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Cardiovascular Disease Risk Factors and Associations with Indicators of Body Fat, Diet, and Physical Activity in U.S. Children Ages 6-11

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CARDIOVASCULAR DISEASE RISK FACTORS AND ASSOCIATIONS WITH INDICATORS OF BODY FAT, DIET, AND PHYSICAL ACTIVITY IN U.S. CHILDREN AGES 6-11

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Research was conducted to determine the prevalence of cardiovascular disease risk factors in U.S. children ages 6-11 and associations with body fat, diet, and physical activity. Data for 685 children ages 6-11 was obtained from the National Health and Nutrition Examination Survey (NHANES). NHANES data was examined to determine the prevalence of cardiovascular disease risk factors in these children, the impact of indicators of body fat on cardiovascular disease risk factors, the association between cardiovascular disease risk factors and dietary components, and the relationship between physical activity and cardiovascular disease risk factors among U.S. children. Children were also evaluated for overweight and obesity based on four obesity anthropometric measurements: weight, body mass index, triceps skinfold, and subscapular skinfold. Approximately 36 percent of all children were either overweight or obese according to body mass index and 39 percent of all children had at least one unfavorable cardiometabolic marker. As body fat increased in the children, the prevalence of unfavorable cardiometabolic markers increased. Minimal significant associations were found between nutrient intakes and cardiovascular disease risk factors or indicators of body fat. No significant associations were found between physical activity and

cardiovascular disease risk factors or indicators of body fat. In conclusion, diet and physical activity did not appear to have a direct impact on cardiovascular health or body fat in children. However, body fatness appears to negatively affect cardiovascular health in this sample, increasing the prevalence of unfavorable cardiometabolic markers.

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TABLE OF CONTENTS

Page

LIST OF TABLES

Table **Page**

LIST OF TABLES, continued

Table **Page**

LIST OF FIGURES

Figure **Page**

LIST OF APPENDIX TABLES

Table **Page**

INTRODUCTION

The prevalence of obesity among children has more than doubled in the last twenty years and has more than tripled in adolescents, reaching pandemic proportions (World Health Organization, 2010). Overweight and obese children are at an increased risk of developing bone and joint problems, sleep apnea, psychosocial problems, and cardiovascular disease. Obese children are more likely to become overweight or obese as adults compared to children of normal weight. This results in an increased risk of developing adult health problems including type 2 diabetes, heart disease, stroke, and cancer (van Lenthe et al.,1998)

Cardiovascular diseases are the leading cause of death in the United States and are closely related to overweight and obesity. The American Heart Association claims that there is strong evidence showing that elevated cholesterol levels in childhood may play a role in the development of atherosclerosis later in life (Kavey et al., 2003). Dietary and physical activity habits along with excess body fat, affect cardiovascular disease risk and these habits are often established during childhood. As a result, poor dietary or physical activity habits in childhood could lead to elevated cholesterol levels and an increased risk of developing cardiovascular disease in early adulthood. Studies examining cardiovascular disease risk and its associations with body fat, diet, and physical activity in U.S. children younger than 12 years of age are limited.

The present study has four main objectives: (1) to examine the prevalence of cardiovascular disease risk factors in U.S. children ages 6-11; (2) to evaluate the impact of indicators of body fat on cardiovascular disease risk factors; (3) to investigate the association between cardiovascular disease risk factors and dietary components; and (4)

to study the relationship between physical activity and cardiovascular disease risk factors among U.S. children. Data from the 2001-2002 and 2003-2004 National Health and Nutrition Examination Surveys (NHANES) will be utilized. I hypothesize that cardiovascular disease risk factors will be prevalent in children ages 6-11 and that prevalence will increase as body fat increases, physical activity decreases, and dietary quality decreases.

REVIEW OF LITERATURE

Cardiovascular diseases are collectively the leading cause of death in the United States accounting for 34.3% of all deaths in the U.S. in 2006 (American Heart Association, 2010; Centers for Disease Control and Prevention, 2009). Atherosclerotic heart disease, otherwise known as coronary heart disease or coronary artery disease, is most often caused by atherosclerosis that occurs due to the deposition of cholesterol in the arterial wall, causing plaque accumulation resulting in the narrowing of arteries and increasing the risk of myocardial infarction and ischemic stroke (American Heart Association, 2010; National Institutes of Health Medline Plus, 2009).

CARDIOVASCULAR DISEASE DEVELOPMENT IN CHILDREN

Adult cardiovascular disease develops silently during childhood and adolescence. Autopsy studies in children and adolescents have found that early atherosclerotic lesions present starting at a young age (Berenson et al., 1998; McGill et al., 2000). Ultrasound imaging has more recently been used to evaluate atherosclerotic plaque development by measuring for carotid intima media thickness.

Recent findings from four major epidemiological studies utilizing ultrasound imaging, including the Bogalusa study, found that cardiovascular disease risk factors in children, specifically high levels of low-density lipoprotein (LDL) cholesterol levels and a higher body mass index (BMI), led to the development of atherosclerosis in young adults (Davis et al., 2001; Gidding et al., 2006; Li et al., 2003; Mahoney et al., 1996; McMahan et al., 2007; Juonala et al., 2008).

Intima media thickness (IMT) begins with endothelial dysfunction and is generally considered the earliest sign of atherosclerosis. Endothelial cells are active in the body and perform duties including regulation of vascular tone and structure. This is accomplished by releasing molecules such as nitric oxide and prostacyclin which control vasodilation and vasoconstriction (Landmesser et al., 2004). Endothelial cells also provide both a non-thrombotic surface and a non-adherent surface of leukocytes for arteries (Ross, 1993). Endothelial dysfunction therefore is defined as impaired vasodilation or vasoconstriction to stimuli, pro-inflammatory surface state, and pro-thrombotic surface state (Groner et al., 2006).

Risk factors for cardiovascular disease include both traditional risk factors known for many years as well as risk factors that have been more recently determined. Traditional risk factors for cardiovascular disease include active smoking, family history of cardiovascular disease, dyslipidemia, and hypertension. Risk factors found more recently include physical inactivity, secondhand smoke exposure, increased inflammatory markers or general inflammation, and obesity. Both traditional and more recently discovered risk factors have been found to be associated with endothelial dysfunction in children and adults (Libby et al., 2002; Landmesser et al., 2004).

OBESITY AND CARDIOVASCULAR DISEASE RISK FACTORS IN CHILDREN

According to the World Health Organization (2010), obesity in children is reaching epidemic proportions all over the world and is considered to be a chronic pediatric disease (World Health Organization, 2010). The prevalence of obesity in United States children, ages 6-11, has increased from 6.5% in 1980 to 17.0% in 2006

(National Center for Chronic Disease Prevention and Health Promotion, 2010). Longitudinal data have shown that childhood and adolescent adiposity and fat distribution tend to track into adulthood, with 50-80% of obese adults claiming to have been obese as an adolescent (Webber et al., 1995; van Lenthe et al., 1998). The impact of obesity can be seen in a number of health problems including heart disease, joint problems, psychosocial problems, and cancer, and as obesity increases in children, these health problems are becoming more prevalent at younger ages. (Costa et al., 2009; Groner et al., 2006).

Obesity is independently associated with cardiovascular disease and increased morbidity and mortality (Poirier and Eckel, 2002). It is widely accepted that atherosclerosis begins in childhood and progresses slowly into adulthood and is influenced by excess weight (Strong et al., 1992; Costa et al., 2009). Severe obesity in children is associated with brachial artery endothelial dysfunction and carotid arterial wall stiffness which are both recognized markers of atherosclerosis (Tounian et al., 2001). In addition, several studies have indicated that BMI in childhood or adolescence predicts carotid intima-media thickness in young adults (Li et al., 2003; Raitakari et al., 2003; Oren et al., 2003).

Zhang et al. (2008) evaluated cardiovascular risk factors in overweight and obese Chinese children. Chinese BMI and World Health Organization weight-for-height indices were utilized as screening criteria to classify 215 children, ages 7.5-13, as either non-obese or obese. A total of 107 non-obese children and 108 obese children were used in the study. According to weight-for-height criterion, obese children had significantly higher mean concentrations of serum triglycerides, LDL cholesterol, apolipoprotein B,

and insulin and significantly lower levels of HDL cholesterol and apolipoprotein A, when compared to their non-obese counterparts. According to BMI criterion, obese children had significantly higher mean concentrations of serum triglycerides, LDL cholesterol, apolipoprotein B, and insulin and significantly lower levels of HDL cholesterol and apolipoprotein A. Chinese children in this study had an increase in unfavorable cardiovascular disease risk factors when obese.

Likewise, a study done by I'Allemand et al. (2008), examined 26,008 overweight European adolescents for cardiovascular risk. Subjects from centers in Germany, Austria, and Switzerland were analyzed for overweight based on German BMI references and had a median age of 12.6 years. After examining cardiometabolic markers, these researchers found that as the degree of overweight increased (overweight to extremely obese), the prevalence of abnormalities in blood pressure, HDL cholesterol, triglycerides and carbohydrate metabolism increased. Cardiovascular risk increased exponentially with the progression of the degree of adiposity, possibly exposing extremely obese children to metabolic and cardiovascular disease prior to puberty. Over 50% of all adolescents classified as obese or extremely obese in this study had at least one adverse cardiovascular risk factor suggesting that full evaluation of cardiovascular risk factors in obese children is needed.

Two studies looking at Brazilian children also found significant associations between BMI and cardiovascular disease risk factors. Costa and associates (2008) evaluated 118 children, ages 8-12, by dividing them into quartiles according to BMI percentiles. Blood pressure and biochemical assessments (triglycerides, HDL cholesterol, glucose, and insulin) were measured and assessed according to quartiles of BMI

percentiles. Blood pressure, glucose levels, triglycerides, and insulin all significantly increased as BMI percentiles increased. HDL cholesterol levels significantly decreased as BMI percentiles increased. The second Brazilian study done by Pereira et al. (2008) evaluated obesity and cardiovascular disease risk factors in 494 male and female children and adolescents between the ages of 2-19. Anthropometric measures, blood pressure, and biochemical assessments (total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, blood glucose, ApoA and ApoB) were measured in all subjects. Subjects were divided into groups based on BMI categories (without excess weight, overweight, obese). Obese children and adolescents had significantly higher levels of total cholesterol, LDL cholesterol and triglycerides compared to subjects having no excess weight. In addition, obese subjects had significantly higher triglyceride levels compared to overweight subjects. No significant difference was found between weight groups for both HDL cholesterol and glucose. Inconsistent results were found for HDL cholesterol and glucose within BMI percentiles in these two studies.

Closer to the United States, in Quebec Canada, cardiovascular disease risk factors are also being seen in adolescents. Lambert et al. (2008), studied adolescents 13-16 years old living in Quebec Canada. Subjects were assessed for cardiometabolic risk factors and their associations with BMI categories. Subjects were divided according to BMI categories (no excess weight, overweight, obese) and cardiometabolic risk factors were measured. Cardiometabolic risk factors included systolic and diastolic blood pressure, total cholesterol, LDL cholesterol, apolipoprotein B, HDL cholesterol, triglycerides, glucose, insulin, and c-reactive protein. The proportion of adolescents with borderline and unfavorable levels of triglycerides, blood pressure, total cholesterol, LDL cholesterol,

HDL cholesterol, ApoB, c-reactive protein and insulin were significantly higher in overweight and obese adolescents compared to adolescents with no excess weight. No significant difference was seen in proportions of adolescents with borderline and unfavorable levels of glucose between BMI categories.

In the United States, Pan and Pratt (2008) examined 4,450 adolescents and teens from the 1999-2000 National Health and Nutrition Examination Survey (NHANES) analyzing subjects for metabolic syndrome and associations with overweight (analyzed using BMI), diet, and physical activity. In this study, metabolic syndrome was defined as having three or more of the following components: waist circumference $\geq 90^{th}$ percentile, fasting blood glucose $\geq$ 100 mg/dL, triglycerides $\geq$ 110 mg/dL, HDL cholesterol $\leq$ 35 mg/dL, or blood pressure (systolic or diastolic) $\geq 90^{th}$ percentile for height, age, and sex or currently taking antihypertensive drugs. Prevalence of metabolic syndrome was significantly higher in overweight subjects than normal weight subjects. Due to the metabolic syndrome being a major risk factor for cardiovascular disease, the Pan and Pratt (2008) study is relevant to the current study and shows that cardiovascular risk factors are being seen in U.S. adolescents and teens.

Two additional studies looking at metabolic syndrome in U.S. adolescents and teens had results consistent with the Pan and Pratt (2008) study (Duncan et al, 2004; Cook et al., 2003). Both found significant increased risk for symptoms of metabolic syndrome in overweight and obese adolescents using the same diagnosis criteria for metabolic syndrome (Duncan et al, 2004; Cook et al., 2003).

These studies provide information regarding cardiovascular disease risk in children showing that body fatness is correlated with an increased risk in developing

cardiovascular disease as well as an increase in prevalence of cardiovascular disease risk factors. While they provide insight, limited information is available regarding cardiovascular disease risk in U.S. children and thus research is warranted.

Recommendations for screening for cardiovascular disease risk factors in children who are overweight or obese have been set by the National Cholesterol Education Program (NCEP) Expert Panel on Blood Cholesterol Levels in Children and Adolescents and the American Academy for Pediatrics. NCEP guidelines state that children who are either overweight (BMI 85^{th}-94^{th} percentile for age) or obese (BMI $\geq 95^{th}$ percentile for age) should be screened for abnormal lipid levels regardless of the presence of other non-lipid cardiovascular disease risk factors (National Cholesterol Education Program, 1992). More recently, the American Academy for Pediatrics states that "overweight children belong to a special risk category of children and are in need of cholesterol screening regardless of family history or other risk factors" (Daniels and Greer, 2008).

DIET AND CARDIOVASCULAR DISEASE RISK FACTORS

It is well recognized that diet can affect cardiovascular health and risk factors for cardiovascular disease. The American Heart Association recommends that individuals consume a diet containing a variety of fruits, vegetables, whole grains, low-fat dairy, lean sources of protein including legumes, poultry and lean meats, as well as consume fish, preferably oily fish, at least twice a week (Lichtenstein et al., 2006). The consumption of these foods promotes the following: an increase in consumption of fiber, vitamins, and phytochemicals; an increased consumption of omega-3 fatty acids; and a decreased consumption of saturated fat.

Pan and Pratt (2008) evaluated 4,450 adolescents for metabolic syndrome as mentioned previously. This study, in addition to evaluating metabolic syndrome and association with BMI, also examined associations with diet. To evaluate diet, the Healthy Eating Index was utilized. The Healthy Eating Index consists of 10 components that each represents different aspects of a healthful diet based on the USDA's 1992 Food Guide Pyramid and the 1990 Dietary Guidelines for Americans. The maximum score for the Healthy Eating Index is 100 and a higher overall score generally indicates a better quality diet. All subjects' diets were evaluated using the Healthy Eating Index and the prevalence of metabolic syndrome was presented by quartiles of overall Healthy Eating Index and Healthy Eating Index components (grains, fruits, vegetables, dairy, meat, total fat, saturated fat, cholesterol, sodium, and variety). Prevalence of metabolic syndrome decreased as overall Healthy Eating Index scores increased and as fruit scores increased. Only fruit scores showed a significant inverse association with prevalence of metabolic syndrome.

Focusing on fruits and vegetables, Joshipura et al. (2001) evaluated the impact of fruit and vegetable intake in 84,251 women and 42,148 men participating in either the Nurses' Health Study or the Health Professionals Follow-up study and of whom were followed for eight consecutive years. Diet was assessed using food frequency questionnaires. Individuals were divided into quintiles of fruit and vegetable intake. Compared with individuals in the lowest quintile of fruit and vegetable intake, individuals with the highest quintile of fruit and vegetable intake had a relative risk for coronary heart disease of 0.80. In addition, as servings of fruit and vegetables increased by one serving per day, coronary heart disease risk decreased by 4%.

Similar findings were discovered by Nikolic et al. (2008). This study evaluated the relationship between dietary intake of fruits and vegetables and the risk of coronary heart disease. Subjects were adults admitted to hospitals having no suspicion of coronary heart disease. Subject pool consisted of 290 adults who were assessed for fruit and vegetable intake using questionnaires. Odds ratios for developing coronary heart disease were calculated based on tertiles of fruit and vegetable consumption. Subjects consuming the most fruit (> 5 items/day) had a 60% lower risk for coronary heart disease compared to subjects consuming the least. Subjects who consumed the most vegetables (> 3 items/day) had a 70% lower risk of coronary heart disease compared to subjects who did not consume vegetables.

While evidence exists that fruits and vegetables have cardioprotective effects, contradictory evidence exists. Bazzano et al. (2002) studied 9,608 adults ages 25-74 years evaluating the relationship between fruit and vegetable intake and cardiovascular disease risk. An inverse correlation was found between fruit and vegetable intake and risk for cardiovascular disease but results were not significant.

Evidence suggests that fruits and vegetables have cardioprotective effects, but results are not conclusive. Pan and Pratt (2008) found no significant association between prevalence of metabolic syndrome, which has implications for heart disease, and vegetable intake. Bazzano and associates (2002) found no significant associations between cardiovascular disease risk and fruit and vegetable intake, differing from findings made by Nikolic (2008) and Joshipura (2001). Additional studies evaluating the impact of fruit and vegetable intake are warranted.

In addition to the impact of fruit and vegetable intake on cardiovascular health, fiber and fatty acids in the diet have been found to have possible impacts.

A review study done by Anderson et al. (2009) found that high levels of dietary fiber intake, especially consumption of whole grains, were associated with significantly lower levels of cardiovascular disease. In addition, cardiovascular risk factors, including dyslipidemia, were commonly lower in individuals consuming whole grains and adequate amounts of dietary fiber.

In regards to dietary fatty acids, the American Heart Association recommends consuming lean meats and reducing saturated fat intake to less the 7% of total energy intake. A review study done by Errkila and associations (2008) examined the effects of dietary fatty acids on cardiovascular health. The study suggested that quality of dietary fats is more important than quantity, although little evidence exists to support this claim. The review found that saturated fatty acids and trans fatty acids increased cardiovascular risk in several studies while omega-6 and omega-3 fatty acids were associated with decreased risk for cardiovascular disease. Specific omega-6 and omega-3 fatty acids seemed to impact cardiovascular disease risk differently. Linoleic acid (n-6), eicosapentaenoic acid (n-3), and docosahexaenoic acid (n-3) were associated with decreased risk for cardiovascular disease but the influence of alpha-linolenic acid was not found to reduce or increase cardiovascular disease risk.

The American Heart Association recommends the following healthy diet goals for adults consuming 2000 kcal/day to maintain a healthy heart. At least 4 ½ cups of fruits and vegetables should be consumed per day. Fish should be eaten at least twice a week at a serving size of 3.5 ounces. Fiber-rich whole grains should be consumed daily at the

amount of three one-ounce servings or more. Sodium should be kept to less that 1,500 mg per day and sugar sweetened beverages to no more than 450 calories per week. Additional dietary measures include consuming at least four servings per week of nuts, legumes, and seeds. Processed meats should be consumed no more than two times per week and less than 7% of total energy intake should come from saturated fat (American Heart Association Healthy Lifestyle, 2010).

While diet plays a role in cardiovascular disease, there continues to be no cause and effect relationships between dietary components and cardiovascular disease risk. It seems that fruits, vegetables, whole grains, and healthy dietary fats can impact cardiovascular health in a positive way but contradictory evidence still exists. More research is warranted examining the impact of dietary components on cardiovascular health, especially in childhood development of cardiovascular disease.

CARDIOVASCULAR DISEASE AND PHYSICAL ACTIVITY

The American Heart Association in conjunction with the American College of Sports Medicine recommends all healthy adults ages 18-65 should get at least 30 minutes of moderate intensity activity five days a week. Children should get at least 30 minutes of age appropriate activity every day of the week to maintain a healthy heart as well as a healthy weight (American Heart Association Healthy Lifestyle, 2010).

Pan and Pratt (2008), as mentioned previously, examined adolescents for metabolic syndrome. Physical activity levels were evaluated and examined for association with metabolic syndrome. Physical activity was ranked in all subjects (n=4,450) and divided into tertiles for evaluation. The tertile with the lowest levels of

physical activity showed the highest prevalence of metabolic syndrome and the tertile with the highest levels of physical activity showed the lowest prevalence of metabolic syndrome, although there was no significant difference.

A review study done by Ignarro et al. (2006) also evaluated the impact of physical activity on cardiovascular health. Three studies examined in this review showed a reduced rate of coronary heart disease in physically active people.

Physical activity is important for overall general health in individuals with and without cardiovascular disease. Limited research exists on the impact physical activity has on cardiovascular health in children.

