ogden, 2008; Hedley; Ogden, 2002). Due to direct and indirect economic costs, as well as the extensive list of health consequences endured by overweight and obese individuals, efforts have been undertaken to halt these alarming trends.

Since 1971 the rate of obesity has more than tripled in the United States for children 6 to 11 years from 4% to 17% and now over 4 million children within this age range are overweight (Ogden, 2008; Institute of Medicine, 2005). Additional research indicates that overweight in childhood is linked to many chronic diseases such as asthma, insulin homeostasis, hypertension, and sleep apnea (Yanovski, 2001; Freedman, 1999; Must, 1999), as well as osteoarthritis (Yanovski; Whitaker, 1997; Felson 1996). Another study specifically investigating cardiovascular risk factors in children found a relationship between overweight in the central part of the body and hypertension, insulin homeostasis, and raised blood lipid levels (Kelishadi, 2007). There is also evidence that childhood obesity often leads to adult obesity (Whitaker; Serdula, 1993). In fact, approximately 80% of the overweight 10-15 year old participants in Whitaker's study were found to be obese at age 25.

Through interpretation of NHANES data (III through 2003-2006) Ogden and others identified significant statistical discrepancies between children of differing racial/ethnic groups. During this time span non-Hispanic black boys between the ages of 12 and 19 showed the greatest increase in obesity prevalence for all three male age groups. At 12.2%, Mexican Americans increased by 7.0% and non Hispanic whites increased by 4.4%. Adolescent girls also showed obesity prevalence increases with non Hispanic black girls leading all subcategories for either gender at 27.7% prevalence and an increase of 14.5% while Mexican American and Non-Hispanic white girls increased by 10.7% and 7.1% respectively (Ogden, 2008). All other racial/ethnic groups were shown to have increased risk for obesity versus Caucasians. These obesity prevalence findings are especially disconcerting considering the Healthy People 2010 objectives 19-1 and 19-2 to halt the trend of increasing obesity prevalence and 19-3 to reduce the overall percentage for children and adolescents to 5% (US Dept. of Health and Human Services, 2000).

Although disparity was seen with respect to prevalence increases amongst many of the subgroups, it is important to note that each classification monitored experienced an increase in obesity prevalence for the years data was collected (Ogden, 2008). As this data suggests, being a racial/ethnic minority increases the likelihood of obesity (Singh, 2008; Kumanyika, 2006). Another indicator, lower socioeconomic status (SES) has also been linked with higher obesity prevalence (Singh). Kumanyika and Grier found that low SES and minority children watch more television, have more fast food restaraunts and less healthy food vendors in their neighborhoods and have more obstacles to physical activity due to safety concerns and unfit facilities (Kumanyika). Studies performed to investigate the association between SES and obesity for school age children discovered a complex relationship which varies by age, gender, and ethnicity (Gordon-Larsen, 2003; Troiano, 1998; Kimm, 1996). Gordon-Larsen and others found that non Hispanic whites' obesity prevalence decreased as SES increased. Conversely, increasing SES for African American females actually increased overweight prevalence in the subjects. Despite the complexity, low SES showed a clear link with higher overall prevalence of childhood obesity (Kumanyika, Gordon-Larsen, Troiano, Kimm).

A 2004 study by Fowler-Brown specifically looked at overweight in children and adolescents from the perspective of family physicians. The study reviewed previous research concerning prevention and treatment. They used the Cochrane Database of Systematic Reviews, the CDC and National Institutes of Health (NIH) websites and other sources, including studies performed between 1990 and 2002. They limited their review by including only randomized controlled trials or large observational studies. Additionally, possible participants were required to have treatment of prevention as the primary aim of the study. The authors concluded by citing existing guidelines for prevention and intervention. The CDC created two sets of guidelines, one for developing school and community programs to promote lifelong physical activity and one for lifelong healthy eating. These guidelines were intended to be used by physicians regarding prevention. Another set of guidelines, adapted from the Maternal and Child Health Bureau of the U.S. Department of Health and Human Services' Health resources and services administration were cited to be used for treatment (Fowler-Brown, 2004).

Anthropometry

Anthropometric measurements are often utilized by human obesity researchers to collect data regarding obesity status. These measurements are grouped into two major categories of methods for gathering data about adiposity, direct and indirect. As the titles suggest, direct methods produce higher accuracy of measurement than indirect ones, however, indirect methods are much more cost effective, less invasive, and overall more practical when performing measurements in a large scale study. Direct methods include dual energy x-ray absorptiometry (DXA formerly DEXA) and hydrostatic weighing (HW) otherwise known as densitometry (Dietz, 1999). Indirect methods include Body Mass Index (BMI), Waist Circumference (WC), bioelectrical impedance analysis (BIA) machines, and skinfold measurement.

