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Cardiorespiratory Fitness and Metabolic Syndrome in Postmenopausal African-American Women

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Abstract

We examined the association of cardiorespiratory fitness with metabolic syndrome in overweight/obese postmenopausal African-American women. Pooled baseline data on 170 African-American women from two exercise trials were examined. Metabolic syndrome was defined as at least three of the following: abdominal obesity, glucose intolerance, hypertension, low high-density lipoprotein cholesterol (HDL-C), and high triglycerides. Cardiorespiratory fitness (VO₂peak) was determined using the Bruce treadmill protocol and categorized as: Very Low (VLCRF < 18 mL·kg⁻¹·min⁻¹), Low (LCRF = 18.0 – 22.0 mL·kg⁻¹·min⁻¹), and Moderate (MCRF > 22.0 mL·kg⁻¹·min⁻¹). Associations of metabolic syndrome with cardiorespiratory fitness were analyzed using one-way ANOVA and linear regression. VO₂peak was significantly lower in the VLCRF compared to the MCRF group. Lower cardiorespiratory fitness was associated with higher prevalence of metabolic syndrome, abdominal obesity, hypertriglyceridemia, and low HDL among overweight/obese postmenopausal African-American women. In fully adjusted models, higher waist circumference and triglycerides were associated with lower VO₂peak levels ($P < 0.01$) and higher HDL-C was associated with higher VO₂peak levels ($P = 0.03$). Overweight/obese postmenopausal African-American women with very low cardiorespiratory fitness are more likely to have metabolic syndrome, higher body mass index, and unhealthier levels of certain metabolic syndrome components than women with moderate cardiorespiratory fitness.

Keywords

Obesity; Cardiorespiratory fitness; African-American; Metabolic Syndrome

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INTRODUCTION

Obesity and a lack of physical activity are two major factors associated with increased risk of developing the metabolic syndrome (MetS), a specific clustering of several cardio-metabolic conditions.[1] MetS has emerged as an underlying risk factor for a wide variety of diseases[4,8,14] and most postmenopausal women exhibit three or more MetS components.[24] Several factors can contribute to the increased prevalence of MetS in postmenopausal women, including age, reduced physical activity and energy expenditure,[20,35] increased caloric intake,[23] variation in hormonal patterns,[33] and attitude and perception relative to weight and weight management after menopause. These risk factors for MetS are of considerable importance to middle-aged and older women's health, due to the fact that MetS components increase through the transition period from pre- to post menopause which, in turn, might explain the increased incidence and prevalence of diseases and comorbidities in women after menopause.[24]

Previous research has consistently demonstrated an inverse association between cardiorespiratory fitness (CRF) and the risk of MetS.[3,6,9,11,13,21,22] CRF is a physiological measurement usually quantified as the highest rate of oxygen consumption ($\text{VO}_{2\text{max}}$ or $\text{VO}_{2\text{peak}}$) during a progressive maximal exercise test on a treadmill.[7] Previous research has shown racial differences in CRF between African-Americans and Caucasians with lower CRF levels in African-Americans, particularly African-American women.[34] Despite a growing body of research which has assessed the importance of CRF as a risk factor for MetS and the previously-observed racial differences in CRF, an important limitation has been that most African-American participants studied were younger (i.e., premenopausal) and in generally good health.[34] Therefore, the aim of the present study was to examine cross-sectional associations of MetS and its individual components with CRF in a sample of overweight or obese postmenopausal African-American women.

METHODS

Study design and participants

We pooled baseline data from two ongoing clinical trials (from 2013–2014) of postmenopausal African-American women for this cross-sectional analysis. Both trials had similar inclusion and exclusion criteria. Participants were recruited from the District of Columbia metropolitan area by placing flyers on community/public housing boards, a community-based mammography facility, churches, grocery stores, and local shops. Inclusion criteria were: 1) African-American women; 2) between the ages of 40 – 65 years old; 3) postmenopausal (last menstrual period ≥ 12 months); 4) sedentary (< 60 minutes of physical activity a week for the past 6 months); 5) never been diagnosed with cancer; and 6) no physical limitations preventing them from exercising. Participants were excluded if they had uncontrolled hypertension, diabetes or use of anti-diabetic medications (including insulin), currently enrolled in another physical activity and/or dietary study or a weight loss program, and inability to consent to study participation. This study was approved by the university institutional review board and meets the ethical standards of the International Journal of Sports Medicine.[18] Written informed consent was obtained and prior to

enrollment participants were required to provide a medical clearance from their personal physician or the study nurse practitioner.

