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Association between domains of physical activity and all-cause, cardiovascular and cancer mortality: Results from the MONICA/KORA Augsburg Cohort Study

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ABSTRACT

Few studies have investigated the independent effects of domain-specific physical activity on mortality. We sought to investigate the association of physical activity performed in different domains of daily living on all-cause, cardiovascular (CVD) and cancer mortality. Using a prospective cohort design, 4,672 men and women, aged 25-74 years, who participated in the baseline examination of the MONICA/KORA Augsburg Survey 1989/1990 were classified according to their activity level (no, light, moderate, vigorous). Domains of self-reported physical activity (work, transportation, household, leisure time) and total activity were assessed by the validated MOSPA (MONICA Optional Study on Physical Activity) questionnaire. After a median follow-up of 17.8 years, a total of 995 deaths occurred, with 452 from CVD and 326 from cancer. For all-cause mortality, hazard ratios and 95% confidence interval (HR, 95% CI) of the highly active versus the inactive reference group were 0.69 (0.48-1.00) for work, 0.48 (0.36-0.65) for leisure time, and 0.73 (0.59-0.90) for total activity after multivariable adjustments. Reduced risks of CVD mortality was observed for high levels of work (0.54, 0.31-0.93), household (0.80, 0.54-1.19), leisure time (0.50, 0.31-0.79) and total activity (0.75, 0.55-1.03). Leisure time (0.36, 0.23-0.59) and total activity (0.62, 0.43-0.88) were associated with reduced risks of cancer mortality. Light household activity was related to lower all-cause (0.81, 0.71-0.95) and CVD (0.72, 0.58-0.89) mortality. No clear effects were found for transportation activities. Our findings suggest that work, household, leisure time and total physical activity, but not transportation activity, may protect from premature mortality.

Keywords: domains of physical activity, exercise, health-promoting effects, mortality

Abbreviations:

| | |
|-------------|---|
| 95% CI | 95% Confidence Interval |
| BMI | Body Mass Index |
| BP | Blood Pressure |
| CDC | Centers for Disease Control and Prevention |
| CVD | Cardiovascular Disease |
| HDL | High-density Lipoprotein (HDL) Cholesterol |
| HR | Hazard Ratio |
| ICD | International Classification of Diseases |
| MET(s) | Metabolic Equivalent(s) |
| MONICA/KORA | Monitoring of Trends and Determinants in Cardiovascular Disease/ Cooperative Health Research in the Region of Augsburg |
| MOSPA | MONICA Optional Study on Physical Activity |

INTRODUCTION

The health-promoting effects of regular physical activity on cardiovascular disease (CVD), chronic morbidity and premature death are well-established [1-3]. Despite the knowledge of its health-enhancing effects, engagement in exercise, especially in industrialized societies, remains poor across many European countries [4]. In recent years, efforts have been made to counter the increasing physically inactive lifestyle of many individuals through campaigns, on both national and international levels (e.g. by Federal Ministries of Health or the World Health Organization), to incorporate physical activity into daily living. Recent recommendations advocate a minimum of 30 minutes of at least moderate-intensity activities on most days of the week [5]. Although the association between physical activity and mortality has been examined extensively in the past several years [6-8], few studies have focused on domain-specific activities performed during daily routines [9-11]. Specifically, analyses of the four most common domains (domestic, transportation, work, leisure time) of physical activity on mortality are sparse [12]. For people not willing or not able to engage in leisure time activities at all, information on the effects of physical activity beyond leisure time is **crucial**. The importance of incorporating regular activities into daily routines has been averred by several physical activity experts in their recommendations, suggesting a protective effect from premature morbidity and mortality [13, 14]. Especially household physical activity in relation to mortality has not been given sufficient attention; the distinct effect of regular housework in terms of all-cause and CVD mortality has only recently been investigated [12, 15]. In addition, few population-based data exist on different types and intensities of activity undertaken during daily routines and their relation to cause-specific mortality [11, 16, 17]. These considerations, and the insufficient prior systematic investigation of physical activity, subdivided into different domains, on all-cause, CVD and cancer mortality in a population-based cohort, were the motivation for this study.

