MAYO CLINIC

ORIGINAL ARTICLE

Lifelong Exercise Patterns and Cardiovascular Health

Martijn F.H. Maessen, MSc; André L.M. Verbeek, MD, PhD; Esmée A. Bakker, BSc; Paul D. Thompson, MD; Maria T.E. Hopman, MD, PhD; and Thijs M.H. Eijsvogels, PhD

Abstract

Objective: To determine the relationship between lifelong exercise dose and the prevalence of cardiovascular morbidity.

Patients and Methods: From June 1, 2011, through December 31, 2014, 21,266 individuals completed an online questionnaire regarding their lifelong exercise patterns and cardiovascular health status. Cardiovascular disease (CVD) was defined as a diagnosis of myocardial infarction, stroke, or heart failure, and cardiovascular risk factors (CVRFs) were defined as hypertension, hypercholesterolemia, or type 2 diabetes. Lifelong exercise patterns were measured over a median of 32 years for 405 patients with CVD, 1379 patients with CVRFs, and 10,656 controls. Participants were categorized into nonexercisers and quintiles (Q1−Q5) of exercise dose (metabolic equivalent task [MET] minutes per week).

Results: The CVD/CVRF prevalence was lower for each exercise quintile compared with nonexercisers (CVD: nonexercisers, 9.6% vs Q1: 4.4%, Q2: 2.8%, Q3: 2.4%, Q4: 3.6%, Q5: 3.9%; $P<.001$; CVRF: nonexercisers, 24.6% vs Q1: 13.8%, Q2: 10.2%, Q3: 9.0%, Q4: 9.4%, Q5: 12.0%; $P<.001$). The lowest exercise dose (Q1) significantly reduced CVD and CVRF prevalence, but the largest reductions were found at 764 to 1091 MET-min/wk for CVD (adjusted odds ratio=0.31; 95% CI, 0.20-0.48) and CVRFs (adjusted odds ratio=0.36; 95% CI, 0.28-0.47). The CVD/CVRF prevalence did not further decrease in higher exercise dose groups. Exercise intensity did not influence the relationship between exercise patterns and CVD or CVRFs.

Conclusion: These findings demonstrate a curvilinear relationship between lifelong exercise patterns and cardiovascular morbidity. Low exercise doses can effectively reduce CVD/CVRF prevalence, but engagement in exercise for 764 to 1091 MET-min/wk is associated with the lowest CVD/CVRF prevalence. Higher exercise doses do not yield additional benefits.

 ■ Mayo Clin Proc. 2016;■■(■):1-10

Physical inactivity is considered a major modifiable risk factor for all-cause mortality,[1,2] whereas habitual physical exercise reduces the risk of cardiovascular morbidity and mortality.[3,4] Regular exercise is also associated with increased survival in the general and athletic populations.[5-7] Therefore, the World Health Organization and the Centers for Disease Control and Prevention recommend that adults engage in at least 150 minutes of moderate-intensity exercise or 75 minutes of vigorous-intensity exercise per week for optimal cardiovascular and global health.[8-10] These guidelines also state that there is even more benefit from 300 min/wk of moderate- and 150 min/week of vigorous-intensity exercise.

Such recommendations suggest increasing benefit with increasing exercise dose, but recent studies suggest a potential U-shaped association, indicating that high doses of exercise may abolish the beneficial health effects.[11,12] Results of the Copenhagen Heart Study indicate that vigorous joggers have similar mortality rates as sedentary nonjoggers (hazard ratio, 1.97; 95% CI, 0.48-8.14; and hazard ratio, 0.66; 95% CI, 0.32-1.38, respectively).[11] The Million Women Study indicates that daily strenuous activities increase the risk of stroke and venous thromboembolism compared with strenuous activities performed for 2 to 3 sessions per week.[12] The notion that exercise might increase the risk of cardiovascular morbidity is striking, but strong evidence is currently lacking.

