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Patterns of Body Fat Deposition in Youth and Their Relation to Left Ventricular Markers of Adverse Cardiovascular Prognosis

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Abstract

The patterns of body fat deposition in healthy youth and their relation to future development of cardiovascular disease remain incompletely understood. To further evaluate these patterns, we measured indirect indexes of central and general fat deposition in healthy adolescents (mean age 15.4 ± 2.3 years) with family histories of hypertension. We examined the relation between these indexes and echocardiographic markers of adverse prognosis as well as the effect of gender and ethnicity. All 225 subjects (64% black and 48% female) had ≥ 1 biologic parent and 1 grandparent with hypertension. Skinfold thicknesses, waist-to-hip girth ratio, Quetelet index, Ponderal index, conicity, and Z score weight – Z score height were measured. Left ventricular (LV) mass, indexed LV mass, relative wall thickness (RWT), and midwall fractional shortening (MFS) were determined using echocardiography. In both black and white subjects, the adiposity indexes were significantly correlated with posterior wall thickness, total LV mass, and indexed LV mass ($p < 0.05$ for all). Additionally, in black subjects, central adiposity was inversely related to MFS and directly related to RWT and septal thickness. General adiposity independently predicted indexed and nonindexed LV mass, whereas central adiposity predicted MFS and RWT. Compared with subjects with normal LV geometry, those with abnormal geometry were heavier and fatter based on every index of obesity ($p < 0.03$ for all). Thus, indexes of fat deposition are significantly correlated with LV markers of adverse prognosis in healthy youth.

Several large-scale epidemiologic studies have shown the importance of obesity in adulthood and its close relation to systemic hypertension, metabolic derangements, and cardiovascular disease.^{1,2} Several studies in adults suggest that a pattern of exaggerated central body fat deposition (i.e., body fat situated in the trunk region), rather than general adiposity (i.e., body fat representative of both central and peripheral regions) is more strongly associated with metabolic derangements, cardiovascular risk factors, and cardiovascular disease.^{3–5} These studies have been performed predominantly in adults. Central fat deposition in youth and its relation to cardiovascular risk factors and subsequent development of cardiovascular disease have received little attention. Because the antecedents of these diseases originate in childhood, the identification of these risk factors in youth presents an important opportunity for primary prevention of cardiovascular diseases. In this regard, obesity or body fatness and the pattern of fat deposition in children and adolescents may be important. We measured primary and derived indexes that indirectly quantitate the extent and pattern of body fat deposition in healthy youth with family histories of primary hypertension and examined the relation between these indexes and known echocardiographic markers of adverse cardiovascular prognosis.

METHODS

Subjects

The sample consisted of 225 subjects (74 male and 70 female African-Americans and 43 male and 38 female Caucasians) with a mean age of 15.4 ± 2.3 years. All subjects were participants in a longitudinal study of the biobehavioral antecedents of cardiovascular disease and had ≥ 1 biologic parent and 1 grandparent with hypertension verified by the patient's physician.⁴ They were nonsmokers, normotensive, apparently physically healthy, and based upon self report, had avoided caffeine for 4 hours and nonprescription medications for 24 hours. Twenty-one subjects were excluded from the analyses due to suboptimal echocardiograms based upon the criteria of Schieken et al.⁵ These subjects were compared with the remaining 225 patients based on anthropometric data and hemodynamics at rest. They did not differ significantly in age, height, or blood pressures at rest ($p > 0.26$ for all). Those with suboptimal echocardiograms had significantly higher supine heart rates and all other indexes of body size and adiposity, which are presented in Table I, as well as central and general adiposity ($p < 0.02$ for all). There were more whites in the suboptimal echocardiographic group ($p < 0.001$).

