1-60

Bogalusa Heart Study Selected Bibliography

(1) Berenson GS. Obesity--a critical issue in preventive cardiology: the Bogalusa Heart Study. *Prev Cardiol* 2005;8(4):234-41.
Abstract: Obesity has become a major public health problem in the United States, with a marked upward trend occurring over the past three decades. It plays a critical role in the development of cardiovascular risk factors that mediate the evolution of asymptomatic cardiovascular disease. Longitudinal observations of children, adolescents, and young adults enrolled in the Bogalusa Heart Study show that obesity persists over time and is linked to the clustering of components of metabolic syndrome including hyperinsulinemia/insulin resistance, dyslipidemia, and hypertension, thereby creating a long-term burden of cardiovascular risk beginning in childhood. This burden is associated with subclinical and adverse structural and functional changes of the cardiovascular system in youth. Ultimately, these changes can result in morbidity from disease, as exemplified in the Framingham Heart Study. Obesity is governed by the interplay of both genetic and environmental factors. Unlike genetic factors, lifestyle behaviors are amenable to modification. Since obesity is so widespread and underlying cardiovascular disease is so prevalent, health education beginning in childhood is suggested as an approach to prevention

(2) Daniels SR. Regulation of body mass and management of childhood overweight. *Pediatr Blood Cancer* 2005 June 15;44(7):589-94.
Abstract: Obesity has become an increasingly important public health problem. Recent evidence suggests that obesity has become a close second to tobacco use as a preventable cause of death in the United States. During the past decade an increase in the prevalence of type 2 diabetes in adolescents has been observed. The association of type 2 diabetes and obesity is well established and most adolescents with type 2 diabetes have body mass index (BMI) in a range that would already be considered obese in an adult. Childhood overweight is also associated with the atherosclerotic process. In the Bogalusa autopsy study, Berenson et al. found that the extent of fatty streaks and fibrous plaques in the aorta and coronary arteries was associated with BMI. There are three modalities currently available for the treatment of overweight in children and adolescents, including behavioral approaches, pharmacologic approaches, and surgical approaches. Surgical intervention may be considered if the BMI > or = 40 kg/m2 and a severe medical comorbidity including type 2 diabetes, obstructive sleep apnea or pseudotumor cerebri, or if the BMI is > or = 50 kg/m2 and comorbid conditions such as hypertension, dyslipidemia, or the metabolic syndrome are present. Behavioral intervention is usually made by a psychologist, behavioral therapist, dietician, or exercise physiologist. There is evidence that the effect of behavioral therapy for weight loss in childhood will be longer lasting than that seen in adults

(3) Katzmarzyk PT, Srinivasan SR, Chen W, Malina RM, Bouchard C, Berenson GS. Body mass index, waist circumference, and clustering of cardiovascular disease risk factors in a biracial sample of children and adolescents. *Pediatrics* 2004 August;114(2):e198-e205.
Abstract: OBJECTIVE: To derive optimal body mass index (BMI) and waist circumference thresholds for children and adolescents, to predict risk factor clustering. DESIGN: Cross-sectional receiver operating characteristic curve analysis. SETTING: The Bogalusa Heart Study, a community-based study of cardiovascular disease risk factors in early life. PARTICIPANTS: A total of 2597 black and white children and adolescents, 5 to 18 years of age, who were examined between 1992 and 1994. MAIN OUTCOME MEASURES: The presence or absence of > or =3 age-adjusted risk factors (low high-density lipoprotein cholesterol level, high low-density lipoprotein cholesterol level, high triglyceride level, high glucose level, high insulin level, and high blood pressure) was predicted from age-adjusted BMI and waist circumference values. RESULTS: The areas under the receiver operating characteristic curves were significantly different from 0.5 for both BMI and waist circumference for all gender/race groups, ranging from 0.73 to 0.82. The optimal BMI thresholds were at the 53rd and 50th percentiles for white and black male subjects, respectively, and at the 57th and 51st percentiles for white and black female subjects, respectively. Similarly, the optimal waist circumference thresholds were at the 56th and 50th percentiles for white and black male subjects, respectively, and at the 57th and 52nd percentiles for white and black female subjects, respectively. The sensitivity and specificity at the thresholds were similar for all gender/race groups, ranging from 67% to 75%. CONCLUSIONS: The use of BMI and waist circumference for the prediction of risk factor clustering among children and adolescents has significant clinical utility. In this sample, race and gender differences in the optimal thresholds were minimal

(4) Freedman DS, Khan LK, Serdula MK, Dietz WH, Srinivasan SR, Berenson GS. The relation of menarcheal age to obesity in childhood and adulthood: the Bogalusa heart study. *BMC Pediatr* 2003 April 30;3:3. Epub@2003 Apr 30.:3.
Abstract: BACKGROUND: Several studies have shown that girls who undergo menarche at a relatively young age tend to be more obese as adults. However, because childhood (pre-menarcheal) levels of weight and height are associated with an earlier menarche, the increased prevalence of adult obesity among early maturers may largely reflect the persistence of childhood obesity into adulthood. METHODS: We examined these interrelationships among 1179 girls (65% white, 35% black) who were examined as children (mean age, 9 y), adolescents, and adults (mean age, 26 y) in the Bogalusa Heart Study. RESULTS: Both white and black women who reported that they underwent menarche before age 12 y had, on average, higher adult levels of weight (+10 kg), body mass index (BMI, +4 kg/m2) and skinfold thicknesses (+6 mm) than did women who underwent menarche after age 13.5 y. However, relatively fat children tended to undergo menarche earlier than did thinner children, with each standard deviation increase in pre-menarcheal BMI increasing the odds of early menarche (<12 y) by approximately 2-fold. Stratified and regression analyses indicated that (1) adult obesity was more strongly associated with childhood obesity than with menarcheal age, and (2) about 60% to 75% of the apparent effect of menarcheal age was due to the influence of childhood obesity on both menarcheal age and adult obesity. CONCLUSIONS: Although additional longitudinal studies are needed, it is likely that the importance of early menarche in adult obesity has been overestimated. Most of apparent influence of menarcheal age on adult obesity is attributable to the association of childhood obesity with both menarcheal age and adult obesity

(5) Berenson GS. Bogalusa Heart Study: a long-term community study of a rural biracial (Black/White) population. *Am J Med Sci* 2001 November;322(5):293-300.
Abstract: The Bogalusa Heart Study, a long-term population study with a continued relationship with a community, addresses the problem of capacity building in minority health research. The study was originally funded as a Specialized Center of Research-Arteriosclerosis (SCOR-A) by the National Heart Lung and Blood Institute (NHLBI). These centers were to conduct research on atherosclerosis, coronary artery disease (CAD), hypertension, diabetes mellitus, and complications of cardiovascular-renal disease as the major causes of deaths in the United States. From earlier research on atherosclerosis, we became interested in the underlying characteristics in early life that would eventually lead to clinical morbidity and mortality from heart disease. An observation at autopsy showed the degree of atherosclerotic involvement in human aortas, from young to older individuals (Figure 1). For example, at age 40 years, marked individual variability occurred in the severity and involvement with atherosclerotic disease. Some individuals showed very little disease, while almost 70% of the surface was diseased in others. Further studies on arterial wall matrix showed aortas from young individuals varied with the extent of disease and its chemical composition. This background stimulated an interest in studying children for early clinical evidence of major adult heart diseases. The Bogalusa Heart Study was begun in 1972 as an epidemiology study of cardiovascular risk factors in children and adolescents; it eventually evolved into observations of young adults. Bogalusa, LA, is a biracial (black/white) rural community 70 miles north of New Orleans, comparable to many other communities in southeastern United States

(6) Berenson GS. Bogalusa Heart Study: a long-term community study of a rural biracial (black/white) population. *Am J Med Sci* 2001 November;322(5):267-74.
Abstract: The Bogalusa Heart Study, a long-term population study with a continued relationship with a community, addresses the problem of capacity building in minority health research. The study was originally funded as a Specialized Center of Research-Arteriosclerosis (SCOR-A) by the National Heart Lung and Blood Institute (NHLBI). These centers were to conduct research on atherosclerosis, coronary artery disease (CAD), hypertension, diabetes mellitus, and complications of cardiovascular-renal disease as the major causes of deaths in the United States. From earlier research on atherosclerosis, we became interested in the underlying characteristics in early life that would eventually lead to clinical morbidity and mortality from heart disease. An observation at autopsy showed the degree of atherosclerotic involvement in human aortas, from young to older individuals (Figure 1). For example, at age 40 years, marked individual variability occurred in the severity and involvement with atherosclerotic disease. Some individuals showed very little disease, while almost 70% of the surface was diseased in others. Further studies on arterial wall matrix showed aortas from young individuals varied with the extent of disease and its chemical composition. This background stimulated an interest in studying children for early clinical evidence of major adult heart diseases. The Bogalusa Heart Study was begun in 1972 as an epidemiology study of cardiovascular risk factors in children and adolescents; it eventually evolved into observations of young adults. Bogalusa, LA, is a biracial (black/white) rural community 70 miles north of New Orleans, comparable to many other communities in southeastern United States

(7) Chen W, Bao W, Begum S, Elkasabany A, Srinivasan SR, Berenson GS. Age-related patterns of the clustering of cardiovascular risk variables of syndrome X from childhood to young adulthood in a population made up of black and white subjects: the Bogalusa Heart Study. *Diabetes* 2000 June;49(6):1042-8.
Abstract: The age-related patterns of clustering of cardiovascular risk variables of Syndrome X from childhood to adulthood were examined in a community-based sample of black and white children (aged 5-10 years, n = 2,389), adolescents (aged 11-17 years, n = 3,371), and young adults (aged 18-37 years, n = 2,115). In the analysis of clustering, insulin resistance index, BMI, triglycerides/ HDL cholesterol ratio, and mean arterial pressure were used either as categorical variables (age-, race- and sex-specific values >75th percentiles) to calculate risk ratios (observed frequency/expected frequency) or as continuous variables (normal scores based on ranks) to compute intraclass correlations. In the total sample, the risk ratio for clustering of adverse levels of all 4 variables was 9.8 for whites ($P < 0.01$) versus 7.4 for blacks ($P < 0.01$); the intraclass correlation was 0.33 for whites ($P < 0.001$) versus 0.26 for blacks ($P < 0.001$). Both the risk ratio and intraclass correlation were significantly higher in whites than in blacks in the total sample. The intraclass correlations of the 4 variables were significant ($P < 0.001$) in all race and age-groups, and they were higher during preadolescence and adulthood than during adolescence. Furthermore, unlike risk ratios, intraclass correlations showed a continuous increase with age during adulthood. When BMI was adjusted, the intraclass correlations involving the other 3 variables were reduced by approximately 50%, and the age-related pattern was no longer evident. These results suggest that the degree of clustering of risk variables of Syndrome X varies with age from childhood to adulthood and is likely influenced by the age-related changes in obesity and the attendant insulin resistance