SUMMARY

Cardiovascular diseases are the leading cause of death in the United States and are closely related to overweight and obesity. Numerous studies demonstrate that as obesity increases in the childhood and adolescent population, cardiovascular disease risk factors are becoming prevalent (Zhang et al., 2008; I'Allemand et al., 2007; Botton et al., 2007; Pereira et al., 2008; Costa et al., 2009; Lambert et al., 2008; Plachta-Danielzik et al., 2008; Pan and Pratt, 2008). It is well documented and understood that dietary and physical activity habits along with excess body fat, affect cardiovascular disease risk and these habits are often established during childhood. As a result, poor dietary or physical activity habits in childhood could lead to elevated cholesterol levels and an increased risk of developing cardiovascular disease in early adulthood. Limitations in current research exist; studies examining cardiovascular disease risk and its associations with body fat, diet, and physical activity in U.S. children younger than 12 years of age are limited.

METHODS

EXPERIMENTAL DESIGN AND ANALYTICAL PROCEDURES

The study design was a cross-sectional study using national data for children ages 6-11 years from the National Health and Nutrition Examination Surveys (NHANES). NHANES data collection was conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention and provides cross-sectional, nationally representative health examination data on non-institutionalized civilians of the United States. The survey samples were selected using a stratified multistage probability design with random sampling of the civilian non-institutionalized population, with over-sampling of certain subgroups.

For this study, the NHANES 2001-2002 and 2003-2004 samples were used which included 2,276 children ages 6-11 years of age. Of the 2,276 participants, 2,194 (96.4%) participated in both the interview and examination process of the NHANES data collection. Children who did not complete the necessary components for this study were excluded, resulting in 685 subjects used for evaluation.

Associations between the following variables were assessed: total serum cholesterol, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, c-reactive protein (CRP), triglycerides, body mass index (BMI), subscapular and triceps skinfolds, body weight, total calories consumed, total fat intake, total cholesterol intake, carbohydrate and protein intake, sugar intake, saturated fat intake, mono-unsaturated fat intake, poly-unsaturated fat intake, omega-3 and omega-6 fatty acid intake, vitamin and mineral intake, fiber intake, and physical activity levels.

NHANES protocol and laboratory procedures are explained in detail on the National Health and Nutrition Examination Survey webpage (Centers for Disease Control and Prevention National Health and Nutrition Examination Survey, 2010). Physical examinations, including anthropometric measurements, were conducted at the mobile examination centers by trained examiners using a standardized protocol. The laboratory measures collected and analyzed included total cholesterol, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, triglycerides, and c-reactive protein (CRP), all of which were measured using fully enzymatic techniques. Triglycerides were measured only in children who had fasted for more than nine hours prior to venipuncture.

The anthropometric measurements used in the present study included weight, height, subscapular skinfolds, and triceps skinfolds, each of which was measured between 3 and 10 repeated standard measures. Weight was measured using a Toledo digital scale and was calculated in pounds then converted to kilograms via the automated system. Standing height was measured using a fixed stadiometer with a vertical backboard and a moveable headboard. Body Mass Index (BMI) was calculated using the weight and height measurements collected (kg/m^2). Triceps and subscapular skinfold measurements were measured to the nearest 0.1 millimeter using a calibrated Holtain skinfold calipers.

Skinfold charts from NHANES II date back to 1976-1980 resulting in possible outdated values, thus skinfold charts from a study done in 2010 by Addo and Himes were used in addition to the NHANES II charts (Addo and Himes, 2010). Subscapular and triceps skinfold category values used to evaluate the subjects for overweight and obesity

were calculated from the Centers for Disease Control and Prevention NHANES II charts and charts from Addo and Himes. These values can be found in Appendices A-5 and A-7.

Dietary intake data was analyzed from the dietary data which was collected using a standardized, trained interviewer-administered 24-hour dietary recall and the USDA automated multiple pass method instrument to determine the individual's food consumption for the previous day. Children ages 6-11 completed the dietary interview with a proxy respondent. Information collected from the 24-hour dietary recall was coded and linked to a database of foods and their nutrient composition. Calculations of total daily nutrient intakes were derived from this database and were used in this study.

NHANES 2001-2002 data included a single 24-hour dietary recall. The nutrient data from this single recall was used for evaluation. NHANES 2003-2004 data included two 24-hour dietary recalls, one conducted through an in-person interview and a second through a telephone interview with a proxy respondent for each child. Nutrient data from the two dietary recalls was averaged and these averages were used for the present evaluation.

Physical activity data was also used in this study. In NHANES 2001-2002 and 2003-2004, parents self-reported the physical activity of their child by responding to the question "How many times per week does your child play or exercise enough to make him/her sweat or breathe hard?" The frequency of physical activity for each child was displayed as times per week.

STATISTICAL ANALYSIS

Associations were analyzed between all variables including: total cholesterol, LDL cholesterol, HDL cholesterol, CRP, triglycerides, BMI, subscapular skinfolds, triceps skinfolds, total calories, total fat intake, total cholesterol intake, carbohydrate and protein intake, sugar intake, saturated fat intake, mono-unsaturated fat intake, poly-unsaturated fat intake, vitamin and mineral intake, fiber intake, omega-3 and omega-6 fatty acid intake, and physical activity.

Variables were set up in a correlation matrix and analyzed using Spearman Rank correlation due to extreme non-normality of most variables. Correlations were adjusted for age, gender, and ethnicity. Statistical significance was set at $P<0.001$.

RESULTS

A total of 685 subjects ages 6-11 (51.8% females) completed the necessary components for this study including the dietary interview, physical activity questionnaire, appropriate laboratory blood draws, and anthropometric measurements.

The mean age of the 685 children was 8.48 years old. Within the 685 children, there was near equal distribution between different age groups with roughly one-sixth of all participants in each age group. In addition, approximately 92% of all children were either of non-Hispanic white, non-Hispanic black, or of Hispanic descent with near equal distribution between these three ethnicities. Demographic information for all subjects is listed in Table 1.

Table 1. Demographics of 685 children

Gender	**% (n)**
Females	51.8 (355)
Males	48.2 (330)
Ethnicity	**% (n)**
Non-Hispanic White	29.9 (205)
Non-Hispanic Black	30.2 (207)
Mexican American	31.8 (218)
Other Race – Including Multi-Racial	5.4 (37)
Other Hispanic	2.6 (18)

Table 1, continued

Age	% (n)
6	17.4 (119)
7	16.5 (113)
8	16.1 (110)
9	17.2 (118)
10	16.6 (114)
11	16.2 (111)

Evaluating for overweight and obesity according to BMI resulted in a finding that 35.78% of girls (n = 127), 36.67% of boys (n = 121), and 36.2% (n = 248) of all children evaluated in this study were either overweight or obese.

According to CDC NHANES II skinfold categories, 28.51 % (n = 100) of girls were overweight or obese according to subscapular skinfold measurements and 23.95% (n = 85) were overweight or obese according to triceps skinfold measurements. In addition, 34.84% (n = 115) of boys were overweight or obese according to subscapular skinfold measurements and 26.97% (n = 89) were overweight or obese according to triceps skinfold measurements. Combining the sexes, 31.39% (n = 215) of all children were overweight or obese according to subscapular skinfold measurements and 25.4% (n = 174) were overweight or obese according to triceps skinfold measurements according to the NHANES II charts.

Skinfold measurements were also compared to skinfold charts found in the Addo and Himes study done in 2010. Addo and Himes (2010) skinfold charts provide more current skinfold measurements and categories. According to Addo and Himes skinfold charts, 37.74% (n = 134) of girls were overweight or obese according to subscapular skinfold measurements and 32.96% (n = 117) were overweight or obese according to triceps skinfold measurements. Of the boys, 38.48% (n = 127) were overweight or obese according to subscapular skinfold measurements and 30.6% (n = 101) were overweight or obese according to triceps skinfold measurements. Again when the sexes were combined, 38.1% (n = 261) of all children were overweight or obese according to subscapular skinfold measurements and 33.72% (n = 231) were overweight or obese according to triceps skinfold measurements.

The prevalence of overweight and obesity in children according to skinfold measurements using Addo and Himes (2010) skinfold charts more closely resembles the proportion of children who were overweight or obese according to BMI, than do the proportions using the CDC, NHANES II, skinfold charts. All proportions of overweight and obese children can be found in Table 2.

Table 2. Prevalence of overweight and obesity according to body fat indicators by gender in 685 children.

Body Fat Indicator	Girls (n = 355)	Boys (n = 330)	All Children (n = 685)
Overweight [% (n)]			
BMI-for-age ≥ 85th-94th percentile (CDC 2000)	21.13 (75)	17.88 (59)	19.56 (134)
Subscapular Skinfold-for-age ≥ 85th-94th percentile (CDC NHANES II)	19.15 (68)	26.36 (87)	22.63 (155)
Subscapular Skinfold-for-age ≥ 85th-94th percentile (Addo and Himes, 2010)	20.28 (72)	16.06 (53)	18.25 (125)
Triceps Skinfold-for-age ≥ 85th-94th percentile (CDC NHANES II)	14.65 (52)	19.09 (63)	16.79 (115)
Triceps Skinfold-for-age ≥ 85th-94th percentile (Addo and Himes, 2010)	18.03 (64)	13.33 (44)	17.66 (121)
Obese [% (n)]			
BMI-for-age ≥ 95th percentile (CDC 2000)	14.65 (52)	18.79 (62)	16.64 (114)
Subscapular Skinfold-for-age ≥ 95th percentile (CDC NHANES II)	9.01 (32)	8.48 (28)	8.76 (60)
Subscapular Skinfold-for-age ≥ 95th percentile (Addo and Himes, 2010)	17.46 (62)	22.42 (74)	19.85 (136)
Triceps Skinfold-for-age ≥ 95th percentile (CDC NHANES II)	9.30 (33)	7.88 (26)	8.61 (59)
Triceps Skinfold-for-age ≥ 95th percentile (Addo and Himes, 2010)	14.93 (53)	17.27 (57)	16.06 (110)

Cardiovascular disease risk factors were assessed for in all subjects based on cutoff values taken from the American Heart Association (American Heart Association, 2010).

Out of all children, 39.56% (n = 271) had borderline high or high total serum cholesterol levels. To determine if the significant level of occurrence of borderline high

or high total cholesterol levels was simply due to high HDL cholesterol levels, cholesterol ratios were assessed. Cholesterol ratios were calculated by dividing total cholesterol by HDL cholesterol values for all children. Of the 271 children with borderline high or high total cholesterol levels, 39.48% (n = 107) had an unfavorable cholesterol ratio of greater than 3.5:1 compared to 25.26% (n = 173) of all 685 children having an unfavorable cholesterol ratio. Of the children with borderline high cholesterol levels (n=204), 31.37% (n=64) had unfavorable cholesterol ratios compared to 62.69% (n=41) of children with high total cholesterol levels (n=67). The American Heart Association recommends cholesterol ratios to fall below 5:1 with optimum ratios being at or below 3.5:1. Thus a ratio of 3.5:1 was used to assess the children.

Borderline high to high LDL cholesterol levels occurred in 21.31% (n = 146) of all children. Low HDL cholesterol levels occurred in 3.07% (n = 21) of all children and high triglyceride levels occurred in 9.93% (n = 68) of all children.

C-reactive protein levels are classified as low risk, average risk and high risk for cardiovascular disease. One subject (0.15%) was classified as high risk for cardiovascular disease based on CRP values. Of all children, 2.77% (n = 19) were classified as being at average risk for cardiovascular disease based upon CRP values. Prevalence of cardiovascular disease risk factors can be found in Table 4 and Figure 1. Cutoff values used to assess for cardiovascular disease risk factors can be found in Table 3.

Table 3. Cardiovascular disease risk factor cutoff values. [1]

Cardiometabolic marker	Levels
Total Cholesterol (mg/dL)	
Normal	< 170
Borderline High	170-199
High	≥ 200
LDL Cholesterol (mg/dL)	
Normal	< 110
Borderline High	110-129
High	≥ 130
HDL Cholesterol (mg/dL)	
Normal	≥ 35
Low	< 35
Triglycerides (mg/dL)	
Normal	≤ 150
High	> 150
C-Reactive Protein (mg/L)	
Low Risk of CVD	< 1.0
Average Risk of CVD	1.0 - 3.0
High Risk of CVD	> 3.0
Cholesterol Ratio[2]	
Optimum Ratio	≤ 3.5:1

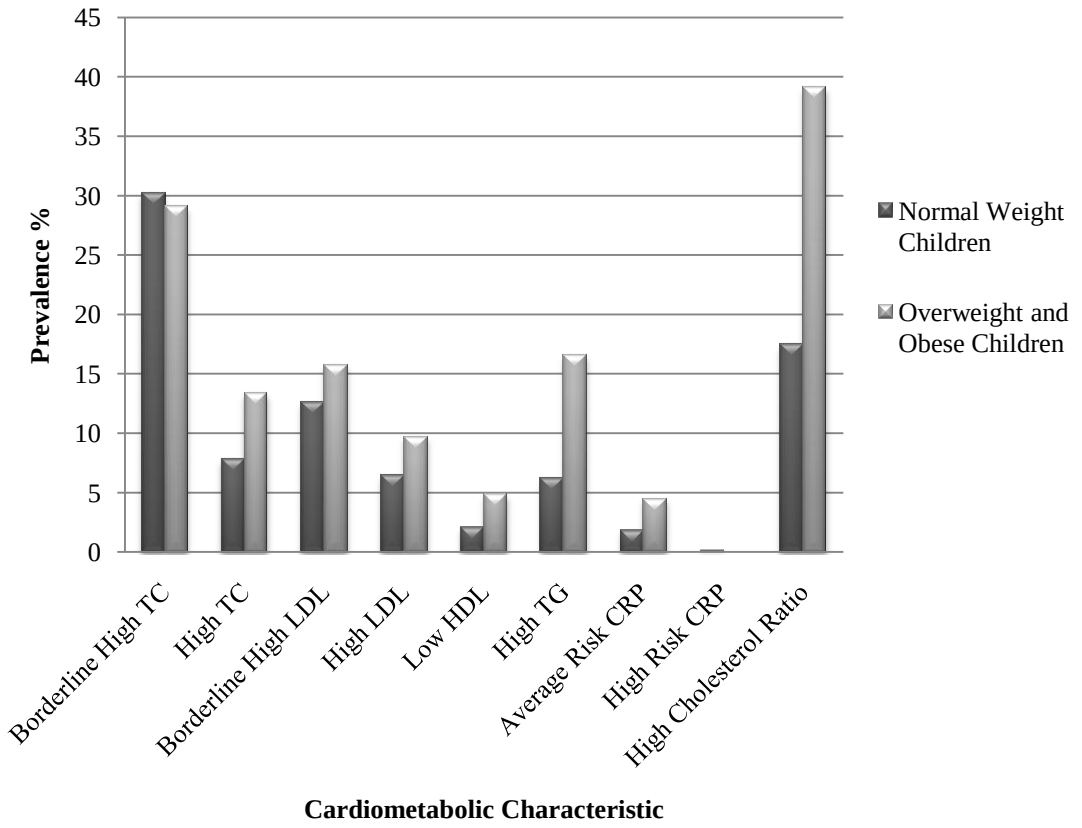
[1] Values were obtained from the American Heart Association. Total cholesterol, LDL cholesterol, HDL cholesterol and Triglyceride levels are recommendations for children. C-reactive protein and cholesterol ratio levels are recommendations used for adults.
[2] Cholesterol ratio is based on total cholesterol and HDL cholesterol levels

Table 4. Prevalence of cardiovascular disease risk factors in 685 children.

Cardiometabolic characteristic	All Children (n=685) % (n)	Normal Weight Children (n=437) % (n)	Overweight and Obese Children (n=248) % (n)
Total Cholesterol (mg/dL)			
Borderline High	29.78 (204)	30.21 (132)	29.03 (72)
High	9.78 (67)	7.78 (34)	13.31 (33)
LDL Cholesterol (mg/dL)			
Borderline High	13.72 (94)	12.59 (55)	15.73 (39)
High	7.59 (52)	6.41 (28)	9.68 (24)
HDL Cholesterol (mg/dL)			
Low	3.07 (21)	2.06 (9)	4.84 (12)
Triglycerides (mg/dL)			
High	9.93 (68)	6.18 (27)	16.53 (41)
C-Reactive Protein (mg/L)			
Average risk	2.77 (19)	1.83 (8)	4.44 (11)
High risk	0.15 (1)	0.15 (1)	0.00 (0)
Cholesterol Ratio[2]			
High	25.26 (173)	17.39 (76)	39.11 (97)

[2] Cholesterol ratio is based on total cholesterol and HDL cholesterol levels

Figure 1. Prevalence of unfavorable cardiometabolic markers in normal weight vs. overweight and obese children

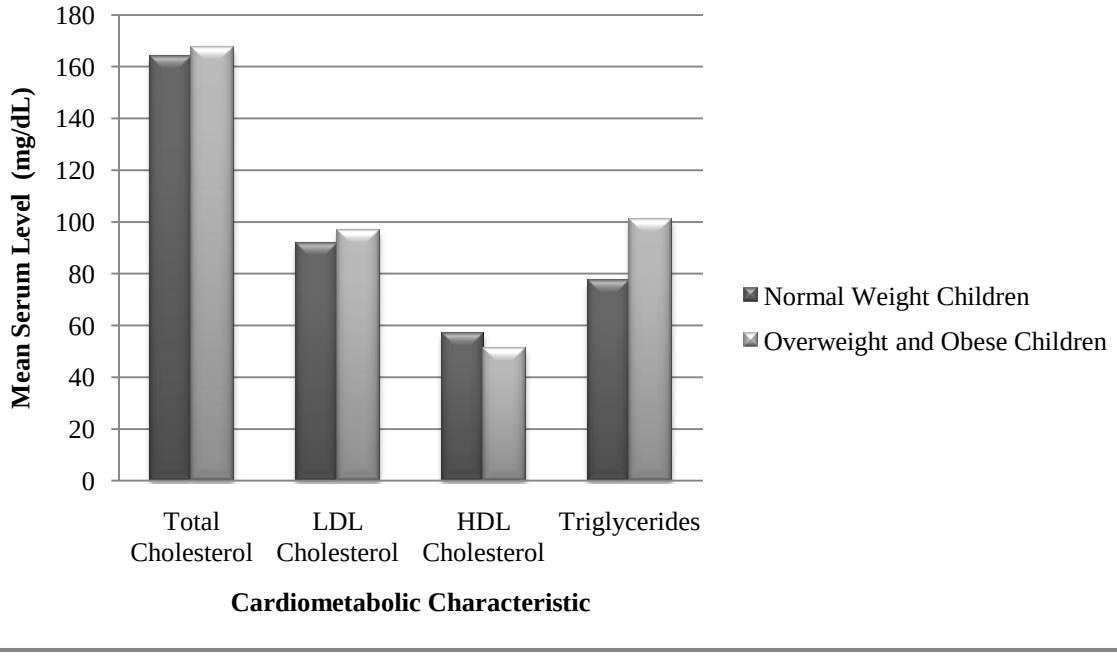


Mean values of cardiometabolic characteristics all fell within favorable levels for both normal weight children and overweight or obese children. Mean values of total cholesterol, LDL cholesterol, triglycerides, c-reactive protein, and cholesterol ratio were higher for overweight and obese children. In addition, the mean value of HDL cholesterol for overweight and obese children was lower than the mean for children of normal weight. Mean values can be found in Table 5 and Figure 2.

Table 5. Mean values of cardiometabolic characteristics in 685 children.

Cardiometabolic characteristic	Mean Value All Children (n=685)	Mean Value Normal Weight Children (n=437)	Mean Value Overweight and Obese Children (n=248)
Total Cholesterol (mg/dL)	165.28	164.03	167.48
LDL Cholesterol (mg/dL)	93.49	91.81	96.44
HDL Cholesterol (mg/dL)	54.65	56.82	50.83
Triglycerides (mg/dL)	85.74	77.13	100.92
C-reactive protein (mg/L)	0.14	0.10	0.22
Cholesterol Ratio	3.14:1	2.99:1	3.42:1

Figure 2. Mean serum levels of total cholesterol, LDL cholesterol, HDL cholesterol and triglycerides within BMI categories



Associations between four obesity anthropometric indicators and cardiometabolic markers were measured in all children. Obesity anthropometric indicators measured in the 685 subjects included body weight, BMI, triceps skinfold measurements and subscapular skinfold measurements. Significant positive correlations between CRP levels and body weight ($r = 0.380$. $p < 0.0001$), BMI ($r = 0.399$, $p < 0.0001$), triceps skinfold ($r = 0.403$, $p < 0.001$), and subscapular skinfold ($r = 0.450$, $p < 0.0001$) measurements. CRP and subscapular skinfold measures possessed the strongest positive significant correlation amongst the four obesity anthropometric indicators.

Total cholesterol was significantly positively correlated with two of the four obesity anthropometric indicators, with correlations between total cholesterol and both triceps ($r = 0.142$, $p = 0.0002$) and subscapular skinfold ($r = 0.152$, $p < 0.0001$) measurements being significant. Blood triglyceride levels were significantly positively correlated with all four obesity anthropometric indicators with the strongest correlation between TG and subscapular skinfold ($r = 0.267$, $p < 0.0001$) measures, followed by BMI ($r = 0.254$, $p < 0.0001$), body weight ($r = 0.234$, $p < 0.0001$), and triceps skinfold ($r = 0.216$, $p < 0.0001$) measurements.

