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Title: Physical activity history and end-of-life hospital and long-term care

Year: 2009

Version:

Please cite the original version:

von Bonsdorff, M., Rantanen, T., Leinonen, R., Kujala, U., Törmäkangas, T., Mänty, M., & Heikkinen, E. (2009). Physical activity history and end-of-life hospital and long-term care. Journal of Gerontology: Medical Sciences, 64A(7), 778-784. https://doi.org/10.1093/gerona/glp029

Physical activity history and end-of-life hospital and long-term care

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Word count of the paper: 2789
Word count of the abstract: 283
Tables and Figures: 3+2

Keywords: aging, physical activity, health care, chronic diseases, decedent population, disability

Running head: Physical activity and end-of-life care

ABSTRACT

Background. Little is known about the early predictors of need for care in late life. The purpose of this study was to investigate whether physical activity from midlife onwards was associated with hospital and long-term care in the last year of life.

Methods. We studied a decedent population of 846 persons aged 66-98 years at death, who on average 5.8 years prior to death, had participated in an interview about their current and earlier physical activity. Data on the use of care in the last year of life are register-based data and complete.

Results. Men needed on average 96 days (SD 7.0) and women 138 days (SD 6.2) of in-patient care in the last year of life. Among men, the risk for all-cause hospital care in the last year of life was higher for those who had been sedentary since midlife (adjusted risk ratio [IRR] 1.98, 95% confidence interval [CI] 1.14-3.42) compared to those who had been consistently physically active while use of long-term care did not correlate with physical activity history. Among women, the risk for long-term care was higher for those who had been sedentary (IRR 2.03, 95% CI 1.28-3.21) or only occasionally physically active (IRR 1.60, 95% CI 1.06-2.43), than for those who had been consistently active from midlife onwards, while use of hospital care did not correlate with physical activity history.

Conclusion. People who had been physically active since midlife needed less end-of-life in-patient care, but patterns differed between men and women.

INTRODUCTION

The need for health care increases with age and closeness to death (1,2), mainly because of increased need for nursing home care among very old frail persons (3,4). However, little is known about the early predictors of need for care in late life (5).

Compression of morbidity theory suggests that healthy life-styles may delay onset of morbidity and thus help compressing the period of disability and high health care costs to near the end of life. (6). Regular physical activity reduces the risk for chronic disabling diseases such as coronary heart disease (7-9) and diabetes (10). Physical activity may be an important factor in preventing disability in old age among people with chronic disease (11-15). Recent long-term studies have found that midlife and old age physical activity lowered the risk of late life mobility difficulties and dementia (16,17) and that former elite athletes had less need for hospital care during later life than age-matched controls (18). However, little is known about the association of physical activity earlier in life and need for in-patient care prior to death among people who die in old age. The longer life-span of physically active people may predispose them to more rather than less need of care at the end of life. On the other hand, persons who exercise regularly may suffer less from chronic diseases and disability in old age and thus need less health and social care services at the end of life than more sedentary people. We studied the association of self-reported physical activity participation from midlife to old age and all-cause hospital and long-term care in the last year of life. Analyses were stratified according to gender and age at death.

METHODS

Participants and data collection

In the year 1988, a random sample of 1600 community-dwelling residents of the City of Jyväskylä in central Finland aged 65-84 years was drawn from the national Population Register as part of the prospective cohort study called Evergreen study (described in detail elsewhere) (19). Participants were interviewed face-to-face in 1988 and in 1996. 1224 people (77%) of the target group took part in the first interview in 1988. From that population, we conducted a nested case study. Cases consisted of 846 persons who had died during 1989-2004. Those who had died in 1988 and those who were alive at the end of the follow-up in January 2005 were excluded, to allow for a one-year follow-up of service use before death (Figure 1).

Data were collected in face-to-face interviews conducted at the participants' homes by trained university undergraduates in 1988 and 1996. In order to shorten the distance from interview to last year of life, the data collection wave more proximal to the last year of life was used. Thus, data collected in 1988 were used for persons who died during 1989-1997 and data collected in 1996 for those who died during 1998-2004, except for persons who had died during 1998-2004 but not participated in the 1996 interview (6%) or were institutionalized by 1996 (3%). For these persons the 1988 interview data were used. The length of time from interview to death ranged between 1-9 years for 91% and 10-16 years for 9% of the participants, average time from interview to death being 5.8 years. The study was approved by the Ethical Committee of the Central Finland Health Care District.

Outcome data

In Finland, university, central, and district hospitals offer specialized care. Health centre in-patient wards and nursing homes (long-term care) provide mainly rehabilitation and palliative care. Data on university hospital, central and district hospital and health centre ward care were drawn from the National Research and Development Centre for Welfare and Health (Stakes) register. The information consisted of dates on all-cause admissions and discharges and the exact public or private institution in which care took place. Data on nursing home care were collected from the local registers of nursing homes in the area. On the basis of the register data, we calculated the exact number of in-patient days of hospital and long-term care in the last year of life. These data were linked to the Evergreen study interview data. The number of hospital and long-term care days in the last year of life were analyzed separately in the negative binomial regression models.

