

Racial differences in energy expenditure and aerobic fitness in premenopausal women¹⁻³

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ABSTRACT

Background: Aerobic fitness, or maximal oxygen uptake ($\dot{V}O_2\text{max}$), and energy expenditure (EE) may be lower in African Americans than in whites.

Objective: The objective of this study was to compare sleeping EE (SEE), resting EE (REE), free-living total EE (TEE), and $\dot{V}O_2\text{max}$ in African American and white women after adjustment for body composition and free-living activity-related energy expenditure (AEE).

Design: Eighteen African American and 17 white premenopausal women were matched for weight, percentage body fat, and age. SEE and REE were measured in a room calorimeter and $\dot{V}O_2\text{max}$ was measured on a treadmill. Fat-free mass (FFM) and fat mass (FM) (4-compartment model), AEE (doubly labeled water and SEE), and regional lean tissue (dual-energy X-ray absorptiometry) were used as adjustment variables in SEE, REE, TEE, and $\dot{V}O_2\text{max}$ comparisons.

Results: The African American women had significantly more limb lean tissue and significantly less trunk lean tissue than did the white women. The African American women also had significantly lower SEE (6.9%), REE (7.5%), TEE (9.6%), and $\dot{V}O_2\text{max}$ (13.4%) than did the white women. Racial differences persisted after adjustment for $\dot{V}O_2\text{max}$, AEE, FFM, and limb lean tissue but disappeared after adjustment for trunk lean tissue. The $\dot{V}O_2\text{max}$ difference was independent of all body-composition variables and of AEE.

Conclusions: African American women had lower aerobic fitness than did white women, independent of differences in lean tissue or AEE. Diminished racial differences in SEE, REE, and TEE after adjustment for trunk lean tissue suggest that low EE in African American women is mediated by low volumes of metabolically active organ mass. *Am J Clin Nutr* 2000;71:500-6.

KEY WORDS African American women, white women, aerobic fitness, energy expenditure, obesity, body composition, fat mass, fat-free mass, lean tissue

INTRODUCTION

Public awareness of obesity has increased, as evidenced by national trends toward greater use of low-energy food products (1). However, the incidence of obesity continues to increase in the United States despite acknowledgment that obesity is one of our nation's most serious health problems (2). Obesity is more

prevalent in African American women than in white women (3); almost 50% of African American women are identified as overweight, whereas 33% of white women are overweight (2).

Several recent studies showed lower resting energy expenditures (REEs) in African American girls (4, 5) and women (6-8) than in their white counterparts. Racial differences persisted after adjustment of REE for fat-free mass (FFM) and in some cases for lean mass (FFM minus bone mass). However, not all studies showed a racial difference (9). Several other factors can affect REE and could conceivably mediate racial differences (eg, exercise training) (10). In addition, not all FFM has the same metabolic activity. For example, organs are known to have higher metabolic rates than do bone and muscle (11-13). Variations in FFM hydration could also affect estimations of metabolically active tissue.

Aerobic fitness, or maximal oxygen uptake ($\dot{V}O_2\text{max}$), was shown to be inversely related to obesity, possibly because $\dot{V}O_2\text{max}$ increases exercise-mediated REE or free-living activity-related energy expenditure (AEE) (10). In addition, $\dot{V}O_2\text{max}$ was shown to be related to longevity, independent of obesity (14). African American children were found to have lower aerobic capacity than white children (15, 16) and African American men were shown to have a greater percentage of type II muscle fibers (17), fibers that generally have lower oxidative capacity, than did white men. We are not aware of any studies comparing the aerobic fitness of African American and white women.

The purpose of this study was to compare $\dot{V}O_2\text{max}$ and REE in normal-weight, sedentary, premenopausal African American and white women. Prior physical activity and muscle mass may

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affect $\dot{V}O_{2\max}$; hence, AEE, FFM, and leg lean tissue were used as adjustment variables. Aerobic fitness, exercise habits, and the amount of metabolically active organ tissue in the trunk may affect REE; hence, $\dot{V}O_{2\max}$, AEE, and various body-composition measures were used as adjustment variables in the comparison of REE between the racial groups.