METHODS

Study population

The presented data were derived from the second MONICA/KORA Augsburg survey (S2), conducted in 1989/1990 in the city of Augsburg and two adjacent counties. The study design, sampling, and data collection have been described in detail elsewhere [18, 19]. In brief, for S2, 6,637 individuals were drawn from a target population of 349,050 residents aged 25-74 years, using two-stage random sampling stratified by age and sex. Of those, 4,940 individuals participated in the baseline survey (baseline response: 76.9%). All subjects are currently followed within the framework of the Cooperative Health Research in the Region of Augsburg (KORA). Individuals with incomplete data on outcome (mortality, n=6), exposure (physical activity, (n=26)), or co-variables (n=268), were sequentially excluded from further analyses. Thus, 4,672 participants (2,373 men and 2,299 women) were available for the final analyses. The study was approved by the local authorities and all subjects provided a written informed consent.

Baseline measurements

MONICA Optional Study on Physical Activity (MOSPA)

The MOSPA questionnaire was designed to assess different domains of physical activity, asking **participants** to report the time usually spent on being physically active during work, transportation (walking or biking), household and/or leisure time, during a normal week over the past year. Based upon the subjects' indications, metabolic equivalents (METs, expressed in minutes per week) were calculated by means of a standardized program derived from the Compendium of Physical Activities [20] and provided by the Centers for Disease Control and Prevention (CDC). Following the recommendations of the CDC and the American College of Sports Medicine [21], intensity categories (no, light, moderate, vigorous) were defined for each physical activity domain. Individuals were graded into the category according to the

highest intensity level of their activities. For instance, subjects who engaged in light and moderate physical activity were categorized as moderately active, whereas cohort members who reported light and vigorous activity were classified in the highest activity level. A minimum time spent while executing the level of physical activity in each category was determined *a priori*. Thus, the four activity levels can be characterized as follows:

Participants who are represented in the category “*no physical activity*” did not report any light, moderate or vigorous activity in the respective domain of physical activity. “*Light physical activity*” was defined as activities causing no or little increase in breathing or heart rate (<3.0 METs). “*Moderate physical activity*” was defined as activities causing little to moderate rise in breathing and heart rate (3.0-6.0 METs). Participants below the cut-off point of 120 minutes per week spent on moderate physical activity were reassigned to light physical activity. The highest activity level, “*vigorous physical activity*”, classifies persons who engage in activities causing moderate to large increase in breathing and heart rate (>6.0 METs). Participants below the cut-off point of 90 minutes per week were reassigned to moderate physical activity.

The MET-minutes per week of the four domains of physical activity were then summed up, thereby creating a fifth rubric (total physical activity) that represents the overall activity level in the study participants. 36 persons who stated no physical activity at all, in any of the four physical activity domains, were allotted to “no physical activity” in each single domain, but were assigned to “light physical activity” for the total activity, in order to avoid a reference group of only 36 subjects.

After restricting the analyses of occupational activity to employed participants only, data from 2,538 cohort members were available for further analyses of work physical activity. With considerations for the activity levels reported in our population, we amended the MOSPA questionnaire to include the following categories for the activity domain variables; four activity levels for transportation and leisure time (no, light, moderate, vigorous), three for

household (no, light, moderate) and total (light, moderate vigorous), and two for work activity (light, moderate).

Outcome definition

End points used in this study were all-cause mortality and mortality from any CVD, cancer or other causes that occurred until December 31st, 2007. Deaths were ascertained by regularly checking the vital status of all sampled persons of the MONICA surveys through the population registries inside and outside the study area. Death certificates were obtained from local health authorities. Using the 9th revision of the International Classification of Diseases (ICD), death certificates were coded for the underlying cause of death. Until December 31st, 2007, 995 subjects died from all-cause mortality (ICD-9: 001-999), 452 from CVD (ICD-9: 390-459), and 326 from cancer (ICD-9: 140-208). 20 individuals were lost to follow-up in the final dataset.

Covariables

Baseline information on socio-demographic factors, medical history, and lifestyle habits were gathered by trained medical staff during a standardized interview. Educational attainment was estimated by recording years of school completed and then dichotomized into low (≤ 11 years of school) and high educational level (≥ 12 years of school).

Assessment of alcohol intake (in grams per day) was based on data regarding weekday and weekend consumption of beer, wine, and spirits and categorized into no, moderate (for men: >0 - <40 g/day, for women: >0 - <20 g/day) and high alcohol consumption (for men: ≥ 40 g/day, for women: ≥ 20 g/day). Study participants provided information about whether they had ever smoked cigarettes regularly (current, past, never).

