JACC: HEART FAILURE
VOL. 3, NO. 9, 2015

ISSN 2213-1779/$36.00
PUBLISHED BY ELSEVIER INC.
http://dx.doi.org/10.1016/j.jchf.2015.05.006

Physical Activity and Heart Failure Risk in a Prospective Study of Men

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ABSTRACT

OBJECTIVES This study investigated if total physical activity, as well as different types of physical activity, were associated with heart failure risk.

BACKGROUND Physical activity has shown to be associated with reduced risks of coronary heart disease and stroke. Studies have also suggested that physical activity is associated with heart failure development.

METHODS A study population of 33,012 men was followed from beginning of 1998 until the end of 2012. First event of heart failure was ascertained through linkage to the Swedish National Patient Register and Cause of Death Register. The data were analyzed by using Cox proportional hazards regression and Laplace regression.

RESULTS During a mean follow-up of 13 years, we ascertained a total of 3,609 first events of heart failure. The average age at study baseline was 60 ± 9 years of age. When examining the entire study population, a U-shaped association between total physical activity and heart failure risk was detected, with both extremely high (57 metabolic equivalent [MET] h/day) and extremely low (38 MET h/day) levels of total physical activity associated with an increased risk of heart failure. When investigating different types of physical activity, we found that walking/bicycling at least 20 min/day was associated with 21% lower risk of heart failure (95% confidence interval: 0.72 to 0.87); corresponding to a median age at heart failure 8 months later for those who had actively walked or biked daily. When looking at long-term behavior of walking/bicycling, the results suggested a trend toward more recent active behavior being more related to heart failure protection than past physical activity levels.

CONCLUSIONS This study suggests that both low levels and high levels of total physical activity, in comparison with moderate levels, could increase heart failure risk in men and that certain types of physical activity are associated with a protective effect on heart failure in men. When examining different types of physical activity, walking/bicycling at least 20 min per day was associated with the largest risk reduction of heart failure. (J Am Coll Cardiol HF 2015;3:681–7)

Heart failure (HF) is a large public health issue with a substantial effect on the disease burden in developed countries, particularly among the elderly (1). In the United States, more than 5.8 million people suffer from HF, and the number of HF sufferers worldwide is around 23 million (1). The lifetime risk for development of HF is around 20% (2).

Physical activity (PA) has been shown to be associated with reduced risks of coronary heart disease (3–5) and stroke (3,5–8). Studies have also suggested that PA is associated with HF development (9–14). To the best of our knowledge, no previous study has investigated the shape of association between total PA and HF modeling the exposure as a continuous variable using flexible spline modeling. Neither has long-term behavior regarding PA in relation to HF risk been investigated previously.

Moreover, previous studies have presented their results by relying only on relative measures of association. These popular risk measures that lack a time unit may be complemented by estimating differences in the percentiles of survival time, presenting results in the metric of time (i.e., days, months) (15).

We therefore examined how total PA and 5 different domains of PA are associated with the development of

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Manuscript received February 17, 2015; revised manuscript received May 11, 2015, accepted May 16, 2015.

ABBREVIATIONS AND ACRONYMS

CI = confidence interval

COSM = Cohort of Swedish Men

HF = heart failure

HR = hazard ratio

MET = metabolic equivalent

PA = physical activity

TPA = total physical activity

HF in a population-based prospective cohort study of men, examining both relative risks and survival percentiles. We also investigated if changes of PA at different time points were associated with HF risk.

METHODS

STUDY POPULATION. The study participants belonged to the Cohort of Swedish Men (COSM), a population-based cohort established between 1997 and 1998. All men born between 1914 and 1948 residing in Örebro and Västmanland counties in Sweden were asked to complete an extensive questionnaire regarding PA, diet, anthropometric traits, and other lifestyle factors.

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We excluded individuals with prevalent HF or myocardial infarction (n = 3,350) from the baseline population, based on linkage of the cohort to the Swedish National Patient Register and the Swedish Cancer Register. This effort was made because the previously mentioned diseases may affect both traditional HF risk factors and HF development. We also excluded individuals with missing information on total PA (n = 9,923) from the study sample. The final study population consisted of 33,012 men.

The questionnaire included information on participants' educational attainment, smoking and alcohol consumption, presence of hypertension, family history of myocardial infarction, diagnosis of diabetes (which was complemented with information from the diabetes register and the Swedish National Patient Register), weight, and height. Information on history of stroke and angina was obtained from the Swedish National Patient Register.

The study has been approved by the Regional Ethical Review Board at Karolinska Institutet.

ASSESSMENT OF PHYSICAL ACTIVITY. Study participants were asked to report how their level of activity at work, home/housework, walking/bicycling, and exercise, had been in the year before study enrollment and at 30 years of age. Questions regarding inactivity (watching television or reading) and an open question about hours per day of sleeping and sitting or lying down were also included in the questionnaire. Each type of PA was assigned an intensity score defined as metabolic equivalent (MET) hours per day, deriving the intensity score from the compendium of physical activities (16). The mean MET values assigned for the different types of PAs were as follows: walking/bicycling ~3.6 MET; exercise ~5.0 MET; work occupation ~1.3 MET for mostly sitting down to 3.9 for heavy manual work; home/household work ~2.5 MET; watching TV/reading ~1.2 MET; sleep ~0.9 MET. Total daily physical activity (TPA) score was then estimated by multiplying the intensity score of each type of PA for its reported duration and then adding all specific activities together. The intensity of an activity was based on the rate of the work and did not take into account the physiological capacity of an individual. Implausible self-reported 24 h were corrected either by adding missing hours or subtracting over-reported hours. The correction time was multiplied by an intensity of 2.0 MET, which corresponded to the average of walking at home (2.5 MET) and sitting (eating, transportation, etc., 1.5 MET).

The questions on TPA in COSM have been validated by a previous study on a subpopulation of COSM. The study found that the correlation comparing self-reported TPA with records (7 days of PA diaries) was 0.56 (17), which suggests reasonable validity.

ASCERTAINMENT OF HF EVENTS. Dates of incident HF hospitalization as well as dates of deaths from HF were ascertained from January 1, 1998, to December 31, 2012, through linkage to the Swedish National Patient Register and the Causes of Death Register. The Swedish National Patient Register represents the inpatient register, which includes all hospital admissions that entailed at least 1 overnight stay, and the outpatient register, which covers diagnoses registered during outpatient care. HF events were identified by using International Classification of Diseases-10 codes I50 (HF) and I11.0 (hypertensive heart disease with HF). We included the first HF event recorded in the registers listed as either the primary or secondary diagnosis of hospitalization or death.

STATISTICAL ANALYSES. Data handling and generation of descriptive statistics were performed in SAS (version 9.2, SAS Institute, Inc., Cary, North Carolina). Stata software version 12.1 (StataCorp LP, College Station, Texas) was used to fit Cox proportional hazards regression and Laplace regression. Hazard ratios (HR) and 95% confidence intervals (CI) were estimated using Cox proportional hazards regression models with attained age as the underlying time scale. Start of follow-up was January 1, 1998, and follow-up was censored at the date of first event of HF, death, or December 31, 2012, whichever occurred first. TPA was modeled as a continuous variable by means of restricted cubic splines with 3 knots of the distribution (at 36, 41, and 48 MET h/day) using the median level of 41 MET h/day as the reference value. We examined the linearity of the dose-response by testing the null hypothesis that the coefficient of the second spline