SUBJECTS AND METHODS

Subjects

The subjects were 18 African American and 17 white premenopausal women who were matched for body weight, percentage body fat, and age. Because of missing data for total body water and free-living total energy expenditure (TEE), percentage body fat, FFM, TEE, and AEE analyses were based on data for 16 African American women and 16 white women. The subjects were selected from a larger ongoing study designed to measure metabolic factors that may predispose women to obesity. All subjects were of normal weight [body mass index (BMI; in kg/m^2) <25] and were free of any metabolic disorders and medications that may affect REE or $\dot{V}O_{2\max}$. According to self-report, none of the African American or white women had other ancestries. All the women were nonsmokers, were sedentary (defined as exercising <1 time/wk for the past year), and had normal menstrual cycles. Before participating in the study, the women provided informed consent to the protocol, which was approved by the Institutional Review Board for Human Use in compliance with the Department of Health and Human Services Regulations for Protection of Human Research Subjects.

Before testing, the subjects remained weight stable for ≥ 4 wk; during that time, the subjects were weighed 5 d each week. During the 2 wk immediately before testing and for the 2 wk of TEE measurement, all meals were provided through the clinical research center to ensure weight stability of <1% variation and to maintain macronutrient intake constant at 20% fat, 16% protein, and 64% carbohydrate. Entrees for lunch and dinner included Stouffer's Lean Cuisine (Nestle Food Co, Solon, OH).

Measurement of total energy expenditure

TEE was measured over 14 d of controlled-diet and energy-balance conditions by using the doubly labeled water technique. The previously described protocol (18) has a theoretical error of <5%. Samples were analyzed in triplicate for H_2^{18}O and $^2\text{H}_2\text{O}$ by isotope ratio mass spectrometry at the University of Alabama at Birmingham, as described previously (19). When all samples were reanalyzed for ^2H and ^{18}O in 7 subjects, values of TEE were in close agreement (CV: 4.3%), as described previously (19). Carbon dioxide production rates were determined by using a fixed assumption for the dilution space ratio (1.0427) using equation R2 of Speakman et al (20) and energy expenditure was calculated by using de Weir's equation 12 (21) with a mean value for the dietary food quotient of 0.92 obtained from the foods provided.

Assessment of free-living activity-related energy expenditure

AEE was estimated by subtracting sleeping energy expenditure (SEE) from TEE after reducing TEE by 10% to account for the thermic response to meals. SEE was used instead of REE to estimate AEE because SEE was based on a much longer period of assessment and had a 45% lower SD than did REE.

Body-composition measures

Four-compartment model

The body-composition criterion method used was body fat determined by the 4-compartment model, as described by Baumgartner et al (22). This model assumes densities of 900 g/L for fat, 990 g/L for water, 3042 g/L for bone mineral, and 1340 g/L for the unmeasured fraction of the body composed of protein and glycogen. The model calculates percentage body fat from the independent measures of total body density (by underwater weight, as described below), the fraction of body weight that is water (by isotope dilution, as described below), and the fraction of body weight that is minerals [by dual-energy X-ray absorptiometry (DXA), as described below].

Total body water

Total body water was determined by isotope-dilution techniques using water labeled with both ^2H and ^{18}O , as described previously (18). Briefly, a mixed dose of doubly labeled water was administered orally after a baseline urine sample (10 mL) was collected. The isotope loading dose was ≈ 0.1 and 0.08 g ^{18}O and ^2H , respectively, per kilogram of body mass. Two samples were collected the morning after doses were administered and an additional 2 samples were collected in the morning 14 d later. All samples were analyzed in triplicate for ^2H and ^{18}O by using the off-line zinc-reduction method (23) and equilibration technique (24), respectively, as described previously (25). Zero-time enrichments of ^2H and ^{18}O were calculated from the intercepts of the semilogarithmic plot of isotope enrichment in urine versus time after dosage. Isotope-dilution spaces were calculated by using the equation of Coward (26). Total body water was taken as the average of the ^{18}O dilution space divided by 1.01 and the ^2H dilution space divided by 1.04. FFM was estimated from total body water by assuming that fat-free tissue has a hydration constancy of 73.2% (27–29), and FM was estimated from the difference between body mass and FFM.