Assessment of Metabolic Syndrome—According to the National Cholesterol Education Program's Adult Treatment Panel III revised guidelines, MetS in women is clinically diagnosed as the presence of three or more of the following: waist circumference > 88 cm, serum triglyceride level ≥ 150 mg/dL, high-density lipoprotein cholesterol (HDL-C) level < 50 mg/dL, blood pressure (BP) $\geq 130/85$ mm Hg, and serum glucose ≥ 100 mg/dL. Waist circumference was recorded using a standard measuring tape and measured at the smallest circumference at the waist. Resting BP was measured using the Omron BP760 Upper Arm Blood Pressure Monitor. Participants were seated comfortably for five minutes with the cuffed arm supported at heart level before measurements were taken. BP was measured twice at 5-minute intervals and the mean BP was recorded. Fasting blood samples were drawn in the morning on a day when the participants did not undergo any significant exercise for the preceding 3 days. Fasting glucose was analyzed on NaF-inhibited and EDTA-anticoagulated plasma on the Vitros 5, 1 FS Chemistry platform using a glucose oxidase slide method. Intra- and inter-assay CVs for the Vitros GLU slide were 1.2–1.5%. Serum lipids were analyzed on the Ortho Clinical Diagnostics Vitros 5, 1 FS Chemistry Systems platform using a multilayered, enzymatic, slide method. Intra- and inter-assay CVs were 1.5–1.8% for total cholesterol, 2.9–3.0% for HDL-cholesterol, 0.9–1.4% for triglycerides, and 1.8–3.7% for calculated LDL. Direct LDL-cholesterol was run as a reflex test when triglycerides were >350 .

Assessment of Cardiorespiratory Fitness—The Bruce treadmill protocol was used to determine CRF using a ParvoMedics TrueOne 2400 metabolic cart (Sandy, UT). The test involved a five minute warm-up followed by increases in treadmill speed and grade every three minutes until volitional exhaustion. Heart rate was measured using a POLAR H7 Bluetooth Smart Heart Rate monitor (Gays Mills, WI). Before each test, gas analyzers were calibrated with certified gases of known standard concentrations. The volume device was calibrated using a 3 liter syringe. Heart rate and respiratory variables were measured continuously during exercise and recovery. As these women were substantially overweight and generally with virtually no history of regular physical activity and especially none approaching a maximal exercise intensity, most of them were unable to achieve the necessary criteria (respiratory exchange ratio (RER), plateau in VO_2 , and maximal heart rate) to ensure that a true $\text{VO}_{2\text{max}}$ was achieved. Thus, the values resulting from these tests to quantify CRF must be considered $\text{VO}_{2\text{peak}}$ measures. We further categorized each participant by levels of CRF in tertiles as Very Low CRF ($\text{VLCRF} < 18.0 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$), Low CRF ($\text{LCRF} = 18.0 - 22.0 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$), and Moderate CRF ($\text{MCRF} > 22.0 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$).

Other Measures—Sociodemographic data including age, marital status, annual income, education, and smoking status were collected. Anthropometric measures of height, weight, and waist circumference were recorded. Weight was measured using a beam balance scale without shoes and recorded to the nearest $\frac{1}{2}$ pound. Height was measured using a stadiometer with the individual standing erect against the board, without shoes and looking

straight ahead. Height was read to the nearest ¼ inch. Body Mass Index (BMI) was calculated based on height and weight (kg/m^2). Obesity was defined as a BMI greater than or equal to $30 \text{ kg}/\text{m}^2$, while overweight was defined as a BMI in the range of $25\text{--}29.9 \text{ kg}/\text{m}^2$. Percent body fat and fat free mass (FFM, kg) of the total body and the legs were measured by a total body dual energy X-ray absorptiometry scan (DXA; Hologic, Waltham, MA) to normalize the absolute $\text{VO}_{2\text{peak}}$ values ($\text{L}\cdot\text{min}^{-1}$) for body mass ($\text{mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$), total body FFM ($\text{mL}\cdot\text{kgFFM}_{\text{total}}^{-1}\cdot\text{min}^{-1}$), and leg FFM ($\text{mL}\cdot\text{kgFFM}_{\text{legs}}^{-1}\cdot\text{min}^{-1}$).

