

Associations of physical activity type, volume, intensity, and changes over time with all-cause mortality in older adults: The Seniors-ENRICA cohorts

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Abstract

Objective: To assess the association of physical activity (PA) type, volume, intensity, and changes over time with all-cause mortality in older adults.

Methods: We used data from 3518 and 3273 older adults recruited in the Seniors-ENRICA-1 and 2 cohorts. PA was assessed with the EPIC questionnaire. Participants reported how many hours they spent a week in walking, cycling, gardening, do-it-yourself (DIY), sports, and housework. Then, time at each intensity (moderate PA [MPA], vigorous PA [VPA], moderate-to-vigorous PA [MVPA] and total PA) was calculated. Changes in PA were calculated from the date of the baseline interview to Wave 1. All-cause mortality was ascertained up January 31, 2022. Analyses were performed with Cox regression models, adjusting for the main confounders.

Results: Walking, gardening, sports, and housework was associated with lower mortality (ranged 20%–46%). Also, MPA, VPA, MVPA was associated with lower risk of mortality (ranged 28%–53%). Analyses of PA change showed that, compared no PA participation (at baseline nor Wave 1), maintain walking, sports, and housework (ranged 28%–53%) and maintaining MPA, VPA, and MVPA (ranged 32%–36%) levels was linked to decreased mortality risk. Those who increased, maintained, or even decreased total PA had lower mortality (57%, 52%, and 36%, respectively) than those with consistently very low PA.

Conclusions: The lower mortality was observed in those with a high baseline level of total PA. Maintaining PA levels such as walking, gardening, and housework, or at all analyzed intensities, was related to lower mortality.

KEYWORDS

activity patterns, aging, exercise, older adults, survival

1 | INTRODUCTION

Physical activity (PA) contributes to lower mortality.¹ According to the current PA recommendations by the World Health Organization,² older adults should do at least 150 min of moderate-intensity, or at least 75 min of vigorous-intensity, or an equivalent combination of moderate-intensity and vigorous-intensity PA. Beyond the overall recommendations, some authors have pointed out the interest of considering the type (i.e., walking, cycling, gardening, sports, do-it-yourself, housework, etc.), volume (i.e., total min/day, time at each intensity, etc.) and intensity (i.e., light, moderate, vigorous, or moderate-to-vigorous PA [MVPA]) in the association of PA with mortality.^{3–5}

Older adults spend a long time in low-intensity PA (e.g., slow walking and housework activities), and less time is devoted to higher intensities.^{6–9} Even though activities such as walking¹⁰ and housework PA⁴ seem to contribute to lower mortality, uncertainties remain. For example, previous studies suggested that light-intensity PA and activities such as walking, running, and cycling were associated with lower all-cause mortality.^{9,11} However, the authors did not find a dose–response association as higher amounts in LPA, or in the mentioned activities, did not promote additional effects or even, in some cases, became null.

On the contrary, studies with repeated measures have investigated changes of PA patterns throughout life, proposing that maximal mortality risk reduction was observed in individuals who maintain PA levels throughout life.^{3,12,13} However, associations between others patterns of changes in PA (i.e., increased or decreased) and mortality risk are weak or inconsistent.^{3,12,13} Also, studies that analyzed changes in PA and mortality focus on changes from middle age to old age and not on changes specifically throughout old age.

Understanding the PA profile of older adults, including changes over time, could provide important information to develop tailor interventions for PA promotion as well as to improve survival. Thus, the aim of this study was to assess the association of PA type, volume, intensity, and changes over time with all-cause mortality in older adults.

2 | METHODS

2.1 | Study participants

We used data from the Seniors-ENRICA 1 and 2 cohorts. The Seniors-ENRICA 1 is a cohort of 3518 participants (53.6% women), aged 60–96 years, selected through stratified random sampling from the noninstitutionalized Spanish population aged 60 years and older. Detailed

information about the methods and sample collection process have been published elsewhere.¹⁴ Baseline data were collected from 2008 to 2010, while the follow-up (Wave 1) was completed in 2012. At baseline and in 2012 data were collected in three stages, including a computer-assisted telephone interview on socio-demographic factors, health behaviors, healthcare services use, and morbidity; and two home visits to perform a physical examination, collect blood and urine samples, and record habitual diet and prescribed medication.