Dual X-ray Absorptiometry adiposity measurements are collected by placing the subject in a prone position on the machine. Then the scan is activated and the subject is instructed to stay motionless or move as little as possible throughout the procedure which usually requires around 30 minutes to complete. As the name indicates DXA uses x-ray beams to measure tissue density and approximate the amounts of the tissues found. The results are separated into three categories: Bone mass, Lean mass, and fat mass.

As with any instrument DXA has its limitations. A study was performed to test the sensitivity of this measurement method. This was accomplished by searching for the smallest distinguishable differences (SDD) for bone, lean, and fat mass in obese and non-obese child subjects using DXA. The study found that the SDD for obese was greater than for non-obese meaning that obese children must lose or gain more fat or lean mass than non-obese children for the machine to read the change accurately (Wosje, 2006).

Another study on anthropometrics and childhood obesity resulted in findings which are relevant to measuring children. The research measured 411 children 6-18 years old to compare DXA to the four compartment model. For this study the four compartment model was considered the standard for its ability to best approximate actual body fatness. They found a standard error of 3.66% for the DXA body fat estimates and two trends. The first was overestimation of percent body fat (%BF) in subjects with high %BF when compared to the four compartment model and the second was underestimation of %BF in subjects with low %BF again in comparison to the four compartment model (Sopher, 2004). These findings combined with the results of the research mentioned previously indicate that DXA is an accurate tool for %BF estimates; however, there is room for improvement.

Hydrostatic weighing has been considered the gold standard for direct measure of adiposity for some time (Claros, 2005; Warner, 1986). Hydrostatic weighing was regarded as the criterion method in the Claros study. This method utilizes the

Archimedes principle which states that "Any object, wholly or partly immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object." (Heath, 1897). It involves fully submerging the subject in a tank of water, while having them expel the air from their lungs as fully as possible, and holding this position until a reading can be taken from a suspended scale. This is usually performed while the subject is seated in a chair or sling.

It is the aim of research to provide the most precise data possible. For adiposity measurements of children, however, this method poses a few problems. Often children are uncomfortable with the prospect of submerging then expelling all air from their lungs. This discomfort can be attributed to several factors including a fear of water, and apprehension stemming from mis or lack of understanding what is involved in the process. Also, health abnormalities as simple as a cold often skew the calculation due to abnormal capacity or inability to empty the lungs properly. The time required and intensive nature of the method versus alternative measurements makes it less attractive as well.

Among body fat estimate methods BMI is unique since it is the only indirect measure of obesity in children which is associated with raised mortality risk from cardiovascular disease later in life (Baker). This method has become the leading measurement used to describe overweight and obesity and is also the method of choice for the CDC and its population survey the National Health and Nutrition Examination Survey (NHANES) to estimate adiposity. It is a simple calculation using height and weight as a ratio, or weight in kilograms divided by the square of height in meters and the resulting number is recorded as the subjects BMI (CDC).

Several studies have concluded that BMI is a valid and reliable tool for approximating adiposity, for instance, one study indicated that BMI corresponded highly with %BF, total body fat and actual fat mass but not with body fat distribution this implies that BMI is not useful for cardiovascular risk factor information (Dencker, 2006). The evidence for BMI as an adiposity assessment tool is mixed however, with some studies showing inconclusive or even negative results. One study found that BMI-defined obesity was present in 19.1% of men and 24.7% of women measured (n= 13,601 with 49% being men), but that obesity as measured by body fat percentage was present in 43.9% of men and 52.3% of women. This data indicates large and unsatisfactory uncertainty in using BMI as an obesity indicator (Romero-Corral, 2008). Another study sought to test the reliability of BMI as an adiposity assessment tool for obese children and adolescents specifically. The investigators concluded that BMI may be useful for research, but the high level of variability in the relationship between BMI and percent body fat for individual obese patients rendered it less effective for that purpose (Widhalm, 2001).

Bio-impedance Analysis (BIA) and another indirect method air displacement plethysmography have been shown to provide adiposity estimates with sufficient reliability for use in research (Ma, 2004; Goran, 1998). Bio-impedance analysis specifically, has shown through research to have lower operator error than BMI or WC and to be less intrusive for child subjects (Taylor, 2002; Tyrell, 2001). Body mass index and BIA are often chosen as a measurement tool for research projects due to their study tested reliability, low levels of intrusion, cost, and reduced error risk. Waist circumference, another anthropometric, indirect measurement method is also commonly utilized for obesity related research projects (Sung, 2008; Savva, 2000).