HDL cholesterol levels were significantly negatively correlated with all four body fat indicators with the strongest negative correlations being between HDL and both BMI ($r = -0.239$. $p < 0.0001$) and weight ($r = -0.235$, $p < 0.0001$) followed by subscapular skinfold ($r = -0.223$, $p < 0.0001$) and triceps skinfold ($r = -0.195$, $p < 0.0001$) measurements. LDL cholesterol levels were significantly positively correlated with three of the four obesity anthropometric indicators. LDL cholesterol was significantly positively correlated with BMI ($r = 0.149$, $p < 0.0001$), triceps skinfold ($r = 0.177$, $p <$

0.0001), and subscapular skinfold (r = 0.185. p < 0.0001) measurements. A slight positive, but not significant, association was seen between LDL cholesterol levels and body weight in children (r = 0.094, p < 0.013). Partial correlation coefficients between cardiometabolic markers and body fat indicators can be found in Table 6.

Table 6. Partial correlation coefficients between body fat indicators and cardiometabolic markers in 685 children.[1]

	CRP	TC	TG	HDL cholesterol	LDL cholesterol
Body weight	0.38[2]	0.11	0.23[2]	-0.24[2]	0.09
BMI	0.40[2]	0.08	0.25[2]	-0.24[2]	0.15[2]
Triceps Skinfold	0.40[2]	0.14[2]	0.22[2]	-0.20[2]	0.18[2]
Subscapular Skinfold	0.45[2]	0.15[2]	0.27[2]	-0.22[2]	0.18[2]

[1] All analyses were adjusted for age, gender, and ethnicity. TC, total cholesterol; TG, triglycerides
[2] Significant at p < 0.001

Significant associations between cardiometabolic factors and body fat indicators were set up in quintiles to evaluate trends in the correlations. Each quintile is represented by 137 children.

Body weight showed significant positive correlations with both c-reactive protein and triglycerides and a significant negative correlation with HDL cholesterol. Within quintiles of body weight, c-reactive protein levels increased from quintile one to five with CRP levels doubling from quintile four to quintile five. Triglyceride levels increased from quintile one to five with the exception of a very small decrease in triglycerides from

quintile one to two. HDL cholesterol levels show an upward trend from quintile one to three followed by a downward trend from quintile three to five. Trends within quintiles of body weight for all three cardiometabolic markers can be found in Table 7.

Table 7. Cardiometabolic marker trends within quintiles of body weight.

	Body Weight Quintiles				
	1 (n=137)	**2 (n=137)**	**3 (n=137)**	**4 (n=137)**	**5 (n=137)**
Body Weight (kg)[1]	21.8	26.8	31.9	39.6	55.7
CRP (mg/L)[1]	0.08	0.09	0.13	0.14	0.29
Triglycerides (mg/dL)[1]	76.99	76.14	80.86	86.98	107.73
HDL cholesterol (mg/dL)[1]	55.24	55.82	58.29	54.80	49.09

[1] Values shown in table are mean values for each quintile.

BMI showed significant positive correlations with c-reactive protein, triglycerides, and LDL cholesterol, as well as a significant negative correlation with HDL cholesterol. C-reactive protein levels increased as BMI increased with the exception of quintile three which show the lowest levels of CRP. Triglyceride levels increased from quintile one to five with the exception of a small decrease in triglyceride levels from quintile one to quintile two. LDL cholesterol levels also increased from quintile one to five with the exception of a small decrease from quintile three to quintile four. Finally, HDL cholesterol levels decreased from quintile one to five with the exception of a small increase from quintile two to quintile three. Trends within quintiles of BMI for all four cardiometabolic markers can be found in Table 8.

Table 8. Cardiometabolic marker trends within quintiles of body mass index.

	Body Mass Index Quintiles				
	1 (n=137)	**2 (n=137)**	**3 (n=137)**	**4 (n=137)**	**5 (n=137)**
BMI (kg/m^2)[1]	14.5	15.9	17.5	19.7	25.1
CRP (mg/L)[1]	0.09	0.11	0.07	0.14	0.31
Triglycerides (mg/dL)[1]	75.69	75.00	80.20	85.70	112.09
HDL cholesterol (mg/dL)[1]	57.02	56.28	56.64	54.81	48.29
LDL cholesterol (mg/dL)[1]	89.39	90.21	94.63	94.31	98.88

[1] Values shown in table are mean values for each quintile.

Triceps skinfold measurements showed significant positive associations with c-reactive protein, total cholesterol, triglycerides, and LDL cholesterol. A significant negative association was found between triceps skinfold measurements and HDL cholesterol.

As triceps skinfold measurements increased, CRP levels showed no continuous trend. CRP levels are lowest in quintile three and highest in quintile five with a downward trend from quintiles one to three and an upward trend from quintiles three to five. No consistent positive trend was shown in total cholesterol levels from quintile one to five of triceps skinfold. The mean total cholesterol level in quintile three is comparable to the mean total cholesterol level in quintile five. Triglyceride levels increased as triceps skinfold measurements increased with the largest increase in triglycerides occurring from quintile four to quintile five. For LDL cholesterol levels there was no consistent positive

trend from quintile one to five. Finally, there was an overall decrease in HDL cholesterol from quintile one to five with the exception of an increase from quintile two to three. Trends within quintiles of triceps skinfold measurements for all cardiometabolic markers can be found in Table 9.

Table 9. Cardiometabolic marker trends within quintiles of triceps skinfolds.

	Triceps Skinfold Quintiles				
	1 (n=137)	**2 (n=137)**	**3 (n=137)**	**4 (n=137)**	**5 (n=137)**
Triceps Skinfold (mm)[1]	6.7	9.4	11.8	15.8	24.2
CRP (mg/L)[1]	0.13	0.09	0.07	0.09	0.33
Total Cholesterol (mg/dL)[1]	160.24	158.45	171.91	163.55	172.24
Triglycerides (mg/dL)[1]	70.88	80.51	81.18	83.35	112.78
HDL cholesterol (mg/dL)[1]	57.69	55.07	57.77	53.35	49.36
LDL cholesterol (mg/dL)[1]	88.39	87.29	97.91	93.53	100.31

[1] Values shown in table are mean values for each quintile.

For the last obesity anthropometric measurement, subscapular skinfold had significant positive associations with c-reactive protein, total cholesterol, triglycerides, and LDL cholesterol as well as a significant negative correlation with HDL cholesterol. As subscapular skinfold measurements increased, there was no continuous trend with CPR. CRP levels were lowest in quintile three and highest in quintile five with a downward trend from quintiles one to three and an upward trend from quintiles three to five. Total cholesterol levels increased from quintile one to five with a slight decrease

from quintile three to quintile four. Triglyceride levels had positive trend with the exception of a decrease from quintile one to two. LDL cholesterol levels increased from quintile one to five and HDL levels decreased across quintiles. Trends within quintiles of subscapular skinfold measurements for all cardiometabolic markers can be found in Table 10.

Table 10. Cardiometabolic marker trends within quintiles of subscapular skinfolds.

	Subscapular Skinfold Quintiles				
	1 (n=137)	**2 (n=137)**	**3 (n=137)**	**4 (n=137)**	**5 (n=137)**
Subscapular Skinfold(mm)[1]	4.7	5.8	7.5	11.1	20.7
CRP (mg/L)[1]	0.11	0.10	0.08	0.12	0.31
Total Cholesterol (mg/dL)[1]	159.58	161.07	167.53	167.05	171.15
Triglycerides (mg/dL)[1]	75.50	72.34	81.80	86.44	112.63
HDL cholesterol (mg/dL)[1]	57.16	56.34	56.13	54.72	48.90
LDL cholesterol (mg/dL)[1]	87.36	90.28	95.02	95.05	99.72

[1] Values shown are mean values for each quintile.

Associations between cardiometabolic factors and dietary intake of total calories, dietary fats including omega-3 and omega-6 fatty acids, dietary cholesterol, fiber, vitamins and minerals were also measured. Four dietary factors were found to have a significant negative correlation with LDL cholesterol levels; vitamin A ($r = -0.151$, $p < 0.0001$), B6 ($r = -0.146$, $p = 0.0001$), B12 ($r = -0.123$, $p = 0.0009$) and total folate ($r = 0.140$, $p = 0.0002$). There was no significant association between LDL cholesterol levels

and dietary fat or fiber intake. Total cholesterol levels were significantly negatively correlated with vitamin A ($r = -0.132$, $p = 0.0005$), but with no other dietary factors. HDL cholesterol levels were significantly positively correlated with alpha-linolenic acid ($r = 0.130$, $p = 0.0006$), but showed no significant correlation with any other dietary factors. C-reactive protein was found to have a significant positive correlation with dietary cholesterol intake ($r = 0.131$, $p = 0.0006$), but had no significant correlation with any other dietary factors. Blood triglyceride levels showed no significant correlation with any dietary factors. Correlation coefficients between cardiometabolic markers and dietary macronutrients, omega-3 and omega-6 fatty acids, vitamins, and minerals can be found in Tables 11 through14.

Table 11. Partial correlation coefficients between cardiometabolic markers and dietary intake of macronutrients, cholesterol, and fiber in 685 children.[1]

Dietary Factor	CRP	TC	TG	LDL Cholesterol	HDL Cholesterol
Total Calories (kcal)	0.01	-0.00	0.01	-0.02	0.03
Carbohydrate (g)	-0.02	-0.04	0.09	-0.05	-0.04
Sugar (g)	0.02	-0.04	0.09	-0.03	-0.07
Protein (g)	0.09	-0.00	-0.05	-0.01	0.08
Dietary Cholesterol (mg)	0.13[2]	0.07	-0.05	0.06	0.10
Dietary Fiber (g)	0.02	-0.07	0.06	-0.08	0.00
Total Fat (g)	0.02	0.04	-0.07	0.02	0.09
Saturated Fat (g)	0.03	0.05	-0.05	0.04	0.07
Monounsaturated Fat (g)	0.02	0.05	-0.07	0.05	0.09
Polyunsaturated Fat (g)	-0.01	0.01	-0.07	-0.03	0.10

[1] All analyses were adjusted for age, gender, and ethnicity. CRP, C-reactive protein; TC, total cholesterol; TG, triglycerides.
[2] Significant at $p < 0.001$

Table 12. Partial correlation coefficients between cardiometabolic markers and dietary intake of omega-3 and omega-6 fatty acids in 685 children.[1]

Fatty Acid	CRP	TC	TG	LDL Cholesterol	HDL Cholesterol
Alpha-linolenic acid (g)	0.03	-0.01	-0.06	-0.05	0.13[2]
Eicosapentaenoic acid (g)	0.05	0.02	-0.06	0.00	0.09
Docosahexaenoic acid (g)	0.11	-0.01	-0.08	-0.05	0.10
Linoleic acid (g)	-0.01	0.00	-0.07	-0.03	0.09
Arachidonic acid (g)	0.11	0.07	-0.03	0.06	0.07

[1] All analyses were adjusted for age, gender, and ethnicity. CRP, C-reactive protein; TC, total cholesterol; TG, triglycerides.
[2] Significant at $p < 0.001$

Table 13. Partial correlation coefficients between cardiometabolic markers and dietary intake of vitamins in 685 children.[1]

Vitamin	CRP	TC	TG	LDL Cholesterol	HDL Cholesterol
Vitamin E, alpha-tocopherol (mcg)	-0.02	0.02	0.00	-0.02	0.08
Vitamin A, RAE (mcg)	0.03	-0.13[2]	0.00	-0.15[2]	0.03
Beta-carotene (mcg)	0.03	-0.02	-0.01	-0.02	0.07
Lycopene (mcg)	-0.02	0.05	0.04	0.02	0.07
Thiamin (mg)	0.02	-0.08	0.03	-0.10	0.02
Riboflavin (mg)	0.03	-0.09	0.02	-0.10	0.02
Niacin (mg)	0.00	-0.06	0.00	-0.09	0.06
Vitamin B6 (mg)	0.03	-0.11	0.02	-0.15[2]	0.04
Folic Acid (mcg)	-0.04	-0.12	0.07	-0.14[2]	-0.03
Vitamin B12 (mcg)	0.06	-0.11	-0.04	-0.13[2]	0.06
Vitamin C (mg)	0.07	-0.01	0.09	0.00	-0.05
Vitamin K (mcg)	0.00	-0.04	-0.05	-0.07	0.09

[1] All analyses were adjusted for age, gender, and ethnicity. CRP, C-reactive protein; TC, total cholesterol; TG, triglycerides.
[2] Significant at $p < 0.001$

Table 14. Partial correlation coefficients between cardiometabolic markers and dietary intake of minerals in 685 children.[1]

Mineral	CRP	TC	TG	LDL Cholesterol	HDL Cholesterol
Phosphorus (mg)	0.07	-0.01	-0.02	-0.02	0.06
Magnesium (mg)	0.03	-0.05	0.04	-0.07	0.03
Iron (mg)	0.00	-0.10	0.06	-0.11	0.00
Zinc (mg)	0.04	-0.07	-0.03	-0.08	0.04
Sodium (mg)	0.02	0.00	-0.03	-0.01	0.06
Potassium (mg)	0.05	-0.03	0.01	-0.04	0.05
Calcium (mg)	0.06	0.02	0.01	-0.05	0.05

[1] All analyses were adjusted for age, gender, and ethnicity. CRP, C-reactive protein; TC, total cholesterol; TG, triglycerides.

Associations were also evaluated between body fat measures and major dietary components including total calories and intakes of dietary fat, carbohydrates, sugar and protein. Body weight and dietary intake of protein were significantly positively correlated (r = 0.146, p = 0.0001). Body weight showed no other significant associations with any other dietary factors. BMI, triceps skinfold, and subscapular skinfold values showed no significant correlation with any dietary factors. Correlation coefficients between body fat indicators and major dietary components can be found in Table 15.

Table 15. Partial correlation coefficients between body fat indicators and major dietary components in 685 children. [1]

Dietary Factor	Weight	BMI	Triceps Skinfold	Subscapular Skinfold
Total Calories (kcal)	0.12	0.08	0.02	0.00
Carbohydrates (g)	0.08	0.05	-0.01	-0.03
Sugar (g)	0.07	0.04	-0.01	-0.02
Protein (g)	0.15[2]	0.11	0.06	0.04
Total Fat (g)	0.11	0.07	0.02	0.01
Saturated Fat (g)	0.12	0.08	0.04	0.03
Monounsaturated Fat (g)	0.10	0.07	0.02	0.02
Polyunsaturated Fat (g)	0.07	0.03	-0.01	-0.02

[1] All analyses were adjusted for age, gender, and ethnicity.
[2] Significant at $p < 0.001$

Finally, associations between cardiometabolic markers and physical activity levels were measured and between obesity anthropometric indicators and physical activity levels. No significant associations were found between physical activity levels and cardiometabolic markers or obesity anthropometric indicators. Partial correlation coefficients for physical activity associations can be found in Table 16.

Table 16. Partial correlation coefficients between physical activity and cardiometabolic markers and body fat indicators in 685 children. [1]

	Physical Activity [2]
C-reactive protein	0.00
Total Cholesterol	-0.08
Triglycerides	0.00
LDL Cholesterol	-0.07
HDL Cholesterol	-0.04
Weight	-0.04
Body Mass Index	-0.05
Triceps Skinfold	-0.06
Subscapular Skinfold	-0.05

[1] All analyses were adjusted for age, gender, and ethnicity.
[2] Parents self-reported the physical activity of their child by responding to the question "How many times per week does your child play or exercise enough to make him/her sweat or breathe hard?"

DISCUSSION

A limited number of studies examining the prevalence of cardiovascular disease risk factors in a nationally representative sample of U.S. children currently exist. In addition, studies examining the impact of weight and body fatness as well as diet and physical activity on cardiovascular disease risk factors in U.S. children are also limited.

This study examined the associations between indicators of body fat, diet and physical activity and cardiovascular disease risk factors in a nationally representative sample of 685 U.S. children ages 6-11 years of age.

In this study, 36.2% of all children were found to be overweight or obese according to BMI. The prevalence of overweight and obesity found in this study is similar to findings by Ogden and colleagues (2006) who utilized NHANES data from 1999-2004. Ogden found that the prevalence of overweight and obesity in children ages 6-11 was 32.2% in 2001-2002 and 37.2% in 2003-2004.

When correlations between indicators of body fat and cardiovascular disease risk factors were examined in this study, adiposity was significantly associated with unfavorable cardiovascular disease risk markers including c-reactive protein levels, LDL and HDL cholesterol levels, total cholesterol and triglyceride levels.

These associations indicate that as weight and body fat increase in children, there is an increase in the risk for cardiovascular disease and a higher probability of unfavorable blood lipids occurring. These findings are in line with several studies that have assessed the relation of obesity indicators and cardiovascular disease risk factors in children in the U.S. and in other countries (Zhang et al., 2008; I'Allemand et al., 2007;

Botton et al., 2007; Pereira et al., 2008; Costa et al., 2009; Lambert et al., 2008; Plachta-Danielzik et al., 2008; Pan and Pratt, 2008).

In the present study, unfavorable levels of all cardiovascular disease risk factors did exist in normal weight children but at a lower prevalence than in overweight and obese children. In addition, overweight and obese children showed higher mean levels of total cholesterol, LDL cholesterol, triglycerides, and c-reactive protein compared to children of normal weight. HDL cholesterol mean levels were lower in overweight and obese children compared to children of normal weight. These findings further indicate the potential adverse health consequences associated with overweight and obesity in childhood. Other studies demonstrate that childhood and adolescent adiposity and fat distribution tend to track into adulthood, with 50-80% of obese adults claiming to have been obese as an adolescent resulting in the possibility of negative health outcomes later in life (Webber et al., 1995; van Lenthe et al., 1998).

Dietary components measured in this study included macronutrient as well as micronutrient intake. Minimal significant associations between dietary components and cardiometabolic markers were observed. Dietary cholesterol intake was significantly positively associated with c-reactive protein levels in this study. The impact of dietary cholesterol intake on c-reactive protein levels was also significant in a study examining the impact of egg consumption on c-reactive protein levels (Tannock et al. 2005). In lean insulin-sensitive, healthy, community dwelling adults, increased egg consumption, and therefore increased dietary cholesterol consumption, significantly increased c-reactive protein levels. Verhamme et al. (2002) demonstrated an increase in c-reactive protein levels in pigs fed a cholesterol-rich diet. When cholesterol was removed from the diet, c-

reactive protein levels decreased. These studies indicate a potential association between dietary cholesterol intake and c-reactive protein levels in the body.

In this study, significant associations between dietary fatty acids and cardiometabolic markers were limited to a single significant positive association between alpha-linolenic acid and HDL cholesterol. In contrast to this finding, Zhao and associates (2004) found that alpha-linolenic acid decreased HDL cholesterol levels in adults consuming 6.5% of energy from alpha-linolenic acid. A study done by Egert and colleagues (2009) demonstrated that alpha-linolenic does not impact HDL cholesterol levels either negatively or positively but that docosapentaenoic acid significantly increases HDL cholesterol levels. Likewise, the consumption of flaxseed, a seed rich in alpha-linolenic acid, showed no changes in HDL cholesterol levels but significant reductions in LDL cholesterol levels in a recent meta-analysis examining the effects of flaxseed consumption on plasma lipid levels (Pan et al., 2009). These findings indicate that the impact of alpha-linolenic acid is not well established but numerous studies demonstrate that alpha-linolenic acid has no significant impact on HDL cholesterol levels. The significant finding in this study could be occurring due to the fact that a cross-sectional study design was used, providing only a single measurement to establish a relationship between dietary components and cardiovascular disease risk factors. Additionally, it is possible that this association is common in children, but limited research exists to examine this possibility.

This study also examined the impact of dietary vitamin and mineral intake on cardiometabolic markers. LDL cholesterol levels were significantly negatively correlated with four major vitamins: vitamin A, vitamin B6, folic acid, and vitamin B12. In

addition, total cholesterol levels were significantly negatively correlated with vitamin A as well. No significant associations were demonstrated between dietary minerals and cardiometabolic markers.

Limited research exists for the interaction of vitamin A with LDL cholesterol levels. It is suggested that vitamin A has the potential to reduce LDL oxidation susceptibility, thereby reducing atherogenicity of LDL cholesterol. A study done by Reavan and colleagues (1993) demonstrated that beta-carotene supplementation in adults, a precursor for vitamin A, showed no significant impact on LDL protection from oxidation, but vitamin E did.

Vitamins B6, B12, and folic acid, on the other hand, may have a role in reduction of atherosclerotic plaque formation, inflammation, and LDL cholesterol levels. A European case-control study consisting of 750 case subjects with documented vascular disease and 800 healthy and disease-free control subjects, demonstrated that as vitamin B6, B12, and folic acid levels decreased, homocysteine levels increased. LDL cholesterol was not measured in this study but due to the possible influence of homocysteine levels on arterial disease, these vitamins may be related to elevated LDL cholesterol levels and further study of this relationship may be warranted (Robinson et al., 1998). Similar study results were found by Schnyder et al. (2002) where supplementation with folic acid, vitamin B12 and B6, lowered homocysteine levels and decreased the incidence of major events following a coronary intervention. In Japan, Cui and colleagues (2010) examined the impact of dietary intake of vitamins B6, B12, and folic acid on risk for cardiovascular disease. High dietary intakes of folate and vitamin B6 were associated with reduced risk

of mortality from stroke, coronary heart disease, and heart failure among the Japanese population. Vitamin B12 showed no significant association.

