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Physical Function and Health-Related Quality-of-Life in a Population-Based Sample

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Abstract

Background—It is of interest to understand whether impaired physical function is associated with health-related quality of life (HRQOL). We examined upper and lower body physical function and its relationship with two domains of HRQOL among men.

Methods—We conducted a population-based observational study of musculoskeletal health among Boston, MA residents, the Boston Area Community Health/Bone Survey. Participants were 1,219 randomly-selected Black, Hispanic, and White males (30–79 years). Upper body function was measured using hand grip strength, while lower body function was measured by combining a timed walk and a chair stand test. HRQOL was measured using the physical (PCS-12) and mental health (MCS-12) component scores of the SF-12. Multivariate linear regression models were used to estimate the association between poor function and HRQOL.

Results—There was a significant association of poor upper body physical function with the MCS-12 (beta coefficient: -4.12 , $p=0.003$) but not the PCS-12 (beta coefficient: 0.79 , $p=0.30$) compared to those without poor function. Those with poor lower body physical function had significantly lower PCS-12 scores (beta: -2.95 , $p=0.007$), compared to those without poor function, but an association was not observed for MCS-12 scores.

Conclusions—Domains of physical function was not consistently related to domains of HRQOL.

Keywords

aging; frail older adults; epidemiology; quality of life; muscle strength

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Introduction

As the U.S. population grows older, frailty in older persons is of increasing public health importance. Although research definitions of frailty are not yet supported by consensus,¹ frailty as a general concept (variously defined) has been associated in recent studies with an increased risk of falls, fracture, and mortality.^{2–5} Low muscle mass and impaired physical function, important components of frailty,⁶ have also been independently linked with adverse health outcomes.^{7–9} Because of greater survivorship of women at older ages, there has been a logical research emphasis on frailty in women, with fewer studies of men.¹⁰

The ‘upstream’ experience of low muscle strength, impaired physical function, and frailty in aging men deserves additional research attention in order to discover possible points of intervention. Associations with health care utilization may reveal opportunities for intervention by the provider, if the impaired individuals are attending health care regularly. It is also of interest to understand whether any adverse effects of low muscle strength, impaired physical function, and frailty on quality-of-life are independent of age-related comorbidity. While a person’s medical history is not modifiable, low muscle strength and frailty in older adults may be improved by physical exercise training^{11–13} or nutritional supplementation¹⁴ and these may be potential routes to improvement of quality-of-life among older persons with impaired physical function.

Our primary objectives in this study were 1) to describe the characteristics of men with physical function impairments in the upper and lower body, and their health-related quality-of-life (HRQOL) in two domains (mental and physical); and 2) to determine whether upper and lower body physical function are independently associated with quality-of-life after adjustment for comorbidities in multivariate models. We also sought to describe access to and use of medical care by physical function group in order to understand whether men with more or less physical function had barriers to care, or if they were accessible for clinical interventions.

Methods

Study design and data collection

Data were obtained from men enrolled in the Boston Area Community Health (BACH)/Bone Survey, which is a cross-sectional observational study of musculoskeletal health and related outcomes in 1,219 (of 1,877 eligible, 65% response rate) randomly-selected Black (n=363), Hispanic (n=397), and White (n=449) male Boston, MA residents aged 30 to 79 years. BACH/Bone subjects were a subset of 2,301 men previously enrolled in the parent Boston Area Community Health (BACH) Survey. The participation rates from BACH to BACH/Bone by race/ethnicity were 64.3% (Black), 62.0% (Hispanic), and 68.4% (White). Persons of other racial/ethnic backgrounds were not enrolled. Data for BACH/Bone were collected during 2002–2005; study protocols were approved by Institutional Review Boards at New England Research Institutes (NERI) and Boston University School of Medicine (BUSM). All participants gave written informed consent separately for participation in each study. Further details regarding the parent BACH study and the BACH/Bone Survey are available.^{15 16}

Measurement of physical function

We measured upper body physical function using hand grip strength as measured by a Jamar Hydraulic Hand Dynamometer (Sammons Preston, Bolingbrook, IL), which measures isometric grip force. Subjects were instructed to exert maximum effort for three seconds twice, with each effort separated by a 1-min rest. The maximum of the two results was used for analysis. In this analysis, we defined poor upper body physical function as men falling

into the lowest 20% of maximum grip strength within their decade of age: (30–39: <33 kg; 40–49: <31 kg; 50–59: <31 kg; 60–69: <27 kg; 70+: <23 kg) vs. men falling into upper quintiles (hereinafter, ‘normal’).