Dual-energy X-ray absorptiometry

Bone mineral content and regional lean tissue (trunk, arm, and leg) were measured by DXA (DPX-L; Lunar Radiation Corp, Madison, WI). Limb lean tissue was determined by summing arm and leg lean tissue. The scans were analyzed by using ADULT, version 1.33 (Lunar Radiation Corp). Bone mineral content was used in the calculation of percentage body fat by using the 4-compartment model (22). DXA lean tissue (soft lean tissue does not include estimates of bone mass) was used as an adjustment variable in the analysis of REE, SEE, and $\dot{V}O_{2\max}$.

Body density

Densitometry was determined by underwater weighing; residual volume was measured simultaneously by a closed-circuit oxygen-dilution technique (30). Body weight was measured by using an electronic scale; a fasting measurement and a measurement immediately after voiding in the morning were taken. The CV for repeat tests of body density on separate days in our laboratory was 0.3%.

Aerobic fitness

$\dot{V}O_{2\max}$ was estimated by using a maximal modified Bruce graded treadmill protocol (12). Heart rate was measured by using a Polar Beat heart rate monitor (model 901201; Polar Electro Inc,



Woodbury, NY). Oxygen consumption and carbon dioxide production were measured continuously via open circuit spirometry and were analyzed by using a Sormedics metabolic cart (model 2900; Yorba Linda, CA). Before each test, the gas analyzers were calibrated with certified gases of known standard concentrations. Standard criteria for heart rate, respiratory quotient, and plateauing were used to ensure achievement of $\dot{V}O_{2\max}$ (31).

Measurement of REE and SEE

The subjects spent 23 h in a whole-room respiration calorimeter ($3.38 \times 2.11 \times 2.58$ m). The design characteristics and calibration of the calorimeter were described previously (32). Oxygen consumption and carbon dioxide production were measured continuously with a magnetopneumatic differential oxygen analyzer (Magnos 4G; Hartmann & Braun, Frankfurt, Germany) and the NDIR industrial photometer differential carbon dioxide analyzer (Uras 3G; Hartmann & Braun). The calorimeter was calibrated before each subject entered the chamber. The zero calibration was carried out simultaneously for both analyzers. The full scale was set at 0–1% for the carbon dioxide analyzer and at 0–2% for the oxygen analyzer.

Each subject entered the calorimeter at 0800. Although metabolic data were collected throughout the 23-h stay, only sleeping and resting metabolic data are reported. The onset of sleep was determined to be when the lights were turned off, between 2130 and 2300 in all cases. Sleep as defined may have included some resting awake time while the subject was falling asleep. Radar motion sensors used to detect spontaneous physical activity indicated that the subjects were inactive during the sleep period. The subjects were awakened at 0630 on their second morning in the calorimeter. REE was then measured for 30 min before the subjects left the calorimeter at \approx 0700. Energy expenditure was calculated by using the de Weir equation (21). REE and SEE were extrapolated over 24 h and expressed as kJ/d.

Statistics

Two-tailed independent *t* tests were used to test differences between the African American and white women in the descriptive

and body-composition variables. One-tailed independent *t* tests were used to determine differences between the 2 groups of women in the metabolic variables because prior research indicated that African American women have lower REEs than do white women (6–8). Because both prior physical activity and muscle mass may affect measurement of $\dot{V}O_{2\max}$, analysis of covariance (ANCOVA) was used to test group racial differences between metabolic variables after adjustment for appropriate covariates. The primary purpose of using ANCOVA for this condition was to reduce error variance. The covariates used as adjustment variables were AEE, FFM, and leg lean tissue. Aerobic fitness, exercise habits, and the amount of active metabolic tissue may affect REE and SEE; hence, $\dot{V}O_{2\max}$, AEE, and various body-composition measures were used as adjustment variables in ANCOVA analysis when racial differences in SEE and REE were compared. Zero-order Pearson product correlations were used to determine relations between lean tissue and SEE and REE. All analyses were undertaken by using SPSS (SPSS Inc, Chicago).

RESULTS

Descriptive and body-composition variables are shown in **Table 1**. No significant differences between racial groups were seen for age, weight, BMI, or FFM. There was a small but significant difference in percentage body fat and FM between the African American and white women. The white women had significantly more trunk lean tissue (12%) than did the African American women; the African American women had 6.3% more limb lean tissue than did the white women, although the difference was not significant. To ensure that racial comparisons in trunk and limb lean tissue were not confounded by the small and nonsignificant total FFM differences between the African American and white women, trunk and limb lean tissue were also analyzed with ANCOVA, with FFM as an adjustment variable. The difference in trunk lean tissue remained significant and the difference in limb lean tissue became significant; the African American women had higher limb and lower trunk lean tissue than did the white women.

