Differences in Exercise Performance and Leisure-Time Physical Activity in Older Caucasians and African-Americans

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Abstract

Purposes: (a) To compare exercise performance and leisure-time physical activity (LTPA) between older Caucasians and African-Americans, (b) to assess the relationship between exercise performance and LTPA, and (c) to determine whether group differences in exercise performance persist after adjusting for differences in LTPA.

Methods: A total of 207 Caucasians and 160 African-Americans who were 65 years of age and older participated in this study. Subjects were characterized on exercise performance by a 6-minute walk test, and by a short physical performance battery (SPPB) score consisting of a repeated chair rise test, a standing balance test, and a 4-meter walk test. Additionally, LTPA was assessed using the Minnesota LTPA questionnaire.

Results: African-Americans had a 5% lower SPPB value (p < 0.009), a 14% shorter 6-minute walk distance (p < 0.001), and a 34% lower LTPA value (p < 0.020). LTPA was significantly related (p < 0.01) to both SPPB and 6-minute walk distance in both groups. Differences in SPPB and 6-minute walk distance between older Caucasians and African-Americans were no longer present (p > 0.05) after controlling for LTPA.

Conclusions: Older African-Americans had impaired exercise performance and lower LTPA compared to older Caucasians. Racial differences in exercise performance were no longer present after adjusting for differences in LTPA.

Introduction

Older African-Americans have up to 50% greater prevalence of disability than older Caucasians (1,2). The high prevalence of functional limitations (1), particularly lower body physical function (3), contribute to the relatively high disability rate in older African-Americans. These impairments in older African-Americans has been determined by self-report in most (1,3,4,) but not in all (5) investigations. Self-report measures are limited by reduced sensitivity to gradual functional loss in non-disabled older African-Americans who may experience subtle declines in exercise performance long before the development of physical disability. The short physical performance battery (SPPB) (6–10) and the 6-minute walk test (11–16) are two simple and objective measures of exercise performance. These measures are predictors of mortality (8,12), morbidity (8), loss of mobility (7,10), and nursing home admission (8).

Physical activity is one lifestyle modification that can decrease the risk of mortality (17,18), morbidity (17,19), development of disability (20–22), and decline in exercise performance (23,24) in older adults. Several studies report that older African-Americans have lower levels of leisure-time physical activity (LTPA) (5,25–29) and are less likely to walk at least eight blocks per week (30) than older Caucasians. However, it is not clear whether the racial differences in exercise performance are related to differences in LTPA.

The purposes of this study were to (a) compare exercise performance and LTPA between older Caucasians and African-Americans, (b) assess the relationship between exercise performance and LTPA in both groups, and (c) determine whether group differences in exercise performance persist after controlling for LTPA.
Methods

Subjects

Recruitment
A total of 367 subjects were recruited for this study via local newspaper advertisements for a free evaluation of exercise performance and physical activity levels. At the beginning of the study visit, subjects agreed to participate by signing the informed consent form approved by the Institutional Review Board at the University of Maryland, Baltimore.

Inclusion and exclusion criteria
To meet the inclusion criteria for this study, all subjects were 65 years of age and older, ambulatory, and lived independently at home. The exclusion criteria were evaluated by administering a medical history questionnaire. Subjects were excluded from this study for having a history of coronary artery disease, stroke, congestive heart failure, peripheral arterial disease, chronic obstructive pulmonary disease, and renal disease.

Measurements

Demographic information
Age, sex, race, education, cardiovascular disease risk factors, and co-morbid conditions were obtained during the medical history interview to begin the evaluation. Height was recorded from a stadiometer (SECA, Germany) and body weight was recorded from a balance beam scale (Health-O-Meter Inc., Bridgeview, IL) after the subjects removed their shoes. From these measurements, body mass index was calculated as follows: weight (kg)/height (m²).

