Exercise Capacity in Adult African-Americans Referred for Exercise Stress Testing*

Is Fitness Affected by Race?

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Study objectives: To determine the factors associated with exercise capacity.

Design: Retrospective evaluation of large stress-testing database.

Setting: Multispecialty tertiary care center.

Patients: A total of 5,069 consecutive patients who were referred for exercise stress testing.

Measurements: We compared levels of fitness in 641 African-Americans (52% male) with 4,428 whites (73% male), and performed univariate and multivariate analyses to determine the predictors of fitness (including race).

Results: Compared with African-American men (mean [± SD] age, 60 ± 11 years), white men (mean age, 63 ± 11 years) have significantly higher exercise capacity (10.7 ± 3.5 vs 11.4 ± 3.4 metabolic equivalents [METs], respectively; p < 0.001). The exercise capacity in African-American and white women was similar (8.5 ± 2.9 vs 8.7 ± 3.0 METs, respectively). However, body mass indexes (BMIs) were significantly higher in both African-American men (29.1 ± 4.3 vs 28.2 ± 4.3 kg/m², respectively; p < 0.001) and women (30.2 ± 5.7 vs 27.9 ± 5.5 kg/m², respectively; p < 0.0001) compared to their white counterparts, as was the prevalence of obesity (men, 44% vs 33%, respectively; women, 37% vs 27%, respectively; both p < 0.001). Although a model containing age, gender, BMI, and race only accounted for 32% of exercise capacity, all independently (p < 0.0001) predicted higher exercise capacity, as follows: younger age (r² = 0.14); male gender (r² = 0.12); BMI (r² = 0.06); and white race (r² = 0.004).

Conclusions: In an adult population of individuals who were referred for exercise stress testing, African-Americans were more obese and had significantly lower exercise capacity than their white counterparts. Emphasis on weight reduction and increasing physical fitness is particularly needed for the prevention of cardiovascular diseases in African-Americans.

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Key words: aging; exercise testing; fitness; obesity; race

Abbreviations: BMI = body mass index; CAD = coronary artery disease; MET = metabolic equivalent.

Physical inactivity is considered to be one of the most significant public health concerns,1,2 and levels of physical fitness are known to be potent predictors of major cardiovascular disease, cardiovascular mortality, as well as all-cause mortality.3–8 In fact, low levels of cardiovascular fitness have been shown to be as strong a predictor of mortality as more conventional coronary artery disease (CAD) risk factors, such as smoking, hypertension, and hyperlipidemia.7,9–11 Since there is a high prevalence...
of sedentary lifestyle, this parameter may contribute to more overall community risk of CAD and mortality than the other risk factors. The importance of physical fitness and exercise capacity as indicators of prognosis has been demonstrated in epidemiologic and population-based studies, as well as in cohorts with known or suspected CAD.

During recent decades, the prevalence of overweightness and obesity, including childhood overweightness, has been increasing at alarming proportions, and some data suggest that this increase is more pronounced in the African-American and Hispanic population than in the white population, particularly among women. In addition, the risk of death from all causes, cardiovascular disease, and cancer increases throughout the range of overweightness and obesity, although the risk associated with high body mass indexes (BMI) may be greater for whites than for African-Americans. In fact, recent evidence has indicated that obesity is associated with more morbidity than smoking, alcoholism, and poverty, and, if the current trends continue, will account for greater number of deaths annually in the United States, thus overtaking cigarette abuse as the leading preventable cause of death. Part of the rise in obesity has been attributed to sedentary lifestyle, since substantial data indicate that most residents of the United States do not participate in physical activity at recommended levels.

Although evidence suggests that the decline in physical activity that occurs during adolescence may be more pronounced in African-Americans compared with whites, we are not aware of studies assessing exercise capacity in adult African-American patients or assessing the impact of race on levels of fitness. The purpose of our study, therefore, was to assess exercise capacity in African-American men and women who were referred for exercise stress testing and to compare their exercise capacity with their white counterparts, as well as to determine whether race is an independent predictor of fitness.

**Materials and Methods**

**Patients**

Using a stress testing report database, we studied 5,069 consecutive patients who were referred for exercise ECG stress testing at the Ochsner Heart and Vascular Institute in New Orleans, LA, including 4,428 whites (73% men) and 641 African-Americans (52% men), and compared obesity status and levels of fitness in both races. This study was approved by the Institutional Review Board at the Ochsner Clinic Foundation.

**Protocol**

All patients were referred for exercise ECG testing using a ramping treadmill protocol, as we have previously described. These ramping protocols are designed to allow exercise durations of 8 to 12 min, with speed and incline increasing slowly every 15 s. The use of hand rails was discouraged during testing, and all tests were symptom limited, with test termination determined by patients’ symptoms (eg, severe fatigue, and greater than moderate level of angina or dyspnea), ST-segment depression of > 2 mm, severe hypertension, hypotension, or serious arrhythmias, as per standard recommendations from the American Heart Association/American College of Cardiology guidelines. Exercise capacity was estimated in metabolic equivalents (METs), using standard formulas based on maximal treadmill speed and incline. At the time of the treadmill test, age and gender were recorded, as were height and weight, in order to determine obesity status as determined by BMI criteria: obesity (BMI, ≥ 30 kg/m²); and severe obesity (BMI, ≥ 35 kg/m²).