Statistical Analysis

Baseline characteristics of the study participants were summarized using frequencies and means. Differences between groups were analyzed using one-way ANOVA and $P < .05$ was considered statistically significant. Post hoc comparisons were completed on adjusted $\text{VO}_{2\text{peak}}$ and MetS variables, and Type 1/familywise error rate was apportioned using the Bonferroni adjustment (1). Multivariable models included age and variables shown to be significant predictors of $\text{VO}_{2\text{peak}}$ in bivariate analyses. We also investigated the linear association of $\text{VO}_{2\text{peak}}$ with MetS components as continuous variables (rather than dichotomous as required for MetS diagnosis) using linear regression. All analyses were conducted using SAS v.9.3 (SAS Institute, Cary, NC).

RESULTS

A total of 170 overweight and obese postmenopausal African-American women completed the study. The mean age was 54.8 ± 5.6 years. While the initial goal of this study was to assess $\text{VO}_{2\text{max}}$ in the study participants, this proved not to be possible on a consistent basis. Thus, the CRF values in this study are based on $\text{VO}_{2\text{peak}}$ values for these women.

There were no significant differences in background characteristics such as age, marital status, income, education, and smoking history among the three CRF groups (Table 1). BMI, body weight, and body fat percentage were significantly greater in the VLCRF group compared to the MCRF group ($P = .001$). For all $\text{VO}_{2\text{peak}}$ variables, whether expressed in absolute units of $\text{L}\cdot\text{min}^{-1}$ or normalized for body weight or total body or leg FFM, women in the VLCRF group had significantly lower values when compared to the MCRF group. These differences were still evident when the $\text{VO}_{2\text{peak}}$ values were adjusted for age, marital status, income, education, and body composition, and MetS components. Importantly in regard to the comparisons across CRF groups, all three CRF groups attained the same levels of heart rate, RER, and RPE during the final stages of their exercise tests (Table 2).

When comparing MetS and its components across CRF groups (Table 3), the VLCRF group had higher percentage of individuals with MetS (62%) compared to LCRF (50%) and MCRF (37.5%) groups. The VLCRF group also had significantly higher waist circumference ($P < .01$) and triglycerides ($P < .01$) when compared to the other two groups. HDL-Cholesterol was significantly higher in the MCRF group when compared to the LCRF and VLCRF groups ($P = .001$). There were no group differences in resting blood pressure and fasting glucose levels.

Associations of VO₂peak with BMI and MetS components are presented in Table 4. In unadjusted linear regression models, CRF was significantly associated with BMI and the following MetS components: waist circumference and HDL cholesterol. These associations were slightly attenuated but remained statistically significant for waist circumference and HDL cholesterol after adjusting for age, marital status, income, education, and other MetS components. In addition, triglycerides were statistically significantly associated with VO₂peak in fully adjusted models. A one standard deviation (SD) higher waist circumference was associated with a 2.68 mL·kg of FFM⁻¹·min⁻¹ lower VO₂peak ($P < 0.01$). Triglycerides were also inversely associated with VO₂peak with a one SD higher triglyceride level being associated with a 1.34 mL·kg of FFM⁻¹·min⁻¹ lower VO₂peak. However, HDL cholesterol was positively associated with VO₂peak levels ($P = 0.03$), with a one SD higher HDL cholesterol resulting in a 1.21 mL·kg of FFM⁻¹·min⁻¹ higher VO₂peak levels ($P < 0.01$).

DISCUSSION

Our findings showing inverse associations between CRF and MetS in overweight/obese postmenopausal African American women are consistent with the results of previous studies in Caucasian and Asian women of comparable age.[21,22,26] The current study provides additional evidence that a number of MetS components are also independently associated with CRF in overweight or obese postmenopausal African-American women. Specifically, our study showed that postmenopausal African-American women with very low CRF ($< 18.0 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$) had significantly higher waist circumference, higher triglycerides, and lower HDL-C levels than women who had moderate CRF. Linear regression analyses also showed that a higher waist circumference and plasma triglyceride level, and lower HDL-C was significantly associated with a lower VO_{2peak} value. Previous research has shown that waist circumference is highly correlated with CRF[2,19,31] but its associations with other MetS components such as triglycerides and HDL-C have been studied much less frequently, [13] especially in postmenopausal overweight and obese African-American women. Therefore, our study extends the previous findings[13] by showing independent associations of triglycerides and HDL-C with CRF in overweight and obese postmenopausal African-American women.