SPPB
Exercise performance was measured by calculating the SPPB score based on the performance of completing a repeated chair rise test, a standing balance test, and a 4-meter walk test. For each of the three tests, subjects are scored on a 0 to 4 ordinal scale, with a score of 0 representing inability to perform the test, and scores between 1 and 4 representing quartiles of performance based on normative data on more than 5,000 community-dwelling people published from the Established Populations for the Epidemiologic Studies of the Elderly (8). The SPPB score is the sum of the three test scores ranging between 0 to 12, with a score of 0 representing the worst possible performance and a score of 12 representing the best possible performance. The SPPB score is a predictor of mortality, disability, and nursing home admission in older community-dwelling men and women (7,8,10). In a subsample of 44 subjects tested twice in our laboratory within two weeks, the test-retest intraclass reliability coefficient and coefficient of variation were 0.84 and 11.5% for the SPPB score.

Repeated chair rise
Lower extremity strength and balance were assessed by performing a repeated chair rise test in which subjects completed five sequential sit-to-stand transfers from an armless 18-inch high, straight-backed chair with their arms folded across their chest as previously described (31). Subjects were instructed to perform this test as quickly as possible, and were timed by a trained research technician with the aid of a stopwatch. In the subsample of 44 subjects, the test-retest intraclass reliability coefficient and coefficient of variation were 0.89 and 6.4% for the time to complete the repeated chair rise test.

Standing balance
Balance was assessed by measuring the time that subjects could hold a stance in side-by-side, semi-tandem, and full-tandem positions as previously described (32). Subjects stood in each of the three increasingly difficult positions for up to a maximum of 10 seconds, with brief rest periods separating the tests. A research technician timed the tests while standing next to the subject. The test-retest intraclass reliability coefficients for the time that subjects could stand in the three respective positions were 0.99, 0.99, and 0.95, and the coefficients of variation were 0.3%, 0.7%, and 3.2%.

4-Meter walking velocity
Walking velocity was assessed by measuring the time required for subjects to walk a distance of four meters marked out in a corridor at their usual pace (6). The subjects stood with their feet together behind the starting line, and were instructed to walk approximately one meter beyond the finish line to avoid slowing down prior to completing the test.
A research technician stood in the middle of the 4-meter course and began timing when one foot crossed the starting line and stopped timing when one foot crossed the finish line. The subjects performed two trials, and the faster of the two was used in the statistical analyses (8,10,33). The test-retest intraclass reliability coefficient and coefficient of variation were 0.96 and 2.4% for the velocity to walk four meters.

6-Minute walk test
In addition to the tests comprising the SPPB score, exercise performance also was determined by measuring ambulatory function during an endurance test. Subjects performed an over ground, 6-minute walk test supervised by a trained research technician as previously described (17). Briefly, two cones were placed 100 feet apart in a marked corridor. Subjects were instructed to walk as many laps around the cones as possible while the research technician timed the test using a stopwatch. The research technician stood at the center of the 100-foot course and provided encouragement every two minutes. Subjects were permitted to stop walking during the test, if necessary, and to resume walking as soon as they could. At completion of the test, the technician recorded the total distance walked. The test-retest intraclass reliability coefficient and coefficient of variation were 0.94 and 10.4% for the total distance covered during the 6-minute walk test (15).

LTPA
The Minnesota LTPA Questionnaire was administered to determine the activity level of the subjects over the preceding year (34). The Minnesota LTPA yields an average daily energy expenditure of physical activity (kcal/d). During a structured interview, subjects were asked whether they had performed various activities over the past year. For each activity performed, the frequency and duration were multiplied by the metabolic equivalent of the activity (i.e. the intensity) to obtain a yearly total of energy expenditure, which was subsequently divided by 365 to convert to a daily value. The Minnesota LTPA is highly correlated (r = 0.83) with the energy expenditure of physical activity (EEPA) derived by the DLW and indirect calorimetry methods in apparently healthy individuals (35). The test-retest reliability coefficient of this measure has ranged between 0.78 and 0.88 (36).