Procedures

Parental informed consent and the subject's assent were obtained before all measurements. Anthropometric measurements were collected using established protocols.^{4,6} Subject's height (centimeters) and weight (kilograms) were measured without shoes using a calibrated Healthometer medical scale. Skin-fold thicknesses (i.e., triceps, subscapular, suprailiac crest) were measured on the right side of the body with Lange calipers using established protocols.⁷ Three sets of readings were recorded at each site to the nearest millimeters and averaged. Waist and hip circumferences (centimeters) were measured at the center of the umbilicus and at the level of the greater trochanters, respectively. Two sets of readings were recorded and averaged. Additional variables derived from these primary measurements included body surface area, waist-to-hip ratio, Quetelet index, Ponderal index, sum of 3 skinfold thicknesses, Z score weight – Z score height, and conicity. Conicity,⁸ an index of central adiposity, was calculated as $(\text{waist circumference [meters]})/0.109 (\text{weight [kilograms]}/\text{height[meters]})^{-1/2}$.

Echocardiographic studies

Echocardiographic studies were performed after completion of all other measurements and a brief rest. Sector-guided M-mode echocardiograms were performed using a Sonos 1000 echocardiograph (Hewlett-Packard, Andover, Massachusetts). Left ventricular (LV) posterior wall thickness, ventricular septal thickness, and LV internal dimension in diastole were measured according to the American Society of Echocardiography convention⁹ and LV mass was derived using the Devereux formula.¹⁰ The total LV mass as well as LV mass indexed for body height (LV mass/height) and the allometric signal of height (LV mass/height^{2.7}) were used in statistical analyses. The relative wall thickness (RWT) was calculated as $(2[\text{LV posterior wall thickness}]/\text{LV internal dimension})$. Four LV geometric patterns (normal, concentric remodeling, concentric hypertrophy, and eccentric hypertrophy) were determined using previously published partition values for RWT and LV mass index.¹¹ All subjects were classified as having 1 of these 4 LV geometric patterns: normal (LV mass/height^{2.7} < 38.87 and RWT < 0.44), concentric remodeling (LV mass/height^{2.7} < 38.87 and RWT ≥ 0.44), concentric hypertrophy (LV mass/height^{2.7} ≥ 38.87 and RWT ≥ 0.44), and eccentric hypertrophy (LV mass/height^{2.7} ≥ 38.87 and RWT < 0.44). The midwall fractional shortening (MFS) and circumferential end-systolic stress were also calculated as previously described.¹² Intra- and inter-reader coefficients of variation for all of the cardiac structures

assessed were <10% which is comparable to previous findings from our laboratory and other studies.^{5,13,14}

Statistical analysis

To obtain parsimonious measurements of adiposity, principal components analysis with varimax rotation was used. The parallel analysis technique was used to determine the number of components to retain. Regression analyses were used to test the independent contributions of variables in the prediction of LV mass, LV mass/height^{2.7}, LV end-diastolic dimension, MFS, and circumferential end-systolic stress. The hierarchical approach was used so that adjustment was made for known predictors before testing the significance of adding new predictors to the regression model.

Relations among individual variables were examined using partial correlations after partialling out the effect of height for most of the relations and using Pearson product-moment correlations when such adjustment was not deemed necessary (e.g., when relating LV mass/height^{2.7} to other variables). Comparisons between individuals with normal and abnormal geometric patterns were performed using *t* tests for continuous variables and chi-square analyses for categorical variables and proportions.

RESULTS

Descriptive characteristics

The summary data for anthropometric and echocardiographic parameters are given for the entire sample by race and sex in Tables I and II, respectively. A series of 2 (race) × 2 (sex) analyses of variance were conducted on these variables. No statistically significant differences between black and white subjects were observed for any anthropometric or demographic measurements (*p* > 0.08 for all). However, systolic and diastolic blood pressures were higher in black than white youth (113 ± 11 vs 109 ± 10 mm Hg; *p* < 0.005 and 61 ± 7 vs 58 ± 6 mm Hg; *p* < 0.05, respectively). As expected, males were taller and had greater waist-to-hip ratio (*p* < 0.001 for both). Females had greater hip circumference and higher values for triceps, subscapular, suprailiac skinfolds, and Ponderal index (*p* < 0.04 for all).

