Journal of the American College of Cardiology
© 2013 by the American College of Cardiology Foundation
Published by Elsevier Inc.

Vol. 61, No. 17, 2013
ISSN 0735-1097/$36.00
http://dx.doi.org/10.1016/j.jacc.2013.01.060

Declining Walking Impairment Questionnaire Scores Are Associated With Subsequent Increased Mortality in Peripheral Artery Disease

Atul Jain, MD, MS,* Kiang Liu, PHD,† Luigi Ferrucci, MD, PHD,‡ Michael H. Criqui, MD, MPH,§ Lu Tian, SCD,‖ Jack M. Guralnik, MD, PHD,¶ Huimin Tao, MS,† Mary M. McDermott, MD†#

Chicago, Illinois; Bethesda, Maryland; and La Jolla and Palo Alto, California

Objectives This study determined whether greater 2-year declines in Walking Impairment Questionnaire (WIQ) stair climbing, distance, or speed scores were associated with higher all-cause and cardiovascular disease (CVD) mortality among men and women with lower extremity peripheral artery disease (PAD).

Background Associations of decline in the WIQ with mortality among people with PAD are unknown.

Methods Participants were 442 men and women with PAD identified from Chicago area medical centers. The WIQ was completed at baseline and at 2-year follow-up. Cox proportional hazard models were used to assess associations across categories of 2-year changes in WIQ stair climbing, WIQ distance, and WIQ speed scores with subsequent all-cause and CVD mortality, adjusting for age, sex, race, ankle-brachial index, body mass index, smoking, comorbidities, and other covariates.

Results One hundred twenty-three participants (27.8%) died during a median follow-up of 4.7 years after the 2-year change in WIQ score measurements. Forty-five participants died from CVD. Adjusting for covariates, participants with WIQ score declines ≥20.0 points had higher all-cause mortality (hazard ratio [HR]: 1.93, 95% confidence interval [CI]: 1.01 to 3.68 for WIQ stair climbing; HR: 2.34, 95% CI: 1.15 to 4.75 for WIQ distance; and HR: 3.55, 95% CI: 1.57 to 8.04 for WIQ speed, respectively) compared with participants with ≥20.0 point improvement in each of the corresponding WIQ categories. Participants with ≥20.0 point declines in the WIQ distance score had higher CVD mortality (HR: 4.56, 95% CI: 1.30 to 16.01) compared with those with ≥20.0 point improvement in the WIQ distance score.

Conclusions Patients with PAD who experienced ≥20.0 point declines in the WIQ stair climbing, distance, and speed scores had a higher rate of all-cause mortality compared with those with less declines in each WIQ score. (J Am Coll Cardiol 2013;61:1820–9) © 2013 by the American College of Cardiology Foundation

Lower extremity peripheral artery disease (PAD) affects more than 8 million Americans (1). Compared with those without PAD, people with PAD are at higher risk for all-cause and cardiovascular mortality (2). The Walking Impairment Questionnaire (WIQ) is a PAD-specific, self-administered questionnaire that measures patient-perceived difficulty climbing stairs and walking specific distances and speeds (3). We previously reported that lower baseline values for the WIQ stair climbing scores were associated with higher all-cause and cardiovascular disease (CVD) mortality in PAD (4). In the present study, we assessed whether greater declines in WIQ stair climbing, distance, and speed scores are associated with higher all-cause and CVD mortality among patients with PAD. We measured 2-year change in the WIQ scores because assessing change over 2 years allowed greater opportunity to identify a significant decline in the WIQ, and because patients with PAD are commonly followed longitudinally in clinical practice for 2 years or more. We hypothesized that greater declines in each WIQ score would be associated with higher all-cause and CVD mortality. In exploratory analyses, we

From the *Department of Medicine, The University of Chicago, Chicago, Illinois; †Department of Preventive Medicine, Northwestern University, Feinberg School of Medicine, Chicago, Illinois; ‡Intramural Research Program, National Institute on Aging, Bethesda, Maryland; §Department of Preventive Medicine, University of California at San Diego, La Jolla, California; ‖Department of Health Research and Policy-Biostatistics, Stanford University, Palo Alto, California; ¶Department of Epidemiology and Public Health, University of Maryland and School of Medicine, Bethesda, Maryland; and the #Department of Medicine Northwestern University, Feinberg School of Medicine, Chicago, Illinois. This study was supported by grants from the National Heart, Lung, and Blood Institute (K12-HL083790, R01-HL083064, R01-HL64739, and R01-HL71223) and by a grant from the National Center for Research Resources, National Institutes of Health (RR-00048). This study was also supported by the National Institute on Aging. The authors have no relationships relevant to the contents of this paper to disclose. William Hiatt, MD, acted as Guest Editor for this paper.

Manuscript received July 27, 2012; revised manuscript received January 22, 2013, accepted January 24, 2013.

assessed whether significant associations of decline in WIQ scores with higher mortality were attenuated by adjustment for progression of PAD and other CVD.