African-Americans generally have lower triglycerides and higher HDL-C levels than Caucasians[12,25,32] which might contribute to the lower prevalence rates of MetS in African-Americans compared to other ethnicities.[13,25] In contrast, obesity, insulin resistance, diabetes, and hypertension are more common in African-Americans than Caucasians[5,10,15,16,25] which creates an interesting paradox in the validity of the current diagnostic criteria for MetS for African-Americans. Despite insulin resistance being the central mediating factor in the development of MetS,[27,28] fasting glucose levels were not associated with CRF in our study. Nevertheless, the level of CRF appears to be a strongly associated with a number of MetS components (i.e., waist circumference, triglycerides, HDL-C) with African-Americans tending to have better levels of triglycerides and HDL-C than their Caucasian counterparts. Further investigation is warranted to examine the potential mechanisms underlying the relationships between these clinically-relevant components of the plasma lipoprotein-lipid profiles and CRF across ethnic and racial groups.

Abdominal obesity, as measured by waist circumference, is an important component of MetS.[1] Women in the VLCRF group had greater body weight, BMI, and percent body fat when compared to women in the MCRF group. Waist circumference was also significantly higher in the VLCRF group compared to the LCRF and MCRF groups. This supports previous research indicating that abdominal obesity is inversely associated with CRF.[9,13,30] A previous study showed that improvements in MetS components with exercise training are more closely related to the reduction of abdominal obesity rather than overall obesity.[7] These findings suggest that the decline in obesity-related health risks that are associated with higher levels of CRF may be mediated by lower levels of waist circumference, independent of BMI. It is also well known that regular exercise is associated with changes in muscle morphology and metabolism that correspond to a marked decrease in metabolic risks.[6,29,30] Therefore, it is possible that higher CRF levels may be characterized by changes in skeletal muscle metabolism that favor better outcomes in the individual MetS components.

This study has several strengths that include accurate diagnostic criteria for MetS and its individual components along with the ability to assess CRF directly. In addition, previous studies with African-Americans included mostly younger, premenopausal, and generally healthier women, whereas our sample consists of overweight or obese, sedentary (defined as < 60 minutes a week of physical activity), postmenopausal women. Therefore, we anticipated our VO_{2peak} values to be lower than previous studies and did not use age-matched normative VO_{2max} data to categorize our sample's CRF levels. Instead, we categorized CRF groups based on the distribution of VO_{2peak} in our participants. Current normative data to categorize CRF levels for participants are usually generated in Caucasian populations, who may differ significantly from African-Americans in terms of lifestyle, diet, and physical activity.[17] Future research is warranted to conduct a population-based study for African-American women assessing VO_{2max}/VO_{2peak} across different age groups. The present study provides a better understanding of the health disparities associated with CRF and the different health effects that aerobic fitness has in minority populations. It also might lead to implications for further interventional studies that focus on increasing CRF among African-American women, especially those who are middle-aged or older where the prevalence of MetS is increasing due to the alarming physical inactivity and high obesity rates.

A limitation of the present study is that the results may not be generalizable to a broader population. However, the present study adds to our current knowledge and provides new and important information about the relationship of CRF and MetS and its individual components in overweight sedentary postmenopausal African American women. Our findings are based on a single cross-sectional study, thus the relationship between CRF and MetS in this population may not be one of cause and effect. Another limitation was that we actually measured VO_{2peak} rather than VO_{2max} levels in these women.

In summary, the level of CRF appears to be a determinant of the prevalence of MetS and its individual components in sedentary overweight or obese postmenopausal African-American women. Furthermore, it appears that the mitochondrial dysfunction associated with insulin resistance also may well differ substantially across our CRF tertile groups. Based on our

present results, it would appear that a clinical trial assessing the impact of increasing CRF in overweight or obese postmenopausal African-American women to at least moderate CRF levels ($> 22.0 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) to prevent or treat MetS and its individual components would be warranted and of substantial importance.

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Table 1

Sociodemographic and clinical characteristics of postmenopausal African-American women according to level of CRF.