(8) Chen W, Srinivasan SR, Elkasabany A, Berenson GS. Cardiovascular risk factors clustering features of insulin resistance syndrome (Syndrome X) in a biracial (Black-White) population of children, adolescents, and young adults: the Bogalusa Heart Study. *Am J Epidemiol* 1999 October 1;150(7):667-74.
Abstract: Recently, independent factors representing different features of insulin resistance syndrome (Syndrome X) have been identified by factor analysis in middle-aged and elderly adult populations. In this study, factor analysis was applied to the clustering characteristics of Syndrome X in a biracial (Black-White) community-based population of 4,522 children (ages 5-11 years), adolescents (ages 12-17 years), and young adults (ages 18-38 years) from the Bogalusa Heart Study who were screened during 1988-1996. Ponderal index (weight (kg)/height (m)3), levels of insulin, glucose, triglycerides, and high density lipoprotein cholesterol, and systolic and diastolic blood pressure were used as measures of components of Syndrome X. No evidence was found to support a one-factor hypothesis for this syndrome, but factor analysis yielded two uncorrelated factors (factor 1: insulin/lipids/glucose/ponderal index; factor 2: insulin/blood pressure). These two factors explained 54.6% of the total variance in the entire sample. The factor loading patterns were very similar in all race and age groups, based on high values of coefficients of congruence (0.89-1.0). These results suggest that Syndrome X is characterized by the linking of a metabolic entity (hyperinsulinemia/insulin resistance, dyslipidemia, and obesity) to a hemodynamic factor (hypertension) through shared correlation with hyperinsulinemia/insulin resistance, and that the clustering features are independent of sex and age in both Black and White populations

(9) Srinivasan SR, Myers L, Berenson GS. Temporal association between obesity and hyperinsulinemia in children, adolescents, and young adults: the Bogalusa Heart Study. *Metabolism* 1999 July;48(7):928-34.
Abstract: Obesity is generally associated with hyperinsulinemia. However, whether obesity precedes or follows hyperinsulinemia is not clear. The present study examined the temporal nature of the association between obesity and hyperinsulinemia in a biracial (black-white) community-based population enrolled in the Bogalusa Heart Study. Three longitudinal cohorts of children (n = 427; baseline age, 5 to 7 years), adolescents (n = 674; baseline age, 12 to 14 years), and young adults (n = 396; baseline age, 20 to 24 years) were selected retrospectively, with a follow-up period of approximately 3 years. In general, longitudinal changes in the mean body mass index (kilograms per meter squared), an indicator of adiposity, and fasting insulin level did not parallel each other. In a bivariate analysis, baseline insulin levels correlated significantly with the follow-up body mass index in adolescents and adults, but not in children. On the other hand, the baseline body mass index correlated significantly with follow-up insulin levels in all cases. Logistic regression analysis showed that the proportion of subjects who developed obesity (body mass index > 75th percentile, specific for age, race, gender, and survey year) at follow-up study increased significantly across baseline quintiles (specific for age, race, gender, and survey year) of insulin only among adolescents, irrespective of race and gender. This relationship disappeared after adjusting for the baseline body mass index. By contrast, a significant positive trend between baseline quintiles of the body mass index and incidence of hyperinsulinemia (> 75th percentile) at follow-up study was noted among all age groups independent of race, gender, and baseline insulin levels. Further, in a multiple stepwise regression model, the best predictor of the follow-up insulin level was the baseline body mass index in children and adults and the baseline insulin in adolescents. The baseline body mass index was the best predictor of the follow-up body mass index in all three age groups. These results, by showing the temporal nature of the relation between obesity and hyperinsulinemia beginning in childhood, support the role of obesity in the development of hyperinsulinemia

(10) Urbina EM, Gidding SS, Bao W, Elkasabany A, Berenson GS. Association of fasting blood sugar level, insulin level, and obesity with left ventricular mass in healthy children and adolescents: The Bogalusa Heart Study. *Am Heart J* 1999 July;138(1 Pt 1):122-7.
Abstract: BACKGROUND: Insulin resistance, often associated with obesity, is hypothesized to be involved in the pathogenesis of essential hypertension and may relate to increased left ventricular mass (LVM). METHODS: We examined correlations between echocardiographic LVM and fasting blood glucose and insulin levels in a cross-section of 216 black and white healthy children and young adults aged 13 to 27 years in Bogalusa, Louisiana. Anthropometric measurements and blood pressure readings were also obtained. RESULTS: Positive bivariate correlation was found between fasting blood glucose level and LVM corrected for growth (LVMC) (LVMC = LVM/Height2.7) with all race/sex groups combined (r = 0.17, P </=.03). Multivariate analyses in a model including race, sex, age, and measures of body size showed no significant correlations between fasting blood glucose level, insulin level, and LVMC. However, when patients were ranked in terciles by fasting insulin level and within each tercile by subscapular skinfold thickness or weight tercile, increasing LVMC with increasing insulin level was found in the highest subscapular skinfold thickness and weight terciles. The largest difference was between high and low insulin groups (P </=.03). When grouped by systolic blood pressure tercile, there was no difference in LVMC with increasing fasting insulin tercile. We concluded that in heavier individuals, increased insulin levels may be

a risk factor for the accumulation of increased LVMC independent of any relation among insulin, obesity, and blood pressure

(11) Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. *Pediatrics* 1999 June;103(6 Pt 1):1175-82.
Abstract: BACKGROUND: Although overweight and obesity in childhood are related to dyslipidemia, hyperinsulinemia, and hypertension, most studies have examined levels of these risk factors individually or have used internal cutpoints (eg, quintiles) to classify overweight and risk factors. OBJECTIVE: We used cutpoints derived from several national studies to examine the relation of overweight (Quetelet index, >95th percentile) to adverse risk factor levels and risk factor clustering. DESIGN: The sample consisted of 9167 5- to 17-year-olds examined in seven cross-sectional studies conducted by the Bogalusa Heart Study between 1973 and 1994. RESULTS: About 11% of examined schoolchildren were considered overweight. Although adverse lipid, insulin, and blood pressure levels did not vary substantially with the Quetelet index at levels <85th percentile, risk factor prevalences increased greatly at higher levels of the Quetelet index. Overweight schoolchildren were 2.4 times as likely as children with a Quetelet index <85th percentile to have an elevated level of total cholesterol. Odds ratios for other associations were 2.4 (diastolic blood pressure), 3.0 (low-density lipoprotein cholesterol), 3.4 (high-density lipoprotein cholesterol), 4.5 (systolic blood pressure), 7.1 (triglycerides), and 12.6 (fasting insulin). Several of these associations differed between whites and blacks, and by age. Of the 813 overweight schoolchildren, 475 (58%) were found to have at least one risk factor. Furthermore, the use of overweight as a screening tool could identify 50% of schoolchildren who had two or more risk factors. CONCLUSIONS: Because overweight is associated with various risk factors even among young children, it is possible that the successful prevention and treatment of obesity in childhood could reduce the adult incidence of cardiovascular disease

(12) Hunter SM, Webber LS, Elkasabany A, Berenson GS. Are some children and adolescents in Louisiana addicted to tobacco? The Bogalusa Heart Study. *J La State Med Soc* 1999 April;151(4):177-81.
Abstract: The US Surgeon General concluded that nicotine in tobacco is addictive. Few studies actually explore the nature of nicotine addiction in youth. In Bogalusa, Louisiana, surveys to assess tobacco usage were administered to 11-18 year olds according to a standardized protocol developed in 1976. In 1991-92, a special substudy explored the nature of nicotine addiction in youth. Overall, 14.7% were current cigarette smokers; however, as many as 44.3% of white females, ages 15-16, indicated they were current smokers. Twelve percent of the surveyed population purchased single cigarettes. Thirty-two percent of current smokers reported they smoke a cigarette within 30 minutes after waking up. Thirty-one percent said they would find it difficult to refrain from smoking in places where it is forbidden. And 23% said they continue to smoke cigarettes when they are ill. From the findings in this study, it is clear there are young people who are addicted to tobacco. It is important to develop prevention of tobacco usage in childhood. Those who are addicted require a carefully developed intervention program to assist them with their cessation efforts

(13) Freedman DS, Serdula MK, Srinivasan SR, Berenson GS. Relation of circumferences and skinfold thicknesses to lipid and insulin concentrations in children and adolescents: the Bogalusa Heart Study. *Am J Clin Nutr* 1999 February;69(2):308-17.
Abstract: BACKGROUND: Although body fat patterning has been related to adverse health outcomes in adults, its importance in children and adolescents is less certain. OBJECTIVE: We examined the relation of circumference (waist and hip) and skinfold-thickness (subscapular and triceps) measurements to lipid and insulin concentrations among 2996 children and adolescents aged 5-17 y. DESIGN: This was a community-based, cross-sectional study conducted in 1992-1994. RESULTS: A central or abdominal distribution of body fat was related to adverse concentrations of triacylglycerol, LDL cholesterol, HDL cholesterol, and insulin; these associations were independent of race, sex, age, weight, and height. These associations were observed whether fat patterning was characterized by using 1) waist circumference alone (after adjustment for weight and height), 2) waist-to-hip ratio, or 3) principal components analysis. Compared with a child at the 10th percentile of waist circumference, a child at the 90th percentile was estimated to have, on average, higher concentrations of LDL cholesterol (0.17 mmol/L), triacylglycerol (0.11 mmol/L), and insulin (6 pmol/L) and lower concentrations of HDL cholesterol (-0.07 mmol/L). These differences, which were independent of weight and height, were significant at the 0.001 level and were consistent across race-sex groups. CONCLUSIONS: These findings emphasize the importance of obtaining information on body fat distribution, waist circumference in particular, in children. Waist circumference, which is relatively easy to measure, may help to identify children likely to have adverse concentrations of lipids and insulin

