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Association Between Cardiorespiratory Fitness and Health Care Costs: The Veterans Exercise Testing Study

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Abstract

Objective: To determine the association between cardiorespiratory fitness (CRF) and annual health care costs in Veterans.

Patients and Methods: The sample included 9942 subjects (mean age, 59±11 years) undergoing a maximal exercise test for clinical reasons between January 2005 and December 2012. Cardiorespiratory fitness, expressed as a percentage of age-predicted peak metabolic equivalents (METs) achieved, was categorized in quartiles. Total and annualized health care costs, derived from the Veterans Administration Allocated Resource Center, were compared using multiple regression, controlling for demographic and clinical characteristics.

Results: A gradient for reduced health care costs was observed as CRF increased, with subjects in the least-fit quartile having approximately $14,662 ($P<.001$) higher overall costs per patient per year compared with those in the fittest quartile, after controlling for potential confounding variables. Each 1-MET higher increment in fitness was associated with a $1592 annual reduction in health care costs (5.6% lower cost per MET), and each higher quartile of fitness was associated with a $4163 annual cost reduction per patient. The effect of CRF was more pronounced among subjects without cardiovascular disease (CVD), suggesting that the results were not driven by the possibility that less-fit individuals had greater CVD. Cost savings attributable to higher fitness were greatest in overweight and obese subjects, with lower savings observed among those individuals with a body mass index less than 25 kg/m^2. In a model including historical, clinical, and exercise test responses, heart failure was the strongest predictor of health care costs, followed by CRF ($P<.01$).

Conclusion: Low CRF is associated with higher health care costs. Efforts to improve CRF may not only improve health but also result in lower health care costs.

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Chronic illnesses are increasing in the United States, in part because of increasing trends in unhealthy lifestyle behaviors including lack of physical activity.[1,2] In the current era of rising health care costs, many health care systems have directed a greater emphasis toward promoting health behaviors that reduce the incidence of disability and disease.[3,4] The Affordable Care Act of 2010 includes federally mandated preventive services for adults that incorporate counseling on health and wellness, including physical activity. The latter reflects the widely recognized observation that more physically active individuals have fewer health problems and lower overall health costs, and modulating fitness, physical activity patterns, or both may have a profound effect on health care utilization.[1,2,5,6] Indeed, numerous recent studies have reported that individuals who are comparatively sedentary have higher overall health care costs, which has been attributed to factors including greater illness, hospitalization, and disability.[3,5-9]

A great deal of epidemiologic evidence has also been published in recent years demonstrating a strong inverse association between level of fitness and adverse health outcomes.[1,2,10-18] Relative to highly fit or moderately fit individuals, low-fit subjects are particularly susceptible not only to higher mortality but also to higher rates of cardiovascular events, type 2 diabetes, stroke, hypertension, particular forms of cancer, and other conditions.[1,2,10-18] In a growing number of studies, fitness has been reported to be a stronger

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predictor of risk for mortality and cardiovascular events than traditional risk factors including hyperlipidemia, hypertension, and smoking.[1,10,12,13,17] These observations have led many national and international health organizations to advocate strategies to improve fitness by promoting physical activity.[12,17,19] Although a great deal of research in recent years has been devoted to the economic consequences of physical inactivity,[3,6-9] surprisingly few data are available regarding the association between objective measures of fitness and health care costs.

Physical activity patterns are often considered a surrogate for fitness,[18,20] in part because direct measures of fitness require an exercise test and are frequently not available. However, quantifying physical activity patterns in epidemiologic studies typically relies on self-report, and self-reported physical activity can be unreliable.[21,22] There is a need for studies on the association between health care costs and fitness using objective measures. The Veterans Health Administration in the US Department of Veterans Affairs Health Care System has been a leader in the development of electronic medical records, which not only enables direct quantification of health expenditures but also detailed observations of history, alterations in health status, and other outcomes.[23] These qualities, along with a unique relational exercise test reporting program that automatically generates a report for distribution within the Veterans Administration (VA) clinical database,[24] and direct measures of fitness determined by a maximal exercise test provided a singular opportunity to assess the association between fitness and health care costs. The demonstration of such an association would provide an objective, economic rationale for employers, health care professionals, and professional organizations to promote physical activity.

PATIENTS AND METHODS

Study Sample

The population included 9942 consecutive patients who were referred for an exercise treadmill test for clinical reasons at the Palo Alto VA Health Care System and the VA Medical Center in Washington, DC, between January 1, 2005, and December 31, 2012. Most tests were performed as part of a routine evaluation, clearance to participate in exercise, or assessment of suspected coronary artery disease. The following subjects were excluded: (1) those unable to complete the test for orthopedic, neurologic, or similar reasons; (2) those with an implanted pacemaker; (3) subjects who were unstable or required emergent intervention; and (4) those with an exercise capacity less than 2 metabolic equivalents (METs). In addition, 5 subjects in the study population were missing data on age and thus were not included.

Exercise Testing

A thorough clinical history, list of medications, and cardiac risk factors were recorded prospectively at the time of testing using computerized forms.[24] Patients underwent symptom-limited treadmill testing using an individualized ramp treadmill protocol as previously described.[25] Heart rate targets were not used as an end point or to judge the adequacy of the test. Estimated METs were calculated from treadmill speed and grade.[26] Exercise capacity was expressed as an age-predicted value calculated from normal standards based on veterans referred for exercise testing.[27] Quartiles of percent-predicted exercise capacity were used to categorize fitness as less than 60%, 60% to less than 80%, 80% to less than 100%, and 100% or greater of the age-predicted values achieved. Clinical and exercise test data were entered into a unique collection and reporting program that automatically generates a report for distribution within the VA clinical database.[24] This program relies on a set of carefully defined clinical and exercise variables that are also stored in a relational database. We used this database to provide the clinical and exercise data for analysis and as the parent database used to query the broader VA database for health care costs.

Calculation of Costs

The Decision Support System is a set of programs that uses relational databases to provide data on the costs, patterns of care, patient outcomes, and workload details of specific patient care encounters within the VA Health Care System. Central to this system is the Veterans Health Information Systems and Technology Architecture with which the VA records clinical data and documents health care encounters. This system includes modules that record data from laboratory, pharmacy, radiology, surgery, and other departments, information from the abstract of the hospital discharge, and records of outpatient