Waist circumference has been shown to provide accurate and reliable estimates of abdominal fat (Pouliot, 1994). Excess abdominal fat has been linked with increased risk of cardiometabolic disease (Kelishadi; Kissebah, 1982). Therefore WC is a valuable research and clinical measurement tool to help in determining overall health status. No generally accepted cut points exist for waist circumference in children; however, data have been collected and analyzed for population representative samples in the United States. Fernandez and his team used (n=4769) boys and (n=4944) girls as a random sample from NHANES III to determine the 90^{th}, 75^{th}, 50^{th}, 25^{th}, and 10^{th} percentiles for WC by racial/ethnic background (Fernandez, 2004). These data may be used to approximate what percentile a subject falls into but not as cut points to determine classification of normal weight, overweight, or at risk for overweight. In another study using waist circumference, Higgins and others found that the 87 children age 4 to 11 analyzed in their study which displayed WC greater than or equal to 71cm had an accompanying higher risk for an adverse CVD risk factor profile than those below that mark. This cut point observation included both genders (Higgins, 2001). A study by Ford indicated that WC also correlates well with BMI. A range of r values between 0.80 and 0.95 were found (Ford, 2003).

Anthropometric measurements have been critical to the creation of meaningful data for the study of obesity. When performing anthropometric measurements, it is imperative to maintain consistency in order to create validity and reliability between subjects. To this end, there are particular standards which exist to help ensure homogeneity in data collecting methods.

Public Policy

Mississippi is among the leading states in highest obesity prevalence among children and adolescents, ranking 1st in the BRFSS. More specifically, in 2003 Mississippi "Overall, 24.0% of students in grades 1 through 8 were found to be overweight, and another 14.7% were at risk for becoming overweight." (Kolbo, 2004). Mississippi is faced with several social factors which affect this prevalence including: family income, racial/ethnic group, and family education levels (RWJF, 2008). Table 1 shows Mississippi statewide percentages for Racial/Ethnic group and Household income as reported by RWJF:

Table 1

Mississippi Demographics and Household Income Levels of Children by Percentage

Household Income		Racial or Ethnic Group	
Higher income (≥ 400% FPL)	15%	Black, Non-Hispanic	45%
Middle income (200-399% FPL)	31%	Hispanic	2%
Near poor (100-199% FPL)	25%	Other	3%
Poor (<100% FPL)	29%	White, Non-Hispanic	51%

Recently, our country has been exploring new options to both gather more information about childhood obesity, and to further attempts at slowing the growing tide. One such measure that seems to be gaining momentum is the mandatory BMI assessment of children in public schools. The practice was pioneered by Arkansas as a statewide practice in 2003 and since that time six more states have adopted similar legislation (Justus, 2007). This practice has fueled a debate over when and how to assess BMI as well as to the overall appropriateness of obesity screening in the public schools of America.

A publication from the Robert Wood Johnson Foundation was created by their Commission to Build a Healthier America and focuses on 10 recommendations for improving the health of America's citizens. These recommendations are based on the commission's views of prevention rather than treatment as a best course for improving health, emphasis on children and families, general integration of health into all areas of policy and decision making, recognition of social factors which often serve as obstacles to attaining health, and the utilization of existing government programs along with the recently enacted stimulus plan to provide resources for as many Americans as possible (McClellan, 2009).

One study found evidence to support the need for small scale analysis in the search for answers to the obesity epidemic (Procter, 2008). The ultimate goal of this "micro-analysis" would be individualizing intervention and/or prevention techniques in order to ensure the highest probability of success. This perspective acknowledges the individuality which plays a role in the development of the condition. Science tends to generalize in order to spot trends in statistical analysis, however, it is individuals which must overcome the disease and each person is comprised of a different combination and varying levels from a common pool of characteristics. The combination of comprehensive and more specifically tailored interventions and prevention tactics may be all that is needed to turn the tide against the obesity epidemic.

Since it is not within the reach of policy to mandate what amount of television viewing will be considered excessive, future policy may be focused towards amounts of advertisements, and the subject matter of those advertisements. Previously, this unbalanced practice has shown a link to a reduction in physical activity, a poorer quality diet, and raised calorie intakes (Denison, 2008). With that evidence in mind, public policy could be used to make scientifically based suggestions about ensuring proper physical activity levels for children especially as viewing times increase. In fact, suggesting more physical activity, a better quality diet, and lower calorie intakes is a completely sound prevention or intervention technique in and of itself, unless the subject has abnormal medical conditions which contribute to the formation of overweight or obesity (Young, 2007).

The Robert Wood Johnson Foundation (RWJF) published a report entitled "Overcoming Obstacles to Health". The report details the health disparities between the privileged and underprivileged persons in America. They list such differences as education, environment and income as key indicators of health quality. The report encourages the institution of public policy measures to reduce the Socioeconomic standing (SES) disparities which often lead to corresponding health disparities. It cites social and economic improvements as reasons for and benefits to be gained by the changes. This particular study commissioned a group of economists to estimate the economic benefit gained if these disparities were eliminated and they arrived at a figure of approximately 1 trillion yearly (RWJF, 2008). The report suggests increasing education efforts starting early in childhood and continuing throughout development until adulthood is reached. Reducing poverty and improving economic conditions are also mentioned. The intended benefit of these efforts would be an overall reduction in the health disparities for poor and socially disadvantaged Americans (RWJF).

