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Original article

Physical activity, fitness, and all-cause mortality: An 18-year follow-up among old people

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Abstract

Background: Little is known about change in physical activity (PA) and its relationship to all-cause mortality among old people. There is even less information about the association between PA, fitness, and all-cause mortality among people aged 80 years and above. The objective is to investigate persistence and change in PA over 5 years as a predictor of all-cause mortality, and fitness as a mediator of this association, among people aged 80 and 85 years at the beginning of an 18-year mortality follow-up period.

Methods: Using Evergreen Project data (started in 1989), 4 study groups were formed according to self-reported changes in PA level, over a 5-year period (starting in 1989–1990 and ending in 1994–1995): remained active (RA, control group), changed to inactive (CI), remained inactive (RI), and changed to active (CA). Mortality was followed up over the 18-year period (1994–2012). Cox models with different covariates such as age, sex, use of alcohol, smoking, chronic diseases, and a 10 m walking test were used to analyze the association between change in PA level and mortality.

Results: Compared to RA, those who decreased their PA level (CI) between baseline and follow-up had higher all-cause mortality (hazard ratio (HR = 2.09; 95%CI: 1.63–2.69) when adjusted for age, gender, and chronic diseases. RI showed the highest all-cause mortality (HR = 2.16; 95%CI: 1.59–2.93). In CA, when compared against RA, the risk of all-cause mortality was not statistically significant (HR = 1.51; 95%CI: 0.95–2.38). In comparison with RA, when walking speed over 10 m was added as a covariate, all-cause mortality risk was almost statistically significant only in CI (HR = 1.37; 95%CI: 1.00–1.87).

Conclusion: Persistence and change in PA level was associated with mortality. This association was largely explained by fitness status. Randomized controlled studies are needed to test whether maintaining or increasing PA level could lengthen the life of old people.

Keywords: All-cause mortality; Fitness; Follow-up study; Functional ability; Old people; Physical activity

1. Introduction

A regular, moderate-to-high level of physical activity (PA) is associated with reduced risk of mortality among people aged 65 or older.[1–7] For example, analyses conducted among persons aged 75–79 and 80+ years showed lower mortality risk among those who participated in ≥15 min of strenuous activity daily, e.g., vigorous walking versus none, and in ≥6 h/day of physically less demanding activities, e.g., gardening versus less than 2 h.[8] A recently published meta-analysis showed that a higher level of total and domain-specific PA was associated with reduced all-cause mortality.[9] Similar results have also been obtained in some cohort studies.[10–14]

Some of the previous studies on long-term changes in the level of PA over time in older people have suggested that increasing and maintaining PA levels can promote longer life among older women,[15,16] although it is less beneficial for women aged at least 75 years or with poor health.[15] Studying the association between PA, fitness, and mortality among older people is problematic. Normal aging processes, based on genetic factors, decline the body capability in such parameters as muscle strength, maximal oxygen uptake and vital capacity, and in increased breathing work. All these changes affect the ability to be physically active or to perform regular exercise. Decline in PA is an indicator of an individual's level of physical fitness, which, in turn, in older people is related to frailty. Diseases and their preliminary stages also have an effect on the level of PA.[17] In addition, observational follow-up studies have found that physical fitness is a stronger predictor of death than PA level.[18]

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The aim of this follow-up study was to investigate change in PA as a predictor of all-cause mortality among people aged 80 or 85 years at the beginning of an 18-year mortality follow-up with special reference to physical fitness as a mediator of this association.

2. Methods

2.1. Study design and target group

This study is part of the Evergreen Project, which is a prospective, population-based study in the city of Jyväskylä in central Finland.[19] A general description of the framework, design, and methodology of the study has been described earlier by Heikkinen[19] and Schroll et al.[20] and hence mentioned only briefly here. In 1989, three hundred and fifty-five 75-year-olds (92.9% of all residents in this age group) and in 1990, two hundred and sixty-two 80-year-olds (91.9%) were interviewed. Altogether 558 interviewees at baseline and 371 at the 5-year follow-up (1994–1995) answered the question on PA. Over the 5-year period, the main reasons for dropout were impaired health, noninterest in participating, relocation outside of the city of Jyväskylä, living in an institution and decease. Of the target group, 357 answered the PA question at both measurement times. They were 80 or 85 years old at the time of measurement in 1994–1995, which is referred to as the baseline in this mortality follow-up paper. Those living in institutions were excluded from this study because their state of health often precluded the collection of data. The Ethical Committee of the University of Jyväskylä approved the study protocol and all of the subjects signed a written informed consent. The study was carried out according to the guidelines on the responsible conduct of research and good research ethics. The methods applied in the data collection conformed to the relevant scientific criteria and were ethically sustainable.