Measures

Present physical activity level and intensity was determined on a seven point scale: moving about only minimally to carry out everyday chores; light physical activity 1-2 times/week; light physical activity several times/week; exercise causing breathlessness and sweating 1-2 times/week; exercise causing breathlessness and sweating several times/week; exercise causing breathlessness and heavy sweating several times/week; and engaging in competitive sports several times/week (20,21). Physical activity earlier in life was determined by asking retrospectively about participation in recreational or competitive sports at the ages of 10-19, 20-39, 40-64, 65-74 years, and 75 years and over (22). The disciplines typically included e.g. skiing, tract and field sports, and gymnastics.

Physical activity was categorized according to self-report data from midlife to old age, because physical activity from age 40 years and over has been found to predict activity in old age (22), and

because midlife physical activity has been observed to be related more closely to health and functional capacity in old age than more distal physical activity behavior (16,17). Three exclusive groups according to physical activity at 40-64 years, 65-74 years, 75 years and over, and present physical activity were formed. The groups were 1) consistently physically active from midlife onwards (consistent participation in recreational or competitive sports from 40 years onwards and at the time of the interview at least light physical activity several times/week), 2) occasionally physically active from midlife onwards (participation in sports at some point, but not consistently, from 40 years onwards and at the time of the interview either active or sedentary), and 3) consistently sedentary from midlife onwards (no engagement in sports from 40 years onwards and at the time of the interview light physical activity 1-2 times/week at most).

Potential confounders included age at death (range 66-98), gender, full-time education (6 years or less vs. more than 6 years), marital status (married or cohabiting/single, widowed, divorced), current smoking (yes/no) and receiving formal home care during the previous year (yes/no). Cognitive functioning was measured with Mini-D test (23), developed from the neuropsychological test of Luria (24). Scores ranged from 0-43, with a higher score indicating better cognitive functioning. Morbidity was assessed according to self-reported physician-diagnosed chronic diseases lasting over three months and primary causes of death obtained from the national Population Register. Causes of death were classified as diseases of the heart and circulatory, nervous, respiratory, digestive, and genitourinary system, and cancer at any site, acute infections, accidents and all other causes of death according to the International Classification of Diseases, ninth version (ICD-9) (25). The time from interview to death was calculated (range 1-16 years) and used as a variable in the models. In addition, self-reported information on instrumental activities of daily living (IADL) disability was collected with regard to ten IADL tasks: preparing

meals, washing clothes, shopping, coping with light and heavy housework, administering and taking medications, using the telephone, using public transport, and handling finances (26,27).

Statistical analyses

Comparisons of discrete baseline characteristics were performed using chi-square tests. For continuous variables, independent sample t-test and ANOVA were used. All tests were performed as two-tailed in SPSS 14.0 with significance level $p<0.05$.

We studied the association between physical activity from midlife onwards and hospital and long-term care using negative binomial regression models, where the strength of an association is measured as an Incidence Rate Ratio (IRR). IRRs are interpreted as relative risk estimates and represent the risk for persons in the predictor variable groups relative to those in the reference group. Hospital and long-term care outcomes were continuous variables with one day as a unit. We estimated risk values (IRR) and their 95% confidence intervals (CI) by comparing those who had been sedentary from midlife onwards and those who had been occasionally physically active from midlife onwards with those who had been consistently physically active from midlife onwards (reference group). The likelihood ratio test was used to assess the interaction effect between gender and physical activity behavior. IRRs were calculated for men and women separately for risk for hospital and long-term care in the last year of life. Modeling was performed with STATA 9 software (29), with significance level set at $p<0.05$ for all effects.

RESULTS

Of the 846 deaths, 26% occurred at the ages of 66-79, 53% at 80-88, and 21% at the ages of 89-98. The mean age of death was 82 (SD 6.2) years for men and 84 (SD 6.1) years for women. 67% of the participants were women. The most common causes of death were diseases of the heart and circulatory system (54%), cancer at any site (19%), diseases of the nervous system e.g. dementia (8%), and acute infections e.g. septicemia (4%). We observed a statistically significant gender interaction for hospital (p=0.027) and long-term care (p=0.001), and thus analyzed care separately for men and women.

Thirty-eight percent of men and 23 percent of women were categorized as physically active from midlife onwards. They suffered less from IADL disability, used less formal home care, and more frequently had higher education than those categorized into sedentary or occasionally physically active groups (Table 1).

For men and women, hospital care decreased and long-term care increased in the last year of life with older age at death (Figure 2 A and B). For men, hospital care decreased with higher level of physical activity from midlife onwards (p for trend 0.026), but there were no differences in long-term care use according to physical activity behavior. For women, we detected an increase in long-term care with lower physical activity level (p for trend 0.021), but there were no differences in hospital care use according to physical activity behavior from midlife onwards (Figure 2 C and D).