TABLE 1
Descriptive and body-composition measures in African American and white women¹

	African American (n = 18)	White (n = 17)	Two-tailed <i>P</i>
Age (y)	35.6 ± 6.9 ²	35.2 ± 7.4	0.39
Weight (kg)	63.3 ± 6.8	65.1 ± 5.6	0.41
BMI (kg/m ²)	23.9 ± 1.1	23.6 ± 1.1	0.39
Four-compartment model ³			
BMC (kg)	2.53 ± 0.30	2.39 ± 0.24	0.15
TBW (L)	32.2 ± 3.0	32.7 ± 4.2	0.71
Bone density (g/cm ²)	1.0367 ± 0.0130	1.0228 ± 0.0120	0.001
Percentage body fat (%)	29.2 ± 4.6	33.1 ± 5.7	0.04
FFM (kg)	44.6 ± 4.0	43.8 ± 5.0	0.60
Fat mass (kg)	18.5 ± 4.1	21.7 ± 4.3	0.04
DXA regional lean tissue			
Limb (kg)	18.6 ± 2.1	17.5 ± 2.0	0.14
Limb adjusted for FFM (kg)	18.7	17.7	0.01
Trunk (kg)	18.0 ± 1.9	20.0 ± 1.9	0.001
Trunk adjusted for FFM (kg)	18.0	20.2	0.001

¹BMC, bone mineral content; TBW, total body water; FFM, fat-free mass; DXA, dual-energy X-ray absorptiometry.

² $\bar{x} \pm$ SD.

³Includes only 16 African American and 16 white women.

TABLE 2

Energy expenditure differences between African American and white women¹

	African American (n = 18)	White (n = 17)	One-tailed P
	<i>kJ/d (kcal/d)</i>		
Sleeping EE	5012 ± 494 (1198 ± 11) ²	5385 ± 510 (1287 ± 122)	0.02
Adjusted for FFM and FM	5025 (1201)	5406 (1292)	0.00
Adjusted for AEE	4958 (1185)	5406 (1292)	0.00
Adjusted for FFM and $\dot{V}O_{2\max}$	5050 (1207)	5343 (1277)	0.05
Adjusted for limb lean tissue	4945 (1182)	5456 (1304)	0.00
Adjusted for trunk lean tissue	5197 (1242)	5192 (1241)	0.98
Resting EE	5159 ± 519 (1233 ± 124)	5665 ± 594 (1354 ± 142)	0.01
Adjusted for FFM and FM	5100 (1219)	5749 (1374)	0.00
Adjusted for AEE	5075 (1213)	5669 (1355)	0.00
Adjusted for FFM and $\dot{V}O_{2\max}$	5205 (1244)	5619 (1343)	0.02
Adjusted for limb lean tissue	5113 (1222)	5715 (1366)	0.00
Adjusted for trunk lean tissue	5293 (1265)	5523 (1320)	0.12
24-h room EE	6422 ± 900 (1535 ± 215)	6778 ± 653 (1620 ± 156)	0.13
Total free-living EE	8238 ± 1431 (1969 ± 342)	9109 ± 1117 (2177 ± 267)	0.03
Adjusted for FFM and FM	8251 (1972)	9104 (2176)	0.05
Adjusted for AEE	8439 (2017)	8929 (2134)	0.01
Adjusted for FFM and $\dot{V}O_{2\max}$	8268 (1976)	9088 (2172)	0.08
Adjusted for limb lean tissue	8192 (1958)	9146 (2186)	0.03
Adjusted for trunk lean tissue	8389 (2005)	8975 (2145)	0.14
Free-living activity-related EE	2435 ± 1368 (582 ± 327)	2816 ± 954 (673 ± 236)	0.19

¹EE, energy expenditure; FFM, fat-free mass; FM, fat mass; $\dot{V}O_{2\max}$, maximal oxygen uptake. EE variables adjusted for body-composition variables were analyzed in 16 African American women and 16 white women.

² $\bar{x} \pm SD$.