Methods to construct a composite physical function variable were adapted from methods developed for a previous study.⁸ Lower body physical function was measured through a combination of two tests: a timed walk test (time needed to walk 50 ft or 15.24 meters) and a chair stand test (time needed to stand up and sit down five times with arms folded). Those completing the walk and chair stand tests were assigned scores corresponding to the quartiles (derived from the population of the current study) of speeds in completing each task, with the fastest speeds scored 4 for chair stand test and 3 for walk speed. Those unable to complete the chair stand and walk test were assigned a score of 0 for that component. The two results from the walk and chair tests were summed to a final score with a possible range of 0 to 7, with higher scores indicating better physical function. The lowest 20% of scores in BACH/Bone men were determined within decade of age (30–39: <3; 40–49: <2; 50–59: <2; 60–69: <2; 70+: <1) and those who fell into the lowest quintile were considered to have poor lower body function in their lower extremities vs. men falling into upper quintiles (hereinafter, ‘normal’).

HRQOL measures—HRQOL was assessed using the Medical Outcomes Study 12-item Short Form Survey (SF-12).¹⁷ We considered both the physical health component score (PCS-12) and mental health component score (MCS-12) to understand separate domains of HRQOL; these scores are standardized to have a mean (standard deviation) of 50 (10) among U.S. adults, with higher scores indicating a better HRQOL.

Covariates

Demographic, anthropometrics, comorbidities, medications, and care-seeking variables—Racial/ethnic groups were self-identified by participants and classified using the Office of Management and Budget categories,¹⁸ and were considered in order to measure health disparities. We examined two measures related to poverty and socioeconomic position. Socioeconomic status (SES) was constructed as function of standardized income and education variables for the Northeastern U.S. and reclassified into low, middle and high.¹⁹ Based on an approximation of the 2003 U.S. Census poverty thresholds,²⁰ we created a variable for ‘living in poverty’ using household size and income thresholds as follows: household sizes of 1–2 persons with incomes of <\$10,000 annually, household sizes of 3–6 with incomes of <\$20,000 annually, household sizes of 7–8 making <\$30,000 annually, and household sizes of 9–11 making <\$40,000 annually were defined as living in poverty; households of the same size earning above these thresholds were considered not impoverished. Body mass index (BMI) was constructed from interviewer-measured weight in kilograms divided by interviewer-measured height in meters squared, and was categorized into three groups (underweight, <18.5 kg/m², normal 18.5–<25.0 kg/m², overweight 25.0–<30.0 kg/m², and obese 30.0+ kg/m²).²¹ Due to the small number of subjects with BMI <18.5 kg/m², underweight and normal BMI categories were combined except for descriptive analyses. Comorbidities were selected based on examination of observed associations with HRQOL in our data, and the potential to be a confounder of the physical function-HRQOL relationship. Except for depression, the presence of comorbidities were based on replies to the query, “Have you ever been told by a health care provider that you have or had...?” We included cardiac disease, vascular disease, stroke, diabetes (type I or type II, hereinafter, ‘diabetes’), high blood pressure, chronic lung disease, arthritis, and kidney disease. Depression was considered present among participants reporting having at least five of eight symptoms in the past week on the abridged Center for Epidemiologic Studies Depression Scale.²² Health care access and utilization were measured using the

following questions: “How many times in the last year did you go to see a health care provider for any reason?” and “Do you go for regular care?”, as well as the health insurance status of the participant (public only/private/none) and whether or not the participant reported trouble paying for health care and/or medications (yes vs. no).

Medications

Participants were asked to gather all medications used in the past four weeks for recording of the label information by the interviewer. Participants were also asked separately if they were taking drugs for specific indications, e.g., high blood pressure. Medications labels and/or responses were coded using the Slone Drug Dictionary,²³ which classifies drug components using a modified form of the American Hospital Formulary Service Drug Pharmacologic Therapeutic Classification System.²⁴ The proportion of persons using a count of four or more prescription medications (as an indicator of polypharmacy) was estimated.

Analytic sample

Of the 1,219 men in BACH/Bone, three were excluded for missing HRQOL measures, 10 were missing lower body physical function measures, while 189 were missing the upper body physical function measure. Due to a strong influence of Parkinson’s disease and multiple sclerosis on both physical function and quality-of-life, we excluded four men who reported having these conditions. Our resulting analysis sample was 1,013 men or 83% of BACH/Bone participants.