(14) Urbina EM, Bao W, Pickoff AS, Berenson GS. Ethnic (black-white) contrasts in heart rate variability during cardiovascular reactivity testing in male adolescents with high and low blood pressure: the Bogalusa Heart Study. *Am J Hypertens* 1998 February;11(2):196-202.
Abstract: Heart rate variability (HRV) is used to study autonomic effects on the heart. The time domain PNN50 (percentage of consecutive RR intervals differing by > 50%) measures high frequency in HRV primarily reflecting parasympathetic activity. The ratio of low to high frequency power (LF/HF) measured by fast Fourier analysis is used to measure sympathetic to parasympathetic balance. In adults, increased sympathetic tone has been found in hypertensive individuals. The present study was performed to look for differences in HRV by race and between subjects with high and low blood pressure (BP). Heart rate variability data was analyzed from Holter monitor recordings in 39 healthy male subjects aged 13 to 17 years (50% white). Half were selected with Korotkoff fourth sound (K4) DBP > 85th percentile for height measured twice, 3 to 5 years apart (average 116/75 mm Hg). Half had DBP < 15th percentile for height (average 101/57 mm Hg). Subjects underwent a physical examination including BP, height, and weight before cardiovascular reactivity testing including measurements taken while supine and standing, and during 20% maximal isometric hand grip, Valsalva maneuver, and immersion of the hand in water at 4 degrees C. The LF/HF ratio was significantly higher and the PNN50 was significantly lower in whites compared with ratios for blacks during all CV reactivity tests (all P < .05). There was a trend for higher LF/HF ratio and lower PNN50 in blacks and whites with higher levels of BP, although this did not reach statistical significance. It was concluded that healthy white adolescents exhibit increased sympathetic tone compared with that of blacks during CV reactivity tests. A trend towards sympathetic predominance during reactivity testing was demonstrated in children with higher levels of DBP

(15) Jiang X, Srinivasan SR, Dalferes ER, Jr., Berenson GS. Plasma insulin-like growth factor 1 distribution and its relation to blood pressure in adolescents: the Bogalusa Heart Study. *Am J Hypertens* 1997 July;10(7 Pt 1):714-9.
Abstract: The distribution of circulating insulin-like growth factor-1 (IGF-1) and its relationship to blood pressure was examined in a community study of 1073 biracial (black-white) adolescents aged 11 to 18 years. Girls of both races displayed higher levels of plasma IGF-1 than did their male counterparts (P < .01), independent of age and sexual maturation. In boys, IGF-1 was correlated positively with height (r = 0.37 P < .001), weight (r = 0.26, P < .001), Tanner stage (r = 0.31, P < .001), and age (r = 0.11, P < .05). Girls, on the other hand, showed an inverse association with age (r = -0.38, P < .001) and Tanner stage (r = -0.10, P < .05). Plasma IGF-1 was correlated positively with systolic blood pressure in boys of both races (r = 0.21 to 0.25, P < .01) and with diastolic blood pressure in white boys (r = 0.18, P < .05), but not in girls of either race. Boys with elevated levels of IGF-1 (>80th percentile) showed significantly higher blood pressure levels, especially during early to middle stages of puberty. Multivariate analysis revealed that IGF-1 was associated with systolic and diastolic blood pressure, independent of age, race, sexual maturation, height, weight, and insulin in boys. These results suggest that plasma IGF-1 may contribute to the regulation of blood pressure only in males during puberty

(16) Greenlund KJ, Johnson C, Wattigney W, Bao W, Webber LS, Berenson GS. Trends in cigarette smoking among children in a southern community, 1976-1994: the Bogalusa Heart Study. *Ann Epidemiol* 1996 November;6(6):476-82.
Abstract: Cigarette smoking among adolescents continues to be a major public health problem in the United States. Smoking trends from 1976-1977 to 1992-1994 were examined in the Bogalusa Heart Study, an investigation of cardiovascular disease risk factors among black and white, male and female adolescents in a semirural town in the southern United States. Age-race-sex specific chi 2 tests for trends over five survey periods were conducted. In almost every age group, black boys and girls were less likely to be current smokers or to have ever smoked or tried cigarettes, as compared with white boys and girls, respectively (P < 0.01). Within age groups, few significant trends in smoking status from 1976-1977 through 1992-1994 were observed among white boys and girls. Among black males and females, however, sharp decreases were observed among all age groups in the prevalence of having ever smoked or tried cigarettes (P = 0.0001) and among the older age groups in the prevalence of being a current smoker (P = 0.0001). Thus, substantial declines in the prevalence of smoking were observed among black children but not among white children. Further research is required to understand why these ethnic differences in smoking occurred so that public health programs may target further the smoking behaviors in children

(17) Jiang X, Srinivasan SR, Berenson GS. Relation of obesity to insulin secretion and clearance in adolescents: the Bogalusa Heart Study. *Int J Obes Relat Metab Disord* 1996 October;20(10):951-6.
Abstract: OBJECTIVE: Earlier we found elevated insulin levels in obese children and adolescents. The present study examines whether alterations in insulin secretion and/or clearance contribute to hyperinsulinemia in obese adolescents. METHODS: Fasting circulating insulin and C-peptide concentrations were examined in 1157 adolescents, aged 11-18 y, from a biracial (black/white) community. In this epidemiologic study, plasma C-peptide was used as a noninvasive measure of insulin secretion by beta cells, C-peptide to insulin ratio as an indicator of hepatic insulin extraction, and insulin to glucose ratio as a measure of insulin sensitivity. Body mass index (BMI) was used as an index of obesity, since it is strongly associated with insulin levels and the C-peptide to insulin ratio more so than with measures of skinfolds and percent body fatness. RESULTS: Obese individuals (BMI > 90th P) had higher levels of plasma insulin (23.7 mu/ml vs 11.7 mu/ml), C-peptide (2.7 ng/ml vs 1.7 ng/ml), and insulin to glucose ratio (0.29 vs 0.15), and lower C-peptide to insulin ratio (0.13 vs 0.16) than non-obese adolescents (all P < 0.001). Elevated C-peptide and decreased C-peptide to insulin ratio were noted in subjects with both obesity and hyperinsulinemia (insulin > 90th P) versus those without these conditions (P < 0.001). Individuals with obesity and low insulin clearance (C-peptide/insulin < 10th P) had 18-fold higher prevalence of hyperinsulinemia versus those without these conditions. Although black adolescents, despite their lower percent body fat, had higher insulin and lower C-peptide and C-peptide to insulin ratio than their white counterparts, BMI related positively to insulin and C-peptide, and inversely with C-peptide to insulin ratio in both races. CONCLUSIONS: These data suggest that both increased insulin secretion and decreased insulin clearance contribute to hyperinsulinema in obese adolescents

(18) Myers L, Strikmiller PK, Webber LS, Berenson GS. Physical and sedentary activity in school children grades 5-8: the Bogalusa Heart Study. *Med Sci Sports Exerc* 1996 July;28(7):852-9.
Abstract: Physical and sedentary activity in children and adolescents has immediate health benefits and can also set a pattern that carries over into adulthood, resulting in long-term health benefits. Activity levels in a free-living biracial sample of children and adolescents, ages 9-15 yr (N = 995), were examined using a 24-h recall instrument, the Self-Administered Physical Activity Checklist. Selected sedentary activities (television watching and video-/computergame playing) were also assessed. Overall, boys were more physically active than girls and engaged in more heavy physical activity, while girls reported a larger percentage of time spent in light and moderate physical activities. Gender and, to a lesser extent, ethnic differences were seen in the types of activities reported. Although most physical activity occurred after school, children who reported no physical education class during school had less physical activity overall. There was a decrease in moderate physical activity with increasing grade levels in school and an increase in sedentary behavior. Black children reported more sedentary activity than white children, and girls reported more than boys. Although this 24-h recall method has limitations, it allows characterization of the activity of groups of children and provides useful data for policy recommendations

(19) Jiang X, Srinivasan SR, Radhakrishnamurthy B, Dalferes ER, Berenson GS. Racial (black-white) differences in insulin secretion and clearance in adolescents: the Bogalusa heart study. *Pediatrics* 1996 March;97(3):357-60.
Abstract: OBJECTIVE: Earlier we found black-white contrast in insulin levels in adolescents. The purpose of this study is to assess whether this difference is attributable to alterations in insulin secretion and/or clearance. METHODS: Fasting circulating insulin and C-peptide concentrations were examined in 1157 adolescents aged 11 to 18 years from a biracial community. Fasting plasma C-peptide, C-peptide to insulin ratio, and glucose to insulin ratio were used as indices of insulin secretion, hepatic insulin clearance, and insulin sensitivity, respectively. RESULTS: After adjusting several covariates (age, sexual maturation, and obesity), black adolescents had higher insulin levels (14.99 vs 12.66 microU/mL in girls). However, they had lower C-peptide levels than their white counterparts, indicating lower insulin secretion by pancreatic beta cells in black adolescents. Moreover, black adolescents had lower levels of C-peptide to insulin ratio than white adolescents (0.14 vs 0.17), suggesting reduced hepatic insulin clearance in black adolescents. In addition, significantly lower levels of glucose to insulin ratio in black girls suggest a reduced insulin sensitivity in this group. Further, differences in insulin levels between white and black girls disappeared after adjusting for differences in C-peptide to insulin ratio. CONCLUSION: These data suggest that elevated insulin levels observed in black adolescents, especially in black girls, may be attributed to their decreased hepatic insulin clearance, not hypersecretion of insulin

(20) Srinivasan SR, Bao W, Wattigney WA, Berenson GS. Adolescent overweight is associated with adult overweight and related multiple cardiovascular risk factors: the Bogalusa Heart Study. *Metabolism* 1996 February;45(2):235-40.
Abstract: Overweight in adolescence is considered an important predictor of long-term morbidity and mortality. The impact of adolescent overweight on adult overweight and related multiple cardiovascular risk factors was examined in a biracial (black-white) cohort (N = 783) who participated in two cross-sectional surveys as adolescents aged 13 to 17 years and as young adults aged 27 to 31 years. The cohort was categorized as adolescent-onset adult overweight (N = 110) or lean (N = 81) according to age-, race-, and sex-specific body mass index (BMI) greater than the 75th percentile or between the 25th and 50th percentiles on both surveys. The risk for overweight adolescents to remain overweight as young adults ranged from 52% in black males to 62% in black females. As young adults, the overweight cohort showed adverse levels of body fatness measures, systolic and diastolic blood pressure, lipoprotein cholesterol, insulin, and glucose as compared with the lean cohort ($P < .01$ to $P < .0001$). The prevalence of clinically recognized hypertension and dyslipidemia increased 8.5-fold and 3.1- to 8.3-fold, respectively, in the overweight cohort versus the lean cohort ($P < .05$ to $P < .0001$). The prevalence of parental history of diabetes mellitus and hypertension increased 2.4-fold ($P < .01$) and 1.3-fold ($P < .05$), respectively, in the overweight cohort. Clustering of adverse values (> 75th percentile) for the total cholesterol to high-density lipoprotein (HDL) cholesterol ratio, insulin level, and systolic blood pressure occurred only among the overweight cohort ($P < .0001$). Thus, excess weight in adolescence persists into young adulthood, and has a strong adverse impact on multiple cardiovascular risk factors, requiring primary prevention early in life

