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Work, household, and leisure-time physical activity and risk of mortality in the EPIC-Spain cohort

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ABSTRACT

Objective. Large-scale longitudinal data on the association of domain-specific physical activity (PA) and mortality is limited. Our objective was to evaluate the association of work, household (HPA), and leisure time PA (LTPA) with overall and cause-specific mortality in the EPIC-Spain study.

Methods. 38,379 participants (62.4% women), 30–65 years old, and free of chronic disease at baseline were followed-up from recruitment (1992 - 1996) to December 31st, 2008 to ascertain vital status and cause of death. PA was evaluated at baseline and at a 3-year follow-up with a validated questionnaire (EPIC-PAQ) and combined variables were used to classify the participants by sub-domains of PA. Associations with overall, cancer, and cardiovascular mortality risks were assessed using competing risk Cox regression models adjusted by potential confounders.

Results. After 13.6 years of mean follow-up, 1371 deaths were available for analyses. HPA was strongly associated to reduced overall (hazard ratio (HR) for Q4 vs. Q1 = 0.47 (0.34, 0.64)) and cause-specific mortalities in women and to lower cancer mortality in men (*P* for trend = 0.004), irrespective of age, education, and lifestyle and morbidity variables. LTPA was associated with lower mortality in women (HR for Q4 vs. Q1 = 0.71 (0.52, 0.98)), but not men. No relationships were found between sedentariness at work and overall mortality.

Conclusions. HPA was associated to lower mortality risk in men and women from the EPIC-Spain cohort, whereas LTPA also contributed to reduce risk of death in women. Considering the large proportion of total daily PA that HPA represents in some population groups, these results are of public health importance.

Introduction

Physical activity (PA) is considered one of the lifestyle cornerstones of health promotion, contributing to healthy living and increased longevity. There is extensive epidemiological evidence supporting the benefits of physical activity for prevention of ischemic heart disease (Thompson et al., 2003), stroke (Wendel-Vos et al., 2004), diabetes (Colberg et al., 2010; The Interact Consortium, 2012), and cancer (WCRF-AICR, 2007). In addition, chronic patients in better physical fitness exhibit reduced mortality than their inactive counterparts (Kokkinos et al., 2009). Nowadays, a recommendation for performing at least 150 min a week of moderate-intensity physical activity (or

Abbreviations: EPIC, European Prospective Investigation into Cancer and Nutrition; EPIC-PAQ, EPIC physical activity questionnaire; HPA, Household physical activity; LTPA, Leisure time physical activity; PA, Physical activity; RPA, Recreational physical activity.

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equivalently 75 min of high-intensity physical activity) has been adopted worldwide as a public health goal for targeting chronic disease risk at all ages (U.S. Department of Health and Human Services, 2008; WHO, 2010).

Large-scale prospective studies allow the evaluation of PA guidelines and a proper characterization of PA effects, by type and intensity, for preventing mortality (Autenrieth et al., 2011; Samitz et al., 2011; Wen et al., 2011). The systematic review and meta-analysis of prospective studies on domain-specific PA and mortality conducted by Samitz et al. (2011) supports a preventive role for different types of PA on all-cause mortality risk. However, for domains such as transportation, work, or daily living activities, the results from this meta-analysis were based on a limited number of studies, since few large prospective cohorts have assessed the effect of domain-specific physical activities on the risk of death (Autenrieth et al., 2011; Sabia et al., 2012; Samitz et al., 2011). Most studies to date have focused on the evaluation of leisure-time physical activity as the main exposure (Nocon et al., 2008; Samitz et al., 2011), which has been the major goal of PA promotion policies. Nevertheless, household and occupational activities could also contribute to meet PA recommendations and have a non-negligible health impact (Autenrieth et al., 2011; Khaw et al., 2006). Accruing evidence suggests that PA at home adds to the benefits of total daily physical activity and significantly contributes to reduce mortality risk (Autenrieth et al., 2011; Besson et al., 2008; Chen et al., 2012; Martínez-Gómez et al., 2014; Ottenbacher et al., 2012; Stamatakis et al., 2009), especially in women in whom low-intensity household activities could account for a large proportion of total daily living activities (Martínez-Gómez et al., 2014), whereas the benefits of occupational PA are less clear (Clays et al., 2014; Holtermann et al., 2012; Khaw et al., 2006; Richard et al., 2015).

The present study was conducted to assess the specific association between physical activity domains (at work, at home, and during leisure time) and risk of cardiovascular, cancer, and total mortality, in men and women of diverse age and lifestyle characteristics from the Spanish EPIC (European Prospective Investigation into Cancer and Nutrition) study.

Methods

Study population

The EPIC (European Prospective Investigation into Cancer and Nutrition) study is a multi-center prospective investigation on half a million volunteers from ten European countries (Riboli and Kaaks, 1997; Riboli et al., 2002). The Spanish branch (EPIC-Spain) included 41,438 participants (62.3% women), 29 to 69 years old at baseline, recruited between 1992 and 1996 from 5 regions (Asturias, Gipuzkoa, Navarra, Granada, and Murcia). The participants were blood donors (≈60%), civil servants, and the general population. Detailed information was gathered for each participant on lifestyle, diet, and clinical and anthropometric variables.