Several significant race and sex differences were noted in the echocardiographic analyses. End-diastolic dimensions of the LV walls, as well as indexed and nonindexed LV mass, were all higher in blacks and males (*p* < 0.002 for all). Black youth also exhibited greater RWT than whites (*p* < 0.001). Statistical adjustment for the higher blood pressure in blacks attenuated, but did not eliminate, these ethnic differences. Left ventricular MFS, expressed as the absolute value or as a percentage of the expected value for the level of circumferential end-systolic wall stress was significantly lower in black youth (*p* < 0.001 for both). There were no gender differences when the MFS was adjusted for the level of wall stress.

Principal components analysis of adiposity measurements

A principal components analysis was conducted using the measurements of adiposity in Table I. Variables entered were conicity, waist-to-hip ratio, triceps, subscapular, suprailiac crest skinfolds, Quetelet index, Ponderal index, and Z score weight – Z score height based upon normative data. Excluded from the analysis were those measurements that were highly correlated with age as a function of growth (i.e., weight, waist circumference, hip circumference). Using the parallel analysis technique, it was determined that 2 components should be retained. The parallel analysis technique compares eigenvalues for multiple sets of randomly generated data with eigenvalues for the actual data. Only when an eigenvalue from the actual data exceeds that from the generated data is a component retained. The 2

components retained included a measure of general adiposity (comprised of the sum of skinfolds, Quetelet and Ponderal indexes, and Z score weight – Z score height), and a measurement of central adiposity (comprised of conicity and the waist-to-hip ratio). To create the actual general and central adiposity measures, the adiposity parameters were standardized and averaged. The alpha coefficient for general adiposity was 0.97 and for central adiposity was 0.92, suggesting a high degree of concordance among the component measurements. Table III depicts the mean values $\pm$ SD for central and general adiposity by race and sex.

Correlational analyses

Table IV presents partial correlation coefficients controlling for height by comparing central and general adiposity and echocardiographic markers by race and sex. Height was used as a covariate to remove any differential impact of growth on all parameters except LV mass/height^{2.7}. Among white and black youth, both aggregate measures of adiposity were significantly positively correlated with nonindexed and indexed LV mass and posterior wall thickness ($p < 0.05$ for all). Among blacks, central adiposity was positively related to the thickness of the ventricular septum and RWT and negatively correlated with MFS ($p < 0.01$ for all). General adiposity was positively associated with ventricular septum and LV end-diastolic dimension ($p < 0.01$ for both). Among whites, LV end-diastolic dimension was positively correlated with both adiposity indexes ($p < 0.05$ for both).

Geometric pattern analyses

Table V depicts the proportions of each geometric type by race and sex. Although most of the youth fell into the normal category, 34% of black males and 24% of black females were classified as having concentric or eccentric LV hypertrophy compared with only 14% and 8% of white males and females, respectively. When subjects with an abnormal LV geometric pattern (concentric remodeling, eccentric hypertrophy, or concentric hypertrophy) were considered together as a group and compared with subjects with normal LV geometry, several important observations emerged. There was a higher proportion of blacks in the abnormal geometry group ($p < 0.01$). In addition, youth in the abnormal geometry group exhibited higher systolic blood pressure at rest and were older, heavier, and fatter based on every index of obesity ($p < 0.03$ for all).