(21) Berenson GS, Wattigney WA, Webber LS. Epidemiology of hypertension from childhood to young adulthood in black, white, and Hispanic population samples. *Public Health Rep* 1996;111 Suppl 2:3-6.:3-6.
Abstract: RESEARCHERS RECORDED BLOOD PRESSURE LEVELS of children and adolescents in the Bogalusa Heart Study (black and white populations) and in the Brooks Country Study (Hispanic population). Hispanic children had smaller stature, while whites and Hispanics tended to be fatter than blacks in childhood. In Bogalusa, black boys showed higher blood pressure levels. Hispanic girls showed lower systolic blood pressure than the other ethnic groups. In cultures with a high prevalence of hypertension, such as blacks in the United States, it is important to understand the effect of environmental factors like dietary intake and electrolytes and obesity on the control of hypertension

(22) Nicklas TA. Dietary studies of children: the Bogalusa Heart Study experience. *J Am Diet Assoc* 1995 October;95(10):1127-33.
Abstract: For more than 20 years the Bogalusa Heart Study has been collecting data on children's dietary intakes in a biracial community. The macronutrient contribution of children's diets is similar to that in diets of adolescents: 13% of energy from protein, 49% from carbohydrate, and 38% from fat. As children get older, mean intakes of vitamins and minerals per 1,000 kcal decrease. Ten-year-old children in 1987-1988 were 3 lb heavier than 10-year-olds in 1973-1974. Yet total energy intakes remained virtually the same from 1973 to 1988. The composition of macronutrients shifted over the 15-year period, with an increase in the percentage of energy from protein and carbohydrate and a decrease in the percentage of energy from total fat, particularly saturated fat. Dietary cholesterol intake also decreased as a result of a decrease in egg consumption. Although the diets of children changed positively from 1973 to 1988, more than 75% of children consumed more total fat, saturated fat, and cholesterol than the recommended amounts. School meals had a major impact on the diets of children. School breakfast and lunch, together, contributed approximately 50% of the day's total intake of energy, protein, cholesterol, carbohydrate, and sodium. About 40% of daily total fat intake came from school breakfast and lunch. The diets of children in the Bogalusa study are similar to those reported in national studies of children. What might be different, however, are the types of foods consumed and their contribution to intakes of specific nutrients.(ABSTRACT TRUNCATED AT 250 WORDS)

(23) Johnson CC, Myers L, Webber LS, Hunter SM, Srinivasan SR, Berenson GS. Alcohol consumption among adolescents and young adults: the Bogalusa Heart Study, 1981 to 1991. *Am J Public Health* 1995 July;85(7):979-82.
Abstract: This report describes the alcohol consumption of adolescents and young adults who participated in the Bogalusa Heart Study, 1981 to 1991. Data were collected in three cross-sectional surveys of school-age children (11 to 19 years) and three surveys of young adults (18 to 32 years). White males had the highest proportion of drinkers and Black females had the lowest. By the end of the decade, adult White and Black male drinkers were about equal. Most individuals drank once or twice a week, but daily drinkers had the highest weekly alcohol intake. An association between alcohol and high-density lipoprotein cholesterol was found only in the latest survey and probably reflects the aging of the cohort

(24) Jiang X, Srinivasan SR, Urbina E, Berenson GS. Hyperdynamic circulation and cardiovascular risk in children and adolescents. The Bogalusa Heart Study. *Circulation* 1995 February 15;91(4):1101-6.
Abstract: BACKGROUND: Hyperdynamic circulation has been reported to be associated with adverse levels of insulin, blood pressure, adiposity, and lipoproteins in the adult population. Whether this putatively insulin-mediated association also occurs in early life is not known. This aspect was examined in 2229 children and adolescents 8 to 17 years old living in Bogalusa, La. METHODS AND RESULTS: Individuals were categorized as hyperdynamic (pulse pressure and heart rate in the upper quartile of the race-sex-age distribution), intermediate, and hypodynamic (pulse pressure and heart rate in the bottom quartile). Systolic blood pressure was significantly greater with a hyperdynamic circulation in both sexes (P < .0001), and several measures of obesity were greater with a hyperdynamic circulation. Hyperdynamic circulation was associated with statistically significant increases in triglyceride (P < .05) and fasting insulin (P < .01) in boys independently of age, race, and obesity. A decreasing trend with HDL cholesterol (P = .06) was also observed in boys. A significant association with total cholesterol (P < .05) was observed only in girls. In the analysis stratified by percent body fat, many of these features still occurred in obese individuals (top quartile) but not in lean individuals (bottom quartile). Further, when a subset of this cohort (n = 1074) was followed over a 3-year period, the above trend persisted significantly in boys. CONCLUSIONS: The present study demonstrates that a hyperdynamic state as defined is associated with increased insulin levels and an adverse cardiovascular risk in early life

(25) Jiang X, Srinivasan SR, Webber LS, Wattigney WA, Berenson GS. Association of fasting insulin level with serum lipid and lipoprotein levels in children, adolescents, and young adults: the Bogalusa Heart Study. *Arch Intern Med* 1995 January 23;155(2):190-6.
Abstract: OBJECTIVE: To assess whether circulating insulin is a major contributor to adverse lipid profiles during the transition from adolescence to young adulthood. METHODS: The association between fasting insulin levels and serum lipid and lipoprotein levels was examined in a cross-sectional survey of 4136 young individuals aged 5 to 30 years from a biracial community. RESULTS: Fasting insulin levels were strongly and positively correlated with serum triglyceride and very-low-density lipoprotein cholesterol levels and negatively correlated with high-density lipoprotein cholesterol levels in all age groups (5 to 11, 12 to 17, 19 to 24, and 25 to 30 years). An increasing impact of insulin level on low-density lipoprotein cholesterol level was observed in young adults aged 25 to 30 years. In multivariate analysis, fasting insulin level was associated with very-low-density lipoprotein cholesterol level for most of the age groups in both races independently of age, sex, glucose levels, obesity, cigarette smoking, and alcohol intake. The independent relationship to low-density lipoprotein cholesterol level persisted in young adults aged 25 to 30 years. The independent and negative association with high-density lipoprotein cholesterol level remained in whites aged 5 to 24 years and blacks aged 19 to 24 years. When individuals were divided into tertiles according to insulin concentration and subscapular skinfold thickness, the independent effect of insulin level and obesity on lipoprotein fractions was also noted. Furthermore, a stronger association of insulin level with lipoprotein fractions was observed in obese than in lean white males. CONCLUSIONS: These data indicate that an increasing association of insulin levels with adverse lipoprotein levels in young adults, especially obese individuals, may have adverse consequence for adult cardiovascular diseases

(26) Jiang X, Srinivasan SR, Bao W, Berenson GS. Association of fasting insulin with longitudinal changes in blood pressure in children and adolescents. The Bogalusa Heart Study. *Am J Hypertens* 1993 July;6(7 Pt 1):564-9.
Abstract: A cohort of children and adolescents (n = 801) aged 5 to 11 years living in Bogalusa, Louisiana was examined in three consecutive cross-sectional surveys over a 6 year period. The relationship between fasting insulin and glucose at baseline and longitudinal changes in blood pressure were examined. Significantly positive correlations were observed between fasting insulin and glucose at baseline and systolic and diastolic blood pressure at follow-up in white boys and girls ($r = 0.19$ to 0.38, $P < .01$), but not in blacks. After adjustment for several covariates, the association still existed in whites. In multiple regression analysis, fasting plasma insulin was observed to be a major contributor of subsequent systolic blood pressure levels independent of age, sex, height, obesity, and glucose levels in white children. These data suggest that insulin can be a determinant of blood pressure levels in children as suggested in adults. The relationship of insulin to blood pressure differs between black and white children and is likely modulated by the multiple mechanisms active in maintenance of blood pressure

(27) Jiang X, Srinivasan SR, Bao W, Berenson GS. Association of fasting insulin with blood pressure in young individuals. The Bogalusa Heart Study. *Arch Intern Med* 1993 February 8;153(3):323-8.
Abstract: BACKGROUND: The relationship between fasting plasma insulin and blood pressure was studied in a cross-sectional survey of children and young adults aged 5 to 26 years. METHODS: Fasting plasma insulin, glucose, blood pressure, and anthropometric measurements were obtained on 3518 individuals. RESULTS: When divided into four age groups, the analyses showed that fasting insulin was significantly and positively correlated to both systolic and diastolic blood pressure in individuals at all age groups, except at 13 to 17 years. In multivariate regression analyses, fasting insulin remained independently associated with blood pressure levels after controlling for glucose levels, body mass index (weight/height) and skinfold thickness in children (aged 5 to 12 years) and young adults (aged 18 to 26 years), although not in adolescents (aged 13 to 17 years). Moreover, fasting insulin was more strongly related to systolic than to diastolic blood pressure. The fasting blood glucose level did not contribute independently to multivariate prediction of blood pressure in young adults. When the children and young adults were divided into tertiles according to fasting insulin and body mass index, the independent effect of insulin and body mass index on systolic pressure was also seen in children and young adults. CONCLUSIONS: The association between plasma insulin and blood pressure noted even in healthy children and young adults help target areas for cardiovascular risk prevention

