

# REDUCED CARDIOVASCULAR FITNESS AND AMBULATORY FUNCTION IN BLACK AND WHITE STROKE SURVIVORS

**Objectives:** To test the hypothesis that quantitative measures of cardiovascular fitness and ambulatory function differ in Black and White hemiparetic stroke survivors.

**Design:** Cross-sectional analysis.

**Setting:** Outpatient academic medical center.

**Participants:** Total of 118 hemiparetic stroke survivors.

**Main Outcome Measures:** Cardiovascular fitness was measured as  $VO_2$  peak and ambulatory function using the six-minute walk distance and 30-foot walking velocity in medically screened, community-dwelling stroke survivors.

**Results:** In 118 subjects (56% Black and 44% White), no differences were seen in 1)  $VO_2$  peak between Black or White men ( $15.0 \pm 4.3$  vs.  $15.1 \pm 3.9$  mL/kg/minute) or women ( $11.5 \pm 2.7$  vs.  $12.3 \pm 3.7$  mL/kg/minute); 2) six-minute walk distance between Black or White men ( $223 \pm 112$  m vs  $226 \pm 132$  m) or women ( $198 \pm 100$  vs  $157 \pm 93$  m); or 3) 30-foot walking velocity between Black or White men ( $0.60 \pm 0.27$  m/second vs  $0.61 \pm 0.31$  m/second) or women ( $0.50 \pm 0.21$  m/second vs  $0.41 \pm 0.23$  m/second).

**Conclusion:** No racial differences were seen in the degree of physical deconditioning in a selected population of community dwelling hemiparetic stroke survivors. (*Ethn Dis.* 2007;17:682–685)

**Key Words:** Hemiparetic, Stroke Outcome, Physical Fitness, Racial Differences

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## INTRODUCTION

Stroke is the third leading cause of death and the main cause of long-term disability in older Americans. Blacks have more than twice the age-adjusted death rate and estimated years of potential life lost from stroke than Whites.<sup>1–3</sup> This higher prevalence and death rate are attributed to an increase in cardiovascular disease risk factors, specifically hypertension, diabetes, and cigarette smoking, which are associated with more severe strokes, coma, and longer hospitalization in Blacks.<sup>4</sup> Stroke is expensive, and it will cost an estimated \$57.9 billion in direct and indirect medical costs in 2006.<sup>5</sup> Disability is common after stroke, and its costs are substantial. Consequently, rehabilitation to promote recovery and functional independence is a critical component of care after stroke.

The National Health Interview Study data show that Black stroke survivors are more physically and functionally limited than White stroke survivors.<sup>6</sup> Studies using the Barthel Index and other self-report questionnaires of activities of daily living show similar performance of activities of daily living by race in stroke survivors.<sup>7</sup> However, in a cohort evaluated 180 days after stroke using the more objective Fugl-Meyer assessment, the Black stroke patients had a 9% higher median level of physical impairment than Whites, indicating greater clinically relevant disability.<sup>8</sup> This result suggests that Blacks suffer worse impairment after stroke. However, few quantitative studies involving direct

assessment examine racial differences in post-stroke physical function. This study examines the hypothesis that Blacks have lower cardiovascular fitness and have poorer ambulatory function after hemiparetic stroke than Whites. These results could have implications for the quality of life and healthcare costs in Black patients with stroke. To test this hypothesis, cardiovascular fitness was assessed with  $VO_2$  peak,<sup>9</sup> and ambulatory function with six-minute walk distance and 30-foot walking velocity in a racially mixed sample of stroke survivors who were recruited and qualified for participation in an exercise rehabilitation study.

## METHODS

For this cross-sectional analysis, baseline data were collected from a racially mixed, community dwelling population of 118 men and women in the chronic phase of stroke recovery with residual hemiparetic gait. Recruitment (July 1997–June 2005) was from hospital neurology clinics and private practices in Maryland for participation in a study examining the effects of treadmill exercise training on physical function.<sup>10</sup> The institutional review

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**Table 1. Subject characteristics and physical function**