Multiple regression

Hierarchical stepwise block multiple regression analyses were conducted on non-indexed and indexed measurements of LV mass and various indexes of cardiac structure and function that are presented in Table II. To control for differential physical growth on each dependent measurement, height was forced into the model in the first block of each regression. Components eligible for the second block included race, sex, blood pressure at rest, heart rate, and the measurements of central and general adiposity. The third block consisted of race and/or sex cross-product terms with those variables whose partial correlations with the dependent measurements differed significantly by race or sex or both. For LV mass, height accounted for an R^2 of 0.39. The second block comprised 5 significant predictors, including general adiposity, sex, race, systolic blood pressure at rest, and heart rate (additional $R^2 = 0.23$, $p < 0.0001$). The final block involved the cross product of sex with systolic blood pressure at rest additional $R^2 = 0.01$, total $R^2 = 0.63$, $p < 0.001$). LV mass indexed by height (LV mass/height) was predicted by height ($R^2 = 0.22$, $p < 0.001$) followed by the second block, which included general adiposity, sex, race, and supine heart rate and systolic blood pressure (additional $R^2 = 0.31$, $p < 0.001$, total $R^2 = 0.53$, $p < 0.0001$). There were no significant interactions with race or sex. The first block of significant predictors for LV mass/height^{2.7} included general adiposity, sex, race, and supine heart rate and systolic blood

pressure (total model $R^2 = 0.37$, $p < 0.0001$). There were no significant interactions with race or sex.

Other selected indexes of cardiac geometry were similarly evaluated. For LV end-diastolic dimension, height accounted for an R^2 of 0.40, $p < 0.001$). The only parameters in the second block that were statistically significant included general adiposity, supine resting heart rate, and systolic blood pressure (additional $R^2 = 0.15$, $p < 0.001$, total model $R^2 = 0.55$, $p < 0.0001$). Height was not a significant predictor of RWT. The only significant predictors observed from the second block included race (blacks more than whites), central adiposity and finally, systolic blood pressure at rest (total model $R^2 = 0.11$, $p < 0.0001$). Selected indicators of cardiac function evaluated included the MFS ratio and circumferential end-systolic stress. Height accounted for an $R^2 = 0.13$ for circumferential end-systolic stress followed by sex and general adiposity (additional $R^2 = 0.06$, total model $R^2 = 0.19$, $p < 0.0001$). For MFS, height was not a significant predictor. The only significant predictors came from the second block, which included race (blacks less than whites) and central adiposity (total model $R^2 = 0.11$, $p < 0.0001$). Table VI shows a summary of the data on multiple regression analyses.

DISCUSSION

The powerful relation between LV hypertrophy and cardiovascular morbidity and mortality is well established.¹⁵⁻¹⁷ More recently, the combination of higher LV mass and lower MFS has been demonstrated to identify individuals at markedly increased risk for fatal and nonfatal cardiovascular events.¹⁸ These and other studies indicate that these surrogate markers, measured using echocardiography, are much stronger predictors of subsequent morbidity and mortality than blood pressure and other conventional risk factors other than age.

Comparison to other studies

Our finding of an association between patterns of fat deposition and echocardiographic markers of adverse prognosis is consistent with and extends the results of earlier work. Previous studies in both adults¹⁹⁻²³ and children^{14,24-26} have shown a significant relation between measurements of general obesity on one hand and LV mass and RWT on the other. A decade and a half ago, Messerli et al¹⁹ reported that cardiac adaptation to obesity in adults consisted of LV dilation and hypertrophy regardless of the level of blood pressure. They showed that obese patients, compared with lean subjects, had greater LV chamber diameter, posterior and septal wall thickness, and greater LV mass. Lauer et al²⁰ also showed that increasing adiposity in adults was significantly correlated with increased LV mass even after adjusting for age and blood pressure. In adults with mild to moderate hypertension, Gottdiener et al²¹ reported that obesity was the strongest clinical predictor of LV mass and LV hypertrophy. Patterns of fat deposition were not assessed in any of these studies. More recently, Vetta et al²² studied the pattern of regional fat distribution in obese, normotensive elderly men, and showed that LV mass was strictly correlated with visceral adipose tissue and hyperinsulinemia.