Statistical Analysis

Due to the complex two-stage cluster sampling design, all analyses were weighted inversely proportional to the probability of being selected, and were conducted in 2009 using version 9.0.1 of SUDAAN.²⁵ This ensures that estimates may be interpreted as representative of the community-dwelling Boston, MA population. To examine statistically significant differences in bivariate analyses, a chi-square test was performed for categorical covariates and a Wald-type test from linear regression was used for continuous variables. To examine the impact of physical function on HRQOL, we applied multiple linear regression models using the PCS-12 and MCS-12 scores as outcome variables (separately). Models were always adjusted for age group and race/ethnicity (as study design variables) and confounding covariates including socioeconomic status, marital status, and comorbidities. We adjusted for depressive symptoms in the model for PCS-12 but not MCS-12 because of the interrelationship between depression and mental health quality-of-life and the potential for ‘overadjustment’. Consistent with the goals of our study to understand the independent contribution of physical function on HRQOL in two domains, the goal of model-building was to build the most parsimonious model that controlled for confounding of the ‘main effects’ examined (poor upper body physical function only, poor lower body physical function only, poor function at both sites vs. none as referent) and the PCS-12 and MCS-12 outcomes. A covariate was defined as a confounder and retained in the model if it changed an association by 15% or more.²⁶

Results

Distributions of characteristics of our study population overall and by status of upper and lower body physical function (poor upper body function, poor lower body function, both poor, normal) are shown in Tables 1 and 2. The mean age of our sample was 47.2 y. Approximately one-third of those with poor upper body function had poor lower body function (Table 1). Black participants, who comprised 25.7% of the sample, comprised 39.6% of those with poor lower body physical function site and 36.6% of those with poor

function at both sites. Men with poor upper body physical function had the lowest proportion of obesity by BMI (28.5%), while men with poor lower body function had the highest (42.2%). Less than 1% of our sample was underweight (BMI <18.5), but all underweight men had either poor upper or lower body physical function. Nine percent of men with both poor upper and lower physical function were underweight. The mean MCS-12 score representing mental health HRQOL was lowest among those with poor upper body function (48.7 ± 11.1), while the mean PCS-12 score representing physical health HRQOL was lowest among those with poor lower body function (46.6 ± 11.7).

Considering SES-related and health care utilization variables, SES differences were more pronounced for men with poor lower body function than poor upper body function when compared to those with normal function (Table 2). Most men with poor lower body function were of middle or low SES, and 27.5% were living at or below the poverty level. Of the physical function groups, the highest proportion of low SES (48.5%) and poverty (36.9%) was observed in the group with poor function at both sites. Men with poor lower body function reported the highest prevalence of trouble paying for health care (25.6%), followed by men with poor function at both sites (21.4%). More men with poor lower body function and poor function at both sites were on public insurance compared to the other physical function groups, and most appeared to have adequate access to care. More than 75% of these groups reported receiving regular care, with medians of 4 and 8 provider visits reported annually for those with poor lower body function and poor function at both sites, respectively. There was a general pattern of higher comorbidity among those with any poor physical function, with the prevalence of most comorbidities markedly higher among those with poor function at both sites compared to those with normal function (with some exceptions). In this comparison, differences were especially pronounced for depression symptoms, diabetes, and stroke. Men with poor lower body physical function or poor function at both sites were more likely to be taking four or more prescription drugs compared to normal men.

Multivariate linear modeling results for the association between physical function and quality-of-life scales are presented in Tables 3–4. Depressive symptoms, diabetes and vascular diseases were confounders of the physical function and physical HRQOL association, and were included in the model (Table 3). In this model, compared to normal function, the adjusted beta coefficients for PCS-12 score were significantly lower for poor lower physical function (-2.95 , $p<0.01$) but not poor upper body function (0.79 , $p=0.30$) or poor function at both sites (-1.65 , $p=0.34$). Diabetes and vascular diseases were strong predictors of lower PCS-12 scores (-5.60 , $p<0.001$ and -9.76 , $p<0.001$, respectively). For mental health quality-of-life represented by the MCS-12, beta coefficients for the three levels of physical function were all in a negative direction but only poor upper body function was significantly associated with the MCS-12 score after adjustment for confounders, including marital status, health insurance status, cardiac and vascular disease (beta coefficient for poor upper body function, -4.12 , $p<0.01$) (Table 4). The variable with the association of the strongest magnitude in the MCS-12 model was cardiac disease (-6.15 , $p<0.001$).