Similarly, the Seniors-ENRICA 2 is a cohort of 3273 (53.1% women), community-dwelling individuals, aged 65–94 years, residing in the city of Madrid and four surrounding large towns (i.e., Getafe, Torrejón, Alcorcón, and Alcalá de Henares). Study participants were selected by sex- and district-stratified random sampling of all individuals holding a national healthcare card. Data were collected between 2015 and 2017 for the baseline, and a follow-up (Wave 1) in 2018, following the same procedures as in Seniors-ENRICA-1 cohort.^{15,16}

Participants in Seniors-ENRICA 1 and 2 provided written informed consent. The study protocols were approved by the Clinical Research Ethics Committee of La Paz University Hospital, in Madrid.

2.2 | Physical activity

PA was assessed with the validated questionnaire developed in the EPIC cohort study.¹⁷ Participants were asked how many hours they spent in a typical week during the past year on each of the following activities: walking (including walking to work, shopping, and during leisure time), cycling (including cycling to work and during leisure time), gardening, do-it-yourself (DIY; i.e., wood-working, metalworking or construction, etc.), sports (i.e., aerobics, swimming, jogging, tennis, etc.) and housework (i.e., cleaning, washing, cooking, childcare, etc.). Self-reported time in each activity was winsorized at the sex-specific 99th percentile to avoid overestimations.

Total PA was calculated as the sum of the time spent in the six PA types (walking, cycling, gardening, DIY, sports, and housework). Moderate PA (MPA) was estimated as the sum of time spent gardening, DIY, and housework, whereas time spent in vigorous PA was estimated as the sum of time spent cycling and practicing sports. Consequently, time in MVPA was estimated using the sum of time spent in cycling, sports, gardening, DIY, and housework. This classification was based on the metabolic equivalent intensities assigned to each activity in the Compendium of Physical Activities¹⁸ and characteristics of PA of the population previously reported, where slow walking accounted for 80% of total time spent walking.⁷

2.3 | Ascertainment of death

The vital status of both cohorts was identified with the National Death Index, an information system that collects data on deaths recorded in civil registries across the country, through combinations of first and last names, dates of birth and national identity card numbers. All-cause mortality was the outcome variable. For analyses on the association between baseline PA and mortality, follow-up was calculated from the date of the baseline interview to the date of death for deceased participants, or the censored date (January 31, 2022) for alive participants; whichever was first; however, for analyses on the relationship between changes in PA and mortality, the follow-up period was calculated from the date of Wave 1 interview (end of the PA change) to the date of death or censored date (Figure S1).

2.4 | Covariates

At baseline, age, sex, educational level (\leq primary, secondary, and university), smoking status (never, former, and current smoker) and alcohol status (never, former, current no habitual, and current habitual) were self-reported. Participants also reported the following chronic diseases diagnosed by a physician: cancer, cardiovascular disease (ischemic heart disease, stroke, or heart failure), hypertension, and diabetes mellitus. We also considered that a subject had hypertension or diabetes based on measurements at home visits. In this case, hypertension was defined as systolic blood pressure (SBP) ≥ 140 mmHg or diastolic blood pressure (DBP) ≥ 90 mmHg, and diabetes as blood glucose level ≥ 126 mg/dL. Body mass index (BMI) was calculated as weight divided by squared height and categorized into normal weight (< 25 kg/m²), overweight (25 – 29.9 kg/m²) and obesity (≥ 30 kg/m²).

2.5 | Statistical analysis

Time at baseline in each type of PA (i.e., walking, cycling, gardening, sports, DIY, and housework) was classified in the following four categories: nonparticipation in the specific PA was considered as the category “none” (0 h/week); and the sex-specific tertiles of time dedicated to the specific PA were calculated among those who spent some time in that activity, so individuals in T1, T2, and T3 were classified, respectively, as having “low”, “middle”, and “high” participation in the specific PA, respectively. The same criterion was used to classify individuals according to the time in MPA, VPA, and MVPA. However, given that the number of participants with 0 h/week in total PA was

very low, those with < 7 h/week of total PA were classified as “very low” PA while the categories “low”, “middle”, and “high” total PA were calculated based on tertiles of total PA among those with ≥ 7 h/week.