Statistical analyses
Unpaired t-tests and Chi-square tests were performed to assess whether differences existed between the older Caucasians and African-Americans on continuous and categorical data, respectively. Analysis of covariance (ANCOVA) was performed to assess group differences in exercise performance and LTPA after adjusting for significant demographic characteristics. Pearson product-moment correlation coefficients and Spearman rank-order correlation coefficients were calculated to determine the association between exercise performance and LTPA. All analyses were performed using the SPSS-PC statistical package (version 11.5). Statistical significance was set at p < 0.05. Measurements are presented as means ± SD.

Results
The demographic measurements of the older Caucasians and African-Americans are displayed in Table 1. The two groups were similar on all characteristics (p > 0.05) except that a higher percentage of Caucasians had a high school degree than African-Americans (p < 0.05).

The exercise performance and LTPA measurements of the older Caucasians and African-Americans, adjusted for education level, are shown in Table 2. African-Americans had a 5% lower SPPB score (p < 0.009), and 11% lower performance score for repeated chair rise (p < 0.046), and a 5% lower performance score for walking velocity (p < 0.001) than Caucasians. Additionally, African-Americans had a 14% shorter 6-minute walk distance (p < 0.001), and were 34% less physically active (p < 0.020) than Caucasians.

The correlation coefficients between exercise performance and LTPA in the older men and women are displayed in Table 3. LTPA was significantly related (p < 0.01) to each exercise performance measure within each group, as well as in a combined group. Group differences in the exercise performance measures between older Caucasians and African-Americans were no longer present (p > 0.05) after controlling for LTPA and education level (Table 4).
The older African-Americans in this study had a 5% lower SPPB score than the older Caucasians. Consequently, the lower exercise performance of non-disabled older African-Americans suggests that they are at greater risk for subsequent disabling and co-morbid conditions, nursing home admission, and mortality than their Caucasian counterparts (7,8,10,37). The lower SPPB score of the African-Americans resulted from lower performance values in the repeated chair rise and walking velocity components. Thus, older African-Americans had impaired exercise performance in the domains of lower extremity strength and ambulation compared to older Caucasians. These findings are in agreement with a study that reported a 21% and 22% lower SPPB score in older African-American men and women than in older Caucasian men and women, respectively (5). Furthermore, other studies indicate that older African-Americans self-report greater lower body disability (20,29), worse physical function (3), greater impairment in activities of daily living (29), and lower likelihood of walking at least eight blocks (30) or one mile (20,29) than older Caucasians.

In addition to the SPPB score and its components, the older African-Americans in this investigation covered a 14% shorter distance during the 6-minute walk test than the older Caucasians. This finding indicates that the older African-Americans had impaired ambulatory function during an endurance-related test. The shorter walking distance of the older African-Americans may be related to lower cardiopulmonary fitness (15,38) as well as impaired lower extremity strength (11). The greater impairment in the repeated chair rise task by the African-Americans in the present investigation and in a previous report (5) supports the notion that their lower 6-minute walk distance may have been partially due to impaired lower extremity strength.

### Table 1. Demographic measurements of older caucasians (n = 207) and African-Americans (n = 160). Values are means (SD) and percentages.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Caucasian</th>
<th>African-American</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>71 (4)</td>
<td>71 (4)</td>
<td>0.689</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>171.6 (8.8)</td>
<td>170.5 (9.3)</td>
<td>0.551</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>84.1 (15.1)</td>
<td>85.2 (15.6)</td>
<td>0.287</td>
</tr>
<tr>
<td>Body mass index</td>
<td>28.4 (4.1)</td>
<td>29.3 (4.7)</td>
<td>0.181</td>
</tr>
<tr>
<td>Sex (% Men)</td>
<td>62</td>
<td>60</td>
<td>0.312</td>
</tr>
<tr>
<td>Smoking (% Never)</td>
<td>52</td>
<td>56</td>
<td>0.171</td>
</tr>
<tr>
<td>(%) Former</td>
<td>42</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>(%) Current</td>
<td>6</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Diabetes (%)</td>
<td>11</td>
<td>20</td>
<td>0.078</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>48</td>
<td>62</td>
<td>0.160</td>
</tr>
<tr>
<td>Hyperlipidemia (%)</td>
<td>42</td>
<td>40</td>
<td>0.793</td>
</tr>
<tr>
<td>High school degree (%)</td>
<td>83</td>
<td>58</td>
<td>0.004</td>
</tr>
</tbody>
</table>