The findings from these studies provide insight into the possible importance of the findings made in children in this study. The importance of these vitamins in regards to cardiovascular disease is controversial but additional research examining the relationship between vitamin B12, B6, folic acid and LDL cholesterol could yield a better understanding of these relationships.

The limited significant findings discovered in this study between diet and cardiometabolic markers could be due to the recall method used by NHANES examiners. A single 24-hour dietary recall was provided for participants of the 2001-2002 NHANES study. A single dietary recall often provides a poor indicator of an individual's actual diet due to variations in diet from day to day. In addition, a proxy respondent (guardian or parent) provided information for the 24-hour dietary recall for the children participating in both the 2001-2002 and 2003-2004 NHANES studies. This method of reporting for children is useful for young children who are not capable of recalling dietary information but provides limitations in that over-reporting, under-reporting, or inaccurate reporting by the proxy respondent is possible. Limited significant findings between diet and cardiometabolic markers in this study may also indicate that associations between diet and cardiovascular disease risk factors do not exist in children, possibly manifesting later in teen or young adult years.

In addition to the examination of dietary components and their impact on cardiovascular disease risk factors in this study, the impact of major macronutrients and

indicators of body fat were also measured. Significant findings were limited to a single significant positive correlation between protein intake and body weight.

Finally, no significant associations were seen between physical activity levels and cardiovascular disease risk factors or indicators of body fat. Similar findings by Pan and Pratt (2008) found no significant relationship between physical activity and risk for metabolic syndrome in U.S. adolescents. Physical activity is strongly encouraged to maintain a healthy weight and a healthy heart. No association was found in this study which could be due to their simply not being an association, or flaws in the determination of the level of physical activity of each child. Levels of physical activity were determined by asking parents or guardians how many hours per week their child engages in physical activity. This question poses potential for under or over-reporting by parents or guardians. Additional studies examining the impact of physical activity on indicators of body fat and cardiovascular disease risk in children is needed to fully understand this relationship.

This study does not go without limitations. Blood pressure was not measured in children less than eight years of age in the NHANES data sets utilized. High blood pressure in childhood is predictive of hypertension as an adult and could have been useful in determining additional cardiovascular risk in the children studied. Another limitation of this study is that associations were not adjusted for pubertal stages in the children. Puberty has potential to affect lipid levels in adolescents and could potential skew results for children nearing puberty, predominately 10-11 year olds.

SUMMARY AND CONCLUSION

The four major objectives for this study were to: (1) to examine the prevalence of cardiovascular disease risk factors in U.S. children ages 6-11; (2) to evaluate the impact of indicators of body fat on the prevalence of cardiovascular disease risk factors; (3) to investigate the association between cardiovascular disease risk factors and dietary components; and (4) to study the relationship between physical activity and cardiovascular disease risk factors among U.S. children.

Data for 685 children ages 6-11 was obtained from the National Health and Nutrition Examination Survey (NHANES). Approximately 36 percent of all children were either overweight or obese according to BMI, and 39 percent of all children had at least one unfavorable cardiometabolic marker. As body fat increased in the children, the prevalence of unfavorable cardiometabolic markers increased. Minimal significant associations were found between nutrient intakes and cardiovascular disease risk factors or indicators of body fat. The association between LDL cholesterol and vitamins B6, B12, and folic acid provide interesting findings and suggest further research. No significant associations were found between physical activity and cardiovascular disease risk factors or indicators of body fat.

In conclusion, diet appears to have minimal impact on cardiovascular health in children. The limited significant findings discovered in this study between diet and cardiometabolic markers could be due to flawed dietary recall methods utilized by NHANES examiners or to the fact that associations between diet and cardiovascular disease risk factors do not exist at a young age.

Physical activity did not appear to have a significant direct impact on cardiovascular health or indicators of body fat in children. These findings may have been influenced by the method of evaluating physical activity or by the fact that associations between physical activity and cardiovascular health or indicators of body fat may not exist in young children.

Finally, body fatness appears to negatively affect cardiovascular health in this sample, increasing the prevalence of unfavorable cardiometabolic markers.

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APPENDIX

Appendix A-1

Centers for Disease Control and Prevention Body Mass Index for Age (in months) Tables

Body Mass Index, or BMI, is calculated using the following formula:
BMI = Weight (in kilograms)/Height (in meters)^2

Male Children, Ages 2-20 years

Age (in months)	3rd Percentile BMI Value	5th Percentile BMI Value	10th Percentile BMI Value	25th Percentile BMI Value	50th Percentile BMI Value	75th Percentile BMI Value	85th Percentile BMI Value	90th Percentile BMI Value	95th Percentile BMI Value	97th Percentile BMI Value
24	14.52095	14.73732	15.09033	15.74164	16.57503	17.55719	18.16219	18.60948	19.33801	19.85986
24.5	14.50348	14.71929	15.07117	15.71963	16.54777	17.52129	18.11955	18.56111	19.2789	19.79194
25.5	14.46882	14.68361	15.03336	15.67634	16.49443	17.45135	18.03668	18.4673	19.16466	19.66102
26.5	14.4346	14.64843	14.9962	15.63403	16.4426	17.38384	17.957	18.37736	19.05567	19.53658
27.5	14.40083	14.61379	14.95969	15.59268	16.39224	17.31871	17.88047	18.29125	18.95187	19.41849
28.5	14.36755	14.57969	14.92385	15.55226	16.34334	17.25593	17.80704	18.20892	18.85317	19.30665
29.5	14.33478	14.54615	14.88866	15.51275	16.29584	17.19546	17.73667	18.13031	18.75949	19.20097
30.5	14.30257	14.51319	14.85414	15.47414	16.24972	17.13726	17.66932	18.05538	18.67078	19.10132
31.5	14.27093	14.48084	14.82027	15.43639	16.20495	17.0813	17.60495	17.98408	18.58695	19.00761
32.5	14.23989	14.44909	14.78707	15.39951	16.1615	17.02753	17.54351	17.91635	18.50792	18.91973
33.5	14.20948	14.41798	14.75453	15.36345	16.11933	16.97592	17.48496	17.85215	18.43363	18.83758
34.5	14.17972	14.3875	14.72264	15.32822	16.07843	16.92645	17.42927	17.79143	18.364	18.76106
35.5	14.15063	14.35767	14.69142	15.29379	16.03876	16.87907	17.37639	17.73414	18.29895	18.69006
36.5	14.12223	14.32851	14.66086	15.26016	16.0003	16.83376	17.32627	17.68022	18.23842	18.62449
37.5	14.09453	14.30002	14.63096	15.22731	15.96304	16.79048	17.27889	17.62963	18.18231	18.56425
38.5	14.06756	14.27222	14.60173	15.19523	15.92695	16.7492	17.23419	17.58231	18.13057	18.50924
39.5	14.04132	14.2451	14.57316	15.16392	15.89203	16.70988	17.19213	17.5382	18.08311	18.45938
40.5	14.01582	14.21868	14.54527	15.13337	15.85824	16.67251	17.15266	17.49725	18.03986	18.41456
41.5	13.99107	14.19297	14.51805	15.10359	15.82559	16.63704	17.11575	17.45941	18.00074	18.37469
42.5	13.96707	14.16796	14.49151	15.07458	15.79406	16.60345	17.08135	17.42462	17.96568	18.33969
43.5	13.94383	14.14367	14.46566	15.04633	15.76364	16.5717	17.04941	17.39282	17.93459	18.30947
44.5	13.92133	14.12009	14.4405	15.01886	15.73434	16.54177	17.01988	17.36395	17.90741	18.28393
45.5	13.89959	14.09723	14.41604	14.99218	15.70614	16.51364	16.99272	17.33795	17.88405	18.263
46.5	13.87858	14.07509	14.39229	14.96629	15.67904	16.48726	16.96789	17.31477	17.86444	18.24658
47.5	13.85832	14.05366	14.36926	14.9412	15.65305	16.46262	16.94533	17.29434	17.8485	18.23459
48.5	13.83877	14.03296	14.34695	14.91694	15.62817	16.4397	16.92501	17.27661	17.83614	18.22694
49.5	13.81995	14.01296	14.32537	14.89351	15.60441	16.41846	16.90688	17.26151	17.8273	18.22354
50.5	13.80182	13.99367	14.30453	14.87093	15.58176	16.39889	16.89089	17.24899	17.82189	18.22431
51.5	13.78439	13.97509	14.28444	14.84921	15.56025	16.38097	16.87701	17.23899	17.81983	18.22915
52.5	13.76763	13.95722	14.2651	14.82838	15.53987	16.36468	16.86519	17.23145	17.82104	18.23799

53.5	13.75152	13.94003	14.24651	14.80844	15.52065	16.35001	16.8554	17.22632	17.82544	18.25071
54.5	13.73606	13.92353	14.22868	14.78941	15.50258	16.33693	16.8476	17.22354	17.83295	18.26725
55.5	13.72123	13.90771	14.21162	14.7713	15.48569	16.32545	16.84176	17.22306	17.84349	18.2875
56.5	13.70702	13.89257	14.19532	14.75414	15.46998	16.31554	16.83784	17.22483	17.85699	18.31136
57.5	13.6934	13.87809	14.17979	14.73792	15.45546	16.3072	16.8358	17.2288	17.87335	18.33875
58.5	13.68036	13.86426	14.16503	14.72266	15.44214	16.30042	16.83563	17.23493	17.89252	18.36957
59.5	13.6679	13.85108	14.15103	14.70836	15.43003	16.29518	16.83729	17.24315	17.9144	18.40373
60.5	13.656	13.83855	14.1378	14.69504	15.41914	16.29148	16.84076	17.25344	17.93893	18.44112
61.5	13.64464	13.82665	14.12534	14.68269	15.40947	16.28932	16.846	17.26575	17.96602	18.48166
62.5	13.63383	13.81537	14.11363	14.67133	15.40103	16.28868	16.853	17.28003	17.99562	18.52525
63.5	13.62355	13.80472	14.10268	14.66094	15.39382	16.28955	16.86173	17.29625	18.02764	18.57179
64.5	13.61379	13.79469	14.09249	14.65154	15.38783	16.29192	16.87217	17.31437	18.06201	18.6212
65.5	13.60456	13.78527	14.08305	14.64312	15.38307	16.29578	16.88428	17.33435	18.09868	18.67337
66.5	13.59584	13.77646	14.07436	14.63567	15.37953	16.30113	16.89805	17.35616	18.13758	18.72823
67.5	13.58764	13.76825	14.06642	14.6292	15.37721	16.30794	16.91346	17.37975	18.17863	18.78569
68.5	13.57996	13.76065	14.05921	14.62369	15.37609	16.3162	16.93048	17.4051	18.22179	18.84564
69.5	13.57278	13.75364	14.05274	14.61914	15.37618	16.3259	16.94909	17.43217	18.26698	18.90802
70.5	13.56612	13.74724	14.04701	14.61555	15.37745	16.33702	16.96925	17.46092	18.31416	18.97273
71.5	13.55998	13.74144	14.042	14.6129	15.37991	16.34955	16.99096	17.49133	18.36325	19.03969
72.5	13.55435	13.73624	14.03772	14.6112	15.38353	16.36346	17.01418	17.52335	18.41421	19.10882
73.5	13.54925	13.73164	14.03417	14.61042	15.38831	16.37875	17.03888	17.55696	18.46699	19.18005
74.5	13.54467	13.72764	14.03134	14.61057	15.39423	16.39537	17.06505	17.59212	18.52152	19.25329
75.5	13.54062	13.72424	14.02922	14.61163	15.40127	16.41333	17.09265	17.6288	18.57775	19.32847
76.5	13.5371	13.72145	14.02783	14.61359	15.40943	16.4326	17.12166	17.66696	18.63564	19.40551
77.5	13.53412	13.71927	14.02714	14.61645	15.41869	16.45315	17.15206	17.70658	18.69513	19.48434
78.5	13.53168	13.71769	14.02717	14.6202	15.42902	16.47496	17.1838	17.74762	18.75617	19.5649
79.5	13.5298	13.71672	14.02791	14.62483	15.44042	16.49801	17.21688	17.79004	18.81872	19.6471
80.5	13.52846	13.71637	14.02935	14.63032	15.45288	16.52229	17.25126	17.83382	18.88272	19.73089
81.5	13.52768	13.71663	14.0315	14.63668	15.46636	16.54776	17.28691	17.87892	18.94814	19.81619
82.5	13.52747	13.71751	14.03435	14.64389	15.48087	16.5744	17.3238	17.92532	19.01491	19.90294
83.5	13.52782	13.71901	14.03791	14.65194	15.49637	16.60219	17.36192	17.97296	19.083	19.99107
84.5	13.52874	13.72113	14.04216	14.66082	15.51287	16.63112	17.40122	18.02183	19.15236	20.08052
85.5	13.53025	13.72387	14.04711	14.67054	15.53034	16.66114	17.44168	18.0719	19.22295	20.17123
86.5	13.53233	13.72724	14.05276	14.68107	15.54876	16.69225	17.48329	18.12312	19.29471	20.26314
87.5	13.535	13.73124	14.0591	14.69241	15.56812	16.72442	17.52599	18.17548	19.36761	20.35618
88.5	13.53826	13.73587	14.06613	14.70455	15.58841	16.75763	17.56978	18.22893	19.44161	20.45031
89.5	13.54212	13.74113	14.07386	14.71749	15.60961	16.79185	17.61462	18.28344	19.51666	20.54545
90.5	13.54657	13.74702	14.08228	14.73121	15.63171	16.82707	17.66049	18.33899	19.59272	20.64155
91.5	13.55163	13.75355	14.09138	14.74571	15.65469	16.86325	17.70736	18.39554	19.66974	20.73856
92.5	13.55729	13.76071	14.10116	14.76099	15.67853	16.90039	17.7552	18.45306	19.74769	20.83643
93.5	13.56356	13.76852	14.11163	14.77703	15.70323	16.93845	17.80398	18.51152	19.82652	20.93509
94.5	13.57044	13.77695	14.12279	14.79382	15.72877	16.97742	17.85369	18.57089	19.9062	21.03449

95.5	13.57793	13.78603	14.13462	14.81136	15.75513	17.01727	17.90429	18.63115	19.98668	21.13459
96.5	13.58604	13.79575	14.14712	14.82965	15.78231	17.05799	17.95575	18.69225	20.06793	21.23532
97.5	13.59477	13.8061	14.1603	14.84867	15.81029	17.09955	18.00807	18.75418	20.1499	21.33665
98.5	13.60411	13.8171	14.17416	14.86841	15.83905	17.14193	18.0612	18.8169	20.23256	21.43852
99.5	13.61408	13.82873	14.18868	14.88888	15.86858	17.18512	18.11512	18.88038	20.31587	21.54088
100.5	13.62467	13.84101	14.20387	14.91006	15.89888	17.22909	18.16981	18.94459	20.39979	21.64368
101.5	13.63588	13.85392	14.21972	14.93194	15.92992	17.27383	18.22525	19.00952	20.48429	21.74689
102.5	13.64771	13.86747	14.23624	14.95453	15.96169	17.31932	18.28141	19.07512	20.56933	21.85044
103.5	13.66017	13.88166	14.25341	14.9778	15.99419	17.36552	18.33827	19.14137	20.65487	21.9543
104.5	13.67325	13.89648	14.27124	15.00176	16.02741	17.41244	18.3958	19.20825	20.74089	22.05842
105.5	13.68696	13.91194	14.28972	15.0264	16.06132	17.46005	18.45398	19.27573	20.82733	22.16276
106.5	13.70129	13.92804	14.30884	15.05172	16.09591	17.50833	18.5128	19.34378	20.91417	22.26727
107.5	13.71624	13.94476	14.32862	15.07769	16.13119	17.55726	18.57222	19.41238	21.00138	22.37192
108.5	13.73182	13.96212	14.34903	15.10433	16.16712	17.60683	18.63222	19.48149	21.08893	22.47666
109.5	13.74801	13.9801	14.37008	15.13161	16.20371	17.65702	18.69279	19.5511	21.17677	22.58145
110.5	13.76483	13.99871	14.39177	15.15954	16.24094	17.7078	18.7539	19.62118	21.26488	22.68625
111.5	13.78227	14.01795	14.41409	15.1881	16.2788	17.75918	18.81554	19.69171	21.35323	22.79103
112.5	13.80033	14.0378	14.43703	15.2173	16.31728	17.81112	18.87767	19.76266	21.44178	22.89575
113.5	13.819	14.05828	14.46059	15.24712	16.35637	17.86361	18.94028	19.83401	21.53051	23.00036
114.5	13.83828	14.07937	14.48478	15.27755	16.39606	17.91664	19.00336	19.90573	21.61938	23.10484
115.5	13.85818	14.10107	14.50957	15.30859	16.43633	17.9702	19.06688	19.97781	21.70837	23.20915
116.5	13.87868	14.12338	14.53498	15.34024	16.47718	18.02425	19.13081	20.05021	21.79745	23.31326
117.5	13.89979	14.1463	14.56099	15.37248	16.5186	18.07879	19.19516	20.12292	21.88659	23.41712
118.5	13.92151	14.16982	14.5876	15.40531	16.56057	18.13381	19.25988	20.19592	21.97576	23.52071
119.5	13.94382	14.19394	14.61481	15.43872	16.60309	18.18929	19.32497	20.26919	22.06494	23.624
120.5	13.96673	14.21866	14.6426	15.4727	16.64614	18.24521	19.39041	20.3427	22.15409	23.72696
121.5	13.99024	14.24396	14.67098	15.50725	16.68972	18.30156	19.45618	20.41643	22.2432	23.82955
122.5	14.01433	14.26985	14.69994	15.54236	16.73381	18.35833	19.52226	20.49036	22.33224	23.93175
123.5	14.03901	14.29633	14.72948	15.57803	16.7784	18.4155	19.58864	20.56448	22.42118	24.03353
124.5	14.06427	14.32338	14.75958	15.61424	16.8235	18.47306	19.6553	20.63877	22.51	24.13486
125.5	14.09011	14.35101	14.79025	15.65099	16.86907	18.53099	19.72222	20.7132	22.59868	24.23571
126.5	14.11653	14.3792	14.82148	15.68826	16.91512	18.58928	19.78938	20.78775	22.68719	24.33606
127.5	14.14351	14.40796	14.85326	15.72607	16.96164	18.64792	19.85678	20.86242	22.77551	24.43589
128.5	14.17106	14.43727	14.88558	15.76439	17.00862	18.70689	19.92439	20.93718	22.86363	24.53516
129.5	14.19916	14.46714	14.91845	15.80322	17.05604	18.76619	19.9922	21.01201	22.95151	24.63386
130.5	14.22782	14.49756	14.95184	15.84255	17.1039	18.82579	20.06019	21.0869	23.03915	24.73197
131.5	14.25703	14.52852	14.98577	15.88237	17.15218	18.8857	20.12835	21.16183	23.12651	24.82945
132.5	14.28678	14.56001	15.02022	15.92268	17.20089	18.94588	20.19667	21.23679	23.21358	24.9263
133.5	14.31707	14.59203	15.05519	15.96347	17.25	19.00634	20.26514	21.31175	23.30035	25.02249
134.5	14.34789	14.62458	15.09066	16.00473	17.29951	19.06706	20.33373	21.38671	23.38679	25.11801
135.5	14.37924	14.65765	15.12664	16.04646	17.34942	19.12803	20.40243	21.46165	23.47289	25.21283
136.5	14.41111	14.69122	15.16311	16.08864	17.3997	19.18924	20.47124	21.53655	23.55863	25.30693