We pooled the data from the Seniors-ENRICA 1 and 2 cohorts to estimate the mortality associated with PA at baseline using Cox proportional hazards models, with years of follow-up time as the timescale. We calculated the hazard ratio (HR) and 95% confidence interval (CI) of mortality for each type of PA, for each intensity of PA (i.e., MPA, VPA, MVPA) and for total PA. “None” participation (or “very low” in total PA) was the reference group in all analyses. *p*-Values for linear trend were calculated using categories of PA as a continuous variable. Two models were built. Model 1 was adjusted for sex, age, educational level, smoking status, alcohol status, BMI, cardiovascular disease, cancer, diabetes mellitus, hypertension, and cohort; and Model 2 was additionally adjusted for the sum of time spent in the rest of types or intensities of PA, as appropriate.

For analyses on changes in PA and mortality, first we calculated the difference (in h/week) between the time in each activity at Wave 1 and baseline (Figure S1). Then, participants were classified into four groups: (i) “none” (those with 0 h/week at baseline and Wave 1); (ii) “decrease” (those in the lowest tertile of change, T1); (iii) “maintain” (those in the middle tertile of change, T2); and (iv) “increase” (those in the highest tertile of change, T3). Similarly, changes in total PA were classified into four groups: (i) “none” (< 7 h/week of total PA at baseline and wave 1); (ii) “decrease” (those in the lowest tertile of change, T1); (iii) “maintain” (those in the middle tertile of change, T2); and (iv) “increase” (those in the highest tertile of change, T3), among those engaging ≥ 7 h/week. Again, the tertiles were sex specific. Cox regression models were also used, with years of follow-up time as the timescale, to estimate HR and 95% CI for the association of groups of change in PAs and mortality risk, considering again “none” (or “very low” in the case of total PA) as the reference group. Regression adjustment for baseline covariates (Seniors-ENRICA 1, 2008–2010 and Seniors-ENRICA 2, 2015–2017) was as described above, with Model 2 adjusted for the sum of the changes in the time spent on all other types of PA, as appropriate. Sensitivity analyzes were performed to refute the possibility of reverse causality. The main analyzes of the study were performed excluding all participants with CVD or cancer. Also, main analyzes were repeated excluding all deaths in the first year of follow-up.

Missing data on covariates at baseline (ranged 0% and 10.1%) were handled by creating a dummy category indicating missing information. Before modeling survival analyses, the proportional hazards assumptions were tested by inspecting the Kaplan–Meier curves using the

test based on the Schoenfeld residuals, and no evidence of non-proportionality was detected. Regression models were computed with stratification by cohort (i.e., using the strata command). Statistical analyses were performed using Stata v.16.0. and establishing a level of statistical significance was set at 2-sided $p < 0.05$.

3 | RESULTS

A total of 6645 participants (3380 from Seniors-ENRICA 1 and 3265 from Seniors-ENRICA 2) with complete data on PA at baseline and vital status ascertained were the main analytic cohort; from those, 3963 individuals (2415 from Seniors-ENRICA 1 and 1548 from Seniors-ENRICA 2)

with complete information on PA at baseline and Wave 1 were considered for the analyses of changes in PA and all-cause mortality (Figure S2). Seniors-ENRICA 1 participants had a mean follow-up of 11.6 (2.7) years, while Seniors-ENRICA 2 participants had a mean follow-up of 5.1 (0.8) years (Figure S1).

Baseline sociodemographic and clinical characteristics of study participants and by total PA categories are presented in Table 1 and by cohort in Table S1. Study participants had an average age of 70.4 years and 53% were women. During a mean follow-up of 8.4 (3.8) years between baseline and date of death or censored date (Figure S1), 1063 participants died (593 men and 470 women). Among the types of PA assessed, walking and housework were the most prevalent (Figure 1). A higher

TABLE 1 Baseline characteristics of participants, by total PA categories in Seniors-ENRICA 1 and 2 cohorts and pooled cohorts ($n = 6645$).