Blood pressure (BP) and body mass index (BMI) were measured by trained medical staff.

BMI was calculated as weight in kilograms divided by height in square meters. BP was

measured with a Hawksley Random Zero sphygmomanometer. Three BP recordings were taken from each individual after completion of the interview, i.e. after being at rest in a sitting position for an average of 30 minutes. The BP results provided are based on the mean of the second and third BP recordings. Further details on the measurement procedures are reported elsewhere [22]. Actual hypertension was defined as blood pressure values $\geq 140/90$ mmHg and/or the usage of antihypertensive medication, given that the subjects were aware that they had hypertension [22].

Nonfasting blood samples were collected from all subjects under standardized conditions in 1989/1990 [23]. Total cholesterol was measured by an enzymatic method (CHOD-PAP, Boehringer Mannheim, Mannheim, Germany) and high-density lipoprotein (HDL) cholesterol was measured after precipitation with phosphotungstic acid/Mg²⁺ (Boehringer Mannheim, Mannheim, Germany) on fresh samples.

Statistical analyses

Baseline characteristics are presented by means and standard deviations for continuous variables. Categorical variables are expressed as relative frequencies. Pearson correlation was computed to determine the relationships between the continuous variables of interest. To avoid multicollinearity, only BMI was used for further analyses, as waist circumference was highly correlated with BMI ($r = 0.79$).

Cox proportional hazards models, with days as the timescale, were applied to compute the hazard ratios and 95% confidence intervals (HR, 95% CI) for all-cause, CVD, and cancer mortality. The proportional hazards assumption was tested by the inspection of $\log(-\log(\text{event}))$ versus \log of event times and proved to be sufficient. Persons categorized in “no physical activity” were defined as the reference group in each physical activity domain, except for work and total activity, in which light physical activity served as the comparison group. **To take the non-linear increase of death risk with age into account, stratification by age**

groups (25-49, 50-59, 60-69, 70-74 years) was included in the Cox models. For each of the four physical activity domains, we calculated HR adjusted for sex, BMI, systolic blood pressure, total-to-HDL cholesterol ratio, education, smoking status, alcohol consumption, myocardial infarction, stroke, diabetes, cancer, self-reported limited physical activity due to health problems and the remaining other domains of physical activity. For total activity, the same model was calculated, but no adjustments for other domains of physical activity were made.

To assess the *a priori* assumed dose-response relation between domain-specific physical activity and type of mortality, linear trend tests across physical activity levels were performed by entering the categorical activity variable as a continuous variable into the Cox model. Effect modifications were tested between physical activity and sex, as well as selected covariates, on mortality by additionally entering an interaction term of the respective variables into the model.

Due to the identified interactions, we then examined the joint effects of leisure time activity and systolic blood pressure, as well as leisure time activity and BMI, on all-cause mortality. Tests were considered statistically significant with a two-sided $p < 0.05$. The statistical software package SAS 9.1.3 (SAS Institute, Inc., Cary, NC) was used to perform all statistical analyses.

RESULTS

Between 1989 and 2007 (median follow-up period 17.8 years), 995 participants died; 452 from CVD and 326 from cancer. Baseline information of the study sample is presented in Table 1. Participants can be described as middle-aged and mostly free of chronic conditions. One fifth of the subjects died during the 17.8 years of follow-up.

With regard to total and work activity, the majority of both men and women were moderately active, whereas during leisure time, light activities were most frequently reported. Different

activity patterns for men and women were observed for transportation activity, in which most men reported no activity and women mainly engaged in moderate activities. This was similar in the household domain, whereby most men reported no activity and light intensity activities predominate among women.

As shown in Table 2, significant risk reductions for all-cause and CVD mortality can be reported for work, household, leisure time (only all-cause) and total physical activity ($p_{\text{trend}} < 0.05$). Engagement in leisure time and total activity was inversely associated with cancer mortality ($p_{\text{trend}} < 0.01$).