137.5	14.44349	14.72531	15.20007	16.13127	17.45036	19.25067	20.54013	21.61141	23.644	25.40031
138.5	14.47638	14.75989	15.23751	16.17434	17.50138	19.31232	20.6091	21.6862	23.72897	25.49294
139.5	14.50977	14.79496	15.27543	16.21784	17.55276	19.37417	20.67814	21.76091	23.81354	25.58481
140.5	14.54365	14.83052	15.31381	16.26177	17.60448	19.43622	20.74722	21.83554	23.89769	25.67591
141.5	14.57802	14.86655	15.35265	16.30612	17.65653	19.49845	20.81635	21.91006	23.98141	25.76623
142.5	14.61287	14.90306	15.39195	16.35087	17.70892	19.56086	20.88551	21.98447	24.06469	25.85575
143.5	14.64819	14.94002	15.43169	16.39603	17.76162	19.62342	20.95468	22.05876	24.1475	25.94446
144.5	14.68398	14.97745	15.47187	16.44158	17.81463	19.68614	21.02386	22.1329	24.22985	26.03234
145.5	14.72022	15.01532	15.51248	16.48751	17.86795	19.74901	21.09304	22.2069	24.31172	26.11941
146.5	14.75692	15.05363	15.5535	16.53382	17.92155	19.812	21.1622	22.28075	24.3931	26.20563
147.5	14.79406	15.09238	15.59495	16.5805	17.97544	19.87512	21.23134	22.35442	24.47397	26.29101
148.5	14.83163	15.13155	15.6368	16.62754	18.02961	19.93836	21.30045	22.42791	24.55434	26.37553
149.5	14.86963	15.17113	15.67904	16.67494	18.08404	20.0017	21.36951	22.50122	24.6342	26.4592
150.5	14.90804	15.21113	15.72168	16.72267	18.13873	20.06514	21.43852	22.57433	24.71352	26.54201
151.5	14.94687	15.25152	15.7647	16.77074	18.19367	20.12866	21.50748	22.64724	24.79232	26.62395
152.5	14.98609	15.2923	15.80809	16.81914	18.24884	20.19227	21.57636	22.71993	24.87058	26.70501
153.5	15.02571	15.33347	15.85184	16.86786	18.30426	20.25594	21.64517	22.7924	24.94829	26.78521
154.5	15.06571	15.37501	15.89595	16.91689	18.35989	20.31968	21.71389	22.86465	25.02545	26.86453
155.5	15.10609	15.41692	15.94041	16.96621	18.41574	20.38347	21.78252	22.93666	25.10206	26.94297
156.5	15.14683	15.45918	15.9852	17.01583	18.4718	20.44731	21.85104	23.00842	25.17811	27.02054
157.5	15.18793	15.50179	16.03032	17.06574	18.52805	20.51119	21.91946	23.07994	25.2536	27.09724
158.5	15.22938	15.54474	16.07576	17.11592	18.5845	20.5751	21.98777	23.15121	25.32853	27.17307
159.5	15.27116	15.58801	16.12151	17.16636	18.64113	20.63903	22.05596	23.22221	25.40289	27.24802
160.5	15.31327	15.63161	16.16756	17.21706	18.69793	20.70298	22.12402	23.29295	25.47668	27.32211
161.5	15.3557	15.67551	16.21391	17.26801	18.75489	20.76694	22.19194	23.36342	25.5499	27.39534
162.5	15.39843	15.71971	16.26054	17.3192	18.81202	20.8309	22.25973	23.43362	25.62256	27.46771
163.5	15.44147	15.7642	16.30743	17.37062	18.86929	20.89486	22.32737	23.50354	25.69464	27.53924
164.5	15.48479	15.80897	16.3546	17.42227	18.9267	20.9588	22.39487	23.57318	25.76616	27.60992
165.5	15.52839	15.85401	16.40201	17.47412	18.98424	21.02272	22.46221	23.64253	25.83712	27.67977
166.5	15.57226	15.89931	16.44967	17.52618	19.04191	21.08663	22.52939	23.7116	25.90751	27.74879
167.5	15.61638	15.94486	16.49756	17.57843	19.0997	21.15049	22.5964	23.78038	25.97734	27.817
168.5	15.66076	15.99065	16.54568	17.63086	19.15759	21.21433	22.66325	23.84887	26.04662	27.88441
169.5	15.70536	16.03667	16.594	17.68347	19.21558	21.27811	22.72993	23.91706	26.11535	27.95102
170.5	15.75019	16.0829	16.64254	17.73624	19.27366	21.34185	22.79643	23.98496	26.18353	28.01686
171.5	15.79524	16.12934	16.69126	17.78917	19.33182	21.40554	22.86275	24.05257	26.25117	28.08193
172.5	15.84049	16.17598	16.74017	17.84225	19.39006	21.46916	22.92889	24.11987	26.31828	28.14624
173.5	15.88593	16.2228	16.78924	17.89546	19.44837	21.53272	22.99485	24.18689	26.38485	28.20983
174.5	15.93155	16.2698	16.83848	17.9488	19.50673	21.5962	23.06062	24.25361	26.45091	28.27269
175.5	15.97734	16.31696	16.88787	18.00225	19.56514	21.65961	23.12619	24.32003	26.51646	28.33484
176.5	16.02329	16.36427	16.9374	18.05581	19.6236	21.72294	23.19158	24.38616	26.58151	28.39632
177.5	16.06939	16.41172	16.98706	18.10947	19.68208	21.78618	23.25677	24.452	26.64606	28.45712
178.5	16.11562	16.4593	17.03683	18.16322	19.7406	21.84932	23.32177	24.51755	26.71014	28.51728

179.5	16.16198	16.507	17.08672	18.21704	19.79912	21.91237	23.38657	24.58281	26.77374	28.57682
180.5	16.20844	16.55481	17.1367	18.27093	19.85766	21.97532	23.45117	24.64778	26.83688	28.63575
181.5	16.25501	16.60271	17.18676	18.32488	19.9162	22.03816	23.51557	24.71247	26.89958	28.6941
182.5	16.30166	16.6507	17.23689	18.37887	19.97473	22.10089	23.57978	24.77688	26.96184	28.75189
183.5	16.34839	16.69875	17.28709	18.4329	20.03324	22.1635	23.64378	24.84102	27.02368	28.80915
184.5	16.39519	16.74687	17.33734	18.48696	20.09172	22.226	23.70758	24.90489	27.08511	28.8659
185.5	16.44203	16.79503	17.38763	18.54102	20.15017	22.28837	23.77119	24.96848	27.14616	28.92217
186.5	16.48892	16.84323	17.43794	18.5951	20.20858	22.35061	23.83459	25.03182	27.20683	28.97798
187.5	16.53583	16.89146	17.48827	18.64916	20.26694	22.41272	23.89779	25.0949	27.26714	29.03337
188.5	16.58276	16.93969	17.53861	18.70321	20.32524	22.47469	23.9608	25.15773	27.3271	29.08835
189.5	16.62969	16.98792	17.58893	18.75723	20.38346	22.53652	24.02361	25.22032	27.38675	29.14297
190.5	16.67661	17.03615	17.63924	18.81121	20.44162	22.59821	24.08622	25.28267	27.44609	29.19725
191.5	16.72351	17.08434	17.68951	18.86514	20.49968	22.65976	24.14864	25.34478	27.50514	29.25123
192.5	16.77038	17.1325	17.73974	18.919	20.55765	22.72115	24.21087	25.40668	27.56393	29.30493
193.5	16.8172	17.18061	17.78991	18.97279	20.61551	22.78239	24.27291	25.46835	27.62247	29.35838
194.5	16.86396	17.22865	17.84001	19.0265	20.67326	22.84346	24.33476	25.52982	27.68078	29.41164
195.5	16.91065	17.27662	17.89003	19.08011	20.73089	22.90438	24.39642	25.59109	27.7389	29.46472
196.5	16.95725	17.3245	17.93995	19.13361	20.78839	22.96514	24.4579	25.65217	27.79683	29.51767
197.5	17.00375	17.37229	17.98977	19.187	20.84574	23.02572	24.5192	25.71306	27.85461	29.57051
198.5	17.05015	17.41995	18.03947	19.24025	20.90294	23.08614	24.58033	25.77379	27.91225	29.6233
199.5	17.09642	17.46749	18.08904	19.29335	20.95999	23.14638	24.64128	25.83436	27.96979	29.67606
200.5	17.14256	17.51489	18.13846	19.3463	21.01686	23.20645	24.70207	25.89477	28.02724	29.72885
201.5	17.18854	17.56214	18.18773	19.39908	21.07356	23.26633	24.76269	25.95504	28.08464	29.78169
202.5	17.23437	17.60923	18.23682	19.45168	21.13007	23.32604	24.82315	26.01519	28.142	29.83463
203.5	17.28002	17.65613	18.28573	19.50409	21.18638	23.38556	24.88346	26.07522	28.19937	29.88771
204.5	17.32548	17.70284	18.33444	19.55629	21.24248	23.4449	24.94362	26.13515	28.25676	29.94097
205.5	17.37074	17.74935	18.38294	19.60827	21.29836	23.50404	25.00363	26.19498	28.3142	29.99447
206.5	17.41579	17.79564	18.43121	19.66002	21.35402	23.563	25.0635	26.25474	28.37173	30.04824
207.5	17.46061	17.8417	18.47925	19.71153	21.40944	23.62176	25.12324	26.31443	28.42937	30.10232
208.5	17.50518	17.88751	18.52703	19.76278	21.46461	23.68033	25.18286	26.37407	28.48716	30.15677
209.5	17.54951	17.93306	18.57455	19.81376	21.51952	23.7387	25.24235	26.43368	28.54513	30.21164
210.5	17.59356	17.97834	18.62179	19.86445	21.57417	23.79687	25.30173	26.49326	28.6033	30.26696
211.5	17.63734	18.02333	18.66873	19.91485	21.62854	23.85484	25.361	26.55284	28.66171	30.3228
212.5	17.68082	18.06802	18.71537	19.96493	21.68262	23.91261	25.42017	26.61243	28.72041	30.3792
213.5	17.72399	18.11239	18.76168	20.01469	21.7364	23.97018	25.47925	26.67204	28.77941	30.4362
214.5	17.76683	18.15644	18.80766	20.06412	21.78988	24.02754	25.53824	26.73169	28.83875	30.49387
215.5	17.80934	18.20014	18.85328	20.11319	21.84304	24.0847	25.59716	26.79141	28.89848	30.55225
216.5	17.8515	18.24349	18.89854	20.1619	21.89587	24.14166	25.65601	26.8512	28.95862	30.6114
217.5	17.89329	18.28646	18.94342	20.21022	21.94836	24.19841	25.71481	26.91109	29.01921	30.67137
218.5	17.93471	18.32904	18.98791	20.25816	22.00051	24.25495	25.77355	26.97108	29.0803	30.73222
219.5	17.97573	18.37122	19.03198	20.30569	22.05229	24.31129	25.83225	27.03121	29.14191	30.794
220.5	18.01634	18.41299	19.07563	20.35279	22.10371	24.36742	25.89093	27.09149	29.20409	30.85677

221.5	18.05652	18.45432	19.11884	20.39947	22.15476	24.42335	25.94958	27.15194	29.26687	30.92058
222.5	18.09626	18.4952	19.16159	20.44569	22.20541	24.47907	26.00823	27.21259	29.3303	30.9855
223.5	18.13555	18.53562	19.20387	20.49145	22.25567	24.53459	26.06687	27.27344	29.39442	31.05158
224.5	18.17437	18.57556	19.24567	20.53674	22.30553	24.58991	26.12553	27.33452	29.45926	31.11888
225.5	18.2127	18.615	19.28696	20.58153	22.35497	24.64502	26.18422	27.39585	29.52487	31.18746
226.5	18.25052	18.65393	19.32773	20.62582	22.40399	24.69994	26.24294	27.45746	29.5913	31.25739
227.5	18.28782	18.69233	19.36797	20.66959	22.45257	24.75466	26.30171	27.51936	29.65857	31.32872
228.5	18.32459	18.73019	19.40766	20.71283	22.50072	24.80919	26.36054	27.58159	29.72674	31.40152
229.5	18.3608	18.76748	19.44678	20.75552	22.54841	24.86352	26.41945	27.64415	29.79585	31.47585
230.5	18.39643	18.8042	19.48531	20.79766	22.59565	24.91767	26.47844	27.70707	29.86595	31.55178
231.5	18.43148	18.84031	19.52325	20.83922	22.64243	24.97163	26.53753	27.77039	29.93707	31.62937
232.5	18.46591	18.87581	19.56057	20.88019	22.68873	25.02542	26.59675	27.83411	30.00927	31.70868
233.5	18.49972	18.91068	19.59726	20.92056	22.73456	25.07902	26.65609	27.89828	30.08258	31.78979
234.5	18.53287	18.94489	19.6333	20.96032	22.7799	25.13246	26.71558	27.9629	30.15706	31.87275
235.5	18.56536	18.97844	19.66867	20.99946	22.82474	25.18572	26.77522	28.02801	30.23276	31.95764
236.5	18.59716	19.01129	19.70335	21.03795	22.86909	25.23883	26.83505	28.09363	30.30971	32.04453
237.5	18.62825	19.04343	19.73733	21.07579	22.91293	25.29179	26.89507	28.15978	30.38797	32.13348
238.5	18.65861	19.07484	19.7706	21.11296	22.95626	25.34459	26.9553	28.2265	30.46758	32.22457
239.5	18.68822	19.10551	19.80312	21.14946	22.99908	25.39725	27.01575	28.29381	30.54859	32.31787
240	18.70274	19.12055	19.8191	21.16745	23.02029	25.42353	27.04607	28.3277	30.58964	32.36537
240.5	18.71706	19.1354	19.83489	21.18526	23.04138	25.44978	27.07645	28.36174	30.63106	32.41344

Appendix A-2

Centers for Disease Control and Prevention Body Mass Index for Age (in months) Tables

Body Mass Index, or BMI, is calculated using the following formula:
BMI = Weight (in kilograms)/Height (in meters)^2

Female Children, Ages 2-20 years

Age (in months)	3rd Percentile BMI Value	5th Percentile BMI Value	10th Percentile BMI Value	25th Percentile BMI Value	50th Percentile BMI Value	75th Percentile BMI Value	85th Percentile BMI Value	90th Percentile BMI Value	95th Percentile BMI Value	97th Percentile BMI Value
24	14.14735	14.39787	14.80134	15.52808	16.4234	17.42746	18.01821	18.44139	19.10624	19.56411
24.5	14.13226	14.38019	14.77965	15.49976	16.38804	17.38582	17.97371	18.39526	19.05824	19.51534
25.5	14.10241	14.34527	14.73695	15.44422	16.31897	17.30485	17.88749	18.30611	18.96595	19.42198
26.5	14.07297	14.31097	14.69516	15.39015	16.25208	17.22693	17.80489	18.22103	18.87853	19.3341
27.5	14.04396	14.27728	14.65429	15.33754	16.18735	17.15202	17.72586	18.13997	18.79591	19.25163
28.5	14.01538	14.2442	14.61434	15.2864	16.12475	17.08009	17.65035	18.06285	18.718	19.17448
29.5	13.98723	14.21175	14.57531	15.23671	16.06429	17.01107	17.5783	17.98962	18.64472	19.10255
30.5	13.9595	14.17992	14.5372	15.18848	16.00593	16.94495	17.50965	17.92019	18.57599	19.03578
31.5	13.93221	14.14871	14.50003	15.14171	15.94967	16.88168	17.44435	17.85452	18.51173	18.97407
32.5	13.90536	14.11813	14.46378	15.09638	15.89548	16.82123	17.38235	17.79253	18.45187	18.91733
33.5	13.87893	14.08818	14.42846	15.0525	15.84336	16.76355	17.3236	17.73416	18.39632	18.86548
34.5	13.85295	14.05885	14.39406	15.01007	15.79329	16.70862	17.26804	17.67936	18.345	18.81843
35.5	13.82741	14.03016	14.3606	14.96907	15.74526	16.65641	17.21564	17.62805	18.29784	18.77609
36.5	13.8023	14.00209	14.32806	14.9295	15.69924	16.60687	17.16634	17.58019	18.25475	18.73838
37.5	13.77763	13.97466	14.29645	14.89136	15.65523	16.55998	17.12009	17.53571	18.21567	18.7052
38.5	13.75341	13.94786	14.26576	14.85465	15.61321	16.5157	17.07685	17.49455	18.18051	18.67647
39.5	13.72964	13.92169	14.23599	14.81934	15.57317	16.474	17.03658	17.45667	18.14919	18.6521
40.5	13.70631	13.89615	14.20714	14.78544	15.53508	16.43486	16.99923	17.422	18.12165	18.632
41.5	13.68343	13.87124	14.1792	14.75293	15.49893	16.39824	16.96476	17.39049	18.09781	18.61608
42.5	13.66101	13.84697	14.15218	14.7218	15.4647	16.36411	16.93312	17.3621	18.07759	18.60425
43.5	13.63905	13.82333	14.12606	14.69205	15.43238	16.33244	16.90428	17.33676	18.06093	18.59643
44.5	13.61756	13.80033	14.10084	14.66365	15.40193	16.3032	16.8782	17.31442	18.04775	18.59253
45.5	13.59654	13.77796	14.07653	14.63661	15.37335	16.27636	16.85483	17.29505	18.03799	18.59246
46.5	13.57599	13.75624	14.05311	14.61091	15.34661	16.25188	16.83413	17.27858	18.03158	18.59614
47.5	13.55592	13.73516	14.03059	14.58652	15.32168	16.22973	16.81606	17.26497	18.02844	18.60348
48.5	13.53635	13.71472	14.00895	14.56345	15.29855	16.20988	16.80058	17.25417	18.02851	18.61441
49.5	13.51728	13.69493	13.9882	14.54167	15.27719	16.19229	16.78765	17.24613	18.03174	18.62883
50.5	13.4987	13.67579	13.96833	14.52117	15.25757	16.17693	16.77723	17.24081	18.03805	18.64667
51.5	13.48065	13.65731	13.94933	14.50194	15.23967	16.16378	16.76927	17.23815	18.04738	18.66785
52.5	13.46311	13.63948	13.93121	14.48396	15.22347	16.15278	16.76375	17.23811	18.05967	18.69229

53.5	13.4461	13.62231	13.91396	14.46721	15.20894	16.14391	16.7606	17.24065	18.07486	18.71992
54.5	13.42963	13.6058	13.89757	14.45169	15.19606	16.13714	16.75981	17.24571	18.09289	18.75065
55.5	13.4137	13.58997	13.88205	14.43738	15.1848	16.13242	16.76132	17.25326	18.1137	18.78441
56.5	13.39833	13.5748	13.86739	14.42427	15.17513	16.12972	16.76509	17.26324	18.13722	18.82113
57.5	13.38352	13.56031	13.85358	14.41233	15.16703	16.12901	16.77108	17.2756	18.16341	18.86074
58.5	13.36927	13.54649	13.84062	14.40156	15.16047	16.13025	16.77925	17.29031	18.19221	18.90315
59.5	13.35561	13.53336	13.82852	14.39194	15.15543	16.1334	16.78956	17.30732	18.22355	18.94832
60.5	13.34252	13.52091	13.81726	14.38345	15.15188	16.13843	16.80197	17.32657	18.25738	18.99615
61.5	13.33003	13.50915	13.80684	14.37609	15.1498	16.14531	16.81644	17.34803	18.29365	19.04659
62.5	13.31814	13.49808	13.79726	14.36984	15.14917	16.154	16.83292	17.37165	18.3323	19.09957
63.5	13.30685	13.4877	13.78852	14.36469	15.14995	16.16446	16.85138	17.39739	18.37327	19.15501
64.5	13.29618	13.47802	13.78061	14.36062	15.15213	16.17665	16.87177	17.42519	18.41651	19.21286
65.5	13.28612	13.46903	13.77353	14.35762	15.15567	16.19056	16.89405	17.45502	18.46197	19.27305
66.5	13.27668	13.46075	13.76728	14.35567	15.16056	16.20613	16.91819	17.48683	18.50959	19.33552
67.5	13.26788	13.45317	13.76185	14.35478	15.16678	16.22334	16.94415	17.52057	18.55932	19.4002
68.5	13.2597	13.4463	13.75724	14.35491	15.17429	16.24214	16.97187	17.5562	18.61111	19.46703
69.5	13.25217	13.44013	13.75345	14.35606	15.18309	16.26252	17.00134	17.59369	18.6649	19.53594
70.5	13.24528	13.43467	13.75047	14.35823	15.19313	16.28443	17.03249	17.63297	18.72064	19.60689
71.5	13.23904	13.42991	13.7483	14.36138	15.20441	16.30785	17.06531	17.67402	18.77829	19.6798
72.5	13.23345	13.42587	13.74694	14.36552	15.2169	16.33273	17.09974	17.71678	18.83778	19.75462
73.5	13.22851	13.42254	13.74637	14.37063	15.23058	16.35906	17.13575	17.76122	18.89907	19.83129
74.5	13.22423	13.41992	13.74661	14.3767	15.24543	16.38679	17.17331	17.8073	18.96211	19.90976
75.5	13.22062	13.41801	13.74764	14.38372	15.26142	16.41589	17.21237	17.85496	19.02685	19.98995
76.5	13.21766	13.41681	13.74946	14.39168	15.27854	16.44633	17.2529	17.90417	19.09324	20.07183
77.5	13.21538	13.41632	13.75206	14.40056	15.29676	16.47809	17.29485	17.95489	19.16123	20.15533
78.5	13.21376	13.41654	13.75544	14.41035	15.31607	16.51113	17.3382	18.00708	19.23077	20.2404
79.5	13.21281	13.41748	13.75961	14.42104	15.33644	16.54542	17.38291	18.06069	19.30182	20.32698
80.5	13.21253	13.41912	13.76454	14.43263	15.35785	16.58094	17.42894	18.11569	19.37432	20.41502
81.5	13.21293	13.42147	13.77024	14.44509	15.38029	16.61764	17.47626	18.17203	19.44822	20.50447
82.5	13.214	13.42453	13.7767	14.45842	15.40374	16.65551	17.52482	18.22968	19.52349	20.59528
83.5	13.21574	13.42829	13.78393	14.47261	15.42817	16.69451	17.5746	18.28859	19.60008	20.68739
84.5	13.21816	13.43276	13.7919	14.48765	15.45357	16.73462	17.62557	18.34873	19.67794	20.78075
85.5	13.22125	13.43793	13.80063	14.50352	15.47991	16.7758	17.67768	18.41007	19.75702	20.87531
86.5	13.22502	13.4438	13.8101	14.52021	15.50718	16.81803	17.7309	18.47255	19.83728	20.97103
87.5	13.22946	13.45037	13.8203	14.53772	15.53537	16.86129	17.7852	18.53615	19.91867	21.06786
88.5	13.23458	13.45764	13.83124	14.55603	15.56444	16.90553	17.84055	18.60082	20.00116	21.16573
89.5	13.24037	13.4656	13.8429	14.57513	15.59439	16.95075	17.89692	18.66653	20.08469	21.26462
90.5	13.24683	13.47425	13.85529	14.59501	15.6252	16.9969	17.95426	18.73325	20.16923	21.36447
91.5	13.25397	13.48359	13.86839	14.61566	15.65684	17.04396	18.01256	18.80093	20.25473	21.46524
92.5	13.26177	13.49362	13.88221	14.63706	15.6893	17.09191	18.07177	18.86955	20.34116	21.56688
93.5	13.27025	13.50432	13.89673	14.65922	15.72257	17.14072	18.13187	18.93906	20.42846	21.66935
94.5	13.27939	13.51571	13.91194	14.68211	15.75662	17.19037	18.19283	19.00943	20.51661	21.77259

