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Household physical activity and mortality in older adults: A national cohort study in Spain

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ABSTRACT

Objective. To examine the association between household physical activity (HPA) and all-cause mortality in a cohort of older adults from Spain, and the role of sedentary time on this association.

Method. Prospective cohort study of 2874 individuals aged ≥62 years. In 2003, the time spent in HPA and the time spent seated were self-reported. The association of HPA with all-cause mortality through 2011 was assessed with Cox regression.

Results. During the follow-up, 970 participants died. In men, HPA was inversely associated with the risk of death only among those with longer sitting time (≥8 h/d): compared to those who did not do HPA, the mortality hazard ratio (HR) was 0.80 (95% confidence interval (CI): 0.60–1.08) and 0.43 (95% CI: 0.27–0.69) for those who spent >0 to 2 h/d and >2 h/d in HPA, respectively (*P* for trend < 0.001). In women, sitting time did not modify the study association. Thus, compared to women who spent <2 h/d in HPA, the HR for mortality was 0.72 (95% CI: 0.56–0.93) and 0.52 (95% CI: 0.39–0.70) for those who spent >2 to 4 h/d, and >4 h/d in HPA, respectively (*P* for trend < 0.001).

Conclusion. In women, HPA is associated with reduced mortality regardless of sitting time. HPA may also contribute to longer survival among men with longer sitting time.

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Introduction

According to the current physical activity (PA) recommendations, older adults should do moderate-intensity PA for at least 150 min throughout the week or do at least 75 min of vigorous-intensity PA throughout the week (USDHHS, 2008b; World Health Organization, 2010). However, only a small percentage of older adults meet this recommendation because most of their PA is performed at light-intensity (Evenson et al., 2012; Troiano et al., 2008). In particular, among older women, household activities (e.g., cleaning, cooking, vacuuming, ironing, watering plants, and grandchild care) might be an important component of their PA (Chen et al., 2012; Ottenbacher et al., 2012).

Information on the effect of household PA (HPA) on mortality in older adults is scarce. Only two studies, conducted in Mexican-American (Ottenbacher et al., 2012) and Taiwanese (Chen et al., 2012) individuals, have assessed this association; in both of them HPA was associated with lower mortality, regardless of other types of PA. Yet, these studies did not examine whether this association was independent of sitting time, which is inversely correlated with the time spent at light-intensity PA (Owen et al., 2010). This is important because older adults are the population subgroup with the highest level of sedentariness (Matthews et al., 2008), and longer sitting time is associated with higher mortality in older adults (Koster et al., 2012).

It is therefore unclear whether HPA plays an independent role in reducing mortality in the elderly, or whether it is only a reflection of the associated lower sedentariness. In this study, we aimed (i) to examine the association between HPA and all-cause mortality in a cohort of older adults from Spain and (ii) to assess the role of sedentary time on this association. We hypothesized that HPA is prospectively associated with reduced mortality in older adults, particularly in those who are very sedentary.

Materials and methods

Study design and population

The study design and procedures have been reported elsewhere (Gutiérrez-Fisac et al., 2004; López-García et al., 2008). Briefly, in 2001 we obtained baseline information from a cohort of 4008 persons (2269 women) representative of the non-institutionalized population aged ≥60 years in Spain. Data were collected by home-based personal interview and physical examination, performed by trained and certified personnel.

In 2003, an attempt was made to contact the subjects again, and this was successful in 3235 of them (1824 women) (Balboa-Castillo et al., 2011b; López-García et al., 2008). Information was obtained by telephone interview

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and the individuals contacted did not differ significantly from those lost to follow-up in socio-demographic and lifestyle characteristics. Since the main exposure variable (i.e., HPA) was included only in the 2003 interview, only participants contacted in 2003 were selected for the current analysis.

The study was approved by the Clinical Research Ethics Committee of the "*La Paz*" University Hospital in Madrid, Spain.

Main exposure variable

Information on the time spent in household activities was obtained with the following question: "How much time do you spend doing household activities on a typical weekday?" The interviewer always gave several examples of common household tasks (e.g., cleaning, cooking, and washing dishes). The same question was asked with reference to a weekend day. The time spent in HPA was calculated as follows: [(household task time on a weekday × 5) + (household task time on a weekend day × 2)] / 7.

Outcome variable

The outcome was all-cause mortality from 2003 to the end of follow-up on December 31, 2011. The number and dates of deaths were obtained by a computerized search of the National Death Index, which contains information on the vital status of all residents in Spain.

Potential confounders

In 2003, data were collected on variables related to both HPA and mortality. Specifically, data were obtained on age, sex, the highest educational level attained (no formal education, primary, and secondary or higher), marital status (single, married, divorced, widowed), and if they lived alone (yes/no).

In addition, body weight in 2003 was self-reported (López-García et al., 2008), whereas height in 2003 was assumed to be the same as in 2001, when it was measured by a portable wall-mounted stadiometer (KaWe, Asperg, Germany) (Gutiérrez-Fisac et al., 2004). Body mass index (BMI) was calculated as weight in kg divided by height in m squared, and obesity was defined as BMI $\geq$ 30 kg/m^2.

Agility limitation was ascertained with the question: "Do you experience any difficulty in bending or kneeling?" (Balboa-Castillo et al., 2011a). Mobility limitation was defined as an affirmative response to any of the following questions: (i) "Do you experience any difficulty in picking up or carrying a shopping bag?"; (ii) "Do you experience any difficulty in climbing one flight of stairs?"; and (iii) "Do you experience any difficulty in walking several city blocks (a few hundred meters)?" (Balboa-Castillo et al., 2011a).