From the Department of Physiology (M.F.H.M., E.A.B., M.T.E.H., T.M.H.E.) and Department of Health Evidence (A.L.M.V., E.A.B.), Radboud Institute of Health Sciences, Radboud University Medical Center, Nijmegen, The Netherlands; Division of Cardiology, Hartford Hospital, Hartford, CT (P.D.T., T.M.H.E.); and Research Institute for Sports and Exercise Sciences, Liverpool John Moores University, Liverpool, UK (T.M.H.E.).

To confirm or reject the U-shaped association between exercise and cardiovascular morbidity, this study aimed to determine the relationship between lifelong exercise dose and the prevalence of cardiovascular morbidity in a physically active population. We collected data from 21,266 participants in the Nijmegen Exercise Study and hypothesized that high lifelong exercise doses relate to a decrease in the prevalence of cardiovascular morbidity.

METHODS

Study Design and Study Population

The Nijmegen Exercise Study is a population-based study of participants in Dutch sporting events (International Nijmegen Four Days Marches and Seven Hills Run) and their family members and friends. The study is designed to examine the impact of a physically active lifestyle on health, quality of life, and the development and progression of cardiovascular disease (CVD). From June 1, 2011, through December 31, 2014, inactive and active participants were recruited via newsletters and Internet advertisements. Participants completed an online questionnaire about demographic characteristics, anthropometric measures, lifestyle factors, lifelong exercise patterns, cardiovascular health status, and family history of CVD. To assess the impact of lifelong physical exercise patterns on cardiac morbidity, participants aged 35 years or older were included in the present study. The study adhered to the Declaration of Helsinki. The Local Committee on Research Involving Human Subjects, region Arnhem-Nijmegen, the Netherlands, approved the study, and all the participants gave their written informed consent.

Lifestyle Factors

Participants were asked about their smoking status (never, former, or current) and the highest level of education they completed. Level of education was categorized as low (elementary school or basic vocational education), intermediate (secondary vocational education), or high/academic (higher professional education or academic education).

History of CVD

Participants were asked whether (yes/no) and when (age) their physician diagnosed CVD (myocardial infarction, stroke, or heart failure) or the presence of cardiovascular risk factors (CVRFs) (hypertension, hypercholesterolemia, or diabetes [type 2]). All the participants were also queried about their (cardiovascular) medication use. To validate the CVD/CVRF diagnosis, we performed a cross-check with medication use. Participants with CVD or CVRFs, who did not report cardiac medication use were excluded from the study. Participants were allocated to the control group if they had no cardiac medical history and did not use cardiac medication. When both CVD and CVRFs were diagnosed, the participant was allocated to the CVD group. Participants with congenital heart disease, defined as a diagnosis of CVD before age 35 years, were excluded from further analysis (Figure 1). Participants were also asked whether CVD was present in their immediate biological family (defined as the participant's parents, brothers, and sisters).

Lifelong Exercise Patterns

The lifelong exercise patterns before CVD/CVRF diagnosis (patients) or before study participation (controls) were evaluated via an exercise history questionnaire, distinguishing 4 age periods: (1) 18 to 29 years, (2) 30 to 49 years, (3) 50 to 64 years, and (4) 65 years and older. In these categories, participants were asked per period whether (yes/no) they performed exercise and the corresponding (1) exercise time (hours) per week and (2) self-perceived intensity (light/moderate/vigorous). Participants who did not complete the exercise questionnaire were excluded from the final analysis. Based on Ainsworth's Compendium of Physical Activities,[13] we assigned a metabolic equivalent of task (MET) value of 2.5 for light-, 4.5 for moderate-, and 8.5 for vigorous-intensity exercise. The MET minutes were calculated by multiplying the exercise time in minutes with the accompanying MET score of the self-perceived intensity.[13] The average weekly amount of lifelong exercise (MET minutes per week) was calculated between age 18 years and age at CVD/CVRF diagnosis for the patients. Calculations were made for control participants between age 18 years and

Mayo Clin Proc. ■ XXX 2016;■■(■):1-10 ■ http://dx.doi.org/10.1016/j.mayocp.2016.02.028
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