**Statistical Analysis**

The baseline characteristics and exercise capacity of African-American and white patients were determined by nonpaired t and χ² analyses. Predictors of exercise capacity, including age, gender, BMI, and race were assessed using univariate and multivariate analyses. All data are presented as mean ± SD.

**Results**

**Patient Characteristics**

The average age of our cohort was 63 ± 11.5 years, including 70% men and 13% African-Americans (53% men). The average BMI was 28.4 ± 4.9 kg/m², and the average exercise capacity was 10.6 ± 3.6 estimated METs. Only 3% of patients had ECG evidence of left ventricular hypertrophy, and 11% of patients had ischemic ST-segment responses. There were no significant racial differences in these parameters.

**African-Americans vs Whites**

Comparing African-American and white men (Table 1), the African-American men were, on average, 3 years younger (p < 0.001), had a higher baseline BMI (p < 0.001), and a higher prevalence of obesity (p < 0.001) and severe obesity (p < 0.001). Exercise capacity, however, was 7% higher (p < 0.001) in white men compared with African-American men (Table 1, Fig 1).

Comparing African-American and white women (Table 1), the African-American women were, on average, 4 years younger (p < 0.001), had considerably higher BMI (p < 0.0001), and a considerably higher prevalence of obesity (p < 0.001) and severe obesity (p < 0.001). Despite being older, white women had a slightly higher exercise capacity (3%; difference not significant) than their African-American counterparts (Table 1, Fig 1).

Moreover, a higher percentage of African-Americans had a low exercise capacity (ie, [6 METs]) compared with whites (21% vs 14%, respectively;
p < 0.01), and a lower percentage of African-Americans had a very high exercise capacity (i.e., ≥ 13 METs) compared with whites (23% vs 34%, respectively; p < 0.01)

**Predictors of Exercise Capacity**

Exercise capacity was strongly and inversely related with age (Table 2, Fig 2). At any given age, exercise capacity was considerably higher in men than in women, and at most ages and in both genders, more so men, exercise capacity was slightly higher in whites than in African-Americans.

Exercise capacity was also inversely related with BMI (Table 2, Fig 3), but was less so than age and gender. At BMIs of < 30 kg/m², African-American men had a slightly lower exercise capacity than their white counterparts, although exercise capacity in both African-American and white obese men was similar. At any given level of BMI, African-American and white women had similar exercise capacities.

In multivariate analysis (Table 2), only slightly > 32% of exercise capacity was predicted by age, gender, BMI, and race. Younger age, male gender, and lower BMI were all independent predictors of higher exercise capacity (all p < 0.0001). Correcting for differences in age, gender, and BMI, white race was a weak ($r^2 = 0.004$), but statistically significant (p < 0.0001), predictor of higher exercise capacity.

**Discussion**

In the present study, we assessed an adult population being evaluated for CAD, and determined that African-American men and women are more obese and have lower exercise capacities, particularly in the men, than their white counterparts. Considerable data exist demonstrating that low cardiorespiratory fitness is a potent predictor of increased risk of premature death, which is mainly due to the increased cardiovascular mortality that has been noticed in unfit individuals.3–8 Population-based studies4–13 from the United States have suggested that the risk of death associated with low cardiorespiratory fitness or physical inactivity is comparable with that of conventional CAD risk factors, including tobacco abuse, hypertension, obesity, and diabetes mellitus, with the most striking differences in overall mortality rates observed when exercise capacity in-

![Figure 1](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/22019/)
increased from a very low level to the next lowest level in otherwise healthy subjects. These data suggest that the greatest health benefits can be achieved by increasing physical activity among patients who have the highest risk and the lowest exercise capacities. Blair and colleagues have demonstrated that exercise of at least moderate duration on an exercise treadmill test was associated with reduced cardiovascular and total mortality, whereas patients who achieved higher durations had only slight reductions in cardiovascular mortality. Importantly, data from this large cohort of men and women have demonstrated inverse associations for exercise capacity and cardiovascular diseases within categories of major CAD risk factors, including obesity.

Overall exercise capacity has also been demonstrated to have a very strong association with cardiac events and all-cause mortality in patients with known or suspected CAD. In one study, the risk of death among those with an exercise capacity of < 5 METs was nearly double the risk among those with peak functional capacities of ≥ 8 METs. In fact, overall exercise capacity has been the only treadmill exercise variable consistently associated with overall outcome, with its prognostic importance being of similar magnitude across a wide range of ages.