2.2. Data collection

Data were collected through structured home interviews, a health questionnaire and laboratory examinations. At the end of the home interview session, the health questionnaire was left with the target individuals to be completed and returned when they came to the laboratory for the health examinations. The home interview session was performed by female university students who had been specially trained for the purpose. One interview session lasted about 1.5–2 h. The structured home interviews comprised several sections: 1) social background, living conditions, lifestyle, and life-history; 2) a health status questionnaire; 3) social activities, social contacts and support; 4) ability to perform activities of daily living; and 5) depressiveness and loneliness. The questions were all closed-ended. The health status section included items on PA. The other items on health status concerned 1) use of alcohol, 2) smoking, 3) PA, and 4) eating habits. The health examinations, conducted in a laboratory environment at the University of Jyväskylä, included 1) an interview on health status and drug use, 2) anthropometric status, 3) physical performance, 4) sensory functions, 5) perceptual motor coordination, 6) cognitive capacity and metacognitions, and 7) neuropsychological functions. The data collection was carried out in the same way using similar study protocols on both measurement occasions.

2.3. PA

Level of self-reported PA was assessed using a validated scale developed by Grimby[21] and Frändin and Grimby[22] on the basis of the original 4-graded scale of Saltin and Grimby.[23] For the analyses, the responses to the 6-scale question were reclassified into 2 groups: inactive (comprising response alternatives 1 = mainly sitting in 1 place, reading or watching TV, and 2 = light PAs such as easy household tasks, and as well as going for an occasional walk or doing easy gardening) and active (comprising response alternatives 3 = moderate PA of about 3 h/week, such as dusting, ordinary gardening, walking longer distances, and cycling, 4 = moderate PA over 4 h/week or intense PA up to 4 h/week, such as heavy gardening, home maintenance or heavy domestic activities involving some breathlessness, and sweating, 5 = active sports at least 3 h/week such as tennis, swimming, jogging, or heavy gardening or heavy leisure-time activities, and 6 = competitive sports, strenuous exercise several times a week involving considerable physical exertion, such as swimming or jogging a longer distance).

On the basis of self-reported changes in PA level during the 5-year period (starting 1989–1990 and ending 1994–1995) 4 study groups were formed: remained active (RA = control group; $n = 152$), changed to inactive (CI; $n = 122$), remained inactive (RI; $n = 62$), and changed to active (CA; $n = 21$). Table 1 shows the frequencies and percentage distributions in each study group for both gender and baseline age.

2.4. Covariates

All the covariates were measured in the years 1994–1995. The items on smoking and use of alcohol have been described in detail earlier,[4] and were used as category variables in this study. The diagnoses of chronic diseases were based on self-report in the interview,[24] and were later confirmed by a medical doctor in a clinical setting. The group of cardiac diseases included myocardial infarction and angina pectoris, cardiac insufficiency and heart arrhythmia. Respiratory diseases included asthma, chronic bronchitis and emphysema, and musculoskeletal diseases included arthrosis, rheumatoid arthritis, and sciatica syndrome. Metabolic diseases comprised diabetes. The group of other diseases comprised insufficiency, anemia, mental illness, neurosis, depression, alcoholism, Parkinson's disease, epilepsy, cataract, glaucoma, gout, obesity, and dementia. Each disease group formed a variable, and the subjects were coded as having a disease or having no disease in the group.

Maximal walking speed over 10 m, used as a continuous variable, was measured at baseline using a stopwatch in the laboratory corridor.[25] At least 2 additional meters were allowed for acceleration and deceleration.

2.5. Mortality

Date of death was recorded for all subjects who had died during the 18-year (1994–2012) follow-up period. This information was obtained from official archives and from the