Yoshinaga et al²⁴ used bioimpedance to estimate the percentage of total body fat in healthy children and examined its relation to echocardiographic LV mass. They showed that total adipose weight significantly correlated with LV mass index. More recently, Gutin et al²⁵ used dual-energy x-ray absorptiometry to assess fat-free mass and percent body fat in 62 subjects (aged 7 to 13 years) and demonstrated that the percent body fat was significantly correlated with LV RWT and MFS. Fat-free mass was also significantly correlated with total LV mass. In a similar study that also used dual-energy x-ray absorptiometry, Daniels et al²⁶ were able to separate the effects on LV mass of fat mass (resulting from obesity) from those

of lean body mass (resulting from linear growth). They also showed that general obesity, like systolic blood pressure, was independently associated with LV mass. However, the clinical impact in normal children and adolescents was small in comparison to lean body mass alone, which explained about 75% of the variance in LV mass.²⁶

Study limitations

First, the most valid and reliable method for the assessment of body composition and pattern of fat deposition in children and adolescents is dual-energy x-ray absorptiometry. Our study did not use this methodology. However, weight, height, and skinfold thicknesses that were used in the determination of Quetelet index and central and general adiposity in this study have both clinical and measurement validity. Height and weight are routinely measured in all patients and skinfold thicknesses are more readily evaluated than dual-energy x-ray absorptiometry. More importantly, measurements such as these in children and adolescents have been associated with future development of increased blood pressure, adverse lipoprotein profile, and early atherosclerotic lesions.²⁷

Second, an important factor in studies using echocardiography to determine LV mass is the method by which total LV mass must be indexed or adjusted for body size. The various methods that have been proposed include indexation by lean body mass, body surface area, body surface area^{1.5}, height, height², height^{2.13}, height^{2.7}, and height³. Liao et al²⁸ have shown that in adults, because of the high correlation among various body size indexes, LV hypertrophy, appears to confer a similar risk of mortality regardless of the method of indexation. In children and adolescents, however, this issue is more complex because of the strong effect of growth on LV mass increase. Daniels et al²⁹ examined this issue by comparing various options to indexation by dual-energy x-ray absorptiometry, which determined lean body mass in a sample of children and adolescents. In that study, the use of height³ was optimal, followed by the use of height^{2.7}. The use of body surface area, height, or height² was inappropriate because of their significant correlation with lean body mass and the use of height^{3.3} resulted in over-indexation.²⁹ Our use of height^{2.7} in our predominantly adolescent sample is consistent with the recommendation by de Simone et al³⁰ and supported by Daniels et al²⁹ as representing an appropriate “compromise between the results for children and adults.”

Conclusion

Although our findings do not imply a cause and effect relation, the associations we have identified in healthy youth between the pattern of body fat deposition and these LV markers of adverse prognosis have clinical import. If substantiated in future studies of larger sample size or long-term follow-up in our youth reveals an independent association with cardiovascular outcomes, these patterns of fatness may provide compelling indications for early primary prevention efforts.

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TABLE I**Anthropometric Characteristics of the Study Population**

	Black (n = 144)	White (n = 81)	p Value
Age (yrs)			R >0.53
Male	16.0 ± 2.5	15.4 ± 2.6	S >0.20
Female	15.3 ± 2.1	15.5 ± 2.4	R*S >0.20
Systolic blood pressure (mm Hg)			R <0.005
Male	117 ± 12	113 ± 9	S <0.001
Female	109 ± 10	105 ± 9	R*S >0.98
Diastolic blood pressure (mm Hg)			R <0.05
Male	60 ± 7	59 ± 6	S >0.57
Female	61 ± 7	58 ± 7	R*S >0.56
Height (cm)			R >0.31
Male	170 ± 10	168 ± 13	S <0.001
Female	162 ± 7	161 ± 8	R*S >0.86
Weight (kg)			R >0.09
Male	68 ± 16	63 ± 19	S >0.10
Female	63 ± 18	60.2 ± 17	R*S >0.77
Hips (cm)			R >0.12
Male	98 ± 10.1	96 ± 12	S <0.04
Female	102 ± 13.6	99 ± 12	R*S >0.95
Waist (cm)			R >0.55
Male	79 ± 11	78 ± 13	S >0.40
Female	77 ± 13	77 ± 14	R*S >0.59
Waist-to-hip ratio			R >0.23
Male	0.81 ± 0.05	0.81 ± 0.05	S <0.001
Female	0.76 ± 0.05	0.77 ± 0.06	R*S >0.32
Triceps skinfold thickness (mm)			R >0.46
Male	13 ± 9	14 ± 11	S <0.001
Female	22 ± 13	23 ± 12	R*S >0.87
Subscapular skinfold thickness (mm)			R >0.45
Male	13 ± 9	14 ± 11	S <0.001
Female	22 ± 13	23 ± 11	R*S >0.69
Suprailiac skinfold thickness (mm)			R >0.33
Male	13 ± 7	12 ± 10	S <0.002
Female	19 ± 11	18 ± 10	R*S >0.92
Sum of 3 skinfold thicknesses (mm)			R >0.74
Male	39 ± 24	41 ± 30	S <0.001
Female	59 ± 33	59 ± 30	R*S >0.79
Conicity			R >0.08
Male	1.16 ± 0.07	1.17 ± 0.01	S >0.07
Female	1.14 ± 0.07	1.17 ± 0.08	R*S >0.41