SEE, REE, and TEE results are shown in **Table 2**. The African American women had a significantly lower absolute SEE (difference of 373 kJ/d), REE (difference of 506 kJ/d), and TEE (difference of 871 kJ/d) than did the white women despite having a comparable FFM. The 356-kJ/d lower total EE of the African American women while the women were in the room calorimeter and the 381-kJ/d lower AEE did not represent significant differences. The differences in SEE, REE, and TEE persisted after adjustment for AEE and $\dot{V}O_{2\max}$, implying that the differences were not mediated by activity or aerobic fitness. The significantly lower SEE, REE, and TEE in the African American women also persisted after adjustment for FFM and for limb lean tissue. However, after adjustment for trunk lean tissue, the significant racial differences disappeared.

Consistent with the fact that organ mass (found only in the trunk lean tissue area) accounts for a higher metabolic rate than do bone or muscle mass, we found that trunk lean tissue was more highly related to SEE and REE than was limb lean tissue (**Figures 1 and 2**). In fact, limb lean tissue was totally unrelated to REE. $\dot{V}O_{2\max}$ was significantly lower (12.4%) in the African American women than in the white women (**Table 3**). This difference persisted when $\dot{V}O_{2\max}$ was adjusted for weight, weight to the power of 0.67, FFM, and lean tissue in the legs and with both FFM and AEE as adjustment variables. These results suggest that the $\dot{V}O_{2\max}$ differences were not mediated by activity or body-composition differences between the white and African American women.

DISCUSSION

Several studies showed that REE is significantly lower in African American children than in white children (4, 5), lower in obese African American women than in obese white women

(6–8), and lower in normal-weight young African American women than in normal-weight young white women (33). Weyer et al (34) found that African American women had lower SEEs than did white women. However, in a study of white and African American children, racial differences were not found in all children (9). Ours is the first study to show that SEE, REE, and TEE were all lower in African American than in white normal-weight women. These differences were independent of FFM, AEE, $\dot{V}O_{2\max}$, and limb lean tissue. However, the differences disappeared after adjustment for trunk lean tissue. In addition, the significantly higher limb lean tissue and significantly lower trunk lean tissue in the African American women suggest that African American women have a larger proportion of their lean tissue as muscle than do white women. Because the more metabolically active organ mass is located in the trunk and not the limb region, these findings suggest that African American women have a relatively smaller organ mass than do white women and that the lower organ mass is responsible for the lower SEE and REE of these women. Finally, despite the greater limb lean tissue, ie, muscle mass, these African American women had lower $\dot{V}O_{2\max}$ than did age- and FFM-matched white women, as we showed previously in African American and white children (16). It is possible that these metabolic and fitness differences contribute to the higher prevalence of obesity in African American women because these differences in SEE and REE are accompanied by large differences in TEE.

The finding of higher limb lean tissue and lower trunk lean tissue in African American women than in white women was surprising, although it was reported that African American women have higher proportions of limb skeletal muscle than do white women (35, 36). All the women in our study were sedentary and none participated in strength-training programs. In