Current high at risk for overweight and overweight prevalence among American children is a major concern. Data from NHANES I (1971–1974) to NHANES 2003–2006 indicated school-aged children, aged 6–11 years, underwent a prevalence increased from 4.0% to 17.0% for overweight (defined as Sex-and age-specific BMI ≥ 95th percentile based on the CDC growth charts) (Ogden; 2008, Hedley; Ogden, 2002). In Addition, from NHANES III(1988) to NHANES 2003-2006, African American adolescents aged 12-19 displayed an increase from 10.7%-18.5% for boys (Ogden, 2008, 2002) and 13.2%-27.7% for girls (Ogden, 2008; Hedley; Ogden, 2002) nationally. There is a strong need for research to investigate all facets of this epidemic including measurement methods, which lead to classification. Several methods exist, both direct and indirect, for measuring adiposity. BMI has been shown to correlate highly with body fat percentage, total body fat, and actual fat mass and is currently used in the NHANES and BRFSS nationally and locally in CAYPOS. Policymakers on the national, state, and local levels are in position to institute guidelines for measurement, classification and dissemination for children. Physical and emotional health of children are affected by these decisions. For these reasons it is important to evaluate the measurement methods used in making weight classification determinations.

Methods

Data Collection Procedures

Each data collector also completed Institutional Review Board IRB training for the protection of human research subjects prior to engaging in any contact with subjects. IRB approval was granted by the Office of the Regulatory compliance of Mississippi State University for the data collection done in September and October, 2007. Following is the Procedure used for obtaining anthropometric measurements for children: Trained investigators obtained all measurements. On the day before data collection, a letter was sent to parents requesting that all participants wear light clothing and minimal hair accessories on the day measurements were taken. Participants were asked to remove their shoes, belts, sweaters, and outerwear (coats, scarves, etc.) prior to measurements. Height was measured to the nearest 0.1 cm on a portable stadiometer. Weight for teachers/staff and kindergarten, first through fifth grade children was measured twice to the nearest 0.1 kg on a Tanita Electronic Scale Model BWB-800A while the participant stood motionless in the center of the scale. Alcohol spray (70% isopropyl alcohol) was used on the scale to sanitize after measurements of participants that were barefoot.

Body Mass Index (BMI) was calculated as weight (kg)/height (m^2). Methods for obtaining height and weight measurements were obtained from the Child and Adolescent Trial for Cardiovascular Health (CATCH) study (Webber et al., 1996).

Waist-to-hip ratio (WHR) was calculated from measurements of waist and hip circumferences. Waist and hip circumferences was obtained using procedures outlined by Crawford in *Pediatric Exercise Science (1996),* using a retractable reinforced polyester measuring tape. Waist girth was measured at the narrowest part of the torso when viewed from the anterior aspect. Clothing was minimal in order not to obstruct identification of the measurement site and measurement. If an obvious narrowing was not evident, the measurement was made approximately midway between the ribs and iliac crest. Hip circumference was measured around the perimeter at the level of the greatest posterior protuberance of the gluteals. The subject stood erect with minimal clothing; the tape was placed horizontally around the site, compressing any overlapping clothing but not the soft tissues. Two measurements were made at each site, and the mean of the two values used as the accepted value.

Bioimpedence Analysis (BIA) was measured using a Tanita TBF-300A Body Composition Analyzer (Tanita/Itin Scale Company, Brooklyn). The machine was used to obtain percent body fatness and body water content. The Tanita TBF-300A is a foot-to-foot BIA device. The individual stands barefooted on the device, which closely resembles a bathroom scale. Measurements obtained from the BIA was percent body fatness and total body water content. Alcohol spray (70% isopropyl alcohol) was used on the scale to sanitize it between participants.

Prior to the bioelectrical impedance analysis, participants were advised to adhere to the following procedures: 1.) abstain from eating and avoid drinking large quantities of fluid within 4 hours of assessment (Participants will be measured prior to lunch or 3 hours after lunch); 2.) void completely; and, 3.) abstain from diuretic agents, including caffeine, prior to measurement unless prescribed by a physician.

Data collectors were also furnished with written guidelines on how to perform measurements for waist circumference (WC), hip circumference, height, and weight collected during the project. Body mass index (BMI), waist to height ratio (WHtR), and waist to hip ratio (WHR) were calculated. Standards were reviewed to ensure appropriate methods were being utilized. These guidelines provided to each data collector are included in appendix A.

The data was collected from six elementary schools in three counties in the Mississippi Delta including, Leflore, Sunflower, and Washington. The research project was funded by a grant from the Delta Health Alliance (DHA) and stipulated that geographic area with 18 counties available would be used for the study. The specific school systems utilized were selected by population density to maximize funding. They also offered cooperation from the school system administration down to the individual school employee level.