Being moderately active at work compared to the light activity group significantly reduced the risk for all-cause and CVD mortality by 31% (95% CI, 0%-52%) and 46% (95% CI, 7%-69%), respectively. For the household domain, significant risk reductions were only observed in light activities (all-cause mortality: 18%; 95% CI, 5%-29%; CVD mortality: 28%, 95% CI, 11%-42%). Compared to being sedentary, being vigorously active during leisure time significantly reduced the risk for all-cause and CVD mortality by 52% (95% CI, 35%-64%) and 50% (95% CI, 21%-69%), respectively. However, neither moderate nor light activities during leisure time were associated with a significantly decreased CVD mortality risk.

Participants engaging in vigorous leisure activity lowered their risk of cancer mortality by 64% (95% CI, 41%-77%). The remarkable decrease in cancer mortality associated with leisure time physical activity is actually already present in light (42%; 95% CI, 20%-58%) and moderately (44%; 95% CI, 23%-60%) active subjects. For total activity, subjects categorized in vigorous activities were at reduced risk for all-cause (27%; 95% CI, 10%-41%) and cancer mortality (38%; 95% CI, 12%-57%). With regard to CVD mortality, a significant trend was observed, but the individual HR did not reach significance.

For transportation activity, however, no significant results or clear trends can be noted for either all-cause, CVD, or cancer mortality.

We also calculated the Cox model with each activity domain entered individually into the multivariable-adjusted model. Almost no statistical differences were observed, indicating that the domains are, in fact, independent of each other. In addition, the above-mentioned results in the fully adjusted model did not change after excluding those persons who died during the first two years of follow-up (n=55, data not shown). Because the relationship between mortality and physical activity was not altered by sex, except for CVD mortality and transportation activity ($p=0.049$), when examining the interactions in any combination, all analyses were performed using combined data with both men and women (range of the p -values across all activity domains: 0.133 to 0.846 for all-cause, 0.190 to 0.886 for CVD and 0.058 to 0.834 for cancer mortality).

Both systolic BP ($p=0.030$) and BMI ($p=0.023$) showed a significant interaction with leisure time physical activity on all-cause mortality. We therefore assessed the joint effects of systolic BP as well as BMI and different levels of leisure time activity. Persons engaging in vigorous leisure activity, in combination with a systolic BP < 140 mm Hg (Figure 1) and a BMI < 30 (Figure 2), respectively, served as reference groups.

As shown in Figure 1, the effect of increasing activity levels during leisure time was stronger among participants with a systolic BP ≥ 140 mm Hg on reducing all-cause mortality.

Compared with the reference group, inactive persons with an increased systolic BP had the highest mortality risk (HR=2.10; 95% CI, 1.36-3.24) in our sample ($p < 0.001$). We recalculated the same model, in which we additionally considered antihypertensive medication, but the results were very similar (data not shown).

Figure 2 demonstrates a different pattern: the highest risk of mortality was found in inactive subjects with a BMI < 30 (HR=2.46; 95% CI, 1.76-3.43) compared to the reference group ($p < 0.001$). On the contrary, mortality risk does not decrease with increasing level of physical activity within obese cohort members [HR=2.18 (95% CI, 1.45-3.28) for no, HR=1.86 (95%

CI, 1.38-2.52) for light and moderate, and HR=2.09 (95% CI, 1.26-3.45) for vigorous leisure physical activity].

DISCUSSION

In our population-based prospective cohort study among middle-aged men and women, work, household, leisure time and total physical activity were significantly associated with a reduced risk of all-cause and CVD (except for leisure activity) mortality. The inverse relationship between leisure time as well as total activity with cancer mortality was highly significant, whereas walking and cycling for transportation was associated with neither all-cause nor cause-specific mortality.

To our knowledge, only one previous European study has individually examined the four most common physical activity domains (domestic, transportation, work, sports/exercise) on mortality, and reported similar results. In addition to total and sports/exercise activities being inversely associated with all-cause and CVD mortality, the authors also found evidence for the benefits of domestic activities, but none for work and transportation-related physical activity [12]. Two other studies have investigated several different forms of physical activity independently in relation to all-cause mortality [9, 11]. With regard to the beneficial impact of leisure time physical activity or total activity, our results are consistent with a previous study which showed a dose-response relationship, predominantly in the leisure time domain, with all-cause mortality [24]. In contrast, the significant results for walking or biking as a means of transportation detected by Andersen et al. [9] and Matthews et al. [11] were not observed in the present study which may be explained by the use of different instruments.