	Black (n = 144)	White (n = 81)	p Value
Quetelet index			R >0.09
Male	23 ±4	22 ±5	S >0.10
Female	24 ± 7	23 ± 5	R*S >0.96
Ponderal index			R >0.13
Male	14 ± 2	13 ± 3	S <0.002
Female	15 ±5	14± 3	R*S >0.88
Normative weight			R >0.30
Male	0.57 ± 1.0	0.44 ± 1.3	S >0.37
Female	0.77 ± 1.50.5	0.52 ± 1.3	R*S >0.76
Normative weight-height difference *			R >0.23
Male	0.49 ± 0.09	0.15 ± 1.3	S >0.36
Female	0.58 ± 1.9	0.46 ± 1.3	R*S >0.58

Numerical data are given in means ± SD.

* Z score weight – Z score height.

TABLE II

Echocardiographic Characteristics of the Study Population

	Black	White	p Value
Ventricular septal thickness (cm)			R <0.001
Male	0.90 ± 0.13	0.81 ± 0.12	S <0.001
Female	0.83 ± 0.13	0.74 ± 0.09	R*S >0.86*
Posterior wall thickness (cm)			R <0.001
Male	0.87 ± 0.11	0.81 ± 0.11	S <0.001
Female	0.80 ± 0.11	0.74 ± 0.08	R*S >0.86
LV internal dimension (cm)			R >0.89
Male	4.97 ± 0.47	4.90 ± 0.46	S <0.001
Female	4.56 ± 0.42	4.62 ± 0.41	R*S >0.32
LV mass (g)			R <0.002
Male	155 ± 39	136 ± 35	S <0.001
Female	121 ± 30	109 ± 269	R*S >0.45
LV mass/height (g/m)			R <0.001
Male	91 ± 20	80 ± 17	S <0.001
Female	75 ± 18	67 ± 14	R*S >0.50
LV mass/height ^{2.7} (g/m ^{2.7})			R <0.002
Male	37 ± 7	33 ± 6	S <0.002
Female	33 ± 6	30 ± 6	R*S >0.70
RWT			R <0.001
Male	0.35 ± 0.05	0.33 ± 0.04	S >0.64
Female	0.35 ± 0.06	0.32 ± 0.03	R*S >0.30
LV MFS (%)			R <0.001
Male	18 ± 2	20 ± 2	S >0.10
Female	19 ± 3	21 ± 2	R*S >0.65
MFS ratio			R <0.001
Male	112 ± 13	120 ± 12	S >0.97
Female	112 ± 14	121 ± 12	R*S >0.92
Circumferential end-systolic stress (×10 ³ dynes/cm ²)			R >0.84
Male	143 ± 27	138 ± 28	S <0.001
Female	122 ± 20	126 ± 28	R*S >0.20

* R*S = the effect of the interaction of race and sex.