### Table 2. Exercise performance and leisure-time physical activity measurements of older caucasians (n = 207) and African-Americans (n = 160). Values are Means (SD).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Caucasian</th>
<th>African-American</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPPB score (0–12 scale, 12 = best)</td>
<td>10.4 (1.2)</td>
<td>9.9 (1.3)</td>
<td>0.009</td>
</tr>
<tr>
<td>Repeated chair rise score (0–4 scale, 4 = best)</td>
<td>2.7 (1.1)</td>
<td>2.4 (1.1)</td>
<td>0.046</td>
</tr>
<tr>
<td>Standing balance score (0–4 scale, 4 = best)</td>
<td>3.8 (0.6)</td>
<td>3.8 (0.4)</td>
<td>0.937</td>
</tr>
<tr>
<td>Walking velocity score (0–4 scale, 4 = best)</td>
<td>3.9 (0.2)</td>
<td>3.7 (0.3)</td>
<td>0.001</td>
</tr>
<tr>
<td>6-Minute walk distance (meters)</td>
<td>487 (99)</td>
<td>420 (91)</td>
<td>0.001</td>
</tr>
<tr>
<td>Leisure-time physical activity (kcal/d)</td>
<td>245 (234)</td>
<td>162 (168)</td>
<td>0.020</td>
</tr>
</tbody>
</table>

**Abbreviation:** SPPB: short physical performance battery.

*Values adjusted for education level.
The older African-Americans in this study were 34% less physically active than compared to the older Caucasians, supporting the findings of previous investigations (25–29). Data from the third National Health and Nutritional Examination Survey indicate that the age-adjusted prevalence of not participating in LTPA was higher in African-Americans (35%) than in Caucasians (18%) (26), and that the prevalence of participating in LTPA at least five times per week was lower in older African-Americans than in older Caucasians (25). Furthermore, fewer older African-Americans report regularly exercising (20,29) or getting enough exercise (29). In a recent investigation assessing the physical activity during the previous seven days with a questionnaire, older African-American men and women reported 39% and 31% less physical activity than their Caucasian counterparts, respectively (5). Consequently, the 34% lower level of LTPA in the older African-Americans in this investigation confirms previous studies, and may negatively impact on their exercise performance and increase the risk of future disability.

LTPA was significantly related to each exercise performance measure in Caucasians, African-Americans, and a combined group in this investigation. This finding suggests that LTPA was equally important in maintaining components of exercise performance (lower extremity strength, balance, and ambulation) in older Caucasians and African-Americans. Furthermore, the strength of association between LTPA and 6-minute walk distance was higher in the older African-Americans than in the Caucasians, suggesting that a physically active lifestyle is particularly important in maintaining ambulatory function in older African-Americans. This notion is supported by a longitudinal study that found walking at least four times per week had a greater protective effect against an increase in lower body disability in older African-Americans than in older Caucasians (20).