	None/Very Low	Low	Middle	High	All (pooled cohorts)
<i>n</i>	485	2117	2029	2014	6645
Age, years	71.06 (7.39)	70.16 (5.99)	69.71 (5.49)	68.74 (5.26)	70.43 (5.89)
Sex, <i>n</i> (%)					
Women	167 (34.43)	1147 (54.18)	1121 (55.25)	1112 (55.21)	3547 (53.38)
Men	318 (65.57)	970 (45.82)	908 (44.75)	902 (44.79)	3098 (46.62)
Educational level, <i>n</i> (%)					
Primary or lower education	289 (59.59)	1192 (56.36)	1241 (61.16)	1341 (66.58)	4063 (61.16)
Secondary education	100 (20.62)	467 (22.08)	416 (20.50)	394 (19.56)	1377 (20.73)
University or higher education	96 (19.79)	456 (21.56)	372 (18.33)	279 (13.85)	1203 (18.11)
Smoking status, <i>n</i> (%)					
Current	83 (17.11)	217 (10.25)	207 (10.20)	207 (10.28)	714 (10.74)
Former	194 (40.00)	749 (35.38)	651 (32.08)	643 (31.93)	2237 (33.66)
Never	208 (42.89)	1151 (54.37)	1171 (57.57)	1164 (57.80)	3694 (55.59)
Alcohol status, <i>n</i> (%)					
Current habitual	185 (43.12)	852 (44.87)	820 (44.88)	841 (46.31)	2698 (45.19)
Current no habitual	82 (19.11)	449 (23.64)	403 (22.06)	397 (21.86)	1331 (22.29)
Former	69 (16.08)	205 (10.80)	188 (10.29)	167 (9.20)	629 (10.53)
Never	93 (21.68)	393 (20.70)	416 (22.77)	411 (22.63)	1313 (21.99)
BMI, kg/m ²					
Obesity*	172 (41.95)	615 (32.20)	499 (27.45)	525 (28.74)	1811 (30.36)
Overweight*	165 (40.24)	868 (45.45)	895 (49.23)	878 (48.06)	2806 (47.04)
Normal weight	73 (17.80)	427 (22.36)	424 (23.32)	424 (23.21)	1348 (22.60)
Chronic diseases, <i>n</i> (%)					
Cancer	16 (3.31)	76 (3.59)	43 (2.12)	46 (2.29)	181 (2.72)
Cardiovascular disease	62 (12.81)	119 (5.62)	102 (5.03)	74 (3.67)	357 (5.37)
Diabetes	170 (35.05)	446 (21.07)	388 (19.13)	407 (20.21)	1411 (21.24)
Hypertension	352 (75.54)	1419 (69.32)	1365 (69.68)	1338 (68.90)	4474 (69.75)

Note: Values are mean (standard deviation), unless otherwise indicated.

Abbreviation: BMI: body mass index.

*Cut-points for overweight and obesity were 25 and 30 kg/m², respectively.

mortality was observed among participants with lower levels of PA (Figure 1). For example, 41.6% of participants classified as very low total PA at baseline (3.09 ± 2.24 h/week) died, but only 11.7% of those with high total PA (39.38 ± 10.39 h/week).