In our study, among all three types of mortality investigated, the greatest risk reductions through engagement in leisure time activities are found for overall cancer mortality. Some

population studies and reviews detected a reduced risk of cancer mortality through enhanced physical activity among men [25], women [11] or both sexes [16, 17, 26, 27], but none of them has independently examined work, transportation, household and leisure time physical activity. A large prospective follow-up study from Finland [16] reported a 21% and 27% lower risk of cancer mortality for men and women, respectively, when comparing high versus low occupational and leisure time physical activity. With regard to our study sample, moderately active individuals almost halved their risk of premature deaths due to cancer, while vigorously active persons reduced their risk by almost two thirds. Likewise, a recent study among 2,560 men investigating the intensity level needed to reduce cancer mortality concluded that people have to engage in at least moderate leisure (sports, exercise) activities (>4.5 METs) to benefit from its effects [28]. Nonetheless, in our population, even light leisure activities (<3.0 METs) offer a 42% risk reduction compared to the inactive reference group. Our findings emphasize the necessity to engage in sports activities and suggest that physical activity in daily routines (e.g. transportation and household activities) do not seem to be sufficient in the prevention of cancer mortality.

The results regarding the interactions of leisure time physical activity with systolic BP and BMI, merit some comment. Subjects who reported to be inactive, had a considerably higher risk of all-cause mortality than participants engaging in vigorous activities in both the systolic BP<140mm Hg and the systolic BP≥140 mm Hg group. Men and women with an increased systolic BP seem to benefit slightly more from enhanced leisure time in contrast to those with a normal systolic BP. These findings are in accordance with other studies reporting that high levels of physical activity or aerobic exercise may protect against the adverse effects of elevated systolic BP [29, 30].

Previous studies have hypothesized that high physical activity may attenuate the increased risk of mortality that is related to adiposity [16, 31]. In our population sample, the beneficial

effects of physical activity on mortality seem to be present in non-obese men and women (BMI<30) only.

The strengths of our study include a long follow-up period and its population-based representative design, while including a wide age range. The careful evaluation of important covariates in the MONICA/KORA Augsburg Surveys at baseline allowed for the adjustment of the most common risk factors related to all-cause, CVD and cancer mortality. Furthermore, data on the concurrent assessment of the four most important domains of physical activity is sparse in the literature, with the majority of previous studies focusing on leisure and/ or work-related physical activity [24, 32]. Besides these strengths, the study has also some limitations that need to be considered. As our data on physical activity were self-reported, reporting bias cannot be fully avoided. However, we used a validated and widely-applied questionnaire [33, 34]. Another limitation is that physical activity was only recorded at baseline, making it impossible to report changes of activity patterns over time. **We do not have follow-up data on physical activity at an individual level; therefore, we must assume that physical activity patterns remain fairly stable over time. This is a general problem in epidemiological studies and previous studies have also addressed this matter in their limitations [10, 12, 16]. Further research is needed to consider subsequent modifications in physical activity patterns during lifetime.** The stringent categorization into low, moderate and vigorous physical activity may have led to misclassification, in some cases. Regardless, this solution worked best to combine the multiple answer options in the MOSPA questionnaire (e.g. subjects engaged in moderate and vigorous physical activity were categorized as vigorously active) and our division most probably reflects the participants' activity level correctly. **We do not have data on other transportation-related exposures and participants who frequently walk or bike close to heavily travelled roads may be exposed to hazardous substances such as diesel exhausts and other fumes, which may counterbalance the positive effects of physical activity.**

In conclusion, the physical activity domains work, household and leisure time as well as total activity showed inverse associations with mortality. The benefits of physical activity in terms of lower all-cause mortality were greatest among participants with an increased systolic BP who were non-obese. In light of the positive health effects ascribed to regular exercise, it is highly important to disentangle the different forms of physical activity, in order to promote those domains that contribute the most to positive health outcomes. It is therefore important that public health agencies endorse physical activity campaigns of any kind.

Nonexercise activities such as housework or work physical activity should be fully integrated into daily routines as their preventive nature has been proven in previous studies on various health outcomes. The findings of this study specifically underline that engagement in nonexercise activities beyond leisure time physical activity may be conducive to successfully reduce all-cause, CVD and cancer mortality risk.

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FIGURE CAPTION

Figure 1. Hazard Ratios (HR)^a of all-cause mortality according to the joint effects of leisure time physical activity and systolic BP

Footnote for figure 1.