Characteristic	VLCRF < 18 mL·kg ⁻¹ ·min ⁻¹ (n = 58)	LCRF 18.0 – 22.0 mL·kg ⁻¹ ·min ⁻¹ (n = 56)	MCRF > 22.0 mL·kg ⁻¹ ·min ⁻¹ (n = 56)
<i>Age, mean (SD)</i>	55.2 (6.1)	55.1 (5.5)	54.3 (5.4)
<i>Marital status, n (%)</i>			
Single/never married	24 (41.4)	19 (33.9)	21 (37.5)
Married/partner	15 (25.9)	13 (23.2)	14 (25.0)
Divorced/separated/widowed	19 (32.8)	24 (42.9)	21 (37.5)
<i>Annual income, n (%)</i>			
\$35,000 or less	37 (63.8)	29 (51.8)	29 (51.8)
\$35,000 to \$49,999	17 (29.3)	21 (37.5)	13 (23.2)
\$50,000 or more	4 (6.9)	5 (8.9)	12 (21.4)
<i>Education, n (%)</i>			
< High school graduate	5 (8.6)	8 (14.3)	6 (10.7)
High school graduate	34 (58.6)	26 (46.4)	31 (55.4)
College graduate	19 (32.8)	22 (39.3)	19 (33.9)
<i>Smoking, n (%)</i>			
Current	14 (24.1)	6 (10.7)	15 (26.8)
Former	20 (34.5)	19 (33.9)	15 (26.8)
Never	24 (41.4)	31 (55.4)	26 (46.4)
<i>Clinical variables</i>			
<i>BMI (kg/m²), mean (SD)</i>	39.2 (7.4)	36.9 (6.5)	34.6 (6.3) ^c
25 – 29.9 kg/m ²	5 (8.6)	8 (14.3)	11 (19.6)
30 – 34.9 kg/m ²	15 (25.9)	14 (25.0)	27 (48.2)
35 – 39.9 kg/m ²	12 (20.7)	18 (32.1)	4 (7.1)
40 kg/m ²	26 (44.8)	16 (28.6)	14 (25.0)
<i>Body Weight (kg), mean (SD)</i>	105.1 (20.8)	100.9 (19.8)	95.3 (18.6) ^c
<i>Fat free mass (kg), mean (SD)</i>			
Total body	52.1 (8.8)	51.5 (7.6)	48.8 (7.1) ^c
Legs	16.4 (2.9)	17.0 (2.6)	16.2 (2.7)
<i>Body fat %, mean (SD)</i>	48.9 (5.1)	47.0 (4.1)	45.3 (5.7) ^c

Note: VLCRF = Very Low CRF; LCRF = Low CRF; MCRF = Medium CRF

^aStatistically significant between VLCRF vs. LCRF, $P < .05$

^bStatistically significant between LCRF vs. MCRF, $P < .05$

^cStatistically significant between VLCRF vs. MCRF, $P < .05$

Table 2

Comparison of aerobic fitness measures between different CRF levels among postmenopausal overweight or obese African-American women.

Characteristic	VLCRF < 18 mL·kg ⁻¹ ·min ⁻¹ (n = 58)	LCRF 18.0 – 22.0 mL·kg ⁻¹ ·min ⁻¹ (n = 56)	MCRF > 22.0 mL·kg ⁻¹ ·min ⁻¹ (n = 56)
<i>VO_{2max} (L·min⁻¹)</i>			
Mean (SD)	1.73 (0.4)	1.88 (0.4)	1.95 (0.5) ^c
<i>VO_{2max} (mL·kg⁻¹·min⁻¹)</i>			
Mean (SD)	15.3 (2.1)	20.1 (0.9) ^a	27.0 (4.1) ^{b, c}
<i>VO_{2max} (mL·kg FFMtotal⁻¹·min⁻¹)</i>			
Mean (SD)	34.7 (7.2)	36.6 (6.9)	38.9 (9.9) ^c
<i>VO_{2max} (mL·kg FFMlegs⁻¹·min⁻¹)</i>			
Mean (SD)	109.2 (23.7)	111.8 (24.5)	113.0 (31.4) ^c
<i>Max heart rate (b·min⁻¹)</i>			
Mean (SD)	151.7 (21.3)	152.8 (17.4)	154.1 (18.6)
<i>Max RER</i>			
Mean (SD)	0.98 (0.1)	0.99 (0.1)	1.02 (0.1)
<i>Max RPE</i>			
Mean (SD)	14.0 (1.9)	13.6 (1.5)	14.1 (1.8)