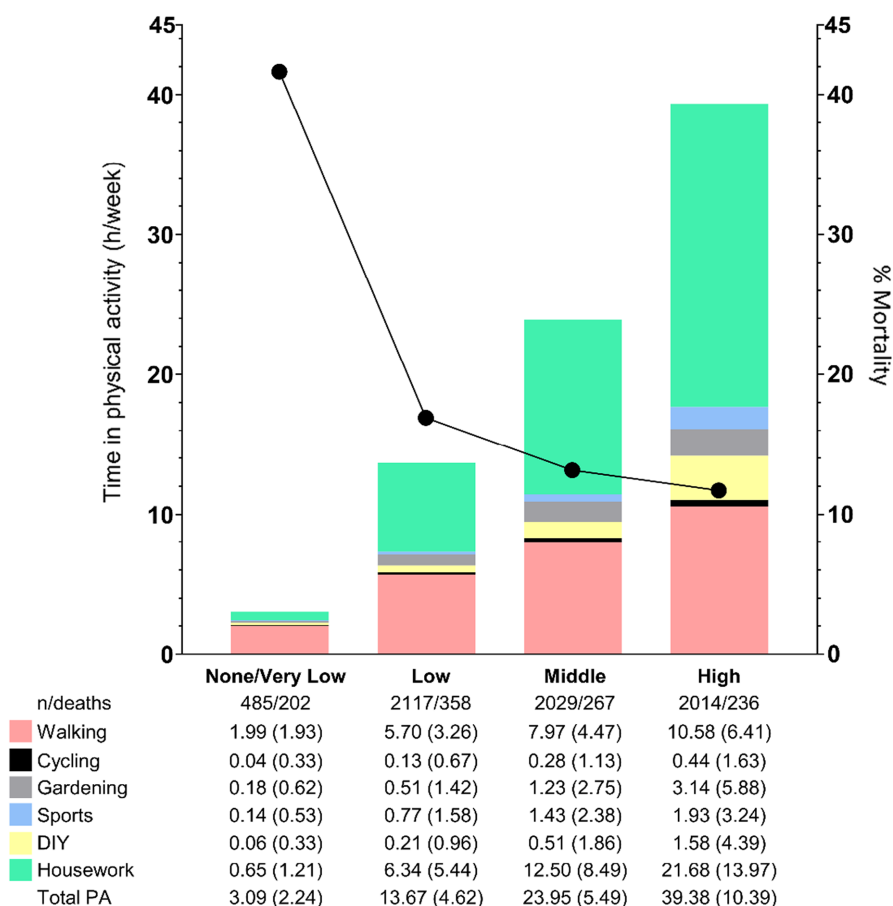
The association between PA at baseline and mortality varied depending on the type of PA (Figure 2; Table S2). Compared with none walking (0 min/week), those engaging in low, middle, or high walking time had a 37%, 46%, and 43% decreased mortality, respectively. Similarly, for housework, the reduction in mortality risk was 29%, 35%, and 40% for those in the low, middle, and high group, respectively, compared with those with no participation in this PA type. Moreover, those with high levels in gardening showed 23% lower mortality and those with low or middle levels of sport had 28% and 36% decreased risk of death, compared to people with no participation in each PA. No relationship between cycling and mortality were observed. When PA was classified by intensity (Figure 3; Table S3), mortality was reduced in those with low, middle, or high levels in MPA (range 35%–46%), MVPA (range 41%–53%) and total PA (range 49%–56%) compared to people with no participation in each intensity or very low for total PA. Moreover, a decrease of 28% and 39% in mortality was observed, respectively, for participants engaging in low and middle levels of VPA versus none.

As regards changes in PA between baseline and Wave 1, with a mean follow-up of 6.4 (3.3) years (Figure S1), 550 participants died (314 men and 236 women). Only around 2% and 10% of participants were classified as constantly no participation in walking and housework PA, respectively. However, in cycling, gardening, DIY and sports, about 50%–80% of participants remained in group “none” in both examinations. (Figure 4; Table S4). Compared with its specific reference group, maintain walking, sports, and housework levels was linked to decreased mortality by 40%, 37%, and 33%, respectively; those who increased levels of gardening and housework had a 29% and 40% lower mortality (Figure 4).

Regarding changes on PA by intensity (Figure 5; Table S5), in comparison with no participation (at baseline nor Wave 1), 37%, 33%, and 39% lower mortality was observed for maintaining MPA, VPA, and MVPA, respectively; reductions in mortality were 46% and 47% for those who increased MPA and MVPA. Already in total PA all groups—decrease, maintain, and increase—showed lower mortality compared to the very low group in both examinations.

The association between PA at baseline and changes in PA and mortality results remained similar in sensitivity analyses, after removing participants with CVD or cancer at baseline (Tables S6–S9) and those with follow-up of less than 1 year of follow-up (Tables S10–S13). Finally,

FIGURE 1 Hours per week in each PA, and mortality y categories of total PA at baseline among participants in the pooled Seniors-ENRICA 1 and 2 cohorts ($n = 6645$). Time spent in physical activities are shown in mean (SD) hours/week. Total PA categories: None/Very Low (<7 h/week), low (Tertile 1), middle (Tertile 2), high (Tertile 3). DIY, Do-it-yourself; PA, Physical activity. The bars show the sum of hours/week of physical activity in each physical activity category. The line shows the % mortality for each of the physical activity category.