^a Adjusted for sex, BMI, total-to-HDL cholesterol ratio, education, smoking status, alcohol consumption, myocardial infarction, stroke, diabetes, cancer, self-reported limited physical activity due to health problems and other domains of physical activity.

$p=0.030$ for interaction between leisure time physical activity and systolic BP

Figure 2. Hazard Ratios (HR)^a of all-cause mortality according to the joint effects of leisure time physical activity and BMI

Footnote for figure 2.

^a Adjusted for sex, systolic blood pressure, total-to-HDL cholesterol ratio, education, smoking status, alcohol consumption, myocardial infarction, stroke, diabetes, cancer, self-reported limited physical activity due to health problems and other domains of physical activity.

$p=0.023$ for interaction between leisure time physical activity and BMI

Table 1. Baseline characteristics

| | Men | Women | Total |
|---|--------------------|--------------------|--------------------|
| | (n = 2,372) | (n = 2,299) | (n = 4,672) |
| Personal characteristics | | | |
| Age (years) ^a | 49.8 (14.2) | 49.4 (13.8) | 49.6 (14.0) |
| BMI (kg/m ²) ^a | 27.1 (3.6) | 26.3 (4.8) | 26.7 (4.3) |
| Total-to-HDL-cholesterol ratio ^a | 5.1 (2.2) | 4.0 (1.5) | 4.5 (1.9) |
| Systolic blood pressure (mm Hg) ^a | 135.6 (17.5) | 129.2 (20.0) | 132.4 (19.0) |
| Diastolic blood pressure (mm Hg) ^a | 81.8 (11.1) | 77.9 (10.8) | 79.9 (11.1) |
| Actual hypertension (%) | 46.0 | 33.3 | 39.7 |
| Low educational level (%) | 67.3 | 81.9 | 74.5 |
| No alcohol consumption (%) | 18.6 | 44.7 | 31.5 |
| Moderate alcohol consumption (%) | 50.1 | 36.9 | 43.6 |
| High alcohol consumption (%) | 31.3 | 18.4 | 24.9 |
| Current smoker (%) | 30.5 | 21.3 | 26.0 |
| Ex-smoker (%) | 39.8 | 16.7 | 28.4 |
| Never smoker (%) | 29.7 | 62.0 | 45.6 |
| Self-reported limited physical activity due to health problems (%) | 26.7 | 23.4 | 25.1 |
| Chronic conditions | | | |
| Diabetes (%) | 5.3 | 4.0 | 4.7 |
| Myocardial infarction (%) | 3.9 | 0.8 | 2.4 |
| Stroke (%) | 1.5 | 0.8 | 1.2 |

| | | | |
|--------------------------|------|------|------|
| Cancer (%) | 1.3 | 1.5 | 1.4 |
| Physical activity | | | |
| <i>Total</i> | | | |
| Light (%) | 7.1 | 10.3 | 8.7 |
| Moderate (%) | 56.6 | 57.5 | 57.0 |
| Vigorous (%) | 36.2 | 32.2 | 34.2 |
| <i>Work^b</i> | | | |
| Light (%) | 6.7 | 7.3 | 7.0 |
| Moderate (%) | 60.2 | 34.0 | 47.3 |
| <i>Transportation</i> | | | |
| No (%) | 41.9 | 27.8 | 35.0 |
| Light (%) | 11.9 | 8.8 | 10.4 |
| Moderate (%) | 27.6 | 38.1 | 32.8 |
| Vigorous (%) | 18.5 | 25.3 | 21.9 |
| <i>Household</i> | | | |
| No (%) | 61.6 | 14.0 | 38.2 |
| Light (%) | 36.3 | 74.8 | 55.3 |
| Moderate (%) | 2.1 | 11.1 | 6.5 |
| <i>Leisure time</i> | | | |
| No (%) | 8.9 | 11.1 | 10.0 |
| Light (%) | 38.3 | 43.8 | 41.1 |
| Moderate (%) | 30.5 | 35.2 | 32.8 |
| Vigorous (%) | 22.3 | 9.8 | 16.2 |
| Deaths | | | |
| All-cause (%) | 26.8 | 15.7 | 21.3 |

| | | | |
|------------|------|-----|-----|
| CVD (%) | 12.3 | 7.0 | 9.7 |
| Cancer (%) | 8.3 | 5.6 | 7.0 |

^aValues are presented as mean (SD).