(28) Frank GC, Nicklas TA, Webber LS, Major C, Miller JF, Berenson GS. A food frequency questionnaire for adolescents: defining eating patterns. *J Am Diet Assoc* 1992 March;92(3):313-8.
Abstract: A self-administered food frequency questionnaire (FFQ) was developed to indicate weekly consumption of 64 foods. Reliability, validity, and usefulness of the tool to define a protein eating pattern were determined. Adolescents (N = 1,108) completed the FFQ during the Bogalusa Heart Study. Two-hour and 2-week reliability measures demonstrated consistency of intake of specific foods. Frequency of foods obtained from seven consecutive 24-hour recalls was compared with frequency obtained from the FFQ. A mean 50% agreement for both frequency and quantity of food intake was observed. Geometric means showed differences in mean number of protein foods by age of adolescent but the only significant difference was for beef intake of 15-year-olds. White children reported more servings of beef, cheese, and vegetables with meat than did black children. Black children reported more servings of eggs, luncheon meat, pork, poultry, and total protein than did white children. Boys reported a greater frequency of total protein foods, specifically, eggs, milk, and poultry, than did girls. Significant correlations were noted between low-density-lipoprotein cholesterol and intake of eggs and luncheon meat. We were able to quantitate the reliability and validity of the FFQ and to use it to explore the association of specific eating patterns with cardiovascular disease risk

(29) Svec F, Nastasi K, Hilton C, Bao W, Srinivasan SR, Berenson GS. Black-white contrasts in insulin levels during pubertal development. The Bogalusa Heart Study. *Diabetes* 1992 March;41(3):313-7.
Abstract: Three hundred and seventy-seven children and adolescents aged 5-17 yr from the biracial (black-white) community of Bogalusa, Louisiana, were evaluated for Tanner stage of sexual development, plasma glucose, and insulin levels during an oral glucose tolerance test. Children of the two races were of similar age, weight, and height at each Tanner stage. Overall insulin response was compared by measuring the area under the insulin curve from the glucose tolerance test. Blacks, especially black females, had significantly higher insulin responses than their white counterparts. The insulin-glucose ratio at the initial t = 0 min baseline did not vary with race or sex throughout the Tanner stages. However, the 30 min postglucose data revealed clear differences between the races with blacks showing a higher insulin-glucose ratio. Ratios increased throughout puberty for both blacks and whites, boys and girls. The trends of racial contrasts seemed to be discernible even at the earliest stage of development. It is concluded that there is a clear difference between blacks and whites in insulin response to a glucose load early in childhood. These findings lead to the hypothesis that the greater prevalence of non-insulin-dependent diabetes mellitus seen in adult blacks, especially females, may be an expression of a difference in insulin secretion and related insulin resistance in early childhood

(30) Srinivasan SR, Wattigney W, Webber LS, Berenson GS. Race and gender differences in serum lipoproteins of children, adolescents, and young adults--emergence of an adverse lipoprotein pattern in white males: the Bogalusa Heart Study. *Prev Med* 1991 November;20(6):671-84.
Abstract: METHODS. Serum lipoprotein profiles in 4,231 individuals, ages 5-26 years, were studied cross-sectionally in a biracial community to describe the race- and gender-specific changes from adolescence into young adulthood. RESULTS. White children and adolescents of both genders showed significantly higher covariates--adjusted triglycerides (9-11 mg/dl) and very-low-density lipoprotein cholesterol (1-2 mg/dl)--and lower total cholesterol (3-14 mg/dl) and high-density lipoprotein cholesterol (6-10 mg/dl) levels than their black counterparts. These black-white differences persisted among young adults of both genders with the exception of total cholesterol levels (higher triglycerides: 23-32 mg/dl; higher very-low-density lipoprotein cholesterol: 5-7 mg/dl; lower high-density lipoprotein cholesterol: 9-11 mg/dl); in addition, white young adult males began to show higher levels of low-density lipoprotein cholesterol (14 mg/dl) than black young adult males. A consistent gender-related pattern emerged only among white young adults with males showing higher triglyceride levels (22 mg/dl), very-low-density lipoprotein cholesterol (5 mg/dl), and low-density lipoprotein cholesterol (10 mg/dl) and lower high-density lipoprotein cholesterol (10 mg/dl) than females. Lipoprotein changes from adolescence into young adulthood were more pronounced among white males than other race-gender groups, resulting in higher triglyceride, very-low-density lipoprotein cholesterol, and low-density lipoprotein cholesterol, a higher total cholesterol/high-density lipoprotein cholesterol ratio, and a lower high-density lipoprotein cholesterol in their young adulthood. According to the National Cholesterol Education Program criteria, a relatively higher proportion of young adult white males was classified as borderline-high (22.6%) or high (9.1%) for low-density lipoprotein cholesterol. Adiposity was the major contributor to the adverse lipoprotein pattern, especially among white males. Sexual maturation and age influenced the lipoprotein levels to a greater extent among white males. Cigarette smoking, alcohol intake, and oral contraceptive use began to emerge as minor but significant factors contributing to the lipoprotein levels in adolescents and young adults. CONCLUSION. These results underscore the desirability of early targeting for primary prevention

(31) Dennison BA, Kikuchi DA, Srinivasan SR, Webber LS, Berenson GS. Serum total cholesterol screening for the detection of elevated low-density lipoprotein in children and adolescents: the Bogalusa Heart Study. *Pediatrics* 1990 April;85(4):472-9.
Abstract: The use of serum total cholesterol measurement was evaluated as a screening tool to predict elevated levels of low-density lipoprotein cholesterol in 2857 children and adolescents, aged 5 to 17 years, examined in 1981 and 1982. Subjects were from the biracial community of Bogalusa, Louisiana. For selected serum total cholesterol values (150 to 210 mg/dL, 3.88 to 5.43 mmol/L), sensitivities were higher for blacks than whites and higher for females than males, whereas the positive predictive values were higher for whites than blacks and higher for males than females. With the age-, race-, and sex-specific 95th percentiles of serum total cholesterol levels as cutoff points, only 44% to 50% of subjects with elevated low-density lipoprotein cholesterol levels (greater than or equal to 95th percentile) were detected, and approximately 50% of those identified had false-positive results. Lowering the serum total cholesterol cutoff point increased the sensitivity, but decreased the specificity and positive predictive value. At the 75th percentiles of serum total cholesterol levels, sensitivities were 92% to 95% for females and 100% for males and specificities were 78% to 79%, but the false-positive results increased to 81% to 84%. The low cost and ease of obtaining serum total cholesterol

measurements contribute to its appeal as a screening tool for hyperlipidemia. However, its poor test characteristics make serum total cholesterol measurement inefficient as a screening tool for detecting elevated levels of low-density lipoprotein cholesterol in children and adolescents

(32) Srinivasan SR, Wattigney W, Webber LS, Berenson GS. Serum apolipoprotein E in children and adolescents: the Bogalusa Heart Study. *Metabolism* 1989 December;38(12):1173-8.
Abstract: Serum apolipoprotein (apo) E levels and its relationship to lipids and lipoprotein cholesterol fractions were examined in a random subsample (n = 561) of children and adolescents (7 to 17 years of age) from a total biracial community. Mean (+/- SD) levels of apo E were higher in blacks (males 4.8 +/- 1.8 mg/dL; females 5.2 +/- 1.8 mg/dL) than in whites (males 3.9 +/- 1.2 mg/dL; females 4.3 +/- 1.0 mg/dL) irrespective of sex (P less than .001). The black-white difference in apo E persisted after controlling for the covariates: sexual maturation, age, adiposity, cigarette smoking, alcohol use, and oral contraceptive use (P less than .001). A sex differential (females greater than males, P less than .01) for apo E was seen in both racial groups. Apo E levels were inversely associated with age (P less than .01) and sexual maturation (P less than .05) only in white males. Apo E related positively and significantly to total cholesterol, low-density lipoprotein cholesterol, and high-density lipoprotein cholesterol fractions (HDL2-C and HDL3-C) in certain race-sex groups. Race, HDL2-C, triglycerides (very-low density lipoprotein cholesterol), HDL3-C, and sex were identified as predictor variables for apo E, in that order, and accounted for 21% of its variability in serum. It is conceivable that the observed race-sex differences in apo E may be related to apo E-HDL subfraction, which is thought to participate in the reverse cholesterol transport

(33) Freedman DS, Srinivasan SR, Harsha DW, Webber LS, Berenson GS. Relation of body fat patterning to lipid and lipoprotein concentrations in children and adolescents: the Bogalusa Heart Study. *Am J Clin Nutr* 1989 November;50(5):930-9.
Abstract: Although a truncal distribution of adipose tissue in adults is associated with several metabolic complications, its importance in early life has received little attention. The relation of several anthropometric measures to serum concentrations of lipids, lipoproteins, and apolipoproteins was therefore examined in 361 children who were between ages 6 and 18 y. (Children had been selected previously because of extreme levels of very-low-density- and low-density-lipoprotein cholesterol.) Analyses revealed two groups of anthropometric variables: truncal measures (waist circumference and subscapular, subcostal, and suprailiac skinfold thicknesses) and thickness of peripheral skinfolds (femoral, triceps, calf, and biceps). After generalized obesity was adjusted for children with high concentrations of both cholesterol fractions had more truncal fat but less peripheral fat than did children with low lipoprotein cholesterol concentrations. A truncal fat pattern was also associated with decreased concentrations of high-density-lipoprotein cholesterol and apolipoprotein A-1. Knowledge of fat patterning may help identify persons prone to hyperlipidemia

(34) Nicklas TA, Webber LS, Thompson B, Berenson GS. A multivariate model for assessing eating patterns and their relationship to cardiovascular risk factors: the Bogalusa Heart Study. *Am J Clin Nutr* 1989 June;49(6):1320-7.
Abstract: Eating patterns were studied in 1275 adolescents and young adults (aged 12-24 y). Factor analysis of 64 foods consumed weekly revealed 17 eating-pattern factors, accounting for 57% of the item variance. Factor I (12 food items from either the seafood or meat group) accounted for 8% of the variance, factor II (snacks), 5%, and factors III (fats and pasta) and IV (beef and chicken), 4% each. Remaining factors accounted for from 1.9% to 3.9%. The factors were effective in discriminating eating patterns across race and gender. Significant age effects were also noted for 10 of the 17 factors. Eating patterns for persons in the upper or lower quartiles differed consistently for specific cardiovascular (CV) risk factors. Use of this statistical model to identify differences in eating patterns by race, gender, and CV risk factors during maturation can assist health professionals in targeting food sources for changing eating behavior