A substantial amount of data has indicated that Americans are becoming overweight at alarming rates, with 31% and 13%, respectively, of Americans classified as overweight and obese in 1960, which had increased to 35% and 26%, respectively, in 1999. During the past decade, the prevalence of class III obesity (i.e., BMI, ≥ 40 kg/m²) has tripled, from 0.78% in 1992 to 2.2% in 2000. The prevalence of overweight children in the United States increased between 1976 and 1980 and 1988 and 1994, and increased by > 10 percentage points between 1988 and 1994 and from 1999 to 2000, with the increase being more marked in Mexican-American and non-Hispanic black adolescents. These progressive increases in body weight are certainly not benign, since excess body weight has been shown to increase the risk of death from any cause, and particularly from cardiovascular disease, in adults between the ages of 30 and 74 years, although the relative risk associated with higher body weight is more pronounced in the younger subjects.

Although the risks associated with higher BMI may be more pronounced for whites than for African-Americans, the prevalence of obesity may be higher in African-Americans, and the risk of death from all causes, cardiovascular disease, cancer, and other diseases increases throughout the range of moderately and severely overweight individuals, both men and women, in all age groups. More recent data have indicated that obesity may lessen life expectancy markedly, especially among younger patients, including African-Americans.

In our patient population, we noted an extremely

<table>
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<th>Variable</th>
<th>Univariate Analysis</th>
<th>Multivariate Analysis</th>
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<tbody>
<tr>
<td></td>
<td>r Value  p Value</td>
<td>r² Value  p Value</td>
</tr>
<tr>
<td>Younger age</td>
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<td>0.14 &lt; 0.0001</td>
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<tr>
<td>Male gender</td>
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<tr>
<td>Lower BMI</td>
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<td>0.06 &lt; 0.0001</td>
</tr>
<tr>
<td>White race</td>
<td>0.10 &lt; 0.0001</td>
<td>0.004 &lt; 0.0001</td>
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Figure 2. Relationship between age and exercise capacity in African-American and white men and women. Exercise capacity was strongly and inversely related with age ($r = -0.35; p < 0.0001$)
high prevalence of obesity, which is considerably higher than the high levels noted in population-based studies. The higher prevalence of obesity in African-Americans, particularly African-American women, is consistent with that found in other studies, although, as mentioned previously, obesity may be less deleterious to the African-American population (especially to women) than to whites. There are some data that have suggested that there is a decline in physical activity during adolescence that may be partly responsible for the increasing prevalence of obesity, and this decline in physical activity may be more pronounced in African-Americans than in whites. We are not aware, however, of previous clinical studies from large populations of adult patients assessing exercise capacity in African-American and white men and women.

Several important study limitations should be emphasized. First, this study was not population-based but rather was conducted using those patients who had been referred for clinical exercise testing, so selection bias may be present. Despite being significantly younger in age, however, the African-American patients had lower exercise capacities than did the older white patients who had been referred for exercise testing. Second, the number of white patients studied was considerably greater than the number of African-Americans. Third, we utilized a database containing information in the stress test clinical report, so we did not have some pertinent clinical information on these patients, including, for example, symptomatic status, reason for referral, prevalence of hypertension and other CAD risk factors, and use of various medications. In addition, we do not know whether the patients had a history of CAD and whether there was a racial difference in the presence and severity of CAD. There is some evidence, however, that hypertension is more prevalent in African-Americans, whereas the prevalence of dyslipidemia is either similar in both races or possibly slightly more prevalent in whites than in African-Americans. Although we do not have definitive data on hypertension, dyslipidemia, or CAD, the prevalence of left ventricular hypertrophy (by ECG criteria) and ischemic ST-segment changes was statistically similar in African-American and white patients, suggesting that these groups were most likely similar regarding prevalence of severe hypertension and severe CAD. In addition, we do not have information on occupational (eg, white collar or blue collar), educational, or socioeconomic status, all of which could have an impact on workplace and leisure-time physical activity. Finally, we estimated exercise capacity indirectly in estimated METs, whereas the use of direct measures of oxygen consumption (or peak oxygen consumption) by cardiopulmonary exercise assessment has the advantage of providing a precise determination of levels of fitness. We have previously demonstrated that estimating exercise capacity in terms of estimated METs generally overestimates true exercise capacity as determined by measured METs during cardiopulmonary assessment, but this overestimation is more marked in younger patients compared with the older patients. The fact that the African-American patients were significantly younger than the white patients would suggest that this overestimation may have been even more marked in the African-American population.
ican group. However, to our knowledge, there are no data comparing the accuracy of standard formulas for estimating exercise capacity based on treadmill speed and incline across various races or other heterogeneous populations.

Despite these study limitations, we believe that our data demonstrate that in an adult population that had been referred for exercise stress testing, African-Americans are more obese and have significantly lower exercise capacity than their white counterparts. These data suggest that a greater emphasis needs to be placed on reducing weight and increasing physical fitness, particularly for the prevention of cardiovascular and other diseases in the African-American population.

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