Characteristic	Blacks (n=66)	Whites (n=52)
Age (years)	62±8	66±9*
Duration from stroke (months)	47±57	44±54
Body mass index (kg/m <sup>2</sup> )	29.2±6.0	27.9±4.4
Current smoker	9 (14%)	7 (13%)
Diabetes mellitus	19 (29%)	17 (33%)
Hypertension	55 (83%)	34 (65%)*
Myocardial infarction	4 (6%)	7 (13%)
Education (median)	Some college (n=55)	Some college (n=49)
Income (median)	\$11,000–\$20,000 (n=40)	\$21–30,000 (n=42)
30-foot walk velocity (m/second)†	.56±.25	.54±.30
6-minute walk distance (m)‡	214±108	201±123
VO <sub>2 peak</sub> (mL/kg/minute)§	13.7±4.2	14.0±4.0
Functional aerobic impairment (%)	52.2±14.0	58.3±16.2

\* *P*<.05

† Gait speed in healthy men and women: 1.2–1.5 m/second.<sup>17</sup>

‡ Six-minute walk distance in healthy men and women: 400–700 m.<sup>12</sup>

§ VO<sub>2 peak</sub> in healthy men and women: 22–35 mL/kg/minute.<sup>18</sup>

board approved the protocol, and subjects provided written informed consent. A total of 357 consecutive subjects underwent screening evaluations, and 207 were excluded because of regular exercise (n=9); neurological (n=66), medical (n=63), or transportation problems and loss to follow-up (n=69). Neurological reasons for exclusion included severe aphasia, dementia, untreated depression, and marked deficits precluding treadmill exercise. Medical reasons included symptoms of heart failure, unstable angina, peripheral arterial occlusive disease, and other medical conditions precluding participation in exercise treadmill training.<sup>11</sup> An additional 32 were not included in this analysis because of Hispanic origin (n=2), failure to identify race (n=2), and incomplete baseline data (n=28).

Body mass index (BMI) was calculated as weight divided by height squared. Information about education and income were obtained from categorical choices contained in self-report surveys. Education choices included grade school, some high school, high school, vocational school, some college, associate's, bachelor's, master's, and doctorate degree. Income choices included <\$11,000, \$11,000–\$20,000,

\$21,000–\$30,000, \$31,000–\$40,000, \$41,000–\$50,000 and >\$50,000. Subjects capable of walking three minutes at 0.13 m/second or faster without electrocardiographic evidence of ischemia or symptoms underwent a peak symptom-limited treadmill test to assess gait safety and measure VO<sub>2 peak</sub>.<sup>10</sup> Functional aerobic impairment was calculated as the ratio of VO<sub>2 peak</sub> to predicted VO<sub>2 max</sub> for age and gender matched healthy sedentary adults.<sup>10</sup> For the six-minute walk distance, subjects were instructed to cover as much distance as possible walking on a level hallway for six minutes.<sup>12</sup> The average time, for three trials, required for subjects to walk a 30-foot walkway at their self-selected comfortable walking speed determined the 30-foot walk velocity.<sup>13</sup>

**Statistical Analysis**

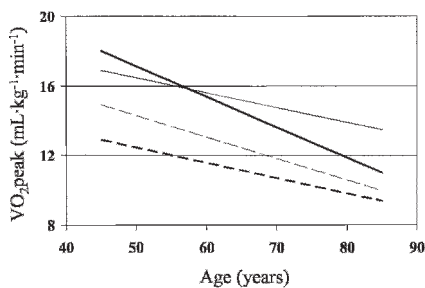
Analysis of variance (ANOVA) was used to determine difference between groups for age, duration from stroke, body mass index, VO<sub>2 peak</sub>, six-minute walk distance, 30-foot walking velocity and functional aerobic impairment. Wilcoxon signed rank tests were used for the nonparametric variables comorbidities, education, and income. (SPSS version 13.0). Analyses of car-

diovascular fitness and ambulatory function were sex-specific and adjusted for age. Data are presented as means plus or minus standard deviations. The level of significance was two-tailed at *P*<.05.

**RESULTS**

Subject demographics and functional characteristics for 118 subjects enrolled in a treadmill training exercise protocol revealed that the Black stroke survivors were younger than White stroke survivors (*P*<.05) and that more Black subjects had hypertension than did White subjects (*P*<.05; Table 1). Other co-morbidities were similar between groups. No significant difference was seen in duration from stroke or median education and income levels between groups. Cardiovascular fitness and physical function did not differ between Blacks and Whites.