Methods

Participant identification. Participants for this analysis were identified from the WALCS (Walking and Leg Circulation Study) and WALCS II studies (Fig. 1). The WALCS and WALCS II are prospective, observational studies designed to identify clinical characteristics associated with functional impairment, functional decline, and mortality in PAD (5,6). The WALCS cohort of 460 participants was assembled from October 1998 to March 2000. The WALCS II cohort of 489 participants with PAD was assembled from November 2002 to April 2004. WALCS II included WALCS participants who consented to participation in WALCS II as well as newly identified participants (Fig. 1). WALCS participants were followed for up to 8 years, whereas newly identified participants for WALCS II were followed for up to 4 years. WALCS participants were ages 55 years and older at the time of enrollment. PAD participants newly identified for WALCS II 4 years later were ages 59 years and older at enrollment. For both WALCS and WALCS II, PAD participants were identified consecutively from among patients diagnosed with PAD in 3 Chicago area noninvasive vascular laboratories. This method ensured a systematic method of enrollment and minimized bias. We did not collect data on the duration of the PAD diagnosis. Onset of PAD is difficult to ascertain accurately because PAD is frequently asymptomatic (5). The institutional review boards of Northwestern University and collaborating sites approved the study protocol. Written informed consent was obtained from all participants.

Exclusion criteria. We excluded participants with an ankle-brachial index (ABI) >0.90 at baseline because they either did not have PAD or because they had noncompressible arteries, which did not allow accurate assessment of PAD severity. At enrollment for WALCS and WALCS II, participants with above- or below-knee amputations or ulcers, nursing home residents, and wheelchair-bound patients were excluded due to severely limited functional capacity at baseline. We did not systematically exclude participants with critical limb ischemia. Non–English-speaking participants were excluded because data collection forms, including the WIQs, were prepared only in English. At baseline, participants with recent major surgery and self-identified or physician-identified dementia, as well as those unlikely to return for 12-month follow-up because of medical illness or logistical issues were excluded.

Walking Impairment Questionnaire. Participants completed the WIQ at baseline and at 2-year follow-up. In the WIQ distance score, the participant records the degree of difficulty walking specific distances (ranging from walking indoors to 1,500 feet or 5 blocks) on a graded scale from 0 to 4 (3). A score of 0 represents the inability to walk the distance in question and a score of 4 represents no difficulty. In the WIQ speed score, the participant is asked to assess the degree of difficulty walking 1 block at specific speeds ranging from walking slowly to jogging on a graded scale ranging from 0 to 4 (3). In the WIQ stair climbing score, the participant reports the degree of difficulty climbing 1, 2, and 3 flights of stairs. This graded score is multiplied by a pre-specified weight for each distance, speed, or number of stair flights. The products are summed and divided by the maximum possible score to obtain a percent score, ranging from 0 (representing the inability to perform any of the tasks) to 100 (representing no difficult with any of the tasks) (7). The WIQ scores have been shown to improve in response to lower extremity revascularization (8) and supervised exercise therapy (9).

Abbreviations and Acronyms

- **ABI** = ankle-brachial index
- **ACE** = angiotensin-converting enzyme
- **BMI** = body mass index
- **CVD** = cardiovascular disease
- **MI** = myocardial infarction
- **PAD** = peripheral arterial disease
- **PCS** = physical component summary
- **WIQ** = Walking Impairment Questionnaire

Ankle-brachial index measurement. Using a handheld Doppler probe (Nicolet Vascular Pocket Dop II, Nicolet Biomedical, Golden, Colorado), systolic pressures were measured in the right and left brachial, posterior tibial, and dorsalis pedis arteries, and then again in reverse order. The ABI was calculated by dividing the mean of the posterior tibial and dorsalis pedis pressures in each leg by the mean of the 4 brachial pressures (10). Average brachial pressures in the arm with highest pressure were used when 1 brachial pressure was higher than the opposite brachial pressure in both measurement sets and the 2 brachial pressures differed by 10 mm Hg or more in at least 1 measurement set, because subclavian stenosis was possible in such cases (11). The lowest leg ABI was used in analyses.

Comorbidities. At baseline, we measured presence of comorbidities that could potentially influence both the WIQ scores and mortality: history of congestive heart failure, angina, myocardial infarction (MI), stroke, diabetes, cancer, and chronic pulmonary disease. Verification of comorbidities was performed using algorithms developed for the Women's Health and Aging Study (12), which combines data from medical record review, medications, patient self-report, selected laboratory values, and a questionnaire completed by the participant's primary care provider. We used similar methods to identify new stroke, MI, and angina that were diagnosed after baseline.

Physical activity. At baseline, participant-reported physical activity was measured with a questionnaire derived from the Harvard Alumni Activity Study that has been validated in participants with PAD (13). Participants were asked the following question: "During the last week, how many city blocks or their equivalent did you walk? Let 12 city blocks equal 1 mile."