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Original research

Associations between physical activity, medical costs and hospitalisations in older Australian women: Results from the Australian Longitudinal Study on Women's Health

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ABSTRACT

Objectives: The aim was to examine the associations between level of physical activity (PA) and non-hospital medical costs, and between physical activity and hospitalisations in older women from 1999 to 2013.
Design: Longitudinal observational study.
Methods: Data were collected from participants in the Australian Longitudinal Study on Women's Health, who completed surveys in 1999 (aged 73–78 years), 2002, 2005, 2008 and 2011. Annual cost data (from the Medicare Benefits Schedule) were available for 1999–2013 and hospital admissions data were available for 2002–2010. Costs were expressed in 2013 Australian dollars (AUD). Prospective associations between self-reported physical activity (categorised as inactive, low, moderate or high) and costs/admissions were examined using quantile regression (for costs) and logistic regression fitted with generalised estimating equations (for hospitalisation).
Results: Median annual costs were AUD122 (95% confidence interval [CI] = 199, 45), AUD284 (CI = 363, 204) and AUD316 (CI = 385, 247) lower in low, moderate and highly active women, respectively, than in those who were inactive [AUD1890 (interquartile range = 1107–3296)]. Odds of hospitalisation were also lower in the low (odds ratio [OR] = 0.88, CI = 0.80–0.96), moderate (OR = 0.77, CI = 0.70–0.85) and highly active (OR = 0.78, CI = 0.71–0.85) women, than in the inactive group.
Conclusions: In inactive older Australian women, a small increase in physical activity may be sufficient to obtain substantial cost savings for the health system and to reduce hospital admissions.

1. Introduction

In older adults, physical inactivity is associated with a range of chronic conditions.[1] It is assumed that this association translates into increased use of health services and thus higher health-related costs, however, there is surprisingly little evidence to support this assumption. Prospective studies that examined associations between physical activity, health services use and costs, have been conducted in Canada,[2,3] Japan,[4] Taiwan,[5] the United Kingdom,[6] and the United States of America.[7,8] Similar data have not previously been published for older Australians. While all previous studies showed that physical inactivity is associated with higher health services use and costs, the magnitude of the effects varies greatly between countries. For example, compared with their active counterparts, inactive older adults had USD125 higher costs in a Japanese study[4] and USD2686 higher costs in a study of US Medicare retirees.[7] Many factors may explain differences in the magnitude of these effects between countries, such as differences in the prevalence of physical inactivity, availability of and access to health services, and characteristics of the population studied. This makes international comparisons difficult. It is therefore important that countries with different health systems publish these data. Information on how health services use differs between active and inactive older adults provides insight into the theoretical potential for cost-savings of physical activity promotion programs.

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The aim of this study was to examine the associations between physical activity and non-hospital medical costs (excluding pharmaceutical costs), and hospitalisations in older Australian women from 1999 to 2013. Lifestyle, health and sociodemographic data were used from the Australian Longitudinal Study on Women's Health (ALSWH). These data were linked with data from the Medicare Benefits Schedule, the Australian government's system for subsidising the costs of medical services, and with hospital admission data from four of the eight states and territories.

2. Methods

The Australian Longitudinal Study on Women's Health (ALSWH) is an ongoing study of the health and wellbeing of three generations of women since 1996.[9,10] Participants were randomly drawn from the national Medicare health insurance database, which includes all Australian citizens and permanent residents. The women were stratified by area of residence (urban, rural, or remote) and then selected by simple random sampling within each stratum; women in the rural and remote strata had twice the probability of selection as women in the urban stratum. Ethics approval was obtained from the Ethics Committees of the Universities of Newcastle and Queensland, and participants signed informed consent. For more details refer to: www.alswh.org.au.

This study used data from the women born in 1921–1926. Baseline surveys were mailed in 1996, with follow-up surveys mailed in 1999, 2002, 2005, 2008 and 2011. At baseline, the sample (n = 12,432, response rate 35.5%) was largely representative of Australian women in this age group, but with a somewhat higher representation of partnered women and women with post-high school education.[11] The respective response rates for surveys were 83.9%, 69.6%, 57.6%, 44.7% and 32.6% relative to the 1996 sample. The main reason for drop-out was death, which reached 40.1% by 2011. For analyses of non-hospital medical costs, data were included from participants who returned the 1999 survey, and excluded from participants who were covered for health services by the Department of Veterans' Affairs (DVA), or who had withdrawn consent to data linkage. For analyses of hospitalisations, data were included from participants who returned the 2002 survey and lived in states for which hospital data were available (see below for details). For both outcomes, observations were excluded if data were missing for physical activity or any confounders. Participants who died during follow-up were included until the end of the year before their year of death. This resulted in 15,162 observations from 7620 women for the outcome "non-hospital medical costs" and 24,336 observations from 4990 women for the outcome "hospitalisations" (Supplementary Appendix Fig. 1).