Differences in all of the exercise performance measurements between the Caucasians and African-Americans were no longer present after controlling for LTPA, suggesting that the lower exercise performance of older African-Americans was explained

<p>| Table 3. Correlation coefficients of exercise performance variables with leisure-time physical activity in older caucasians (n = 207), African-Americans (n = 160), and in a combined group (n = 367). |
|---------------------------------|----------------|----------------|----------------|</p>
<table>
<thead>
<tr>
<th>Exercise performance variables</th>
<th>Caucasian</th>
<th>African-American</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPPB score</td>
<td>0.35*</td>
<td>0.37*</td>
<td>0.37*</td>
</tr>
<tr>
<td>Repeated chair rise score</td>
<td>0.23*</td>
<td>0.31*</td>
<td>0.26*</td>
</tr>
<tr>
<td>Standing balance score</td>
<td>0.37*</td>
<td>0.20*</td>
<td>0.35*</td>
</tr>
<tr>
<td>Walking velocity score</td>
<td>0.23*</td>
<td>0.30*</td>
<td>0.27*</td>
</tr>
<tr>
<td>6-Minute walk distance</td>
<td>0.31*</td>
<td>0.60*</td>
<td>0.37*</td>
</tr>
</tbody>
</table>

Abbreviation: SPPB: short physical performance battery.
*P < 0.01.

<p>| Table 4. Adjusted* exercise performance measurements of older caucasians (n = 207) and African-Americans (n = 160). values are means (SD). |
|---------------------------------|----------------|----------------|----------------|</p>
<table>
<thead>
<tr>
<th>Variables</th>
<th>Caucasian</th>
<th>African-American</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPPB score (0–12 scale, 12 = best)</td>
<td>10.2 (1.2)</td>
<td>10.1 (1.3)</td>
<td>0.240</td>
</tr>
<tr>
<td>Repeated chair rise score (0–4 scale, 4 = best)</td>
<td>2.6 (1.1)</td>
<td>2.5 (1.1)</td>
<td>0.341</td>
</tr>
<tr>
<td>Standing balance score (0–4 scale, 4 = best)</td>
<td>3.8 (0.6)</td>
<td>3.8 (0.4)</td>
<td>0.750</td>
</tr>
<tr>
<td>Walking velocity score (0–4 scale, 4 = best)</td>
<td>3.8 (0.2)</td>
<td>3.8 (0.3)</td>
<td>0.812</td>
</tr>
<tr>
<td>6-Minute walk distance (meters)</td>
<td>478 (99)</td>
<td>468 (91)</td>
<td>0.452</td>
</tr>
</tbody>
</table>

Abbreviation: SPPB: short physical performance battery.
*Values adjusted for education level and leisure-time physical activity.
by their lower level of LTPA. Therefore, identifying barriers to physical activity and developing interventions to increase physical activity in older, non-disabled African-Americans may have a significant impact on their exercise performance and reduce the risk of subsequent disability.

Although the results of this study suggest that differences in exercise performance between older Caucasians and African-Americans were related to differences in LTPA, several limitations exist. The cross-sectional design of this study does not infer a cause and effect relationship between LTPA and exercise performance. Although it is possible that a low level of LTPA leads to low exercise performance, it is also plausible that low exercise performance results in low LTPA in older Caucasians and African-Americans. Additionally, the assessment of physical activity was obtained via questionnaire, and therefore is subject to inherent limitations such as recall errors and bias. However, the Minnesota LTPA questionnaire is a reliable and valid measure of daily physical activity in older adults (35). The primary strengths of this study include a relatively large sample of older Caucasians and African-Americans who were well-characterized on a number of measurements to quantify exercise performance.

In summary, the major findings of this investigation were: (a) older African-Americans were 5–28% lower on measures of exercise performance and were 34% less physically active than compared to older Caucasians, (b) physical activity was significantly related to each measure of exercise performance, and (c) the exercise performance of older African-Americans was similar to that of older Caucasians after adjusting for group differences in LTPA. In conclusion, older African-Americans had impaired exercise performance and lower LTPA compared to older Caucasians. Furthermore, racial differences in exercise performance were no longer present after adjusting for differences in LTPA.

Acknowledgments

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References

Racial differences in exercise and activity