Subject's birthdates, grade, ethnicity, and gender were provided by the schools taking part in the project. For each data collection excursion, the research team would travel from Starkville to the destination school and setup individual stations for check in, height, weight, waist and hip circumference, and bioimpedence analysis (BIA) measurements. The subjects, each of which had given prior consent, were brought to the data collection site at the school (usually the gym of auditorium) by classroom with supervision provided by a teacher. Upon arrival each subject was identified at check-in and provided with a data sheet attached to a clipboard. The data sheets contained space for each specific measurement including multiple spaces for two measurements for each subject of height, weight, hip circumference, and waist circumference. The BIA machine measurements were also performed twice for each subject by the Tanita machine produced a printout with all results obtained by the instrument. This printout was attached to the respective subject's data sheet after collection. Each station provided privacy for the subject being measured by utilization of screens and care was taken to avoid sharing information gathered with the subjects.

<u>Measurements of Children</u>

The first activity involved with measurement was the parental consent forms (appendix B) sent out to parents enabling the children to take part in the study. This process was completed by assigning random numerical identifiers to each subject and then distributing and collecting the consent forms with the aid of the schools. During the measurement process, a representative from the school and multiple trained data collectors were present at all times. A note was sent to the subjects parents on the day before data was collected. The note included instructions that the children should minimize hair accessories and wear light clothing to help ensure accuracy. Subjects were asked to remove any coats, scarves, sweaters, belts, shoes or other items that would interfere with accurate measurements. Height, WC, HC, and weight were collected for all subjects. Height was recorded to the nearest 0.1 cm from measurements taken on a portable stadiometer. These measurements were repeated until agreement was found within 0.2 cm. In addition, all subjects < seven years of age had their weights measured by an electronic scale instead of the BIA per manufacturer instructions. These measurements were recorded to the nearest 0.1 kg and repeated until agreement within 0.2 kg was found. The two readings were then averaged to produce a final height and weight measurement for each subject. For second grade or older subjects a *Tanita TBF-300A Body Composition Analyzer (Tanita/Itin Scale Company, Brooklyn)* was used to collect weight measurements. The Tanita scale also provided a BMI and a body fat % reading. For any measurements using the Tanita machine subjects were instructed to remove their socks and ensure skin to sensor contact by pulling up pant legs if necessary. In the case of subjects wearing nylons a drop of saline solution was placed on the sensor pads to promote conductivity as per manufacturer instructions. Children whose age and gender specific BMI percentiles were below the 85th percentile were classified as normal, those at or above the 85^{th} percentile were at risk for overweight and those at or above the 95^{th} percentile were classified as overweight.

SAS statistical software package was used to perform data analysis for this study. The BMI measurement was calculated as weight in kg / (height in meters)^2. Results were recorded and also assigned a separate BMI code of normal, at risk for overweight, or overweight. Two other measures underwent calculations to reach final results; waist to hip ratio (WHR) and waist to height ratio (WHtR). WHR was calculated by dividing the subjects WC (cm) measurement by the HC (cm) and displaying the outcome as a decimal. Similarly, WHtR was calculated by dividing the subjects WC (cm) measurement by the height (cm) and expressing the outcome as a decimal. The cutoff point for an acceptable WHtR value was < 0.50 with measurements assigned a code value of above or below.

Results and Discussion

The subjects ranged from 5-11 years of age. There were a total of 827 subjects for which data were collected. Of those, 789 were African American. The following table (2) lists the demographic breakdown of the subjects including age, gender, and racial/ethnic background:

Table 2

Number of Subjects by Age, Gender and Racial/Ethnic Background

Caucasian		
Age	Male	Female
5	4	0
6	3	5
7	3	5
8	5	4
9	1	0
10	0	0
11	0	1
Totals	16	15

African American		
Age	Male	Female
5	45	49
6	117	118
7	122	121
8	78	87
9	23	16
10	3	2
11	0	1
Totals	388	394

Hispanic		
Age	Male	Female
5	0	0
6	1	1
7	1	3
8	0	0
9	0	0
10	0	0
11	0	0
Totals	2	4

Asian		
Age	Male	Female
5	0	0
6	0	0
7	0	7
8	1	0
9	0	0
10	0	0
11	0	0
Totals	1	7

All subjects were used for calculation of BMI statistics. 475 had normal range BMI's, 135 were at risk for overweight, and 217 were classified as overweight. This corresponded with 57.44, 16.32, and 26.24% respectively. There was a total of 42.56% of subjects overweight or at risk for overweight. The following table (3) illustrates the number of subjects displaying normal, at risk for overweight, or overweight BMI categories by age (note: the data include all ethnicities and genders):