^b Unemployed subjects (n=2,134 ; 45.7%) were excluded.

Table 2. Hazard Ratios (HR) by domain and physical activity level for all-cause, CVD and cancer mortality

| | All-cause 995 events | | | CVD 452 events | | Cancer 326 events | |
|--------------------------------|-------------------------|------------------|----------------------------------|-------------------|----------------------------------|----------------------|----------------------------------|
| | No. of subjects | No. of deaths | HR ^a (95% CI) | No. of deaths | HR ^a (95% CI) | No. of deaths | HR ^a (95% CI) |
| <i>Work^b</i> | | | | | | | |
| Light | 328 | 36 | Reference | 17 | Reference | 13 | Reference |
| Moderate | 2210 | 198 | 0.69 (0.48-1.00) | 75 | 0.54 (0.31-0.93) | 78 | 0.84 (0.46-1.54) |
| | | | <i>p</i> =0.048 | | <i>p</i> =0.028 | | <i>p</i> =0.574 |
| <i>Transportation</i> | | | | | | | |
| No | 1633 | 333 | Reference | 145 | Reference | 108 | Reference |
| Light | 485 | 86 | 1.08 (0.85-1.37) | 31 | 0.94 (0.63-1.39) | 40 | 1.49 (1.03-2.15) |
| Moderate | 1533 | 374 | 1.16 (1.00-1.35) | 180 | 1.23 (0.98-1.55) | 121 | 1.19 (0.91-1.56) |
| Vigorous | 1021 | 202 | 0.95 (0.80-1.14) | 96 | 1.02 (0.78-1.34) | 57 | 0.89 (0.64-1.24) |
| | | | <i>p</i> _{trend} =0.774 | | <i>p</i> _{trend} =0.395 | | <i>p</i> _{trend} =0.836 |

| <i>Household</i> | | | | | | | |
|---------------------|------|-----|----------------------------|-----|----------------------------|-----|----------------------------|
| No | 1785 | 502 | Reference | 242 | Reference | 153 | Reference |
| Light | 2582 | 418 | 0.82 (0.71-0.95) | 174 | 0.72 (0.58-0.89) | 153 | 0.95 (0.74-1.22) |
| Moderate | 305 | 75 | 0.90 (0.69-1.18) | 36 | 0.80 (0.54-1.19) | 20 | 0.90 (0.54-1.49) |
| | | | $p_{\text{trend}}=0.043$ | | $p_{\text{trend}}=0.017$ | | $p_{\text{trend}}=0.607$ |
| <i>Leisure Time</i> | | | | | | | |
| No | 466 | 137 | Reference | 53 | Reference | 57 | Reference |
| Light | 1918 | 406 | 0.73 (0.60-0.89) | 182 | 0.81 (0.59-1.11) | 135 | 0.58 (0.42-0.80) |
| Moderate | 1533 | 374 | 0.78 (0.64-0.95) | 187 | 0.97 (0.71-1.33) | 108 | 0.56 (0.40-0.77) |
| Vigorous | 755 | 78 | 0.48 (0.36-0.65) | 30 | 0.50 (0.31-0.79) | 26 | 0.36 (0.23-0.59) |
| | | | $p_{\text{trend}} < 0.001$ | | $p_{\text{trend}} = 0.145$ | | $p_{\text{trend}} < 0.001$ |
| <i>Total</i> | | | | | | | |
| Light | 407 | 143 | Reference | 61 | Reference | 52 | Reference |
| Moderate | 2665 | 593 | 0.91 (0.76-1.10) | 278 | 0.98 (0.74-1.30) | 193 | 0.81 (0.60-1.11) |
| Vigorous | 1600 | 259 | 0.73 (0.59-0.90) | 113 | 0.75 (0.55-1.03) | 81 | 0.62 (0.43-0.88) |

$p_{\text{trend}}=0.001$

$p_{\text{trend}}=0.030$

$p_{\text{trend}}=0.005$

^a Adjusted for sex, BMI, systolic blood pressure, total-to-HDL cholesterol ratio, education, smoking status, alcohol consumption, myocardial infarction, stroke, diabetes, cancer, self-reported limited physical activity due to health problems, and other domains of physical activity. No adjustments for other types of physical activity in **total activity**.

^b Analyses restricted to working participants (n=2,538).