(35) Johnson CC, Hunter SM, Amos CI, Elder ST, Berenson GS. Cigarette smoking, alcohol, and oral contraceptive use by type A adolescent--the Bogalusa Heart Study. *J Behav Med* 1989 February;12(1):13-24.
Abstract: Type A behavior pattern (TABP) is an independent risk factor for cardiovascular (CV) disease and is characterized by hostile, aggressive, competitive behavior. TABP characteristics and CV risk factors have been found in children and adolescents. TABP has been correlated with adult alcohol consumption, but studies associating Type A and smoking are mixed. The purpose of this study is to investigate the smoking, alcohol use, and oral contraceptive use of Type A children and adolescents. The Hunter-Wolf Type A scale and a health habits questionnaire were evaluated for 2092 children, ages 8-17 years, within the context of a comprehensive biracial epidemiological CV screening in Bogalusa, Louisiana. Global Type A and factor components were evaluated: hostility, eagergy, desire for control, drive, and competitiveness. Correlation coefficients reflected the strongest associations between hostility and smoking and between hostility and drinking for white males. The age at menarche appeared to be correlated with the drive component

(36) Frank GC, Webber LS, Nicklas TA, Berenson GS. Sodium, potassium, calcium, magnesium, and phosphorus intakes of infants and children: Bogalusa Heart Study. *J Am Diet Assoc* 1988 July;88(7):801-7.
Abstract: Electrolyte and mineral intakes assessed by 24-hour dietary recall were examined for race and sex differences in cohorts of infants and school-age children at 6 months and at 1, 2, 3, 4, 10, 13, 15, and 17 years. A fourfold increase in sodium intake occurred from 6 months to 4 years, and potassium intake doubled. Sodium increased from 0.88 gm at 6 months to 3.21 gm at 4 years and 3.67 gm by 17 years; a slight increase for potassium was noted from 4 to 17 years for boys. Calcium intake was relatively constant from 6 months to 17 years. Boys had higher intakes of sodium and sodium per kilogram body weight than did girls. Black children at 2, 3, and 4 years had significantly higher sodium, potassium, calcium, phosphorus, and magnesium expressed as total intake and per kilogram body weight than white children did. At 6 months, 66% of the infants exceeded the National Research Council's recommended range for sodium. At 1 to 10 years, 90% to 100% and at 13 to 17 years, 60% to 65% exceeded the recommended range. In contrast, 58% to 77% of preschool children and only 5% to 20% of school-age children surpassed the recommended potassium range. Fifty percent to 70% of children more than 10 years old achieved the recommended range for potassium. Approximately half of the children 6 months through 4 years of age met the

Recommended Dietary Allowance (RDA) for calcium. Sixty percent to 80% of adolescents ingested less than two-thirds the RDA. Girls had lower intakes than did boys.(ABSTRACT TRUNCATED AT 250 WORDS)

(37) Burke GL, Hunter SM, Croft JB, Cresanta JL, Berenson GS. The interaction of alcohol and tobacco use in adolescents and young adults: Bogalusa Heart Study. *Addict Behav* 1988;13(4):387-93.
Abstract: Alcohol and tobacco usage patterns were assessed in 1,811 children and young adults, 12-24 years of age. The prevalence of cigarette smoking and alcohol consumption increased with age in all race and sex groups. Smokeless tobacco use (chewing tobacco and snuff) was primarily seen in white males with the highest prevalence rates in 12-15 year olds. Among white males who reported smokeless tobacco usage, 44% of the 12-17 year olds and 80% of the 18-24 year olds reported concurrent alcohol use. There was a significant interaction between alcohol consumption and cigarette smoking in all four race-sex groups (p less than 0.001). Given the potential synergistic relationship between ethanol and tobacco products on oral and upper gastrointestinal tract cancer, as well as between smoking and cardiovascular disease, the long term effects from these behaviors could be troublesome. Since healthy lifestyles are established in youth, early intervention on alcohol and tobacco use is needed to prevent the future morbidity and mortality from cancer and cardiovascular disease

(38) Freedman DS, Srinivasan SR, Cresanta JL, Webber LS, Berenson GS. Cardiovascular risk factors from birth to 7 years of age: the Bogalusa Heart Study. Serum lipids and lipoproteins. *Pediatrics* 1987 November;80(5 Pt 2):789-96.
Abstract: Serum lipids and lipoprotein cholesterol fractions were examined in a newborn cohort that was followed from birth to 7 years of age. Although white and female infants had higher cord blood levels of high-density lipoprotein cholesterol (HDL-C) than did black and male infants, respectively, these differences did not persist throughout early childhood. Mean levels of all serum lipids and lipoproteins increased greatly in the first 6 months of life, and by 2 years of age, levels approached those seen in adolescents. Infants consuming cow's milk had higher 6-month levels of serum total cholesterol and low-density lipoprotein cholesterol than did formula-fed infants. However, milk source in infancy did not significantly influence total cholesterol or low-density lipoprotein cholesterol levels at age 7 years. Serum lipid and lipoprotein levels at age 7 years were associated with previously measured levels as early as 6 months of age, and infants with unfavorable levels were likely to have similar adverse levels at 7 years of age. In addition, increases in obesity between 6 months and 7 years of age were positively associated with increases in levels of serum triglycerides. These results suggest that certain persons at increased risk for cardiovascular disease can be identified in infancy

(39) Nicklas TA, Frank GC, Webber LS, Zinkgraf SA, Cresanta JL, Gatewood LC, Berenson GS. Racial contrasts in hemoglobin levels and dietary patterns related to hematopoiesis in children: the Bogalusa Heart Study. *Am J Public Health* 1987 October;77(10):1320-3.
Abstract: Racial differences in hemoglobin (Hgb) levels were explored in two groups of children at different maturational stages, the pre-adolescent (10-year-olds: Whites n = 160, Blacks n = 56,) and the adolescent (15-year-olds; Whites n = 60, Blacks n = 44). Mean Hgb levels were higher for Whites than Blacks in both age groups. When all the dietary components (i.e., iron, zinc, copper, folacin, ascorbic acid and vitamins B12, E and B6) were considered as a group, they accounted for 8.4 per cent of the Hgb variance in 10-year-olds and 10.1 per cent of variance in 15-year-olds. However, even after controlling for the variations in dietary patterns of the adolescents and pre-adolescents, race still accounted for a notable proportion of Hgb variance in both age groups (9.1 per cent in 10-year-olds and 7.0 per cent in 15-year-olds). Within each race, gender accounted for a greater percentage of the Hgb variance in the adolescents than in the pre-adolescents. Our results indicate that in all likelihood racial differences in Hgb levels during childhood exist independent of racial differences in intake of specific "blood building" nutrients and maturational changes

(40) Freedman DS, Srinivasan SR, Burke GL, Shear CL, Smoak CG, Harsha DW, Webber LS, Berenson GS. Relation of body fat distribution to hyperinsulinemia in children and adolescents: the Bogalusa Heart Study. *Am J Clin Nutr* 1987 September;46(3):403-10.
Abstract: The relation of body fat distribution to plasma levels of glucose and insulin during an oral glucose tolerance test was examined in 355 Black and White school-age children. Both central and peripheral fat were similarly related to fasting, 30-min, and 1-h glucose. Unlike peripheral fat, central body fat was more strongly related to the 1-h insulin response (r = 0.35 vs 0.26); this association remained significant for central fat independent of peripheral fat (r = 0.18). The strong relation of central fat to insulin response was noted in both races and sexes but not in either sexually immature or relatively thin children. These findings indicate that, even in early life, a central body fat pattern relates positively to insulin response to glucose load. Thus, knowledge of body fat localization may help identify persons most susceptible to hyperinsulinemia in early life

(41) Croft JB, Freedman DS, Cresanta JL, Srinivasan SR, Burke GL, Hunter SM, Webber LS, Smoak CG, Berenson GS. Adverse influences of alcohol, tobacco, and oral contraceptive use on cardiovascular risk factors during transition to adulthood. *Am J Epidemiol* 1987 August;126(2):202-13.
Abstract: Risk factors for cardiovascular disease were measured in 990 young adults, aged 17-24 years, in a 1982-1983 survey of the biracial (black-white) community of Bogalusa, Louisiana. Even after controlling for age and obesity, several lifestyle factors (cigarette smoking, alcohol consumption, and oral contraceptive use) were independently related (p less than 0.05) to levels of serum lipids, lipoprotein cholesterol fractions, and blood pressure. Oral contraceptive use was associated with increased levels of both serum triglycerides (20 mg/dl, blacks; 25 mg/dl, whites) and low density lipoprotein (LDL) cholesterol (19 mg/dl, whites), and decreased levels of high density lipoprotein (HDL) cholesterol (-6 mg/dl, whites). Linear regression analyses also showed that cigarette smoking was associated with elevated levels of serum triglycerides (ranging from 15 to 26 mg/dl) and decreased levels of HDL cholesterol (ranging from -9 to -11 mg/dl) in white males and females. Although persons who smoked cigarettes were also likely to consume alcohol, alcohol intake in nonsmokers was positively associated with levels of serum triglycerides, LDL cholesterol, and very low density lipoprotein

cholesterol in white males, and with blood pressure levels in black males. A statistically significant association between alcohol intake and HDL cholesterol levels (r = 0.24) was observed only in white females who did not smoke. These adverse influences of lifestyle factors on cardiovascular disease risk may provide a rational basis for intervention during adolescence and early adulthood

(42) Freedman DS, Srinivasan SR, Webber LS, Berenson GS. Divergent levels of high density lipoprotein cholesterol and apolipoprotein A-I in children. The Bogalusa Heart Study. *Arteriosclerosis* 1987 July;7(4):347-53.
Abstract: Clinical studies indicate that levels of apolipoprotein A-I (apo A-I), the major protein moiety of the high density lipoprotein (HDL) particle, may provide more information concerning the risk of future cardiovascular disease than do levels of HDL cholesterol (HDL-C). Therefore, the relationship of HDL-C to apo A-I levels was examined in a biracial sample of 2849 5- to 17-year-olds. The mean HDL-C to apo A-I ratio, a measure of HDL composition, was 0.42. However, marked interindividual variation was found: HDL-C/apo A-I levels varied from 0.27 (10th percentile) to 0.57 (90th percentile). Furthermore, only 26% of the variation in HDL-C levels was explained by concomitant variation in apo A-I. Increasing levels of triglyceride (and very low density lipoprotein cholesterol) were related to decreases in both the HDL-C/apo A-I ratio and the magnitude of the correlation between HDL-C and apo A-I. Low density lipoprotein cholesterol, race, and age were also related to the HDL-C/apo A-I ratio, but influenced HDL composition less strongly than did triglyceride levels. These observations may be explained by the bidirectional transfer of cholesteryl esters and triglycerides between HDL and triglyceride-rich lipoproteins. The current study documents the influence of triglyceride levels on HDL composition in a general population of children and adolescents, and emphasizes the interrelationships between the various lipid and lipoprotein fractions