Table 3

Body Mass Index (BMI) Category

Age	Normal	At risk	Overweight
5	61	21	16
6	128	48	69
7	153	39	70
8	107	21	47
9	24	4	12
10	1	2	2
11	1	0	1
Totals	475	135	217
%	57.44	16.32	26.24

Of the 827 total, only 224 were age 7 or older and underwent BIA measurements with the Tanita BIA machine to measure percent body fat. Of those a randomized sample of 39 were taken to derive a mean, standard deviation, median, minimum, and maximum. Once the data collection was finished and anomalies were corrected/discarder, proc UNIVARIATE of the SAS statistical software system was run on all variables. A skewness value near 1.0 was a required result for each variable in order for it to approximate a normal distribution. Raw data for only height and WHR displayed acceptable distributions with a skewness of 0.3972 and 0.6233 respectively. Weight and HC displayed skewness values of 1.749 and 1.16 and were transformed by taking the log of the data points. Once this function was performed these two variables normalized their distributions, showing skewness values of 0.803 for weight and 0.7839 for HC, allowing further statistical analysis to be performed. BMI, WC, and WHtR showed 1.777, 1.561, and 1.532 skewness values respectively and were transformed by taking the log of the log or double log of the data points. This action reduced BMI, WC, and WHtR skewness values to 1.025, 1.106, and 0.9341 and normalized their distributions to allow further statistical analysis. This analysis provided means, standard deviations, and ranges for each variable tested as shown in the following table (4).

Table 4

Anthropometric Measures of Subjects

Variable	Number of Subjects	Mean	Standard Deviation	Range
Height (cm)	827	125.363	8.671	50.15
Weight (kg)	827	29.617	9.484	68.95
BMI (kg/m^2)	826	18.546	4.175	27.3
Waist Circumference (cm)	826	61.647	10.288	53.4
Hip Circumference (cm)	826	73.341	9.891	62.25
Waist to Hip Ratio	826	0.839	0.049	0.364
Waist to Height Ratio	825	0.491	0.069	0.418

BMI, height, weight, WC, HC, WHR, WHtR, and Percent Body Fat had a generalized linear models approach performed using SAS proc GLIMMIX. This SAS program module tests each variable against all others to measure significant effects. For height, grade was the only significant variable identified. This result was expected since grade increase usually denotes age increase and age increase correlates with height increase in child populations. WHR had two significant variables revealed through proc GLIMMIX, school and grade. WHR being significantly affected by school was investigated further and found to be the result of the differences between the least square means of the WHR for each school; the results are displayed in the following table (5).

Table 5

Waist to Height Ratio by School

School Code	WHR Estimate	Letter Code*
994	0.8477	A
997	0.8456	A B
995	0.8442	A B
998	0.8338	B C
993	0.8304	C
996	0.8248	C

*Schools with the same letter are not significantly different

The above data indicates that schools 993, 994, and 996 were statistically different from 3 of the other 5, and schools 995, 997, and 998 were different from only 2 others. WHR was significantly affected by grade as well indicating that, for the subjects measured WHR increased as grade increased. Weight showed grade as a significant variable and HC showed school and grade as significant. The significance of grade to weight and HC was expected since increase in grade generally denotes increase in age and this normally corresponds with increased weight as well as larger overall size and greater HC in children. HC, similar to WHR, showed school as a significant variable. The significant effect of school on HC was investigated further and found to be the result of the differences between the least square means of the WHR for each school. The results are included in the following table (6).

Table 6

Least Square means of WHtR by School

School	WHtR Estimate	Letter Code*
995	4.307	A
997	4.305	A
998	4.285	A B
996	4.283	A B
994	4.256	B
993	4.252	B

*Schools with the same letter are not significantly different

BMI, WC, and WHtR underwent the double log mathematical transformation to bring their distributions closer to an approximation of normalcy. BMI indicated grade as significant while WC and WHtR indicated grade and school as significant. The result of BMI and WC being affected by grade was expected since the BMI measure is a ratio of weight and height, and WC normally increases on average with increase in age. Both variables used to calculate BMI (height and weight) indicated grade as significant so it mathematically follows that their ratio will display a similar trend. The significant affect of grade on WHtR and school on both WC and WHtR was unexplained. To summarize the significant variables for each group: grade was significant for all variables analyzed and additionally, school was significant for WC, HC, WHR, and WHtR.

The following variables were also analyzed for interaction and correlation using proc CORR from the SAS statistical software package: height, weight, BMI, percent fat (pctfat), WC, HC, WHR, and WHTR. For all tests performed the level of significance was ($p = 0.05$). Results indicated no interaction between variables. This is a positive result and suggests that no variables which showed statistical significance were interfered with by other variables. High correlations were seen for several variable couplings. Each of the following variable couplings listed were also tested with a $p=0.05$. WC vs. BMI correlated at 0.92396. Height and weight also showed an expected high correlation of 0.92087. Weight also correlated with HC at the highest overall mark of 0.94135. In addition, HC and WC correlated at 0.92826. These correlations indicate a positive relationship between the two linked variables. For instance, as height increased for the subjects, weight increased as well at a nearly identical rate. As previously mentioned this association was expected, along with HC and WC. WC vs. BMI correlation was also expected and is consistent with results from research performed by Ford reported in the article “Trends in waist circumference among U.S. adults” published in 2003 in the journal Pediatrics.