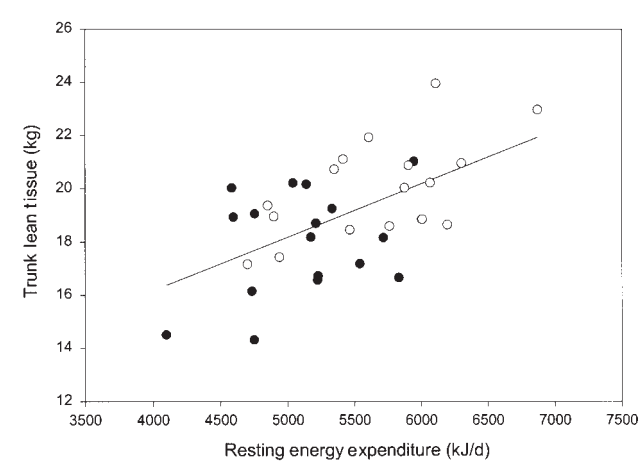
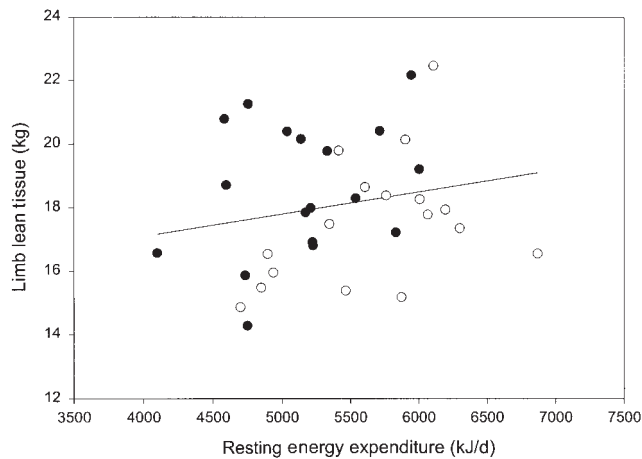
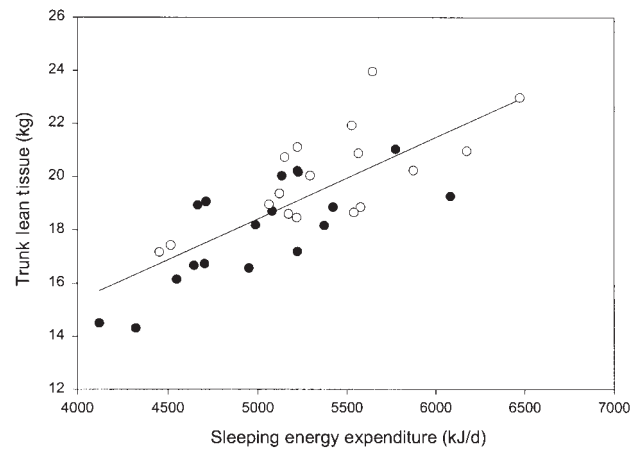
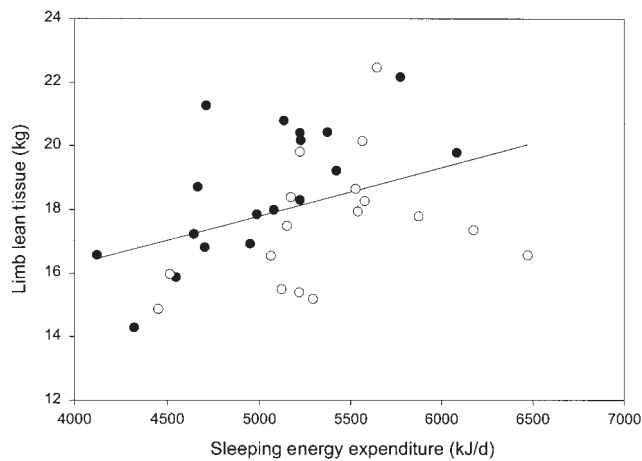


FIGURE 1. Relation between limb lean tissue and sleeping energy expenditure ($R = 0.39$, $P < 0.03$) and between limb lean tissue and resting energy expenditure ($R = 0.20$, $P > 0.24$) in 18 African American (●) and 17 white (○) women.

FIGURE 2. Relation between trunk lean tissue and sleeping energy expenditure ($R = 0.77$, $P < 0.001$) and between trunk lean tissue and resting energy expenditure ($R = 0.57$, $P < 0.001$) in 18 African American (●) and 17 white (○) women.

addition, the nonsignificantly lower AEE and significantly lower $\dot{V}O_2\text{max}$ in the African American women suggest that the greater limb lean tissue in these women was not caused by greater physical training.

Limb lean tissue consists primarily of muscle, whereas trunk lean tissue includes both muscle and organ mass. The DXA scan allows regional analysis of soft lean tissue mass and FM but cannot differentiate between soft muscle and organ tissue. However,

TABLE 3

Maximal exercise test results in African American and white women¹

	African American (n = 18)	White (n = 17)	Two-tailed P
$\dot{V}O_2\text{max}$ (L/min)	1.90 ± 0.30^2	2.17 ± 0.38	0.02
Adjusted for wt in kg (L/min)	1.90	2.17	0.02
Adjusted for $\text{wt}^{0.67}$ (L/min)	1.92	2.14	0.02
Adjusted for FFM (L/min)	1.89	2.21	0.00
Adjusted for leg lean tissue (L/min)	1.86	2.21	0.00
Adjusted for FFM and AEE (L/min)	1.88	2.20	0.00
RERmax	1.23 ± 0.07	1.20 ± 0.10	0.18
HRmax (beats/min)	179 ± 10	179 ± 10	0.42
VEmax (L/min)	72.3 ± 11.0	85.7 ± 14.7	0.06

¹ $\dot{V}O_2\text{max}$, maximal oxygen uptake; FFM, fat-free mass; AEE, activity related energy expenditure; RERmax, respiratory exchange ratio at $\dot{V}O_2\text{max}$; HRmax, maximum heart rate; VEmax, maximum ventilation.