(43) Riley WA, Freedman DS, Higgs NA, Barnes RW, Zinkgraf SA, Berenson GS. Decreased arterial elasticity associated with cardiovascular disease risk factors in the young. Bogalusa Heart Study. *Arteriosclerosis* 1986 July;6(4):378-86.
Abstract: Noninvasive ultrasonic examinations were performed in 1984 on a biracial sample of 109 10- to 17-year-old adolescents to determine whether elastic properties of the carotid arteries are associated with cardiovascular disease risk factors in the young. The subjects examined were in either the upper (high risk) or lower (low risk) race-, sex-, and age-specific tertile for both serum total cholesterol (TC) and systolic blood pressure (SBP) during a 1981-82 community survey. The pressure-strain elastic modulus (Ep), a measure of stiffness, for the carotid arteries was calculated by dividing the pulse pressure by the fractional diameter increase in the carotid artery during the cardiac cycle, as measured by ultrasonic techniques. Repeat studies on 20 randomly selected subjects demonstrated high reproducibility of the elasticity measurements (intraclass correlation coefficient = 0.84). The mean Ep in the high risk group was 5.1 kPa higher than in the low risk group, after controlling for race, sex, and age (one-sided p value = 0.03). Furthermore, a positive parental history of myocardial infarction was related to increased Ep levels (p less than 0.05), independently of race, sex, age, TC, and SBP. The results indicate that ultrasonic techniques can detect functional differences in the carotid arteries of children and adolescents that are associated with the risk of cardiovascular disease as adults

(44) Farris RP, Cresanta JL, Webber LS, Frank GC, Berenson GS. Dietary studies of children from a biracial population: intakes of vitamins in 10- and 13-year-olds. *J Am Coll Nutr* 1985;4(5):539-52.
Abstract: Impact of vitamin supplements upon dietary intakes of eight vitamins was examined in 10- and 13-year-old children randomly selected from a biracial community, Bogalusa, LA. More younger children reported taking supplements daily (17%) than did adolescents (12%). Over 90% of the children surveyed had dietary intakes of vitamin E and niacin that met or exceeded the RDA. One-half to two-thirds of children using supplements had adequate intakes of ascorbic acid from diet alone. Children who most needed ascorbic acid supplements were the least likely to take them. One-quarter to one-half of the children did not consume the RDA levels of vitamin A, thiamine, and riboflavin. Adolescents had less adequate vitamin A intakes than younger children. In all surveys, a higher proportion of girls than boys had intakes that did not meet the RDA for vitamins B6 and B12. Vitamin intakes of Bogalusa children and adolescents were comparable to other U.S. surveys. Inclusion of vitamin E and niacin in supplements may be unnecessary

(45) Croft JB, Hunter SM, Webber LS, Watson RB, Berenson GS. Cigarette smoking behavioral distinctions between experimental nonadopters and adopters in children and adolescents--a consideration of transitional smoking experience: the Bogalusa Heart Study. *Prev Med* 1985 January;14(1):109-22.
Abstract: A cigarette-smoking questionnaire to examine behavior, attitudes, and beliefs related to cigarette use was administered to children, ages 8-17, in a biracial community. Children who experimented with cigarettes but did not adopt the habit (experimental nonadopters) and children who continued to smoke (adopters) were identified and characterized. Follow-up behavior was examined 2 years later. Adopters were more likely to have smokers as friends and family members, more likely to have purchased their first cigarettes, more likely to believe smoking to be pleasurable for themselves and others, and less likely to consider smoking harmful. Adopters who maintained smoking behavior 2 years later had, during the initial survey, reported having more friends who also smoked and were more likely to believe smoking to be enjoyable. Experimental nonadopters were more likely to try the first cigarette alone, reported having fewer friends and family members who smoked, and believed greater health risks to be associated with cigarette use. Experimental nonadopters who maintained nonsmoking behavior 2 years later, especially in the older cohort, exhibited higher agreement with the negative consequences of cigarette smoking (health beliefs) and theories concerning smoking behavior of others

(46) Croft JB, Webber LS, Parker FC, Berenson GS. Recruitment and participation of children in a long-term study of cardiovascular disease: The Bogalusa Heart Study, 1973-1982. *Am J Epidemiol* 1984 September;120(3):436-48.
Abstract: The Bogalusa Heart Study has been highly successful in recruitment and screening of children and adolescents in Bogalusa, Louisiana. From 1973 to 1982 in four cardiovascular risk factor surveys, 80-93% of the biracial pediatric population was examined. Overall participation rates compare favorably with those of similar studies. The authors examine methods and strategies involved in obtaining community support, identifying and contacting the eligible population, and implementing recruitment campaigns. Several of the more successful motivational efforts are described. Attrition and the broader problem of decreasing participation rates in older adolescents are examined. Recommendations are advanced for dealing with this problem age group

(47) Hunter SM, Wolf TM, Sklov MC, Webber LS, Watson RM, Berenson GS. Type A coronary-prone behavior pattern and cardiovascular risk factor variables in children and adolescents: the Bogalusa Heart Study. *J Chronic Dis* 1982;35(8):613-21.
Abstract: The relationship between Total score from the Hunter-Wolf A-B Self-Rating Scale for children (and derived Factors) and several cardiovascular risk factor variables was observed in children ages 10-17 in a biracial community. After analysis, effects of age, weight and height were removed from the Total A-B score, each Factor score, and risk factor variable. Differences in risk factor variables were observed in relation to A-B, race and sex. For each sex-race group, the four Factor scores and Total score were ranked into quintiles. Children in the upper quintile referred to as Type A children and those in the lower quintile, Type B. For Factor 1, which describes eagerness and energy in children (Eagergy), significant mean differences were found for serum total, beta- and pre-beta-lipoprotein cholesterol and triglycerides. In each instance, children classified as Type A exhibited approximately 10 mg/dl higher readings, except for pre-beta-lipoprotein cholesterol in which a 2 mg/dl difference was noted. Two significant second order interactions were found for systolic and diastolic blood pressure. Black boys who scored in the A direction had higher systolic blood pressures, while Type A girls had higher diastolic blood pressures than their Type B counterparts (p less than 0.05). For Factor IV, which is related to feeling hurried, there was an approximate 10 mg/dl difference in serum total and beta-lipoprotein cholesterol in the direction opposite to that predicted. Although the relationships between A-B coronary behavior pattern and risk factor variables in children are of low magnitude, the relationships are being observed in the direction that might be predicted. Measurement of Type A in children requires further refinement in concept identification and valid measurement

(48) Wolf TM, Hunter SM, Webber LS, Berenson GS. Self-concept, locus of control, goal blockage, and coronary-prone behavior pattern in children and adolescents: Bogalusa heart study. *J Gen Psychol* 1981 July;105(1st Half):13-26.
Abstract: Four measures that are hypothesized to be correlates of cardiovascular risk factor variables were tested in children and adolescents. A psychosocial questionnaire, including Type A coronary-prone behavior pattern and three additional measures (self-concept, locus of control, and goal blockage), was administered to 384 ten- to 17-year-old students in a biracial public school. White scored higher than did blacks on Type A behavior, and Type A behavior increased with age. Contrary to other reports, a negative relationship was found (excluding white boys and black girls) between self concept and Type A behavior. Blacks had a higher level of self-concept than did whites. Boys were found to have a more external locus of control than did girls, and blacks were more externally oriented and experienced greater goal blockage than did whites. Sufficient test-retest reliability was found to justify use of the four measures in future research

(49) Hunter SM, Webber LS, Berenson GS. Cigarette smoking and tobacco usage behavior in children with adolescents: Bogalusa Heart Study. *Prev Med* 1980 November;9(6):701-12.

(50) Foster TA, Webber LS, Srinivasan SR, Voors AW, Berenson GS. Measurement error of risk factor variables in an epidemiologic study of children-the Bogalusa heart study. *J Chronic Dis* 1980;33(10):661-72.

(51) Berenson GS, Voors AW, Webber LS, Dalferes ER, Jr., Harsha DW. Racial differences of parameters associated with blood pressure levels in children--the Bogalusa heart study. *Metabolism* 1979 December;28(12):1218-28.
Abstract: Racial differences in prevalence of essential hypertension are well known. In order to explore these differences at an early age in terms of etiology, we investigated schoolchildren in an entire, biracial community. A sample of 278 children, stratified by diastolic (fourth-phase) blood pressure and specific for age, race, and sex, was reexamined 1--2 yr after initial observation for the following: (1) a physical examination and urinalysis to exclude secondary hypertension; (2) 24-hr urine sodium, potassium, plasma renin activity, and serum dopamine beta-hydroxylase; (3) 1-hr oral glucose tolerance test; and (4) heart rate and blood pressure at rest and under standarized physical stress. We found that 24-hr urine sodium was positively associated with blood pressure level as measured on the same day for the high blood pressure strata of black children. Urine potassium excretion was lower in blacks than in whites, although their intakes seemed equal. In the high blood pressure strata especially, black boys had lower renin activity than whites, and the resting-supine and stressed systolic blood pressures were higher in black boys than in any other group. In these black boys, resting and stressed systolic pressures were negatively related to plasma renin activity. On the other hand, dopamine beta-hydroxylase levels in white children were higher than in blacks for all blood pressure strata, and in the high blood pressure strata white children had higher 1-hr glucose levels and faster resting heart rates than black children. Different mechanisms may play a role in and contribute to the early stage of essential hypertension