Limitations

This project had several limitations. Data for this study were collected only on subjects whose parents/guardians had given prior consent. Despite training provided for the data collectors human error may have occurred. The bioimpedance analysis was collected for subject age 7-11only per the manufacturer's instructions. Some variability was discovered in data collection which was corrected/eliminated.

Conclusion

As the body of research for overweight in children has grown, it has become increasingly clear that this is a complicated disease. It is complicated by varying numbers and combinations of causes, criteria for diagnoses, and interventions. The rate with which this disease has spread indicates environmental and lifestyle factors as major causes, specifically a reduction in physical activity levels and higher calorie, lower nutrient density diets.

Data collection has been a key tool in developing understanding of prevalence and trends for this disease. Anthropometric measures have played a large role in this development. BMI is the preferred measure for obesity researchers; however, other measures such as waist circumference, hip circumference, waist to height ratio, and waist to hip ratio provide additional and valuable information when developing health profiles for children. In evaluating these anthropometric measures in terms of accuracy, cost effectiveness, ease of use, and practicality BMI is clearly the top choice due to accuracy and practicality advantages.

Many of the other measure listed are equal in cost effectiveness, ease of use, and for some practicality as well, however, the increased accuracy and precision produced when taking height and weight measures as opposed to more objective measures such as waist circumference, hip circumference, and calculations using these measures such as waist to height ratio, and waist to hip ratio separate BMI as superior.

This study will contribute to the overall body of at risk for overweight and overweight research. Mississippi has distinct demographic, geographic, and economic characteristics which individualize its struggle with this disease. In the future more research is needed to provide improved and continued insight into how best to attack this problem.

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APPENDIX A

MEASUREMENT GUIDELINES FOR DATA COLLECTORS

Measurement Protocols

Height Protocol**

1. Have the subject remove his/her shoes and hair accessories.

2. Have the subject stand with heels, buttocks, and upper back (but not necessarily the head) touching the stadiometer and feet together with arms hanging in a relaxed position by the sides of the body.

3. Instruct the subject to take a deep breath, hold their breath, look straight ahead, and stretch up as far as possible while keeping the heels on the ground.

4. Lower the headboard on the stadiometer to the uppermost portion of the head, compressing the hair, if necessary. Lower the board until it firmly touches the crown of the head.

5. Adjust your eye level to the level of measurement before attempting to read the measurement by standing on a step stool or squatting down.

6. Record the measurement to the nearest 0.1 cm. Be sure to tell the subject that he/she can breathe again.

**From CATCH SPAN Protocol

Weight Protocol**

1. Turn the scale on using the "on/zero" switch.
   The display should read 0.0. If it does not, press the "on/zero" switch again.

2. Set the unit of display to kg using the "kg/lb" switch.

3. Instruct the subject to step gently onto the center of the scale and stand still with arms at their side. Record weight to the nearest 0.1 kg.

4. After weight is obtained, ask the subject to step off the scale.

5. Ensure that the scale is zeroed before the next measurement.

**From the Tanita Electronic Scale Model BWB-800A instruction manual.

Bioelectrical Impedance Analysis Protocol**

1. Subjects will be instructed prior to measurement of the expected protocol. Make sure subjects follow the protocol as closely as possible. Remove shoes, jackets, sweaters, etc. before stepping onto BIA.

2. Ask subject about any electrical implants such as pacemakers. Subjects with pacemakers or other electrical devices in their bodies cannot participate in BIA.

3. Enter <u>0.5</u> kg for clothes weight.

4. Select male or female. (Use standard mode for all children)

5. Enter age. (Subject must be at least 7 years of age for this measurement)

6. Enter height in cm. Round to the nearest whole cm-.5 or greater, round up/less than .5, round down

7. Enter 00 for goal.

8. Have subject step onto the BIA making sure their heels are on the posterior electrodes and the front part of the feet are in contact with the anterior electrodes. Make sure the subject stands without moving on the platform until the measurement has been completed. Once the measurement is complete, inform the subject that they can step off the platform and thank the subject for participating.

9. Repeat the measurement if needed. A second measurement is needed if the subject moved enough that at least one of his/her feet lost contact with the electrodes.

***From Tanita TBF-300A instruction manual.*

<u>Waist to Hip Circumference Instructions</u>**

1. Waist is measured at the narrowest part of the torso (above the umbilicus and below the xiphoid process). If there is no obvious natural waist, measure at the navel.