TABLE III

The Mean Values for Central* and General† Adiposity by Race and Sex

	Black	White	p Value
Central adiposity			R >0.12
Male	0.06 ± 0.73	0.13 ± 0.83	S <0.001
Female	-0.44 ± 0.82	-0.16 ± 0.94	R*S >0.35
General adiposity			R >0.49
Male	-0.18 ± 0.63	-0.26 ± 0.82	S <0.003
Female	0.20 ± 1.10	0.11 ± 0.88	R*S >0.94

* Central adiposity = body fat situated in the trunk region;

† general adiposity: body fat representative of both truncal and peripheral regions.

TABLE IV
Partial Correlation Coefficients Between Echocardiographic Data and Central* and General† Adiposity by Race and Sex‡

Echocardiographic Variable	Race				Sex			
	Black		White		Male		Female	
	Central Adiposity	General Adiposity	Central Adiposity	General Adiposity	Central Adiposity	General Adiposity	Central Adiposity	General Adiposity
Ventricular septal thickness	0.27 [§]	0.27 [§]	0.13	0.18	0.07	0.14	0.22 [§]	0.37 [¶]
Posterior wall thickness	0.33 [¶]	0.32 [¶]	0.23 [§]	0.30 [¶]	0.16	0.23 [§]	0.27 [¶]	0.45 [¶]
LV internal dimension	0.10	0.37 [¶]	0.28 [§]	0.49 [¶]	0.16	0.23 [§]	0.23 [§]	0.55 [¶]
RWT	0.24 [¶]	0.09	0.04	-0.04	0.14	0.03	0.12	0.11
LV MFS	-0.29 [¶]	-0.14	0.05	0.01	-0.03	-0.07	-0.14	-0.10
LV mass	0.29 [¶]	0.44 [¶]	0.30 [¶]	0.46 [¶]	0.10	0.34 [¶]	0.33 [¶]	0.65 [¶]
LV mass/height	0.29 [¶]	0.45 [¶]	0.30 [¶]	0.46 [¶]	0.10	0.34 [¶]	0.33 [¶]	0.65 [¶]
LV mass/height ^{2,7}	-0.29 [¶]	0.47 [¶]	0.29 [¶]	0.45 [¶]	0.10	0.35 [¶]	0.33 [¶]	0.65 [¶]

* Central adiposity = body fat situated in the trunk region;

† general adiposity = body fat representative of both truncal and peripheral regions;

‡ partialling out height;

§ p < 0.05;

¶ p < 0.01;

¶¶ p < 0.001.

TABLE V

The Proportion of Subjects in the Four Different Left Ventricular Geometric Patterns by Race and Sex

	Black	White
Normal		
Male	48 (64.9%)	36 (83.7%)
Female	51 (72.9%)	35 (92.1%)
Concentric remodeling		
Male	1 (1.4%)	1 (2.3%)
Female	2 (2.9%)	0 (0%)
Eccentric hypertrophy		
Male	23 (31.1%)	6 (14%)
Female	12 (17.1%)	3 (7.9%)
Concentric hypertrophy		
Male	2 (2.7%)	0 (0%)
Female	5 (7.1%)	0 (0%)

Chi-square statistic for race 11.2; p <0.02.

TABLE VI

Summary Data from Multiple Regression Analyses

Model	R ² Change	Significance
Dependent variable: LV mass/height		
Height (cm)	0.22	0.001
General adiposity	0.15	0.001
Sex	0.09	0.001
Race	0.03	0.001
Supine systolic blood pressure (mm Hg)	0.02	0.005
Supine heart rate (beats/min)	0.02	0.002
Dependent variable: LV mass/height ^{2.7}		
General adiposity	0.21	0.001
Sex	0.11	0.001
Race	0.03	0.001
Supine heart rate (beats/min)	0.01	0.04
Supine systolic blood pressure (mm Hg)	0.01	0.04
Dependent variable: MFS		
Height (cm)	0.001	0.65
Race	0.08	0.001
Central adiposity	0.03	0.01