Note: VLCRF = Very Low CRF; LCRF = Low CRF; MCRF = Medium CRF; FFM = Fat Free Mass; RER = Respiratory Exchange Ratio; RPE = Rate of Perceived Exertion

^aStatistically significant between VLCRF vs. LCRF, $P < .05$

^bStatistically significant between LCRF vs. MCRF, $P < .05$

^cStatistically significant between VLCRF vs. MCRF, $P < .05$

Adjusted for age, marital status, income, education, and body composition, MetS components, and other VO_{2max} values

Table 3

Comparison of MetS characteristics between different levels of CRF among postmenopausal overweight or obese African-American women.

Characteristic	VLCRF < 18 mL·kg ⁻¹ ·min ⁻¹ (n = 58)	LCRF 18.0 – 22.0 mL·kg ⁻¹ ·min ⁻¹ (n = 56)	MCRF > 22.0 mL·kg ⁻¹ ·min ⁻¹ (n = 56)
Metabolic syndrome			
Yes, n (%)	36 (62.1)	28 (50.0)	21 (37.5) ^c
Metabolic Syndrome Components			
<i>Waist circumference (cm)</i>			
Mean (SD)	115.7 (14.0)	110.5 (14.6) ^a	107.7 (13.9) ^c
> 88 cm, n (%)	57 (98.3)	55 (98.2)	52 (92.9)
<i>Resting blood pressure (SBP/DBP, mm Hg)</i>			
Mean (SD)	128.2 (18.4) / 82.8 (12.1)	126.9 (17.0) / 82.0 (10.2)	127.6 (18.3) / 81.2 (10.1)
130/85 mmHg, n (%)	33 (56.9)	27 (48.2)	28 (50.0)
<i>Fasting glucose (mg/dL)</i>			
Mean (SD)	100.3 (13.8)	99.5 (18.3)	101.6 (16.4)
100 mg/dL, n (%)	25 (43.1)	24 (42.9)	29 (51.8)
<i>Triglycerides (mg/dL)</i>			
Mean (SD)	122.7 (48.0)	111.4 (57.1) ^a	104.8 (52.4) ^c
150 mg/dL, n (%)	18 (31.0)	15 (26.8)	12 (21.4) ^c
<i>HDL cholesterol (mg/dL)</i>			
Mean (SD)	49.2 (10.7)	54.8 (16.4)	63.7 (20.9) ^{b, c}
50 mg/dL, n (%)	35 (60.3)	35 (62.5)	48 (85.7) ^c

Note: VLCRF = Very Low CRF; LCRF = Low CRF; MCRF = Medium CRF; SBP = systolic blood pressure; DBP = diastolic blood pressure

^aStatistically significant between VLCRF vs. LCRF, $P < .05$

^bStatistically significant between LCRF vs. MCRF, $P < .05$

^cStatistically significant between VLCRF vs. MCRF, $P < .05$

Adjusted for age, marital status, income, education, body composition, and other MetS components

Linear Regression Estimates of VO_{2max} ($mL \cdot kg^{-1} \cdot min^{-1}$) with BMI and MetS Components in a sample of African-American Women (N = 170).

Table 4

Characteristic	Linear Regression Parameter Estimates ^a			
	β^1	P-Value	β^2	P-Value
Body Composition				
BMI (kg/m^2)	-2.83	<0.01	-2.84	<0.01
MetS Components				
Waist circumference (cm)	-2.80	<0.01	-2.65	<0.01
Blood pressure (systolic/diastolic)(mmHg)	0.41 / 0.04	0.53 / 0.96	0.46 / 0.01	0.49 / 0.99
Fasting glucose (mg/dL)	-0.44	0.50	-0.32	0.62
Triglycerides (mg/dL)	-1.12	0.09	-1.23	0.06
HDL cholesterol (mg/dL)	1.99	<0.01	1.82	<0.01

^aChange in VO_{2max} ($mL \cdot kg^{-1} \cdot min^{-1}$) for one standard deviation increase in each characteristic

β^1 = unadjusted; β^2 = adjusted for age, marital status, income, education; β^3 = adjusted for age, marital status, income, education, and other MetS components