Effect of Physical Activity Assessment on Prognostication for Peripheral Artery Disease and Mortality

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Abstract

Objective: To examine whether a simple question about the performance of regular vigorous activity is associated with peripheral artery disease (PAD) and mortality.

Methods: A total of 1288 individuals undergoing nonemergency coronary angiography were assessed for participation in regular vigorous activity by questionnaire. Data on demographic characteristics, ankle-brachial indexes, and cardiovascular outcomes were prospectively collected.

Results: Compared with those who denied participation in regular vigorous activity, those who reported participation were less likely to have PAD (odds ratio, 0.58; 95% CI, 0.39-0.86), had higher ankle-brachial indexes, had better Walking Impairment Questionnaire scores ($P<.001$), and experienced reduced all-cause mortality rates (hazard ratio, 0.48; 95% CI, 0.31-0.74). When added to the Framingham Risk Score, the response improved the net reclassification index for all-cause (32.6%) and cardiovascular (32.0%) mortality.

Conclusion: Among at-risk individuals, regular vigorous activity is associated with decreased PAD and all-cause mortality. Simple and readily available, a single yes/no query about participation in regular vigorous exercise could be used to improve risk stratification.

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Patients with or at risk of vascular disease experience high rates of future adverse clinical events and cardiovascular mortality. Although traditional risk calculators, such as the Framingham Risk Score in the United States and the Systemic Coronary Risk Evaluation system in Europe,[1] use traditional risk factors to give general prognosis, tools that provide more refined risk prediction, such as the Reynolds Risk Score or the Lifetime Atherosclerotic Cardiovascular Disease Risk Estimator, are increasingly being pursued.[2,3] Many have studied novel modalities, including cardiorespiratory fitness,[4] genomic assays,[5] proteomic assays,[6] and imaging assays,[7] each with the hope of refining our ability to predict an individual's lifetime risk of cardiovascular disease or death. Although these newer assays are increasingly more sophisticated, it is widely recognized that an individual's physical fitness and habitual activity level can strongly predict the risk of adverse outcomes.[8-11] However, details on physical activity patterns often require lengthy questionnaires, and objective fitness measurements by exercise testing can be costly, time-consuming, and at times intimidating to elderly individuals.

Current recommendations on physical activity mandate regular physical activity at least at a moderate intensity,[12] a level commonly reflected by feelings of shortness of breath or perspiration. This study aims to determine whether a simple question regarding an individual's participation in regular activity vigorous enough to elicit sweating, shortness of breath, or palpitations could be used to predict the presence of vascular disease and improve risk prediction over current models. We further hypothesized that this simple binary tool could be a reliable measure of lower-extremity function that correlates with the established ankle-brachial index (ABI) and Walking Impairment Questionnaire (WIQ) tools.

METHODS

Study Population

The Genetic Determinants of Peripheral Arterial Disease study examines individuals (n=1755) who underwent elective, nonemergency coronary angiography for angina, shortness of breath, or an abnormal stress test result at Stanford University and Mount Sinai Medical Centers between January 1, 2004, and March 1, 2008, as previously described.[13,14] The study was funded by the National Heart, Lung, and Blood Institute. Participants were included in the study if complete data on all relevant covariates, including age, sex, race, smoking history, systolic blood pressure, medications, total cholesterol level, high-density lipoprotein cholesterol level, ABI, body mass index, creatinine level, diabetes mellitus, and coronary artery disease (CAD) status, were available. On the basis of these criteria, 1288 individuals were included in the current study.

ABI Calculation and Peripheral Artery Disease Determination

Before coronary angiography, posterior tibialis, dorsalis pedis, and brachial artery systolic pressures were measured using 5-MHz Doppler ultrasonography, and the ABI for each patient was calculated. Each patient was then classified as having peripheral artery disease (PAD) by an ABI of 0.9 or less in either leg. Individuals with an ABI greater than 0.9 were classified as the non-PAD reference group. Remaining eligible patients with an ABI greater than 1.40 were excluded (n=14).[15]

Covariates

A trained clinical research assistant at enrollment obtained detailed information on all included covariates. Demographic information, cardiovascular risk factors, comorbid conditions, medications, and characterization of physical activity were acquired by self-report. An experienced cardiologist who was masked to participant details evaluated the coronary angiograms. Hemodynamically significant CAD was defined as greater than 60% stenosis.[16] Participation in regular vigorous activity was evaluated by the patient's binary (yes/no) response to the question, "At least once a week, do you engage in some form of regular activity, such as brisk walking, jogging, bicycling, or swimming, long enough to work up a sweat, get your heart thumping, or become short of breath?"[17]

Questionnaire

Complete WIQ data were available in more than 99% of these individuals for all 3 WIQ category scores. The WIQ consists of 3 primary categories assessing walking distance, stair climbing, and walking speed, as previously described.[18] Lifetime occupational activity and lifetime recreational activity were quantified using a questionnaire modeled after the Harvard Alumni studies of Paffenbarger and colleagues.[19] Responses were translated to energy expenditure in kilocalories per week by a Microsoft Access Program (Microsoft Inc).[9]

Mortality

The outcomes of interest in this analysis were all-cause and cardiovascular mortality, including deaths secondary to myocardial infarction, cardiac arrest, stroke, heart failure, or aneurysm rupture. Mortality and cause of death were ascertained through telephone or postal communication, medical record review, and the Social Security Death Index. Mean follow-up time was 5 years.

Statistical Analyses

For all survival analyses, the follow-up time was defined as the period between the enrollment interview and the last confirmed follow-up or date of death. Baseline demographic characteristics were compared using a *t* test (continuous variables) or a χ^2 test (categorical variables). All covariates were continuous except race (categorical), sex, smoking, use or nonuse of lipid-lowering and antihypertensive medications, diabetes mellitus, and CAD status (dichotomous). The association between reported participation in regular vigorous activity and presence of PAD was investigated using logistic regression models. The association of reported participation in regular vigorous activity with the baseline ABI was assessed using linear regression models. Logistic and linear regression models were adjusted using variables of age, sex, race, systolic blood pressure, medications, body mass index, smoking, diabetes, cholesterol levels, CAD, and creatinine level. Cox proportional hazards regression models were calculated to investigate the association of reported participation in regular vigorous activity with all-cause and cardiovascular mortality in the full study sample and in subgroup analysis among individuals with PAD. Proportional hazards assumptions were evaluated by the Schoenfeld residuals tests.

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