Medicare is the Australian government's system for subsidising the costs of medical services, including general practitioner and some out-of-hospital specialist, pathology, radiology, dental and allied health services, and limited additional primary health care services, for all Australian citizens and permanent residents.[12] For the current analyses, total annual costs for Medicare-subsidised health services were calculated per participant for the years 1999–2013. These costs cover both the government rebate and the "gap" between the government-scheduled fee and the actual fee, which is paid by the patient. The ALSWH data were linked with Medicare data using deterministic linkage based on a unique identifier. Total annual costs were multiplied by inflation factors, with 2013 as the reference year.[13] Annual costs are presented in AUD (in 2013, the average exchange rate was USD0.90 for 1 AUD) and corrected for inflation.

In Australia, hospital admission data are collected and stored at a state level. The ALSWH data were linked with hospital data from New South Wales, Queensland, South Australia and Australian Capital Territory using probabilistic linkage based on name, date of birth, address, and address history. For most states, hospital data were available from 1 June 2002 to 31 December 2010. For the Australian Capital Territory, hospital data were available from July 2004 to June 2013; these participants were excluded from the analyses for years that no hospital data were available. For Queensland, public hospital data were available for the full period, while private hospital data were available from 2007. This means that we may have misclassified Queensland participants who were admitted only to a private hospital between June 2002 and December 2006 as not having been hospitalised. Any admissions recorded from 1 June 2002 to 31 December 2010 were included, except repeated day-admissions for dialysis, chemotherapy, rehabilitation and depression. A dichotomous variable was created for each year, indicating whether the participant had had one or more hospitalisations during that year.

Physical activity was assessed using the modified Active Australia questionnaire (which correlates moderately with pedometry [r = 0.42] in this age group).[14] The modified version differs from the original version in that it asks participants about household as well as garden chores.[15] Participants reported time in the last week spent walking, in moderate and vigorous leisure-time activities and in vigorous household or garden chores. Minutes per week spent in each activity were multiplied by a metabolic equivalent (MET) score: 3.33 for walking, moderate leisure-time and household and gardening chores, and 6.66 for vigorous leisure-time activity. These MET values are somewhat lower than recommended in the Active Australia questionnaire manual[16] but in line with recommended generic MET values in the report on the development of the Australian PA guidelines.[17] Amount of physical activity was calculated as the sum of MET-minutes/week from each of the domains and categorised as: inactive = 0 – <50 (reference category), low = 50 – <500, moderate = 500 – <1000, and high = ≥1000 MET-minutes/week.

Survey variables were measured using the same methods across all surveys (except education which was assessed at baseline only), and categorised as shown in Table 1. Body mass index (BMI) was calculated using self-reported weight and height values (kg/m^2). Smoking status was measured in 1999 and 2011 only. As there was little within-person variation in smoking status over time, the 1999 status was carried forward to the following surveys. Depression was assessed by asking: "In the past 3 years, have you been diagnosed with or treated for depression?" (yes/no). Ability to walk was measured with the question "Does your health now limit you in walking 100 metres?" from the Short Form-36.[18] Participants were classified as *unable to walk 100 m* if they responded with 'yes limited a lot' and *able to walk 100 m* if they responded with 'no, not limited at all' or 'yes, limited a little'.

Descriptive statistics were used to summarise participant characteristics. Differences in annual median costs for categories of physical activity were examined using quantile regression to account for the skewness of the costs data. To account for the within-person correlation of the repeated measures, robust standard errors were used. Physical activity at each survey was associated with the average of the annual costs for the year of survey and the two subsequent years. For example, physical activity at survey 1999 was related to annual cost data averaged over 1999–2001. 'Age' was included to adjust for increasing costs over time due to age-related decline in health.

The association between level of physical activity and risk of hospitalisation was examined using logistic regression with generalised estimating equations (GEE) to account for repeated measures and with exchangeable correlation structure. Physical activity at each survey was associated with the risk of hospitalisation in the same year and the subsequent two years. 'Age' was included as the time variable.

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