95.5	13.28919	13.52777	13.92785	14.70572	15.79143	17.24082	18.2546	19.08063	20.60555	21.87658
96.5	13.29966	13.5405	13.94445	14.73005	15.827	17.29206	18.31718	19.15262	20.69525	21.98126
97.5	13.31079	13.5539	13.96173	14.75508	15.86329	17.34405	18.38051	19.22537	20.78568	22.0866
98.5	13.32257	13.56797	13.97968	14.78081	15.9003	17.39678	18.44458	19.29884	20.87678	22.19255
99.5	13.33502	13.58269	13.99829	14.80722	15.93802	17.45022	18.50936	19.37301	20.96853	22.29907
100.5	13.34811	13.59807	14.01757	14.8343	15.97641	17.50434	18.57481	19.44784	21.06089	22.40613
101.5	13.36185	13.6141	14.03751	14.86204	16.01546	17.55912	18.64091	19.52329	21.15381	22.51367
102.5	13.37624	13.63077	14.05809	14.89043	16.05517	17.61454	18.70762	19.59935	21.24727	22.62168
103.5	13.39126	13.64809	14.07931	14.91946	16.09551	17.67057	18.77493	19.67596	21.34123	22.73009
104.5	13.40693	13.66605	14.10116	14.94911	16.13646	17.7272	18.8428	19.75312	21.43565	22.83889
105.5	13.42323	13.68463	14.12364	14.97938	16.17801	17.78438	18.91121	19.83077	21.53049	22.94803
106.5	13.44016	13.70384	14.14675	15.01026	16.22014	17.84212	18.98012	19.9089	21.62573	23.05747
107.5	13.45772	13.72368	14.17046	15.04173	16.26284	17.90037	19.04952	19.98748	21.72133	23.16719
108.5	13.4759	13.74413	14.19478	15.07378	16.30609	17.95912	19.11937	20.06647	21.81725	23.27714
109.5	13.4947	13.76519	14.2197	15.10641	16.34988	18.01835	19.18965	20.14584	21.91347	23.3873
110.5	13.51411	13.78685	14.2452	15.1396	16.39418	18.07803	19.26034	20.22558	22.00996	23.49762
111.5	13.53412	13.80911	14.27129	15.17334	16.43899	18.13815	19.3314	20.30564	22.10667	23.60808
112.5	13.55474	13.83197	14.29796	15.20762	16.48428	18.19867	19.40282	20.38601	22.20358	23.71865
113.5	13.57596	13.85541	14.32519	15.24242	16.53005	18.25959	19.47457	20.46665	22.30066	23.82929
114.5	13.59777	13.87943	14.35298	15.27775	16.57627	18.32088	19.54662	20.54754	22.39789	23.93997
115.5	13.62017	13.90402	14.38132	15.31358	16.62293	18.38251	19.61895	20.62866	22.49522	24.05066
116.5	13.64315	13.92918	14.4102	15.3499	16.67002	18.44447	19.69154	20.70997	22.59264	24.16134
117.5	13.6667	13.9549	14.43962	15.38671	16.71751	18.50675	19.76436	20.79145	22.69011	24.27198
118.5	13.69082	13.98118	14.46957	15.42399	16.7654	18.5693	19.83739	20.87308	22.78761	24.38254
119.5	13.7155	14.008	14.50003	15.46173	16.81368	18.63213	19.91061	20.95484	22.88511	24.49299
120.5	13.74074	14.03535	14.531	15.49992	16.86231	18.6952	19.984	21.03669	22.98258	24.60333
121.5	13.76653	14.06324	14.56247	15.53855	16.9113	18.7585	20.05753	21.11861	23.08	24.71351
122.5	13.79287	14.09166	14.59444	15.57761	16.96062	18.82202	20.13118	21.20059	23.17734	24.82351
123.5	13.81974	14.12059	14.62688	15.61709	17.01026	18.88572	20.20493	21.28259	23.27458	24.93331
124.5	13.84714	14.15003	14.6598	15.65696	17.06021	18.94959	20.27876	21.3646	23.3717	25.04288
125.5	13.87506	14.17997	14.69319	15.69724	17.11045	19.01362	20.35264	21.44659	23.46867	25.15221
126.5	13.9035	14.21041	14.72703	15.73789	17.16097	19.07779	20.42657	21.52854	23.56546	25.26126
127.5	13.93244	14.24133	14.76132	15.77891	17.21174	19.14207	20.50052	21.61043	23.66206	25.37002
128.5	13.96188	14.27272	14.79605	15.8203	17.26277	19.20645	20.57446	21.69224	23.75845	25.47846
129.5	13.99182	14.30459	14.8312	15.86203	17.31403	19.27091	20.64838	21.77396	23.8546	25.58657
130.5	14.02224	14.33691	14.86677	15.9041	17.36551	19.33544	20.72227	21.85555	23.95049	25.69432
131.5	14.05314	14.36969	14.90275	15.94649	17.41719	19.40001	20.79609	21.937	24.0461	25.80169
132.5	14.0845	14.4029	14.93913	15.98919	17.46907	19.46462	20.86984	22.01829	24.14141	25.90868
133.5	14.11633	14.43656	14.9759	16.0322	17.52112	19.52924	20.94349	22.0994	24.23641	26.01525
134.5	14.1486	14.47063	15.01305	16.07549	17.57333	19.59386	21.01703	22.18031	24.33108	26.12139
135.5	14.18132	14.50512	15.05056	16.11907	17.6257	19.65846	21.09045	22.26101	24.42539	26.22709
136.5	14.21447	14.54002	15.08844	16.1629	17.6782	19.72302	21.16371	22.34148	24.51933	26.33233

137.5	14.24805	14.57531	15.12666	16.207	17.73082	19.78754	21.23681	22.4217	24.61288	26.43709
138.5	14.28204	14.61099	15.16522	16.25134	17.78356	19.85199	21.30974	22.50166	24.70603	26.54136
139.5	14.31643	14.64705	15.20411	16.2959	17.83638	19.91636	21.38246	22.58133	24.79876	26.64513
140.5	14.35122	14.68347	15.24332	16.34069	17.88929	19.98063	21.45498	22.66071	24.89106	26.74838
141.5	14.3864	14.72025	15.28283	16.38568	17.94227	20.0448	21.52727	22.73977	24.98291	26.8511
142.5	14.42195	14.75737	15.32264	16.43087	17.99531	20.10884	21.59931	22.8185	25.0743	26.95328
143.5	14.45788	14.79484	15.36274	16.47625	18.04838	20.17274	21.67111	22.89689	25.16522	27.0549
144.5	14.49415	14.83262	15.40311	16.52179	18.10149	20.23648	21.74263	22.97493	25.25564	27.15596
145.5	14.53078	14.87073	15.44374	16.5675	18.15461	20.30006	21.81386	23.05259	25.34557	27.25645
146.5	14.56773	14.90914	15.48462	16.61335	18.20774	20.36346	21.8848	23.12987	25.43498	27.35636
147.5	14.60502	14.94784	15.52574	16.65934	18.26085	20.42667	21.95543	23.20675	25.52387	27.45567
148.5	14.64262	14.98682	15.5671	16.70546	18.31395	20.48967	22.02573	23.28323	25.61223	27.55439
149.5	14.68052	15.02607	15.60867	16.75168	18.36701	20.55245	22.0957	23.35928	25.70005	27.6525
150.5	14.71871	15.06559	15.65044	16.79801	18.42002	20.61499	22.16532	23.43491	25.78731	27.75
151.5	14.75718	15.10535	15.69241	16.84442	18.47298	20.67729	22.23458	23.51008	25.87401	27.84688
152.5	14.79592	15.14535	15.73456	16.89091	18.52586	20.73934	22.30346	23.58481	25.96013	27.94314
153.5	14.83492	15.18558	15.77689	16.93746	18.57866	20.80112	22.37196	23.65907	26.04568	28.03877
154.5	14.87417	15.22602	15.81937	16.98407	18.63136	20.86261	22.44007	23.73285	26.13065	28.13377
155.5	14.91365	15.26666	15.86199	17.03071	18.68396	20.92382	22.50777	23.80615	26.21502	28.22813
156.5	14.95335	15.30749	15.90476	17.07738	18.73643	20.98472	22.57506	23.87895	26.2988	28.32185
157.5	14.99326	15.34849	15.94764	17.12407	18.78878	21.04531	22.64192	23.95126	26.38197	28.41494
158.5	15.03336	15.38966	15.99063	17.17076	18.84098	21.10557	22.70835	24.02305	26.46453	28.50739
159.5	15.07365	15.43098	16.03372	17.21744	18.89302	21.1655	22.77434	24.09433	26.54648	28.59919
160.5	15.11411	15.47244	16.0769	17.26409	18.9449	21.22508	22.83987	24.16508	26.62782	28.69036
161.5	15.15473	15.51403	16.12014	17.31072	18.9966	21.28431	22.90494	24.23529	26.70853	28.78088
162.5	15.19549	15.55572	16.16345	17.35729	19.04811	21.34317	22.96954	24.30497	26.78862	28.87077
163.5	15.23639	15.59752	16.2068	17.40381	19.09942	21.40166	23.03366	24.37411	26.86808	28.96002
164.5	15.2774	15.63941	16.25018	17.45026	19.15052	21.45977	23.09731	24.44269	26.94692	29.04864
165.5	15.31852	15.68136	16.29358	17.49662	19.20139	21.51749	23.16045	24.51071	27.02513	29.13663
166.5	15.35972	15.72338	16.33699	17.54289	19.25204	21.5748	23.22311	24.57818	27.1027	29.22399
167.5	15.40101	15.76544	16.38039	17.58905	19.30243	21.63171	23.28525	24.64508	27.17965	29.31073
168.5	15.44235	15.80753	16.42378	17.63509	19.35257	21.68819	23.34689	24.71141	27.25597	29.39686
169.5	15.48374	15.84964	16.46712	17.68099	19.40245	21.74426	23.40801	24.77716	27.33167	29.48237
170.5	15.52517	15.89175	16.51042	17.72675	19.45204	21.79989	23.46861	24.84234	27.40673	29.56729
171.5	15.56661	15.93385	16.55366	17.77236	19.50136	21.85508	23.52868	24.90694	27.48118	29.6516
172.5	15.60805	15.97592	16.59682	17.81779	19.55037	21.90982	23.58823	24.97096	27.555	29.73533
173.5	15.64949	16.01795	16.63989	17.86304	19.59907	21.96411	23.64723	25.0344	27.6282	29.81848
174.5	15.69089	16.05992	16.68286	17.90809	19.64746	22.01794	23.7057	25.09725	27.70079	29.90107
175.5	15.73225	16.10183	16.72571	17.95294	19.69552	22.0713	23.76363	25.15951	27.77277	29.98309
176.5	15.77356	16.14364	16.76842	17.99756	19.74325	22.12419	23.82101	25.22119	27.84414	30.06456
177.5	15.81478	16.18536	16.81099	18.04195	19.79062	22.1766	23.87784	25.28228	27.91491	30.1455
178.5	15.85592	16.22696	16.8534	18.0861	19.83764	22.22852	23.93412	25.34279	27.98509	30.22591

179.5	15.89695	16.26842	16.89563	18.12998	19.88429	22.27996	23.98985	25.40271	28.05468	30.3058
180.5	15.93785	16.30974	16.93767	18.1736	19.93057	22.3309	24.04503	25.46204	28.12369	30.3852
181.5	15.97862	16.35089	16.97951	18.21693	19.97646	22.38135	24.09964	25.5208	28.19213	30.46411
182.5	16.01923	16.39185	17.02112	18.25996	20.02195	22.43128	24.1537	25.57897	28.26	30.54255
183.5	16.05966	16.43262	17.0625	18.30269	20.06704	22.48072	24.20721	25.63656	28.32732	30.62053
184.5	16.0999	16.47318	17.10363	18.3451	20.11172	22.52963	24.26015	25.69357	28.39408	30.69807
185.5	16.13993	16.51351	17.14448	18.38717	20.15598	22.57804	24.31254	25.75002	28.46031	30.77519
186.5	16.17973	16.55358	17.18506	18.42889	20.19981	22.62592	24.36437	25.80589	28.52602	30.8519
187.5	16.21929	16.5934	17.22534	18.47025	20.2432	22.67329	24.41564	25.8612	28.5912	30.92822
188.5	16.25859	16.63293	17.2653	18.51124	20.28614	22.72013	24.46636	25.91595	28.65588	31.00417
189.5	16.2976	16.67216	17.30494	18.55184	20.32862	22.76644	24.51653	25.97014	28.72007	31.07976
190.5	16.33631	16.71107	17.34423	18.59205	20.37064	22.81222	24.56614	26.02379	28.78378	31.15502
191.5	16.37471	16.74965	17.38316	18.63184	20.41219	22.85747	24.61521	26.07689	28.84702	31.22997
192.5	16.41277	16.78787	17.42171	18.67121	20.45326	22.90219	24.66372	26.12945	28.90981	31.30462
193.5	16.45047	16.82573	17.45986	18.71015	20.49383	22.94637	24.7117	26.18148	28.97215	31.379
194.5	16.4878	16.8632	17.49761	18.74863	20.53392	22.99002	24.75913	26.23299	29.03407	31.45314
195.5	16.52473	16.90025	17.53492	18.78665	20.57349	23.03313	24.80603	26.28399	29.09558	31.52704
196.5	16.56124	16.93689	17.5718	18.82419	20.61256	23.07571	24.8524	26.33448	29.1567	31.60075
197.5	16.59733	16.97308	17.60821	18.86125	20.65111	23.11774	24.89824	26.38446	29.21743	31.67427
198.5	16.63295	17.0088	17.64415	18.8978	20.68912	23.15924	24.94356	26.43396	29.27781	31.74764
199.5	16.66811	17.04404	17.67959	18.93384	20.72661	23.2002	24.98836	26.48298	29.33784	31.82088
200.5	16.70276	17.07879	17.71452	18.96935	20.76355	23.24062	25.03265	26.53153	29.39755	31.89401
201.5	16.7369	17.11301	17.74892	19.00432	20.79994	23.28051	25.07643	26.57962	29.45695	31.96706
202.5	16.77051	17.14669	17.78278	19.03874	20.83578	23.31986	25.11972	26.62726	29.51606	32.04007
203.5	16.80356	17.17981	17.81607	19.07258	20.87105	23.35867	25.16251	26.67447	29.57491	32.11305
204.5	16.83603	17.21234	17.84878	19.10585	20.90576	23.39696	25.20482	26.72125	29.6335	32.18603
205.5	16.8679	17.24429	17.88089	19.13852	20.93988	23.43471	25.24665	26.76761	29.69187	32.25905
206.5	16.89915	17.2756	17.91238	19.17059	20.97343	23.47193	25.28802	26.81358	29.75004	32.33212
207.5	16.92975	17.30628	17.94324	19.20204	21.00638	23.50863	25.32892	26.85915	29.80802	32.40529
208.5	16.95969	17.3363	17.97344	19.23285	21.03874	23.5448	25.36937	26.90436	29.86584	32.47859
209.5	16.98894	17.36564	18.00298	19.26301	21.07049	23.58045	25.40938	26.9492	29.92352	32.55204
210.5	17.01749	17.39427	18.03182	19.29252	21.10163	23.61558	25.44895	26.9937	29.98109	32.62567
211.5	17.0453	17.42218	18.05996	19.32135	21.13216	23.65019	25.4881	27.03787	30.03857	32.69952
212.5	17.07236	17.44935	18.08737	19.34949	21.16206	23.68429	25.52684	27.08173	30.09599	32.77362
213.5	17.09864	17.47576	18.11403	19.37693	21.19134	23.71788	25.56517	27.12528	30.15337	32.84802
214.5	17.12413	17.50137	18.13993	19.40366	21.21997	23.75097	25.60311	27.16856	30.21074	32.92272
215.5	17.14879	17.52618	18.16505	19.42965	21.24797	23.78356	25.64067	27.21157	30.26812	32.99779
216.5	17.1726	17.55015	18.18937	19.45491	21.27532	23.81564	25.67786	27.25433	30.32554	33.07324
217.5	17.19555	17.57328	18.21286	19.47941	21.30202	23.84724	25.7147	27.29686	30.38304	33.14912
218.5	17.2176	17.59553	18.23552	19.50314	21.32805	23.87835	25.75118	27.33918	30.44063	33.22546
219.5	17.23874	17.61689	18.25732	19.52608	21.35343	23.90898	25.78733	27.3813	30.49835	33.30231
220.5	17.25894	17.63733	18.27824	19.54823	21.37812	23.93912	25.82317	27.42325	30.55623	33.37969

221.5	17.27818	17.65683	18.29826	19.56957	21.40215	23.9688	25.85869	27.46505	30.6143	33.45766
222.5	17.29643	17.67537	18.31736	19.59008	21.42548	23.99801	25.89392	27.50671	30.6726	33.53624
223.5	17.31367	17.69293	18.33552	19.60975	21.44813	24.02676	25.92887	27.54826	30.73114	33.61548
224.5	17.32987	17.70948	18.35273	19.62857	21.47008	24.05505	25.96356	27.58971	30.78997	33.69542
225.5	17.34501	17.725	18.36896	19.64651	21.49134	24.08289	25.99799	27.63109	30.84911	33.77609
226.5	17.35907	17.73946	18.38419	19.66358	21.51188	24.11029	26.03219	27.67242	30.90861	33.85756
227.5	17.37203	17.75286	18.39841	19.67975	21.53171	24.13725	26.06617	27.71372	30.96849	33.93984
228.5	17.38385	17.76515	18.41159	19.695	21.55082	24.16378	26.09993	27.75502	31.0288	34.023
229.5	17.39451	17.77632	18.42371	19.70933	21.56921	24.18988	26.13351	27.79633	31.08956	34.10707
230.5	17.40399	17.78635	18.43475	19.72272	21.58686	24.21557	26.16692	27.83769	31.15082	34.1921
231.5	17.41226	17.79521	18.4447	19.73516	21.60378	24.24084	26.20016	27.8791	31.21261	34.27814
232.5	17.4193	17.80288	18.45352	19.74662	21.61996	24.26571	26.23326	27.92061	31.27496	34.36522
233.5	17.42508	17.80934	18.46121	19.7571	21.63539	24.29019	26.26624	27.96223	31.33793	34.45341
234.5	17.42958	17.81456	18.46773	19.76658	21.65006	24.31427	26.29911	28.00399	31.40154	34.54273
235.5	17.43278	17.81852	18.47308	19.77505	21.66397	24.33798	26.33189	28.04591	31.46583	34.63326
236.5	17.43465	17.82119	18.47722	19.78248	21.67712	24.3613	26.36459	28.08801	31.53085	34.72503
237.5	17.43515	17.82256	18.48014	19.78887	21.68949	24.38426	26.39723	28.13034	31.59664	34.8181
238.5	17.43427	17.82259	18.48182	19.7942	21.70108	24.40686	26.42984	28.17291	31.66324	34.9125
239.5	17.43199	17.82127	18.48223	19.79846	21.71189	24.4291	26.46243	28.21574	31.73069	35.00831
240	17.43031	17.82009	18.48196	19.80018	21.717	24.4401	26.47872	28.23727	31.76474	35.05675
240.5	17.42827	17.81856	18.48136	19.80162	21.72191	24.45101	26.49502	28.25888	31.79903	35.10556

Appendix A-3

Body Mass Index for Age (in years) Percentile Tables
for Male and Female Children Ages 6-11

Body Mass Index Categories for Males[1,2]

AGE (in years)	Normal	Overweight	Obese
6	<17.1758	17.1758 - <18.7346	≥18.7346
7	<17.6435	17.6435 - <19.5605	≥19.5605
8	<18.2575	18.2575 - <20.5299	≥20.5299
9	<18.9745	18.9745 - <21.5740	≥21.5740
10	<19.7572	19.7572 - <22.6419	≥22.6419
11	<20.5750	20.5750 - <23.6842	≥23.6842

Body Mass Index Categories for Females[1,2]

AGE (in years)	Normal	Overweight	Obese
6	<17.3246	17.3246 - <19.2049	≥19.2049
7	<17.9312	17.9312 - <20.1327	≥20.1327
8	<18.6778	18.6778 - <21.2036	≥21.2036
9	<19.5123	19.5123 - <22.3500	≥22.3500
10	<20.3898	20.3898 - <23.5160	≥23.5160
11	<21.2722	21.2722 - <24.6571	≥24.6571

[1] Body mass index categories are defined according to Centers for Disease Control and Prevention BMI percentiles with normal weight being 5^{th} - $<85^{th}$ percentiles, overweight being 85^{th} - $<95^{th}$ percentiles, obese being $\geq 95^{th}$ percentile.
[2] Age-in-year BMI values are the average of twelve age-in-month BMI values taken from Body Mass Index for Age Tables from the Centers for Disease Control and Prevention.