2. Hip is measured at the maximal circumference of the hips or buttocks region, whichever is larger (above the gluteal fold).

3. WHR is calculated by dividing the waist measurement by the hip measurement.

4. Repeat measurements. Two values should be recorded for each circumference.

A third measurement should be taken if the first two differ by more than .5 cm.

Note: All measurements will be recorded to the nearest .1cm
Use the indicator on the tape measure to ensure proper tension.

**From *ACSM's Guidelines for Exercise Testing and Prescription*

APPENDIX B

SAMPLE PARENTAL CONSENT FORMS

Informed Consent for Parents of Children at Carver Elementary School
Mississippi State University

Title of Study: *Improving Health in the Mississippi Delta through Coordinated School Health Program*

Study Site: Carver Elementary School

What is the purpose of this project? This project studies the benefits of a new school health program at Carver Elementary School. There are three questions we are trying to answer with this project. First, does a school health program improve understanding of nutrition knowledge of children and parents? Second, how does a school health program affect school policies? Third, are there any changes in body measurements of children and teachers over time?

How will the research be conducted? The school principal will select teachers and teacher assistants to help. Students will be weighed in regular school clothes. Their height and weight will be taken in private and not shared with anyone. Height and weight will be taken using the same equipment as a doctor might use. Waist and hips will be measured with a tape measure. Trained researchers will take the measurements. Your child's name will be replaced by a number for privacy. This number will protect the child from being identified by teachers or researchers. Other researchers will not have access to your child's name. We want to follow-up with students each year to learn about the long-term effects of the school health program.

Are there any risks or discomforts? Some children and adults may feel embarrassed to be weighed and measured. We will take extra care so no one is embarrassed. We will take the measurements in private. We will not share this information with anyone.

Benefits: Students who participate may benefit from changes to healthier eating habits and increased physical activity. This program may help children learn and do better in school. It will also help us measure the success of school health program.

Will this information be kept confidential? Yes. The information will not be given out. Your child's name will be replaced by a number to keep his or her information private. The information we collect will be kept in a locked drawer on the MSU campus.

Whom to contact if you have questions about the study: If you have questions about this research project, please contact Sylvia Byrd, (662) 325-0919 or reach her by e-mail at shb5@msstate.edu

Whom to contact about your rights as a research participant in this study: For more information regarding human participation in research, please contact the Mississippi State University (MSU) Regulatory Compliance Office at (662) 325-5220

What if I do not want to participate? Please understand that your participation is voluntary. You or your child will not be penalized for choosing not to participate. You may choose to stop at any time.

Please complete the following information:

I give permission for my child ____________________________ who is a student
(Please print child's first and last name)

at Carver Elementary School in ______________________ grade to participate in this research project. (Please print child's grade)

___________________________________ ____________________
Parent/Guardian Signature Date

___________________________________ ____________________
Investigator Signature Date
Sylvia H. Byrd

Informed Consent for Parents of Children at Carver Elementary School
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Title of Study: *Improving Health in the Mississippi Delta through Coordinated School Health Program*

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What is the purpose of this project? This project studies the benefits of a new school health program at Carver Elementary School. There are three questions we are trying to answer with this project. First, does a school health program improve understanding of nutrition knowledge of children and parents? Second, how does a school health program affect school policies? Third, are there any changes in body measurements of children and teachers over time?

How will the research be conducted? The school principal will select teachers and teacher assistants to help. Students will be weighed in regular school clothes. Their height and weight will be taken in private and not shared with anyone. Height and weight will be taken using the same equipment as a doctor might use. Waist and hips will be measured with a tape measure. Body fat will be measured by a device that looks like a bathroom scale. Body fat will be measured on second through fifth graders only. Students will be asked to remove their shoes and socks in order to be measured. Alcohol spray will be used on the scale to clean it between students. Trained researchers will take the measurements. Your child's name will be replaced by a number for privacy. This number will protect the child from being identified by teachers or researchers. Other researchers will not have access to your child's name. We want to follow-up with students each year to learn about the long-term effects of the school health program.

Are there any risks or discomforts? Some children and adults may feel embarrassed to be weighed and measured. We will take extra care so no one is embarrassed. We will take the measurements in private. We will not share this information with anyone.

Benefits: Students who participate may benefit from changes to healthier eating habits and increased physical activity. This program may help children learn and do better in school. It will also help us measure the success of school health program.

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What if I do not want to participate? Please understand that your participation is voluntary. You or your child will not be penalized for choosing not to participate. You may choose to stop at any time.

Please complete the following information:

I give permission for my child ___________________ who is a student of Carver
(Please print child's first and last name)
Elementary School in the _______________________ grade to participate in this research project. (Please print child's grade)

_________________________________ ________________
Parent/Guardian Signature Date

Sylvia H Byrd

_________________________________ ___February 22, 2007_
Investigator Signature Date
Sylvia H. Byrd