Discussion

In a community-based sample of men, upper and lower body measurements of physical function were examined, consisting of upper body physical function as measured by hand grip strength from a hand dynamometer, and a composite variable for lower body function comprised of scores from a chair stand test and a walk test. The characteristics of men in the lower 20% of these measures within their age peers by decade were examined. Because of the strong association of physical function with age, we chose to use age-specific cutpoints

to define poor function and as a result, examined men who were functioning poorly relatively to their peers (the lowest 20% of scores), with further adjustments by age in multivariate models. Considering our results for mental HRQOL, we observed an independent association only for upper body physical function, while there was no association after adjustment for confounding for lower body physical function or physical function at both sites. The magnitude of the observed effect of poor upper body function effect was a four-unit decrease in mental HRQOL mean score to 40.5. The decrease was similar in magnitude to what was observed in the parent BACH survey for the impact of diabetes among men.²⁷

The underlying reason for an independent association of poor upper body function with mental HRQOL is unknown, but hand grip strength has been found to be predictive of functional decline in many studies²⁸ and is characterized as a ‘vital sign’.²⁹ In our study, it may be functioning as a marker for poorer health overall in relation to one’s peers, which in turn may affect mental HRQOL. We observed the highest prevalence of depressive symptoms among those with poor lower function and poor upper and lower function. As such, the lack of independent association between any poor lower body function and mental HRQOL score was unexpected, but was explained by confounding by the variables in our models, including cardiovascular disease.

Considering our results for physical HRQOL, we observed an independent association only for lower body physical function (of the magnitude of approximately a three-unit decrease). The SF-12 has more emphasis on lower body domains and contains questions such as stair climbing and vacuuming but also contains broader assessments. An association of measured physical function with self-reported physical HRQOL, while somewhat expected, is not necessarily a given. A previous investigation of the association between performance-based and self-reported measures of physical functioning among frail older adults found only modest associations ($r=0.48-0.55$), suggesting that physical HRQOL is not explained entirely by objective measures.³⁰ For either physical or mental HRQOL, we did not observe that poor physical function in both domains was related more strongly to HRQOL compared to poor function in one domain or the other in a ‘dose-response’ fashion. This suggests that each domain makes a unique contribution to HRQOL.

In a previous study of correlates of HRQOL among a sample of older adults (aged 70–89), lower chair stand scores and walk times were associated with lower HRQOL after adjustment for comorbidity, while grip strength was not associated with HRQOL, although these authors did not report HRQOL results for each of the physical and mental health domains separately permitting further comparison to our results.³¹ A prior cross-sectional study of men aged 65 and older in Japan who had cardiovascular risk factors found frailty was associated with higher General Health Questionnaire-28 scores (indicating poorer mental health), and lower scores on the WHOQOL-26 scale in both the physical and psychological health domains, indicating decreased function.³² In an Italian study of persons aged 80 and older, persons with depression had poorer scores on a timed walk test and Short Physical Performance Battery tests, but showed no differences in grip strength by depression status.³³ Results by Yanagita *et al.* found that results for timed walk tests and chair stands were significantly poorer among depressed persons aged 80 and older compared to those who were not depressed, but again found no differences for grip strength.³⁴ A study of grip strength and HRQOL found that among community-dwelling men with a mean age of 65.7, decreasing grip strength was associated with poorer physical functioning and poorer general health but not poorer mental health.³⁵ Again, our study was of younger men and measured grip strength as an age-peer-relative measure. As such, this may explain the differences in our findings compared to other studies.

While we observed that men with poor lower body function were more likely to be of lower SES and living in poverty, these men did appear to have adequate access to care according to health care utilization variables, although quality of received care is unknown. Similar to our findings, a large study of Medicare beneficiaries found that those with mobility limitations did not have different use of preventive care compared to those without mobility limitations.³⁶ This suggests that men can be reached by providers for clinical interventions.

Our study has both strengths and limitations. Our physical function test was adapted from an existing measure but is more weighted towards chair stands,⁸ does not contain a balance test, and was not formally validated. However, in a previous publication, we have shown that the composite correlated well with theoretically-related variables (e.g., age, grip strength, fat mass) in the expected directions.³⁷ As a cross-sectional analysis, it is not possible to determine cause and effect; our study only represents a ‘snapshot’ of correlated measures at point in time. While we had a variety of measured covariates including sociodemographics and comorbidities, it is possible that our observed associations are affected by confounding by unmeasured variables related to both physical function and HRQOL. Strengths of our study include the broad age range, race/ethnic and socioeconomic diversity of participating men. Although typically studies of frailty concepts focus on older populations, the younger study population allowed us to examine poor functioning relative to one’s peers. The use of a relative measure reduces generalizability, however, and is a limitation of our analysis.