Appendix A-4

APPENDIX P

Subscapular Skinfold Norms from NHANES II

From National Center for Health Statistics, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

Subscapular Skinfold in Millimeters for Persons 6 Months–19 Years of Age—United States, 1976–1980

Sex and Age	Number of Examined Persons	Mean	Standard Deviation	Percentile								
				5th	10th	15th	25th	50th	75th	85th	90th	95th
Male												
6–11 months	179	6.5	1.9	4.0	5.0	5.0	5.5	6.0	7.5	8.0	8.5	9.0
1 year	370	6.6	1.9	4.0	4.5	5.0	5.0	6.5	7.5	8.0	9.0	10.5
2 years	375	6.1	2.2	3.5	4.0	4.0	5.0	5.5	7.0	7.5	9.0	10.0
3 years	418	5.7	1.6	4.0	4.0	4.0	4.5	5.5	6.5	7.0	7.5	9.0
4 years	404	5.5	2.2	3.5	3.5	4.0	4.0	5.0	6.0	7.0	7.5	9.0
5 years	397	5.3	2.4	3.0	3.5	4.0	4.0	5.0	6.0	6.5	7.0	8.0
6 years	133	6.0	3.9	3.5	3.5	4.0	4.0	5.0	6.0	8.0	10.0	16.0
7 years	148	5.8	3.1	3.5	4.0	4.0	4.0	5.0	6.0	7.0	7.5	11.5
8 years	147	6.7	4.9	3.5	4.0	4.0	4.5	5.0	6.5	8.0	11.0	21.0
9 years	145	7.0	5.0	3.5	4.0	4.0	4.5	6.0	7.0	10.0	12.0	15.0
10 years	157	8.6	6.6	4.0	4.0	4.5	5.0	6.0	9.5	11.5	17.0	22.0
11 years	155	10.0	8.5	4.0	4.0	4.5	5.0	6.5	10.0	17.5	25.0	31.0
12 years	145	9.2	6.8	4.0	4.5	4.5	5.0	6.5	10.0	15.5	19.0	22.5
13 years	173	9.1	7.3	4.0	4.5	5.0	5.0	7.0	9.0	13.0	15.0	24.0
14 years	186	8.9	5.3	4.5	5.0	5.5	6.0	7.0	9.0	12.0	13.5	20.0
15 years	184	10.0	8.2	5.0	5.5	6.0	6.0	7.5	10.0	12.0	16.0	24.5
16 years	178	10.8	6.4	5.0	6.0	6.5	6.5	9.0	12.5	14.5	21.5	25.0
17 years	173	10.1	5.3	5.5	6.0	6.5	7.0	8.5	11.5	14.0	17.0	20.5
18 years	164	11.9	6.7	6.0	7.0	7.0	8.0	10.0	14.0	16.0	18.0	24.0
19 years	148	12.5	6.9	7.0	7.0	7.5	8.0	10.5	13.5	16.5	22.0	29.0
Female												
6–11 months	177	6.7	1.7	4.5	5.0	5.0	5.5	6.5	7.5	8.0	9.0	10.0
1 year	336	6.7	2.0	4.0	4.0	5.0	5.0	6.5	8.0	8.5	9.5	10.5
2 years	336	6.5	2.2	4.0	4.5	4.5	5.0	6.0	7.5	8.5	9.5	11.0
3 years	366	6.3	2.2	3.5	4.0	4.5	5.0	6.0	7.0	8.0	9.0	11.0
4 years	396	6.2	2.2	3.5	4.0	4.5	5.0	5.5	7.0	8.0	9.0	10.5
5 years	364	6.5	3.5	4.0	4.0	4.5	5.0	5.5	7.0	8.0	10.0	12.0
6 years	135	6.8	3.8	4.0	4.0	4.0	5.0	6.0	7.5	9.0	10.5	14.0
7 years	157	7.0	3.7	3.5	4.0	4.0	4.5	6.0	7.5	9.0	12.0	16.5
8 years	123	7.4	4.9	3.5	4.0	4.5	5.0	6.0	8.0	10.5	12.0	15.0
9 years	149	9.6	7.5	4.0	5.0	5.0	5.5	7.0	9.5	13.0	21.0	29.0
10 years	136	10.4	6.6	4.5	5.0	5.0	6.0	8.0	13.5	18.0	19.5	23.0

continued

Appendix A-4, continued

Subscapular Skinfold in Millimeters for Persons 6 Months–19 Years of Age—United States, 1976–1980—*continued*

Sex and Age	Number of Examined Persons	Mean	Standard Deviation	Percentile								
				5th	10th	15th	25th	50th	75th	85th	90th	95th
Female cont'd												
11 years	140	11.4	8.1	4.5	5.0	5.5	6.5	8.0	12.0	17.0	22.0	29.0
12 years	147	11.5	7.5	5.0	5.5	6.0	6.5	9.0	13.0	17.0	22.0	29.0
13 years	162	11.9	8.5	4.5	5.5	6.0	7.0	9.5	14.0	17.5	20.0	29.0
14 years	178	13.2	7.7	6.0	6.5	7.0	7.5	10.5	16.0	22.0	26.0	31.0
15 years	145	13.1	6.9	6.0	7.0	7.5	8.5	10.5	16.0	20.5	22.5	27.5
16 years	170	15.2	9.2	6.5	7.5	8.5	9.5	12.0	16.5	23.5	26.0	36.6
17 years	134	15.9	9.2	6.5	7.0	8.0	9.5	13.0	19.5	27.0	29.0	37.0
18 years	170	15.3	8.6	7.0	7.5	8.0	10.0	13.0	18.5	22.0	27.5	34.5
19 years	158	16.0	9.5	7.0	7.5	8.5	9.5	13.0	18.5	23.5	26.5	35.5

Appendix A-4, continued

APPENDIX O

Triceps Skinfold Norms from NHANES II

From National Center for Health Statistics, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

Triceps Skinfold in Millimeters for Persons 6 Months to 19 Years of Age—United States, 1976–1980

Sex and Age	Number of Examined Persons	Mean	Standard Deviation	Percentile								
				5th	10th	15th	25th	50th	75th	85th	90th	95th
Male												
6–11 months	179	10.4	3.1	6.5	7.0	7.0	8.0	10.0	12.0	14.0	15.0	16.0
1 year	370	10.4	2.7	6.5	7.0	7.5	8.5	10.0	12.0	13.0	14.0	15.5
2 years	375	10.2	2.9	6.0	7.0	7.0	8.0	10.0	12.0	13.0	14.5	15.0
3 years	418	10.0	2.6	6.5	7.0	7.5	8.0	9.5	11.5	12.5	13.0	15.0
4 years	404	9.6	3.0	6.0	6.5	7.0	7.5	9.0	11.0	12.0	13.0	15.0
5 years	397	8.9	2.9	5.5	6.0	6.5	7.0	8.0	10.5	11.5	12.5	14.5
6 years	133	9.3	4.4	5.0	5.5	6.0	6.5	8.0	10.5	12.0	13.0	17.5
7 years	148	9.2	4.0	5.0	5.5	6.0	6.5	8.5	11.0	12.0	15.0	17.5
8 years	147	10.5	4.9	5.5	6.0	6.0	7.0	9.0	12.0	16.5	17.0	22.0
9 years	145	10.6	5.7	5.0	5.0	6.0	7.0	9.0	12.5	16.0	19.0	23.0
10 years	157	12.6	6.6	5.0	6.0	6.5	7.5	11.0	16.5	20.0	22.0	26.0
11 years	155	13.3	7.7	4.5	5.5	6.0	7.5	10.5	17.0	22.0	25.0	30.0
12 years	145	12.4	6.4	5.0	6.0	6.0	8.0	11.0	15.0	18.0	21.5	26.5
13 years	173	11.2	7.0	5.0	5.5	6.0	7.0	9.0	12.5	16.5	20.5	22.5
14 years	186	10.4	5.8	4.0	5.0	5.5	6.0	9.0	13.0	15.0	17.0	23.0
15 years	184	10.1	7.2	5.0	5.0	6.0	6.0	7.5	11.0	14.5	18.0	22.0
16 years	178	10.9	6.6	4.5	5.0	5.5	6.5	8.0	13.0	18.5	20.5	25.5
17 years	173	8.5	4.6	4.0	4.5	5.0	5.5	7.0	10.5	12.5	15.0	18.0
18 years	164	11.1	6.6	4.0	5.0	5.0	6.0	9.5	14.5	17.5	19.0	22.5
19 years	148	10.9	6.1	5.0	5.5	6.0	6.5	9.0	13.0	16.0	18.5	23.0
Female												
6–11 months	177	9.9	2.6	6.5	7.0	7.0	8.0	10.0	11.5	12.5	13.0	14.5
1 year	336	10.6	3.3	6.0	7.0	7.5	8.0	10.5	12.0	13.5	15.0	16.5
2 years	336	10.6	3.0	6.0	7.0	7.5	8.0	10.5	12.5	13.5	15.0	16.0
3 years	366	10.3	2.9	6.0	7.0	7.0	8.0	10.0	12.0	12.5	13.5	16.5
4 years	396	10.4	3.1	6.0	6.5	7.5	8.0	10.0	12.0	13.0	14.0	15.5
5 years	364	10.6	3.2	6.0	7.0	7.5	8.5	10.5	12.5	14.0	14.5	16.0
6 years	135	11.0	3.9	6.0	7.0	7.5	8.0	10.0	12.0	14.5	16.0	18.5
7 years	157	11.5	4.5	6.0	7.0	7.5	9.0	10.5	13.0	15.0	18.0	20.0
8 years	123	11.9	5.2	6.0	6.5	7.0	8.5	11.0	14.0	16.0	18.0	21.0

continued

Appendix A-4, continued

Triceps Skinfold in Millimeters for Persons 6 Months to 19 Years of Age—United States, 1976–1980—*continued*

Sex and Age	Number of Examined Persons	Mean	Standard Deviation	Percentile								
				5th	10th	15th	25th	50th	75th	85th	90th	95th
Female cont'd												
9 years	149	14.3	6.5	7.0	7.5	8.5	10.0	13.0	16.0	20.0	23.0	27.0
10 years	136	14.5	5.9	7.0	8.0	8.0	10.0	13.5	18.0	21.0	22.5	24.5
11 years	140	15.7	6.9	8.0	8.5	9.0	11.0	14.0	19.5	21.5	23.0	29.5
12 years	147	15.1	6.0	7.5	8.0	9.0	11.5	13.5	18.5	21.5	23.0	27.0
13 years	162	15.9	7.9	6.0	7.5	9.0	10.5	15.0	19.0	22.0	25.0	30.0
14 years	178	17.6	7.5	8.0	10.0	10.5	12.0	17.0	21.5	25.0	29.5	32.0
15 years	145	17.1	7.1	8.5	9.5	10.0	11.5	16.5	20.5	24.5	26.0	32.1
16 years	170	19.5	7.2	11.0	11.5	12.0	14.0	18.0	23.0	27.0	30.5	33.1
17 years	134	19.8	7.8	9.5	11.0	11.5	14.0	20.0	24.5	26.5	28.5	34.5
18 years	170	19.9	7.6	11.0	12.0	12.5	14.0	18.0	23.5	27.0	32.5	35.0
19 years	158	20.4	7.6	10.5	11.5	13.0	15.0	19.0	25.0	28.0	30.0	33.5

Appendix A-5

Skinfold Percentiles Calculated from CDC NHANES II Tables
Female Children Ages 6-11, Triceps and Subscapular Percentiles[1]

Female Percentiles for Triceps Skinfold-For-Age (mm)			
Age	<85th	85th-94th	≥95th
6	<14.5	14.5 - <18.5	≥18.5
7	<15.0	15.0 - <20.0	≥20.0
8	<16.0	15.0 - <21.0	≥21.0
9	<20.0	20.0 - <27.0	≥27.0
10	<21.0	21.0 - <24.5	≥24.5
11	<21.5	21.5 - <29.5	≥29.5

Female Percentiles for Subscapular Skinfold-For-Age (mm)			
Age	<85th	85th-94th	≥95th
6	<9.0	9.0 - <14.0	≥14.0
7	<9.0	9.0 - <16.5	≥16.5
8	<10.5	10.5 - <15.0	≥15.0
9	<13.0	13.0 - <29.0	≥29.0
10	<18.0	18.0 - <23.0	≥23.0
11	<17.0	17.0 - <29.0	≥29.0

[1] Skinfold categories are defined according to Centers for Disease Control and Prevention percentiles with normal weight being 5th - <85th percentiles, overweight being 85th - <95th percentiles, obese being ≥95th percentile.

Appendix A-5, continued

Skinfold Percentiles Calculated from CDC NHANES II Tables
Male Children Ages 6-11, Triceps and Subscapular Percentiles[1]

Male Percentiles for Triceps Skinfold-For-Age (mm)			
Age	<85th	85th-94th	≥95th
6	<12.0	12.0 - <17.5	≥17.5
7	<12.0	12.0 - <17.5	≥17.5
8	<16.5	16.5 - <22.0	≥22.0
9	<16.0	16.0 - <23.0	≥23.0
10	<20.0	20.0 - <26.0	≥26.0
11	<22.0	22.0 - <30.0	≥30.0

Male Percentiles for Subscapular Skinfold-For-Age (mm)			
Age	<85th	85th-94th	≥95th
6	<8.0	8.0 - <16.0	≥16.0
7	<7.0	7.0 - <11.5	≥11.5
8	<8.0	8.0 - <21.0	≥21.0
9	<10.0	10.0 - <15.0	≥15.0
10	<11.5	11.5 - <22.0	≥22.0
11	<17.5	17.5 - <31.0	≥31.0

[1] Skinfold categories are defined according to Centers for Disease Control and Prevention percentiles with normal weight being 5th - <85th percentiles, overweight being 85th - <95th percentiles, obese being ≥95th percentile.

Appendix A-6

TABLE 4
Smoothed percentiles for triceps skinfold-for-age (mm): girls aged 1.50–19.99 y[1]

				Percentiles									
Age	*L*	*M*	*S*	3rd	5th	10th	25th	50th	75th	85th	90th	95th	97th
1.50–1.99 y	0.0360	9.9142	0.2451	6.23	6.61	7.23	8.40	9.91	11.69	12.77	13.55	14.79	15.67
2.00–2.49 y	0.0302	9.9121	0.2491	6.18	6.56	7.19	8.38	9.91	11.72	12.82	13.62	14.89	15.78
2.50–2.99 y	0.0187	9.9069	0.2572	6.09	6.48	7.12	8.33	9.91	11.78	12.92	13.76	15.10	16.03
3.00–3.49 y	0.0073	9.8997	0.2654	6.00	6.39	7.04	8.28	9.90	11.84	13.03	13.90	15.31	16.29
3.50–3.99 y	−0.0038	9.8896	0.2739	5.91	6.30	6.96	8.22	9.89	11.90	13.14	14.05	15.53	16.56
4.00–4.49 y	−0.0145	9.8783	0.2828	5.82	6.21	6.88	8.17	9.88	11.96	13.25	14.21	15.75	16.85
4.50–4.99 y	−0.0245	9.8683	0.2921	5.72	6.12	6.80	8.11	9.87	12.02	13.37	14.37	16.00	17.16
5.00–5.49 y	−0.0338	9.8612	0.3017	5.62	6.03	6.72	8.05	9.86	12.10	13.50	14.55	16.27	17.49
5.50–5.99 y	−0.0420	9.8656	0.3118	5.53	5.94	6.64	8.00	9.87	12.19	13.66	14.76	16.57	17.86
6.00–6.49 y	−0.0492	9.8987	0.3220	5.45	5.87	6.58	7.98	9.90	12.31	13.86	15.02	16.93	18.30
6.50–6.99 y	−0.0553	9.9820	0.3322	5.40	5.83	6.55	7.99	9.98	12.51	14.13	15.36	17.39	18.85
7.00–7.49 y	−0.0603	10.1312	0.3424	5.39	5.82	6.57	8.05	10.13	12.78	14.50	15.81	17.97	19.54
7.50–7.99 y	−0.0643	10.3502	0.3524	5.41	5.86	6.63	8.18	10.35	13.15	14.98	16.37	18.69	20.38
8.00–8.49 y	−0.0671	10.6312	0.3620	5.46	5.93	6.73	8.34	10.63	13.60	15.55	17.03	19.52	21.34
8.50–8.99 y	−0.0687	10.9571	0.3712	5.54	6.03	6.86	8.55	10.96	14.10	16.18	17.77	20.44	22.41
9.00–9.49 y	−0.0689	11.3030	0.3797	5.63	6.13	7.00	8.77	11.30	14.64	16.84	18.54	21.40	23.51
9.50–9.99 y	−0.0674	11.6449	0.3876	5.72	6.24	7.14	8.99	11.64	15.16	17.50	19.30	22.34	24.59
10.00–10.49 y	−0.0643	11.9683	0.3947	5.80	6.34	7.28	9.19	11.97	15.65	18.12	20.02	23.23	25.61
10.50–10.99 y	−0.0596	12.2721	0.4010	5.87	6.43	7.40	9.38	12.27	16.12	18.69	20.68	24.05	26.55
11.00–11.49 y	−0.0533	12.5632	0.4065	5.94	6.51	7.52	9.57	12.56	16.56	19.24	21.31	24.82	27.42
11.50–11.99 y	−0.0458	12.8489	0.4110	6.01	6.60	7.64	9.76	12.85	16.98	19.76	21.90	25.53	28.23
12.00–12.49 y	−0.0373	13.1392	0.4146	6.09	6.70	7.76	9.95	13.14	17.40	20.26	22.47	26.22	28.99
12.50–12.99 y	−0.0281	13.4475	0.4171	6.19	6.82	7.91	10.16	13.45	17.84	20.78	23.04	26.89	29.73
13.00–13.49 y	−0.0186	13.7811	0.4186	6.31	6.95	8.08	10.40	13.78	18.29	21.30	23.63	27.56	30.46
13.50–13.99 y	−0.0088	14.1399	0.4190	6.45	7.11	8.28	10.66	14.14	18.76	21.85	24.22	28.23	31.18
14.00–14.49 y	0.0010	14.5203	0.4183	6.61	7.30	8.49	10.95	14.52	19.25	22.40	24.81	28.88	31.88
14.50–14.99 y	0.0109	14.9146	0.4166	6.79	7.50	8.73	11.26	14.91	19.75	22.95	25.40	29.52	32.54
15.00–15.49 y	0.0209	15.3149	0.4141	6.98	7.71	8.98	11.57	15.31	20.23	23.48	25.96	30.12	33.16
15.50–15.99 y	0.0311	15.7180	0.4110	7.19	7.94	9.24	11.90	15.72	20.71	24.00	26.50	30.69	33.74
16.00–16.49 y	0.0413	16.1220	0.4075	7.40	8.17	9.51	12.23	16.12	21.19	24.51	27.03	31.23	34.29
16.50–16.99 y	0.0518	16.5208	0.4038	7.61	8.40	9.78	12.56	16.52	21.65	24.99	27.53	31.74	34.80
17.00–17.49 y	0.0625	16.9078	0.4000	7.82	8.64	10.04	12.88	16.91	22.09	25.46	28.00	32.22	35.26
17.50–17.99 y	0.0737	17.2818	0.3961	8.03	8.86	10.30	13.19	17.28	22.52	25.90	28.45	32.66	35.69
18.00–18.49 y	0.0853	17.6471	0.3923	8.24	9.09	10.56	13.50	17.65	22.93	26.32	28.87	33.07	36.09
18.50–18.99 y	0.0975	18.0086	0.3885	8.44	9.31	10.81	13.81	18.01	23.33	26.73	29.28	33.48	36.48
19.00–19.49 y	0.1101	18.3699	0.3848	8.64	9.53	11.06	14.12	18.37	23.73	27.14	29.69	33.87	36.86
19.50–19.99 y	0.1228	18.7333	0.3812	8.84	9.76	11.32	14.43	18.73	24.13	27.55	30.11	34.27	37.24