For men, with the active group as the reference, the adjusted risk for all-cause hospital care in the last year of life was higher for those who had been sedentary (risk ratio [IRR] 1.98, 95% confidence interval [CI] 1.14-3.42). The long-term care risk did not differ according to physical

activity (Table 2). For women, the risk for hospital care did not differ according to physical activity. The risk for long-term care in the last year of life was higher for those women who had been sedentary (IRR 2.03, 95% CI 1.28-3.21) or occasionally physically active (IRR 1.60, 95% CI 1.06-2.43) from midlife onwards, with the consistently physically active as the reference (Table 3). The results remained the same when we used data solely on earlier physical activity as a predictor of need for care.

We stratified the study group according to age at death (66-79, 80-88, and 89-98 years). For men, the results were similar for all age strata for the risk of hospital and long-term care. For women who had died at the age of 66-79 or 80-88 years, the risk for long-term care in the last year of life was lower among the consistently active women compared to others. However, for women who died at the age of 89-98 years, the statistical significance of physical activity behavior on need for long-term care was diminished (data not shown).

In addition, the proximity of the interview and death was investigated by excluding persons who had died 1-2 years after the interview, but it did not change the results.

DISCUSSION

Men who reported consistent physical activity from midlife onwards needed fewer days of hospital care in their last year of life than those who reported less physical activity. For women who died before 90 years of age, the same was true for long-term care. All analyses were performed for a decedent population who had taken part in an ante mortem interview about their physical activity participation. These data were linked with register-based data on hospital and long-term care during the year preceding death.

Our results are in agreement with earlier studies about the need for end-of-life in-patient care and age at death. Hospital care with aggressive forms of care decreases (29,30) and need for long-term care increases with older age at death (2,3). However, most of the earlier research has not included care given both in a hospital and nursing home, which underestimates the total care needed at the end of life (31).

To the best of our knowledge, this is the first study to report on the association of physical activity and the need for hospital and long-term care at the end of a long life. For sedentary men, the higher use of hospital care may be due to their higher incidence of conditions requiring specialized care or longer duration of care compared to physically more active men (32). In men, physical activity earlier in life and length of long-term care in the last year of life did not correlate. A potential explanation is that men needing care are often cared for at home by their spouses and they tend to die before their caregivers (32). Our analyses showed that sedentary women needed more days of long-term care in their last year of life than more active women. This could be due to the fact that sedentary women might have suffered from disability more frequently than their active counterparts and thus would have needed more long-term care at the end of life.

A plausible explanation for the preventive effect of physical activity on the need for care is in line with the disablement process described by Nagi (33). Consistent physical activity from midlife onwards can reduce the risk of disease (6,8,34) and development of functional limitations (14,35). This further postpones or prevents the development of disability (36-38) which is often reflected in increased need for assistance and care in activities of daily living (39). We were able to confirm the relation between physical activity from midlife onwards and disability in old age by further analysis (data not shown). The risk for disability in old age was higher for those who had been sedentary or occasionally active from midlife onwards compared to the consistently active. Thus, consistent physical activity from midlife onwards might help decrease the development and progression of disability, which in turn could contribute to an increase in active life expectancy and a reduced need for end-of-life care.

The strengths of the study are the decedent study population, the ante-mortem interviews used with register-based data for hospital and long-term, long follow-up, wide range of ages at death and the prospective design. Limitation in the study was that physical activity data were collected with retrospective interview and were based on self-report. Potential recall bias and possible subclinical cognitive impairments the participants might have had at the time of the interview may have influenced the results (5,40,41). Persons who were physically active at the time of the interview may recall their earlier physical activity more accurately. To be categorized as physically active, a person had to report engagement in recreational or competitive sports over all three periods in time, which consistently sedentary persons would probably not report by mistake. Furthermore, we cannot rule out the possibility, that some participants were sedentary in their midlife due chronic diseases. However, we performed subgroup analyses for those who had a disease of the heart and circulatory system. The association of physical activity with need for

hospital and long-term care did not differ from the results for the whole study population (data not shown). It has been reported earlier that a higher level of physical activity in midlife correlates with higher function in old age, regardless of adjustment for chronic diseases at baseline (39). Data were not available for us to take into account in our analyses care that took place outside institutions. However, we did adjust the models for marital status, as the spouse is the most likely provider of care outside the institutions. More detailed information on onset of chronic conditions and physical activity behavior throughout the life-span should be included in future studies. It should also be emphasized that our study is based on observational data and therefore definite conclusions about cause and effect can not be drawn.

Our findings among people who died after 66 years of age, suggest that consistent long-term physical activity may decrease the need for end-of-life hospital care for men and long-term care for women regardless of the common chronic diseases people may have. However, physical activity may not reduce the need for long-term care at the end of life for women with extremely long lives, which is the group of people that will continue to grow within the next few decades in Western countries. Our results provide novel information, which need to be confirmed in further studies.

CONFLICT OF INTEREST

None disclosed.

ACKNOWLEDGEMENTS

The study was funded by the Ministry of Education, Finland and Juho Vainio Foundation, Finland.

We thank Ms Ritva Sakari-Rantala for helping with collecting data on hospital and long-term care use and Dr Mirja Hirvensalo for her expert opinion on physical activity questions.

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Legends for figures:

Figure 1. Formation of the study population, deaths and data collection wave used

Figure 2. All-cause hospital, long-term and total care in the last year of life according to age at death (A and B) and physical activity behavior (C and D) for men and women