Our findings on HRQOL may suggest opportunities for interventions. Trials of physical training have been largely shown to improve strength^{12, 13} and physical function¹¹ in the elderly according to systematic reviews and as such, may consequently improve HRQOL. Nutritional supplementation with essential amino acids is receiving attention as a strategy for increasing muscle mass in the elderly.^{38 14} In our study, those with impaired function visited health care regularly, so they appear to be accessible by providers. Given the relative ease of evaluating physical function, a more holistic model of health care may allow better incorporation of dietary and exercise interventions to these high risk populations, with a subsequent potential increase in HRQOL.

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Table 1

Demographic characteristics and physical and mental health component scores by physical function status among men in the BACH/Bone Survey (N=1,013).

Variables	Mean $\pm$ SD or N (%) [*]				
	Overall (N=1,013)	Normal Physical Function (N=689)	Poor Upper Body Physical Function (N=192) [†]	Poor Lower Body Physical Function (N=190) [†]	Poor Upper & Lower Physical Function (N=58)
Race/ethnicity					
Black	25.7%	23.8%	24.4%	39.6%	36.6%
Hispanic	12.8%	11.0%	15.7%	18.0%	14.5%
White	61.5%	65.2%	59.9%	42.4%	48.9%
Body mass index categories					
Underweight	0.9%	0.0%	3.7%	3.9%	9.2%
Normal	24.8%	24.4%	27.0%	22.2%	20.5%
Overweight	41.3%	43.2%	40.8%	31.7%	36.9%
Obese	33.0%	32.4%	28.5%	42.2%	33.4%
Married or living with partner (% yes)	51.7%	53.7%	51.8%	36.2%	34.3%
Mental Health Component Score (MCS-12)	51.0 $\pm$ 9.3	51.7 $\pm$ 8.6	48.7 $\pm$ 11.1	49.9 $\pm$ 10.6	49.2 $\pm$ 13.1
Physical Health Component Score (PCS-12)	51.1 $\pm$ 8.4	52.0 $\pm$ 7.4	50.7 $\pm$ 9.0	46.6 $\pm$ 11.7	47.3 $\pm$ 11.5
Poor upper body physical function (% yes)	19.4%	--	---	31.0%	---
Poor lower body physical function (% yes)	14.7%	--	23.6%	---	---

^{*} All estimates are inversely weighted to the probability of being sampled. Percents shown are column percents.

[†] Includes men who have poor function at both sites.

Table 2

Weighted socioeconomic characteristics, health care utilization, and comorbidities by physical function status among men in the BACH/Bone Survey (N=1,013).

Mean ± SD or N (%) *					
Variables	Overall (N=1,013)	Normal Physical Function (N=689)	Poor Upper Body Physical Function (N=192 [†])	Poor Lower Body Physical Function (N=190 [†])	Poor Upper & Lower Physical Function (N=58)
Socioeconomic status					
Low	21.1%	18.4%	21.2%	42.4%	48.5%
Middle	49.7%	51.3%	45.5%	44.5%	39.4%
High	29.2%	30.4%	33.3%	13.0%	12.1%
Poverty (% yes)	19.6%	19.6%	18.0%	27.5%	36.9%
Times seen a health care provider in last year	6.9 ± 0.5	6.2 ± 10.2	6.9 ± 10.4	10.7 ± 17.2	9.6 ± 11.3
Median (25%, 75%)	3 (1, 7)	3 (1, 6)	3 (1, 8)	4 (2, 10)	8 (3, 12)
Health insurance status					
Private	69.1%	70.8%	70.4%	51.6%	43.2%
Public only	16.1%	14.8%	17.5%	29.7%	45.4%
None	14.8%	14.4%	12.1%	18.7%	11.3%
Do you go for regular care? (% yes)	76.4%	78.7%	69.8%	76.6%	85.6%
Are you having trouble paying for health or medical care, medications? (% yes)	16.0%	14.5%	15.4%	25.6%	21.4%
Comorbidities (% yes)					
Arthritis	16.2%	16.2%	15.4%	19.9%	24.4%
Cardiac diseases [‡]	8.0%	8.1%	7.0%	11.0%	13.9%
Chronic lung disease	3.7%	3.1%	7.2%	2.2%	3.9%
Depression symptoms	12.0%	9.9%	18.1%	18.5%	26.1%
Diabetes	7.4%	6.0%	9.4%	15.4%	19.5%
High blood pressure	25.9%	24.5%	27.9%	32.2%	34.2%
Kidney disease	1.2%	0.7%	1.9%	2.5%	1.0%
Stroke	1.8%	1.3%	1.8%	4.8%	4.0%
Vascular diseases [§]	6.6%	4.8%	10.7%	10.0%	7.4%
Use of 4+ prescription medications (% yes)	15.9%	14.3%	18.5%	23.2%	25.4%