² $\bar{x} \pm \text{SD}$.


there is no reason to believe that limb muscle mass is not related to trunk muscle mass, ie, that persons with a relatively large limb muscle mass should not have a relatively large trunk muscle mass. It was reported previously that African American women have longer limbs than do white women of similar height (35). It is possible that the lean tissue differences in trunk and limb were due to differences in limb and trunk length. We did not measure limb or trunk length in this study but the previous study showed limb length differences of only 2.5%. In contrast, we found 12.2% more trunk lean tissue in the white women than in the African American women, suggesting that differences in limb and trunk lean tissue are not solely a function of differences in limb and trunk length. In addition, it is well established that bone densities tend to be higher in African American persons than in white persons. It is logical that African American persons also tend to have more muscle mass, because muscle mass and bone density are related (36). Differences in bone density between African American and white persons are consistent with the differences in lean tissue found in this study and others (35, 36). Because it is known that African American women have more dense bones and thus more bone mineral content than do white women (37), it is possible that FFM was overestimated in the African American women, which would account for the lower adjusted REE reported in the other studies. We avoided this limitation by using a 4-compartment model that includes bone mineral content, total body water, and body density in the analysis.

Svendson et al (38) showed that DXA-derived trunk lean tissue is more highly related to REE than is appendicular lean tissue, supporting the hypothesis that trunk lean tissue is related to metabolically active visceral organs. We also showed stronger correlations of trunk lean tissue with both SEE and REE than with limb lean tissue (Figures 1 and 2). Sparti et al (39) did not find an independent relation (after adjustment for FFM) between REE and organ mass (left ventricular mass, liver, and kidney mass estimated from a combination of M-mode echocardiography and computed tomography) in a group of young white subjects. It is possible that the sample was relatively homogeneous in regard to the ratio of organ mass to FFM. If this were the case, the variability of relative organ mass would be truncated, reducing the probability of finding a relation with REE.

The sedentary African American women in our study had lower $\dot{V}O_2$ max than did age- and FFM-matched sedentary white women. Identical and high maximal heart rates (179 beats/min) with high and similar respiratory exchange ratios (African American women, 1.23; white women, 1.20) were observed during the $\dot{V}O_2$ max treadmill test, indicating that the subjects gave maximal effort regardless of their race. The differences in $\dot{V}O_2$ max in this study were independent of body weight, allometric scaling of body weight, and FFM. In addition, adjustment for leg lean tissue, which is more active during treadmill exercise, served only to increase (to almost 16%) the $\dot{V}O_2$ max difference between African American women and white women.

AEE was used as an adjustment variable to determine whether differences in $\dot{V}O_2$ max may be mediated by differences in habitual physical activity. The $\dot{V}O_2$ max differences between the 2 groups of women were independent of AEE, suggesting that the difference was independent of activity. There are limitations to the use of AEE as a surrogate for physical training because AEE measures only energy expenditure in excess of the sum of sleeping and postprandial energy expenditure and therefore gives no indication of the intensity and duration of physical activity.

However, the subjects in this study all reported that they did not participate in regular physical training. Therefore, we believe that it is unlikely that the higher $\dot{V}O_2$ max in the white women was mediated by high-intensity training. These results suggest that the differences in $\dot{V}O_2$ max were not mediated by activity or by body composition. Potential differences in plasma hemoglobin concentration, pulmonary function, and muscle fiber type have all been hypothesized as possible mechanisms for low $\dot{V}O_2$ max in African American persons (15, 16). We did not examine these variables in this study.

In summary, the results of this study suggest that African American premenopausal women have lower SEE, REE, TEE, and $\dot{V}O_2$ max than do white women. The lower $\dot{V}O_2$ max in the African American women was independent of body composition and AEE. The explanation for this difference in aerobic fitness remains unclear. The lower SEE, REE, and TEE values were independent of $\dot{V}O_2$ max, AEE, and all body-composition variables except trunk lean tissue, presumably because of smaller visceral organ mass in African American women than in white women. 

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