Appendix A-6, continued

TABLE 4
Smoothed percentiles for triceps skinfold-for-age (mm): girls aged 1.50–19.99 y[1]

				Percentiles									
Age	*L*	*M*	*S*	3rd	5th	10th	25th	50th	75th	85th	90th	95th	97th
1.50–1.99 y	0.0360	9.9142	0.2451	6.23	6.61	7.23	8.40	9.91	11.69	12.77	13.55	14.79	15.67
2.00–2.49 y	0.0302	9.9121	0.2491	6.18	6.56	7.19	8.38	9.91	11.72	12.82	13.62	14.89	15.78
2.50–2.99 y	0.0187	9.9069	0.2572	6.09	6.48	7.12	8.33	9.91	11.78	12.92	13.76	15.10	16.03
3.00–3.49 y	0.0073	9.8997	0.2654	6.00	6.39	7.04	8.28	9.90	11.84	13.03	13.90	15.31	16.29
3.50–3.99 y	−0.0038	9.8896	0.2739	5.91	6.30	6.96	8.22	9.89	11.90	13.14	14.05	15.53	16.56
4.00–4.49 y	−0.0145	9.8783	0.2828	5.82	6.21	6.88	8.17	9.88	11.96	13.25	14.21	15.75	16.85
4.50–4.99 y	−0.0245	9.8683	0.2921	5.72	6.12	6.80	8.11	9.87	12.02	13.37	14.37	16.00	17.16
5.00–5.49 y	−0.0338	9.8612	0.3017	5.62	6.03	6.72	8.05	9.86	12.10	13.50	14.55	16.27	17.49
5.50–5.99 y	−0.0420	9.8656	0.3118	5.53	5.94	6.64	8.00	9.87	12.19	13.66	14.76	16.57	17.86
6.00–6.49 y	−0.0492	9.8987	0.3220	5.45	5.87	6.58	7.98	9.90	12.31	13.86	15.02	16.93	18.30
6.50–6.99 y	−0.0553	9.9820	0.3322	5.40	5.83	6.55	7.99	9.98	12.51	14.13	15.36	17.39	18.85
7.00–7.49 y	−0.0603	10.1312	0.3424	5.39	5.82	6.57	8.05	10.13	12.78	14.50	15.81	17.97	19.54
7.50–7.99 y	−0.0643	10.3502	0.3524	5.41	5.86	6.63	8.18	10.35	13.15	14.98	16.37	18.69	20.38
8.00–8.49 y	−0.0671	10.6312	0.3620	5.46	5.93	6.73	8.34	10.63	13.60	15.55	17.03	19.52	21.34
8.50–8.99 y	−0.0687	10.9571	0.3712	5.54	6.03	6.86	8.55	10.96	14.10	16.18	17.77	20.44	22.41
9.00–9.49 y	−0.0689	11.3030	0.3797	5.63	6.13	7.00	8.77	11.30	14.64	16.84	18.54	21.40	23.51
9.50–9.99 y	−0.0674	11.6449	0.3876	5.72	6.24	7.14	8.99	11.64	15.16	17.50	19.30	22.34	24.59
10.00–10.49 y	−0.0643	11.9683	0.3947	5.80	6.34	7.28	9.19	11.97	15.65	18.12	20.02	23.23	25.61
10.50–10.99 y	−0.0596	12.2721	0.4010	5.87	6.43	7.40	9.38	12.27	16.12	18.69	20.68	24.05	26.55
11.00–11.49 y	−0.0533	12.5632	0.4065	5.94	6.51	7.52	9.57	12.56	16.56	19.24	21.31	24.82	27.42
11.50–11.99 y	−0.0458	12.8489	0.4110	6.01	6.60	7.64	9.76	12.85	16.98	19.76	21.90	25.53	28.23
12.00–12.49 y	−0.0373	13.1392	0.4146	6.09	6.70	7.76	9.95	13.14	17.40	20.26	22.47	26.22	28.99
12.50–12.99 y	−0.0281	13.4475	0.4171	6.19	6.82	7.91	10.16	13.45	17.84	20.78	23.04	26.89	29.73
13.00–13.49 y	−0.0186	13.7811	0.4186	6.31	6.95	8.08	10.40	13.78	18.29	21.30	23.63	27.56	30.46
13.50–13.99 y	−0.0088	14.1399	0.4190	6.45	7.11	8.28	10.66	14.14	18.76	21.85	24.22	28.23	31.18
14.00–14.49 y	0.0010	14.5203	0.4183	6.61	7.30	8.49	10.95	14.52	19.25	22.40	24.81	28.88	31.88
14.50–14.99 y	0.0109	14.9146	0.4166	6.79	7.50	8.73	11.26	14.91	19.75	22.95	25.40	29.52	32.54
15.00–15.49 y	0.0209	15.3149	0.4141	6.98	7.71	8.98	11.57	15.31	20.23	23.48	25.96	30.12	33.16
15.50–15.99 y	0.0311	15.7180	0.4110	7.19	7.94	9.24	11.90	15.72	20.71	24.00	26.50	30.69	33.74
16.00–16.49 y	0.0413	16.1220	0.4075	7.40	8.17	9.51	12.23	16.12	21.19	24.51	27.03	31.23	34.29
16.50–16.99 y	0.0518	16.5208	0.4038	7.61	8.40	9.78	12.56	16.52	21.65	24.99	27.53	31.74	34.80
17.00–17.49 y	0.0625	16.9078	0.4000	7.82	8.64	10.04	12.88	16.91	22.09	25.46	28.00	32.22	35.26
17.50–17.99 y	0.0737	17.2818	0.3961	8.03	8.86	10.30	13.19	17.28	22.52	25.90	28.45	32.66	35.69
18.00–18.49 y	0.0853	17.6471	0.3923	8.24	9.09	10.56	13.50	17.65	22.93	26.32	28.87	33.07	36.09
18.50–18.99 y	0.0975	18.0086	0.3885	8.44	9.31	10.81	13.81	18.01	23.33	26.73	29.28	33.48	36.48
19.00–19.49 y	0.1101	18.3699	0.3848	8.64	9.53	11.06	14.12	18.37	23.73	27.14	29.69	33.87	36.86
19.50–19.99 y	0.1228	18.7333	0.3812	8.84	9.76	11.32	14.43	18.73	24.13	27.55	30.11	34.27	37.24

Appendix A-6, continued

TABLE 2
Smoothed percentiles for triceps skinfold-for-age (mm): boys aged 1.50–19.99 y[1]

				Percentile									
Age	*L*	*M*	*S*	3rd	5th	10th	25th	50th	75th	85th	90th	95th	97th
1.50–1.99 y	−0.0982	9.7466	0.2464	6.20	6.55	7.14	8.27	9.75	11.52	12.62	13.43	14.74	15.66
2.00–2.49 y	−0.1065	9.6551	0.2495	6.11	6.46	7.05	8.17	9.66	11.44	12.55	13.37	14.69	15.63
2.50–2.99 y	−0.1229	9.4769	0.2559	5.94	6.29	6.87	7.99	9.48	11.28	12.41	13.25	14.60	15.57
3.00–3.49 y	−0.1392	9.3113	0.2626	5.77	6.12	6.70	7.82	9.31	11.14	12.29	13.14	14.54	15.53
3.50–3.99 y	−0.1555	9.1537	0.2698	5.62	5.96	6.54	7.65	9.15	11.01	12.18	13.06	14.50	15.53
4.00–4.49 y	−0.1715	8.9913	0.2778	5.45	5.79	6.36	7.48	8.99	10.88	12.08	12.98	14.47	15.54
4.50–4.99 y	−0.1871	8.8176	0.2866	5.28	5.61	6.18	7.29	8.82	10.74	11.97	12.90	14.44	15.56
5.00–5.49 y	−0.2021	8.6349	0.2963	5.09	5.42	5.99	7.10	8.63	10.59	11.86	12.82	14.42	15.60
5.50–5.99 y	−0.2164	8.4553	0.3071	4.91	5.23	5.80	6.90	8.46	10.45	11.76	12.76	14.44	15.67
6.00–6.49 y	−0.2298	8.2999	0.3189	4.73	5.06	5.62	6.73	8.30	10.35	11.70	12.75	14.51	15.82
6.50–6.99 y	−0.2423	8.1976	0.3314	4.59	4.91	5.47	6.59	8.20	10.32	11.73	12.83	14.71	16.11
7.00–7.49 y	−0.2540	8.1739	0.3445	4.49	4.81	5.38	6.52	8.17	10.39	11.88	13.06	15.07	16.59
7.50–7.99 y	−0.2648	8.2395	0.3578	4.44	4.77	5.35	6.52	8.24	10.57	12.17	13.43	15.62	17.29
8.00–8.49 y	−0.2748	8.3857	0.3712	4.43	4.77	5.36	6.58	8.39	10.87	12.59	13.96	16.36	18.20
8.50–8.99 y	−0.2841	8.5913	0.3844	4.45	4.80	5.42	6.69	8.59	11.25	13.11	14.61	17.25	19.30
9.00–9.49 y	−0.2926	8.8356	0.3974	4.49	4.86	5.50	6.83	8.84	11.68	13.70	15.34	18.25	20.54
9.50–9.99 y	−0.3006	9.0972	0.4099	4.55	4.92	5.59	6.98	9.10	12.14	14.33	16.12	19.33	21.87
10.00–10.49 y	−0.3082	9.3464	0.4217	4.60	4.98	5.67	7.12	9.35	12.59	14.95	16.88	20.40	23.21
10.50–10.99 y	−0.3153	9.5503	0.4328	4.63	5.02	5.73	7.22	9.55	12.97	15.49	17.57	21.39	24.46
11.00–11.49 y	−0.3222	9.6840	0.4429	4.63	5.03	5.75	7.28	9.68	13.26	15.91	18.12	22.21	25.54
11.50–11.99 y	−0.3286	9.7329	0.4520	4.60	5.00	5.73	7.28	9.73	13.42	16.19	18.51	22.83	26.38
12.00–12.49 y	−0.3347	9.6954	0.4600	4.53	4.94	5.66	7.22	9.70	13.45	16.30	18.70	23.20	26.93
12.50–12.99 y	−0.3405	9.5778	0.4669	4.44	4.84	5.56	7.10	9.58	13.36	16.25	18.70	23.33	27.19
13.00–13.49 y	−0.3460	9.3915	0.4728	4.33	4.72	5.42	6.94	9.39	13.17	16.07	18.54	23.24	27.18
13.50–13.99 y	−0.3512	9.1601	0.4777	4.20	4.58	5.26	6.75	9.16	12.89	15.78	18.25	22.97	26.96
14.00–14.49 y	−0.3559	8.9122	0.4816	4.06	4.43	5.10	6.55	8.91	12.59	15.44	17.89	22.60	26.60
14.50–14.99 y	−0.3601	8.6733	0.4848	3.94	4.30	4.95	6.37	8.67	12.28	15.10	17.52	22.20	26.19
15.00–15.49 y	−0.3635	8.4643	0.4872	3.84	4.19	4.82	6.21	8.46	12.01	14.79	17.19	21.83	25.80
15.50–15.99 y	−0.3660	8.2983	0.4892	3.75	4.10	4.72	6.08	8.30	11.80	14.54	16.92	21.53	25.48
16.00–16.49 y	−0.3673	8.1842	0.4909	3.70	4.04	4.65	5.99	8.18	11.65	14.37	16.73	21.33	25.27
16.50–16.99 y	−0.3673	8.1258	0.4923	3.66	4.00	4.61	5.94	8.13	11.58	14.30	16.66	21.25	25.20
17.00–17.49 y	−0.3663	8.1247	0.4936	3.65	3.99	4.60	5.93	8.12	11.59	14.32	16.69	21.30	25.27
17.50–17.99 y	−0.3642	8.1877	0.4949	3.67	4.01	4.63	5.98	8.19	11.69	14.45	16.84	21.50	25.52
18.00–18.49 y	−0.3615	8.3189	0.4961	3.72	4.07	4.69	6.07	8.32	11.88	14.69	17.13	21.88	25.96
18.50–18.99 y	−0.3582	8.5027	0.4973	3.80	4.15	4.79	6.19	8.50	12.15	15.03	17.53	22.38	26.56
19.00–19.49 y	−0.3546	8.7141	0.4984	3.88	4.24	4.90	6.34	8.71	12.46	15.42	17.98	22.95	27.23
19.50–19.99 y	−0.3509	8.9348	0.4994	3.97	4.34	5.02	6.50	8.93	12.79	15.82	18.45	23.55	27.93

Appendix A-6, continued

TABLE 3
Smoothed percentiles for subscapular skinfold-for-age (mm): boys aged 1.50–19.99 y[1]

				Percentile									
Age	*L*	*M*	*S*	3rd	5th	10th	25th	50th	75th	85th	90th	95th	97th
1.50–1.99 y	−0.3827	5.8414	0.2767	3.63	3.84	4.19	4.88	5.84	7.09	7.92	8.55	9.63	10.44
2.00–2.49 y	−0.4078	5.7779	0.2748	3.61	3.82	4.16	4.83	5.78	7.01	7.82	8.45	9.52	10.32
2.50–2.99 y	−0.4582	5.6469	0.2711	3.57	3.76	4.09	4.74	5.65	6.83	7.63	8.24	9.30	10.09
3.00–3.49 y	−0.5086	5.5132	0.2677	3.52	3.71	4.02	4.64	5.51	6.66	7.44	8.04	9.08	9.86
3.50–3.99 y	−0.5591	5.3813	0.2651	3.47	3.64	3.94	4.54	5.38	6.50	7.25	7.84	8.87	9.66
4.00–4.49 y	−0.6095	5.2551	0.2638	3.41	3.58	3.86	4.44	5.26	6.34	7.09	7.67	8.70	9.49
4.50–4.99 y	−0.6597	5.1370	0.2638	3.34	3.51	3.79	4.34	5.14	6.21	6.94	7.53	8.56	9.37
5.00–5.49 y	−0.7094	5.0215	0.2654	3.28	3.43	3.70	4.24	5.02	6.08	6.82	7.41	8.47	9.30
5.50–5.99 y	−0.7579	4.9017	0.2689	3.19	3.35	3.61	4.14	4.90	5.96	6.70	7.31	8.40	9.27
6.00–6.49 y	−0.8040	4.7885	0.2743	3.11	3.26	3.51	4.03	4.79	5.85	6.61	7.24	8.39	9.32
6.50–6.99 y	−0.8466	4.7139	0.2817	3.04	3.19	3.44	3.95	4.71	5.80	6.59	7.25	8.49	9.52
7.00–7.49 y	−0.8844	4.7007	0.2910	3.01	3.15	3.41	3.92	4.70	5.83	6.68	7.39	8.76	9.93
7.50–7.99 y	−0.9163	4.7407	0.3018	3.00	3.15	3.40	3.93	4.74	5.94	6.85	7.64	9.19	10.56
8.00–8.49 y	−0.9416	4.8172	0.3139	3.01	3.16	3.42	3.97	4.82	6.10	7.10	7.99	9.77	11.41
8.50–8.99 y	−0.9603	4.9274	0.3268	3.04	3.19	3.47	4.03	4.93	6.31	7.42	8.42	10.50	12.48
9.00–9.49 y	−0.9729	5.0737	0.3402	3.09	3.25	3.53	4.12	5.07	6.58	7.81	8.95	11.38	13.81
9.50–9.99 y	−0.9802	5.2439	0.3535	3.14	3.31	3.60	4.23	5.24	6.88	8.26	9.55	12.41	15.38
10.00–10.49 y	−0.9832	5.4157	0.3662	3.20	3.37	3.68	4.34	5.42	7.19	8.71	10.16	13.48	17.10
10.50–10.99 y	−0.9828	5.5760	0.3776	3.25	3.43	3.75	4.44	5.58	7.48	9.14	10.75	14.55	18.85
11.00–11.49 y	−0.9797	5.7219	0.3874	3.30	3.49	3.82	4.53	5.72	7.74	9.53	11.29	15.54	20.51
11.50–11.99 y	−0.9745	5.8541	0.3952	3.35	3.54	3.88	4.62	5.85	7.97	9.87	11.77	16.40	21.96
12.00–12.49 y	−0.9670	5.9749	0.4010	3.39	3.59	3.94	4.70	5.97	8.17	10.17	12.16	17.08	23.07
12.50–12.99 y	−0.9572	6.0965	0.4047	3.44	3.64	4.00	4.78	6.10	8.37	10.42	12.48	17.58	23.81
13.00–13.49 y	−0.9453	6.2330	0.4065	3.51	3.71	4.08	4.88	6.23	8.56	10.67	12.77	17.95	24.21
13.50–13.99 y	−0.9318	6.3961	0.4066	3.59	3.80	4.18	5.01	6.40	8.78	10.92	13.05	18.23	24.38
14.00–14.49 y	−0.9167	6.5929	0.4054	3.70	3.92	4.31	5.17	6.59	9.03	11.21	13.35	18.48	24.42
14.50–14.99 y	−0.9001	6.8202	0.4032	3.83	4.05	4.46	5.35	6.82	9.32	11.52	13.67	18.71	24.40
15.00–15.49 y	−0.8817	7.0694	0.4006	3.97	4.21	4.63	5.55	7.07	9.63	11.85	14.00	18.96	24.38
15.50–15.99 y	−0.8609	7.3362	0.3981	4.12	4.36	4.81	5.76	7.34	9.96	12.21	14.36	19.23	24.39
16.00–16.49 y	−0.8376	7.6251	0.3961	4.27	4.53	5.00	5.99	7.63	10.32	12.61	14.77	19.56	24.51
16.50–16.99 y	−0.8110	7.9385	0.3948	4.44	4.71	5.20	6.24	7.94	10.72	13.05	15.23	19.96	24.74
17.00–17.49 y	−0.7809	8.2763	0.3944	4.61	4.90	5.41	6.50	8.28	11.15	13.54	15.74	20.45	25.08
17.50–17.99 y	−0.7475	8.6462	0.3948	4.79	5.09	5.63	6.78	8.65	11.64	14.09	16.33	21.03	25.54
18.00–18.49 y	−0.7111	9.0550	0.3960	4.98	5.30	5.87	7.09	9.06	12.18	14.71	16.99	21.72	26.15
18.50–18.99 y	−0.6723	9.4930	0.3978	5.18	5.52	6.12	7.42	9.49	12.76	15.38	17.72	22.48	26.85
19.00–19.49 y	−0.6314	9.9431	0.4000	5.37	5.74	6.38	7.75	9.94	13.36	16.08	18.47	23.27	27.58
19.50–19.99 y	−0.5892	10.3940	0.4025	5.56	5.94	6.63	8.08	10.39	13.97	16.78	19.22	24.05	28.32

Appendix A-7

Skinfold Percentiles Calculated from Addo and Himes Tables
Female Children Ages 6-11, Triceps and Subscapular Percentiles[1]

Female Percentiles for Triceps Skinfold-For-Age (mm)			
Age	<85th	85th-94th	≥95th
6	<13.995	13.995 - <17.16	≥17.16
7	<14.74	14.74 - <18.33	≥18.33
8	<15.865	15.685 - <19.98	≥19.98
9	<17.17	17.17 - <21.87	≥21.87
10	<18.405	18.405 - <23.64	≥23.64
11	<19.50	19.50 - <25.175	≥25.175

Female Percentiles for Subscapular Skinfold-For-Age (mm)			
Age	<85th	85th-94th	≥95th
6	<8.275	8.275 - <11.245	≥11.245
7	<8.665	8.665 - <12.31	≥12.31
8	<9.54	9.54 - <14.25	≥14.25
9	<10.83	10.83 - <16.92	≥16.92
10	<12.27	12.27 - <19.77	≥19.77
11	<13.695	13.695 - <22.33	≥22.33

[1] Skinfold categories are defined according to Centers for Disease Control and Prevention percentiles with normal weight being 5th - <85th percentiles, overweight being 85th - <95th percentiles, obese being ≥95th percentile.

Appendix A-7, continued

Skinfold Percentiles Calculated from Addo and Himes Tables
Male Children Ages 6-11, Triceps and Subscapular Percentiles[1]

Male Percentiles for Triceps Skinfold-For-Age (mm)			
Age	<85th	85th-94th	≥95th
6	<11.715	11.715 - <14.61	≥14.61
7	<12.025	12.025 - <15.345	≥15.345
8	<12.85	12.85 - <16.805	≥16.805
9	<14.015	14.015 - <18.79	≥18.79
10	<15.22	15.22 - <20.895	≥20.895
11	<16.05	16.05 - <22.52	≥22.52

Male Percentiles for Subscapular Skinfold-For-Age (mm)			
Age	<85th	85th-94th	≥95th
6	<6.6	6.6 - <8.44	≥8.44
7	<6.765	6.765 - <8.975	≥8.975
8	<7.26	7.26 - <10.135	≥10.135
9	<8.035	8.035 - <11.895	≥11.895
10	<8.925	8.925 - <14.015	≥14.015
11	<9.7	9.70 - <15.97	≥15.97

[1] Skinfold categories are defined according to Centers for Disease Control and Prevention percentiles with normal weight being 5th - <85th percentiles, overweight being 85th - <95th percentiles, obese being ≥95th percentile.