Cardiovascular fitness decreased with age (Figure 1). VO<sub>2 peak</sub> values were lower for women than for men. No significant differences were seen in 30-foot walking velocity, six-minute walk distance, VO<sub>2 peak</sub>, or functional aerobic impairment between Black and White subjects (Table 2).



**Fig 1. Relationship of cardiovascular fitness to age in stroke subjects. Regression lines for VO<sub>2</sub> peak data for Black men (thick solid line), White men (thin solid line), Black women (thick dashed line) and White women (thin dashed line) are shown**

## DISCUSSION

This study used objective, quantitative functional measures to test the hypothesis that ambulatory function and cardiovascular fitness differ by race in community-dwelling hemiparetic stroke survivors. Although the study enrolled a small number of subjects compared to cardiopulmonary or epidemiology studies, this database represents one of the largest groups of biracial stroke survivors undergoing a systematic measurement of cardiovascular fitness and gait deficit severity. The data confirm an increased prevalence of hypertension in Blacks compared to Whites.<sup>14</sup> Most importantly, the data show that Black stroke survivors do not have lower cardiovascular fitness and ambulatory capacity than Whites.

Our results demonstrating that cardiovascular fitness and ambulatory function are comparable in Blacks and Whites differ from findings of greater disability in blacks in larger epidemio-

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logic studies. Traditionally, these studies use the Barthel Index<sup>6</sup> or Fugl-Meyer.<sup>8</sup> The dichotomy is possibly due to the quantitative measurement of VO<sub>2</sub> peak to quantify oxygen consumption during maximal exercise and the 30-foot walking velocity and six-minute walk distance to assess ambulatory function.

The failure to find racial differences in functionality could be due to selection bias inherent in the study of community-dwelling stroke survivors volunteering for an exercise intervention. Consequently, more severely impaired subjects, irrespective of race, may be underrepresented. Additional study limitations include the cross-sectional design, limited transportation for participants, and relatively small sample size. Nevertheless, inclusion criteria were similar; hence, we believe our sample was representative of the population of Black and White stroke subjects who would be interested in further rehabilitation for their functional disabilities. Several studies show ethnicity is not a significant factor in determining willingness to enroll in rehabilitation.<sup>15,16</sup> As education, income, and function levels were similar in this cohort, racial differences in

function found in other studies could be due to differences in education and income and other psychosocial reasons. Larger community-based studies using more quantitative measures, in addition to questionnaire-based measures of functionality, would address these issues.

From a population-based perspective, these results indicate that stroke survivors are markedly deconditioned and have poor ambulatory function independent of race. In a subset of subjects, function as assessed by the Barthel, Rivermead mobility, Frenchay and Stroke Impact Scale mobility subscale (Patterson, Goldberg, Macko unpublished data) was also similar for Blacks and Whites. It was recently reported that six months of treadmill aerobic training can significantly improve VO<sub>2</sub> peak and ambulatory function in older stroke survivors 6 to 288 months after stroke.<sup>10</sup> These results highlight the potential for meaningful recovery in the chronic period in both Blacks and Whites. The potential for exercise training to improve mobility, endurance, and strength, as well as reduce the risk of recurrent stroke, has been well established. Thus, assertive exercise rehabilitation regardless of race has implications for the reduction of progressive disability and risk for long-term care facing stroke survivors.

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**Table 2. Cardiovascular fitness and physical function**

	Black Men (n=41)	Black Women (n=25)	White Men (n=33)	White Women (n=19)
30-foot walk velocity (m/second)	.60±.27	.50±.21	.61±.31	.41±.23
Six-minute walk distance (m)	223±112	198±100	226±132	157±93
VO <sub>2</sub> peak (mL/kg/minute)	15.0±4.3	11.5±2.7	15.1±3.9	12.3±3.7
Functional aerobic impairment (%)	50.0±13.8	55.8±13.7	54.2±14.0	65.3±17.8

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**AUTHOR CONTRIBUTIONS**

*Design concept of study:* Macko, Goldberg  
*Acquisition of data:* Macko, Goldberg  
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*Manuscript draft:* Hinson, Patterson, Macko, Goldberg  
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*Acquisition of funding:* Macko, Goldberg  
*Administrative, technical, or material assistance:* Macko, Goldberg  
*Supervision:* Macko, Goldberg