The EPIC study protocol was approved by the Medical Ethical Committee of the Bellvitge Hospital (Barcelona) and all of the participants gave informed consent.

Assessment of physical activity

The EPIC physical activity questionnaire (EPIC-PAQ) included specific items for occupational, household and recreational activities, referred to a typical week of the previous year both in summer and winter. In order to assess the amount of PA at work the participants were asked to rank their job according to its physical demand, as sedentary, standing occupation, manual work, and heavy manual work, or none. For non-occupational PA, they were requested to specify how many hours per week they usually spent in housework, gardening, do-it-yourself, or recreational activities (walking, cycling, and sports). The EPIC physical activity questionnaire was validated against objective measures of energy expenditure, as described elsewhere (Peters et al., 2012).

PA was assessed at two moments in time using the same questionnaire. Baseline data were gathered during a face-to-face interview, whereas a follow-up telephone survey was used to update information between 1996 and 1999 (3.3 ± 0.4 years after the first assessment). Summer and winter times were averaged, and the amount of weekly time dedicated to each activity was obtained as the mean between the baseline and follow-up assessments. For occupational PA, the participants with a concordant response in the two surveys were classified accordingly as sedentary, non-sedentary, and non-workers, respectively, and an additional category was included for those participants reporting a change in occupational PA at follow-up. Correlation coefficients (ρ) between the two assessments for men/women were 0.46/0.42 for recreational PA, and 0.46/0.48 for household PA.

The estimated average time spent in each activity was weighted by a specific MET intensity value (Ainsworth et al., 1993), and total MET · h · week^{-1} spent in each activity was computed. A household PA (HPA) variable was defined as the sum of housework, do-it-yourself activities, and gardening, whereas recreational (leisure-time) physical activity (RPA) comprised the sum of walking, cycling, and sports.

Assessment of dietary, anthropometric, lifestyle and clinical variables

Diet of the previous year was assessed using a validated dietary history method (EPIC Group of Spain, 1997a, 1997b) and total nutrient and energy intakes were estimated using specific food composition tables (Slimani et al., 2007). Height (to the nearest 1 cm) and weight (to the nearest 100 g) were measured in all the participants using standard procedures, with the subjects barefoot and in light clothing. Waist was recorded at the narrowest torso circumference or at the midpoint between the iliac crest and the lower ribs. Body mass index was computed as weight (in kg) divided by height (in m) squared. Questionnaire information was collected on educational level, habit of smoking, prevalence of chronic diseases, and alcohol consumption.

End-point ascertainment

Death cases occurring during follow-up through December 31st 2008 were identified by record linkage with the Spanish National Statistics Institute (www.ine.es). Underlying causes of death were registered and coded according to the International Classification of Diseases. ICD-10 codes I00–I99 were used to define cardiovascular mortality, codes C00–C99 were used for cancer deaths, and codes A00–R99 for overall organic causes of death.

The mean follow-up (±s.d.) was 13.6 (±1.4) years. For the present analysis, exclusions affected the participants without complete physical activity data in the two assessments ($n = 683$, including lost to follow-up), and further those with prevalent ischemic heart disease, stroke, cancer, or asthma at baseline ($n = 2376$). A final sample of 38,379 subjects, completing 523,773 person-years was available for analysis, among whom there were 1371 exitus from non-external causes, including 758 deaths from cancer, and 291 from cardiovascular disease.

Statistical analyses

Sex-specific quartiles of household and recreational activities combined were defined to explore the distribution of the baseline characteristics of the participants according to PA levels. Descriptive statistics included means and standard deviations for continuous variables, and frequencies for categorical ones.

Hazard ratios of overall and cause-specific mortalities were estimated for levels of occupational, household, and recreational PA using multivariate Cox regression models, with age as the time scale, and the lowest category of PA as the reference. Entry time was defined as age at recruitment, and exit time was defined as age at death or censoring. Competing-risk models were implemented to evaluate death risks due to specific causes in the presence of other competing causes of death. For all-cause mortality, death due to external causes was defined as the competing event. All models were conducted separately for men and women. Household activity was categorized into sex-specific quartiles. For RPA, the same categories were defined for men and women in line with current PA recommendations (U.S. Department of Health and Human Services, 2008; WHO, 2010): <7.5, 7.5–14.9, 15.0–29.9, and ≥30 MET-h/week. The final models were mutually adjusted for all PA variables considered, and also center, educational level (none, primary, technical/professional school, secondary, university, unknown), body mass index (in kg/m^2), waist and hip circumferences (in cm), baseline hypertension, hyperlipidemia, or diabetes (yes, no, unknown), habit of smoking (never, former, current, unknown), alcohol consumption (in g/day), energy intake (in kcal/day), and Mediterranean diet score (Buckland et al., 2009). To better account for non-linear associations of covariates, alcohol intake and anthropometric variables were modeled as restricted cubic splines (with