Study participants also reported tobacco and alcohol consumption (Guallar-Castillón et al., 2001). Leisure-time PA was evaluated with the validated Spanish version of the PA questionnaire used in the Nurses' Health Study and the Health Professionals' Follow-up Study (Martinez-Gonzalez et al., 2005). This questionnaire rates participation and time devoted to each activity per week in 16 different activities: walking, dancing, stationary bicycling, bicycling outdoors, competitive running, jogging, gardening, skiing, climbing, football, going to the gym, judo, swimming, tennis, sailing, and other team sports. The annual duration of each activity (>6 months per year, 3–6 months per year, and < 3 months per year) was also ascertained. The total time spent in leisure-time PA was calculated as the sum of times for all activities weighted by the annual period of participation in each activity.

Sedentary behavior was estimated by the total time spent seated, based on the following question referred to leisure time: "About how much time do you spend sitting down on weekdays?" (Balboa-Castillo et al., 2011b). The same question was asked with reference to a weekend day. Thus, the number of hours per day spent seated was calculated as follows: [(sitting hours on a weekday × 5) + (sitting hours on a weekend day × 2)] / 7.

Finally, the following diseases diagnosed by a physician and reported by the study participant were recorded: coronary heart disease, stroke, diabetes mellitus, hip fracture and cancer at any site.

Statistical analysis

Of the participants followed until 2003, the following persons were excluded from the analysis: 245 who died between 2001 and 2003, 44 who lacked data on HPA, and 72 without data on potential confounders. Accordingly, we conducted the analyses with 2874 individuals (1246 men and 1628 women).

Firstly, we checked that there was no collinearity between activity variables (i.e., HPA, leisure-time PA, and sitting time). On average, women spent 2.1 h/d more in household tasks than men. Thus, categories of HPA were defined separately for men (0 h/d,>0 to 2 h/d, and >2 h/d) and women (≤2 h/d,>2 to 4 h/d, and >4 h/d). The association between sex-specific categories of HPA and mortality was summarized with hazard ratios (HRs) and their 95% confidence interval (CI) obtained from Cox regression. Test for linear trends was also performed by modeling time spent in HPA (h/d) as a continuous variable. Follow-up duration in number of days was used as the time scale, which started at the date of interview in 2003 and continued until date of death or December 31, 2011.

Four Cox models, with progressive adjustment for potential confounders, were fitted. The first model adjusted for age, sex, and educational level; the second model further adjusted for marital status, living alone status, BMI, activity limitations (mobility and agility) and comorbidities (coronary heart disease, stroke, diabetes mellitus, hip fracture, and cancer); the third model additionally adjusted for alcohol consumption, smoking status and leisure-time PA; and the final model additionally adjusted for sitting time.

We also conducted several sensitivity analyses for assessing the robustness of the main results. We performed stratified analyses by age and education. Similar stratifications were performed by health status (obesity, activity limitations and comorbidities) and several lifestyles (smoking, alcohol intake, and leisure-time PA). We tested for interactions of HPA with these covariates by including appropriate interaction terms in the Cox models and using likelihood ratio tests.

To examine the role of sitting time on the association between HPA and mortality, we performed Cox regression adjusted for potential confounders across groups of HPA and sitting time. We used the cut-off point of 8 h/d, in accordance with previous research (van der Ploeg et al., 2012), to classify older adults with low (<8 h/d) or high (≥8 h/d) levels of sitting time. We also tested whether the study association varied with sitting time by using likelihood ratio tests which compared models with interaction terms (products of HPA by sitting time categories) and models without those terms.

We assessed the assumption of proportionality of hazards both graphically and by testing the significance of the interaction between the main exposure variable and years of follow-up, and we found no evidence of departure from such assumption (P for interaction > 0.2). Analyses were performed with STATA® version 11.1. All tests were 2-sided and statistical significance was set at $P < 0.05$ for main effects and $P < 0.1$ for interactions.

Results

Table 1 shows the baseline characteristics of the study participants according to HPA. During an average follow-up of 7.3 years and 20,980 person-years of observation, 970 deaths occurred. Table 2 shows the association between HPA and mortality. In analyses adjusted for socio-demographic variables, obesity, activity limitations and comorbidities, those men who did household activities for >0 to 2 h/and for >2 h/d had, respectively, a mortality HR = 0.67 (0.52–0.86) and 0.63 (0.45–0.87) compared with men who did no household activities. This association decreased in magnitude and was no longer significant after further adjustment for lifestyle variables and sitting time. In women, there was a clear inverse dose–response relationship between the time spent in household activities and mortality independently of all potential confounders. Compared to women who spent less than 2 h/d in household tasks, the fully-adjusted mortality HR was 0.72 (95% CI: 0.56–0.93) and 0.52 (95% CI: 0.39–0.70) for those who spent >2 to 4 h/d and >4 h/d in HPA (P for trend < 0.001).

To assess the robustness of results, we examined the study association within groups defined by socio-demographic variables, BMI, activity limitations and comorbidities (Table 3). We found an inverse dose–response relation between HPA and mortality in most groups among women (P for trend < 0.05), but not in men (all P for trend > 0.05). Similar sex-specific results (data not shown) were obtained when we stratified the analyses by smoking (smoking, non-smoking), and alcohol intake (drinker, non-drinker). Likewise, when stratifying by leisure-time PA, HPA was only significantly associated (P for trend < 0.001) with mortality in women with low levels of this PA (<sex-specific median in the cohort), although we also found a trend for significance

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