* All estimates are inversely weighted to the probability of being sampled. Percents shown are column percents. Data were missing for SES (n=53) and health insurance status (n=2).

[†] Includes men who have poor function at both sites.

[‡] Including any history of coronary artery bypass or angioplasty, myocardial infarction, angina, or congestive heart failure.

[§] Including any history of carotid artery surgery, intermittent claudication, surgery or angioplasty for arterial disease of the leg, aortic aneurysm, deep vein thrombosis, Raynaud's disease, or peripheral vascular disease.

Table 3

Multivariate linear modeling results for physical function and physical health component scores (PCS-12) among men in the BACH/Bone Survey (N=1,013).

	Beta (standard error)	T-test p-value *	Wald F-test p-value [†]
Poor physical function			0.02
Both upper and lower body	-1.65 (1.71)	0.34	
Lower body only	-2.95 (1.08)	0.007	
Upper body only	0.79 (0.75)	0.30	
None	Referent	Referent	
Race/ethnicity			0.58
Black	-0.47 (0.77)	0.54	
Hispanic	0.33 (0.77)	0.67	
White	Referent	Referent	
Age, y	-0.12 (0.02)	<.001	<.001
SES categories			<.001
Low	-4.41 (1.01)	<.001	
Middle	-1.48 (0.61)	0.02	
High	Referent	Referent	
Depression	-4.45 (1.43)	0.002	0.002
Diabetes (referent: no)	-5.60 (1.16)	<.001	<.001
Vascular diseases [‡] (referent: no)	-9.76 (1.48)	<.001	<.001

* P value shown is from a test of whether the level of the variable is significantly associated with the PCS-12 score compared to the referent group.

[†] P value shown is from a test of whether overall variable is significantly associated with the PCS-12 score.

[‡] Including any history of carotid artery surgery, intermittent claudication, surgery or angioplasty for arterial disease of the leg, aortic aneurysm, deep vein thrombosis, Raynaud's disease, or peripheral vascular disease.

Table 4

Multivariate linear modeling results for physical function and mental health component scores (MCS-12) among men in the BACH/Bone Survey (N=1,013).

	Beta (standard error)	T-test p-value*	Wald F-test p-value†
Poor physical function			0.02
Both upper and lower body	−0.66 (2.76)	0.81	
Lower body only	−1.36 (1.11)	0.22	
Upper body only	−4.12 (1.38)	0.003	
None	Referent	Referent	
Race/ethnicity			0.33
Black	0.82 (0.92)	0.37	
Hispanic	1.56 (1.07)	0.14	
White	Referent	Referent	
Age, y	0.09 (0.03)	0.009	0.009
SES categories			0.64
Low	1.05 (1.31)	0.42	
Middle	0.85 (0.97)	0.38	
High	Referent	Referent	
Married or living with partner (referent: no)	2.01 (0.83)	0.02	0.02
Insurance status			<.001
None	2.20 (1.00)	0.03	
Public	−3.41 (1.50)	0.02	
Private	Referent	Referent	
Cardiac diseases§ (referent: no)	−6.15 (1.80)	<.001	<.001
Vascular diseases‡ (referent: no)	3.41 (1.68)	0.04	0.04

* P value shown is from a test of whether the level of the variable is significantly associated with the MCS-12 score compared to the referent group.

† P value shown is from a test of whether overall variable is significantly associated with the MCS-12 score.

§ Including any history of coronary artery bypass or angioplasty, myocardial infarction, angina, congestive heart failure.

‡ Including any history of carotid artery surgery, intermittent claudication, surgery or angioplasty for arterial disease of the leg, aortic aneurysm, deep vein thrombosis, Raynaud's disease, or peripheral vascular disease.