(52) Voors AW, Webber LS, Berenson GS. Time course studies of blood pressure in children--the Bogalusa Heart Study. *Am J Epidemiol* 1979 March;109(3):320-34.
Abstract: Blood pressures (BPs) were taken with a mercury sphygmomanometer and an automatic recorder on 3524 children representative of an entire geographic community. For all children ages 5, 8, 11, and 14 years in the initial examination, age-specific systolic and diastolic (4th phase) selected percentiles were assessed. Of these children, 1101 were reexamined after one year. Observations from a group of 35 fifth-graders examined monthly for eight months were pooled to observe intra-child BP variability. This estimate was used to reduce to zero in a statistical adjustment the regression toward the mean of the BPs for the after-one-year reexamined children. It was found that those children initially in the top ten percentiles had, upon reexamination, on the average only 3 mmHg lower systolic and 1 mmHg lower diastolic levels. In a multiple regression analysis, the previous year's BP contributed a partial correlation coefficient of 0.6--0.7 for each age cohort to the variability of the BP, controlling for other determinants. These findings, based on reliable, basal-like measurements, point to a degree of persistence which is quite high. The higher the degree of tracking the more likely that primary hypertension begins early in life

(53) Srinivasan SR, Foster TA, Berenson GS. Efficacy of a simplified primary screening procedure for detection of hyperlipoproteinemias in a pediatric population. *Clin Chem* 1979 February;25(2):242-6.
Abstract: We examined the efficacy of a simple primary screening procedure for detecting beta- and pre-beta-lipoprotein abnormalities in 3183 children, ages 5-14, residing in Bogalusa, Louisiana. This procedure is based on the ability of beta- and pre-beta-lipoproteins to form insoluble complexes with heparin in the presence of Ca2+; the turbidity produced by the reaction was considered as an index of the concentration of these two classes of lipoproteins. Our results indicate a close relationship (r = 0.88)

between the beta- + pre-beta-lipoprotein index (turbidity) and the concentrations of these lipoproteins. Comparison of serum lipid and beta- + pre-beta-lipoprotein values of 5% of the children whose results fell outside the normal limits (upper and lower 5%) indicated that serum total cholesterol was not reflecting the beta- + pre-beta-lipoprotein concentration of a given child. The variability of alpha-lipoprotein concentration in these children accounted for this discrepancy. Measuring the serum beta- + pre-beta-lipoprotein index may be more useful for large-scale screening and for detecting subtle abnormalities than are determinations of either cholesterol or triglycerides

(54) Berenson GS, Srinivasan SR, Frerichs RR, Webber LS. Serum high density lipoprotein and its relationship to cardiovascular disease risk factor variables in children--the Bogalusa heart study. *Lipids* 1979 January;14(1):91-8.
Abstract: Serum high density lipoprotein is increasingly recognized as a negative risk for cardiovascular disease. The distribution and interrelationship of serum lipids, lipoproteins, anthropometric measurements and blood pressures were determined in some 5,000 children. Children had mean +/- S.D. alpha-lipoprotein cholesterol levels (mg/100 ml) of 36 +/- 15 at birth, 51 +/- 22 at 6 mo, 53 +/- 18 at 1 yr, 60 +/- 19 at preschool age (2 1/2-5 1/2 yr) and 68 +/- 22 at school age (5-14 yr), reflecting a sharp increase in alpha-lipoprotein between birth and school-age years, when these levels remained relatively stable through age 14. Although white children tended to have higher levels of total cholesterol and alpha-lipoprotein at birth than black children, during childhood this trend was reversed and the differences were pronounced in school-age children (p less than 0.0001). Unlike in adulthood, boys had slightly higher levels of alpha-lipoprotein than girls. The alpha-lipoprotein was negatively correlated with pre-beta-lipoprotein and to a lesser extent with beta-lipoprotein classes. There was an inverse relationship between alpha-lipoprotein and obesity with a consistently significant relationship (p less than 0.01) in older children (10-14 yr). Children with higher levels of alpha-lipoprotein have lower levels of blood pressure, beta-lipoprotein and a lower obesity index

(55) Voors AW, Webber LS, Frerichs RR, Berenson GS. Body height and body mass as determinants of basal blood pressure in children--The Bogalusa Heart Study. *Am J Epidemiol* 1977 August;106(2):101-8.
Abstract: Body height and body mass as determinants of basal blood pressure in children--The Bogalusa Heart Study. Am J Epidemiol 106:101-108, 1977. Risk factor variables for coronary artery disease were measured in a total biracial community study of 3524 children, ages 5-14 years. Anthropometric variables, serum lipids, and blood pressure (BP) were measured in a rigid randomized design. Blood pressure data were obtained with an automatic recording instrument that avoids excessive pressure readings in obese children by the use of an over-sized arm cuff bladder with a built-in infrasonic transducer. By reducing the anxiety of the child and by taking multiple readings, pressures were obtained that approached published basal levels. A multiple regression analysis showed that all measured variables could account for 39% of the systolic BP variation. Major determinants were based on weight (W) and height (H). The BP levels, when related to H and to a weight-height index (W/H3), suggest a strong influence of H and an additional influence of W/H3 on BP, both consistent and proportionate over the entire ranges of H and W/H3. The total spectrum of observed correlates of BP, resulting from the multiple regression analysis, suggests that the BP measured under basallike conditions increases as the child grows and is proportional to lean body mass and total body mass. Practical criteria for evaluating abnormal blood

pressure levels in children should be based on normative values derived from body weight and body height rather than from age

(56) Foster TA, Voors AW, Webber LS, Frerichs RR, Berenson GS. Anthropometric and maturation measurements of children, ages 5 to 14 years, in a biracial community--the Bogalusa Heart Study. *Am J Clin Nutr* 1977 April;30(4):582-91.
Abstract: An epidemiological survey of anthropometric and maturation variables was conducted on 3,524 children from the biracial community of Bogalusa, Louisiana. These children, representing 93% of the population, were examined during the school year September 1973 through May 1974. Black boys differed slightly from white boys in height and weight; black girls were taller and heavier than white girls. The black children had longer upper arm lengths and smaller upper arm circumferences than the white children. The median ponderosity (weight divided by the cubed height) decreased with increasing heigth for the four race-sex groups, and a skewed distribution of ponderosity indicated an excess of heavy children among the tall. Based on the Tanner criteria for grading secondary sex characteristics, maturation occurred earlier in the more ponderous girls, although such was not the case for boys. Whereas the Tanner secondary sex characteristics appeared earlier in black girls, white girls reported menarche earlier. The racial and sexual differences known to exist in triceps skinfold were observed for this population. No statistically significant difference was observed overall for height and weight between children within this one community and those of the National Health Examination Survey. However, Bogalusa girls at the 95th percentile were heavier after age 11 than girls of the United States. Also, there was a tendency for white girls in this community to report reaching menarche at an earlier age than black girls, which contrasts slightly with the national sample

(57) Frerichs RR, Srinivasan SR, Webber LS, Berenson GS. Serum cholesterol and triglyceride levels in children from a biracial community--the Bogalusa heart study. *Adv Exp Med Biol* 1977;82:204-7.:204-7.

(58) Voors AW, Foster TA, Frerichs RR, Webber LS, Berenson GS. Studies of blood pressures in children, ages 5-14 years, in a total biracial community: the Bogalusa Heart Study. *Circulation* 1976 August;54(2):319-27.
Abstract: Blood pressure, height, weight, maturation, triceps skinfold thickness, serum lipids, and hemoglobin were measured as risk factors for coronary artery disease in 3,524 children (93% of the eligible population) in Bogalusa, Louisiana. Nine blood pressures were taken on each child by trained observers with mercury sphygmomanometers (Baumanometer) and Physiometrics automatic recorders in a rigid randomized design in a relaxed atmosphere with other children present. The pressures observed were low compared to reported data. Black children had significantly higher blood pressures than white children. This difference, starting before age 10, was largest in the children in the upper five percent of the pressure ranks. Stepwise multiple regression analysis revealed that this racial differnce was significant when measured by an automatic recorder. Body size, expressed by height and by weight/height3 index, was a strong determinant of blood pressure level. Other positive determinants were blood hemoglobin and external maturation

(59) Frerichs RR, Srinivasan SR, Webber LS, Berenson GR. Serum cholesterol and triglyceride levels in 3,446 children from a biracial community: the Bogalusa Heart Study. *Circulation* 1976 August;54(2):302-9.
Abstract: Serum lipid profiles of 3,446 (91% of population) children, ages 5-14 years, were determined in a biracial community (Bogalusa, Louisiana) as part of a program investigating the early natural history of atherosclerosis. Black children had significantly higher mean levels of serum cholesterol than white children (170 mg/dl vs 162 mg/dl, P less than 0.0001). On the other hand, significantly lower levels of triglycerides were found in blacks than in whites (61 mg/dl vs 73 mg/dl, P less than 0.0001). Girls had higher levels of triglycerides than boys in both races (blacks, 64 mg/dl vs 59 mg/dl, P less than 0.001; whites, 77 mg/dl vs 69 mg/dl, P less than 0.001). The racial differences in serum cholesterol and triglyceride levels were even more apparent at the 95th percentile. The serum cholesterol level remained relatively constant in all children until ages 11 and 12 years, after which a slight reduction occurred. This reduction was more pronounced in boys than in girls. In contrast, a significant increase in the level of triglycerides with age was observed in all children except black girls, the increasing slope being most pronounced in white girls

(60) Srinivasan SR, Frerichs RR, Webber LS, Berenson GS. Serum lipoprotein profile in children from a biracial community: the Bogalusa Heart Study. *Circulation* 1976 August;54(2):309-18.
Abstract: Serum lipoprotein profiles in 3182 children, ages 5-14 years, were studied in a biracial community as part of the Bogalusa Heart Study to describe the early natural history of atherosclerosis. White and black children showed similar mean levels of beta-lipoproteins. Pre-beta-lipoprotein levels, however, were significantly higher in white shildren, while significantly higher levels of alpha-lipoprotein were found in black children. Girls had generally higher levels of beta- and pre-beta-lipoprotein and lower levels of alpha-lipoprotein than boys, although the differences were not significant at each age group. With age there was little change in alpha-lipoprotein levels, a significant increase in pre-beta-lipoprotein levels and a slight but significant decrease between 11 and 14 years in beta-lipoprotein levels. The correlation of alpha-lipoprotein was negative with beta-lipoprotein and, to a greater extent, with pre-beta-lipoprotein. The above inverse relationships were significantly greater in white children than in black children, suggesting differences in lipoprotein profiles in the two groups. Lipoprotein values from a total community study are now available for comparison with the currently recommended upper normal limits for lipoproteins. Since only a very small percentage of children could be considered as hyperlipoproteinemic by those specific levels in this community, we suggest that distributions and percentiles be used to evaluate children for hyperlipoproteinemia