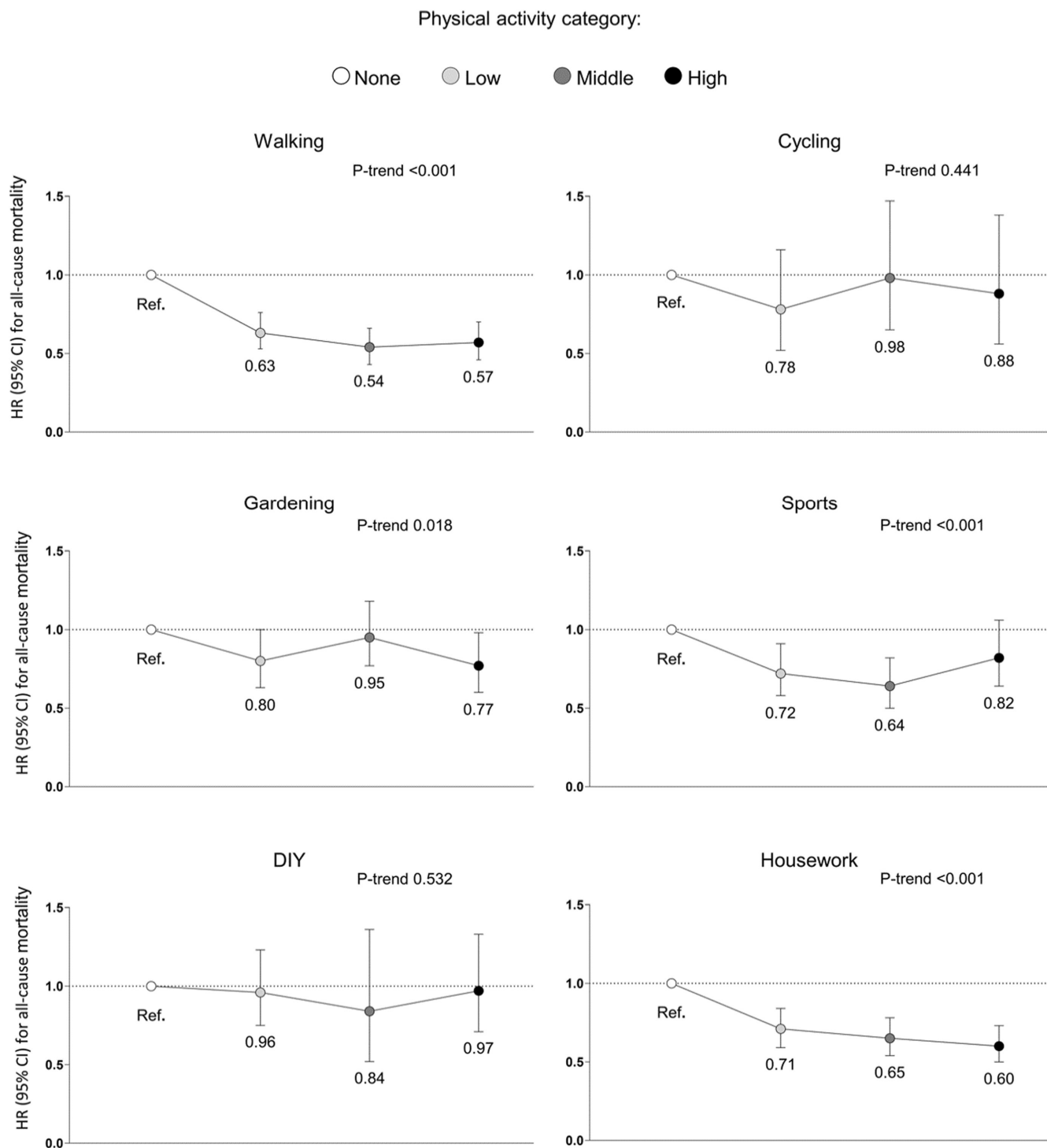


FIGURE 2 Associations between different physical activities at baseline and all-cause mortality in the pooled Seniors-ENRICA 1 and 2 cohorts ($n=6645$). Values are hazard ratios (HR) and their 95% confidence interval (CI). PA categories: none (0 h/week), low (Tertile 1), middle (Tertile 2), high (Tertile 3). Model adjusted for sex, age, educational level, smoking status, alcohol status, BMI status, cardiovascular disease, cancer, diabetes mellitus, hypertension, cohort, and sum of time spent in all other physical activities. DIY: Do-it-yourself.

considering the possible moderating role that hypertension or diabetes mellitus may play in these associations, we repeated this analysis excluding hypertension or diabetes mellitus from the model and found very similar results (data not shown).

4 | DISCUSSION

In this study, we found that participation in different type, volume, intensity, and changes over time of PA is related to mortality in older adults. Walking and housework at

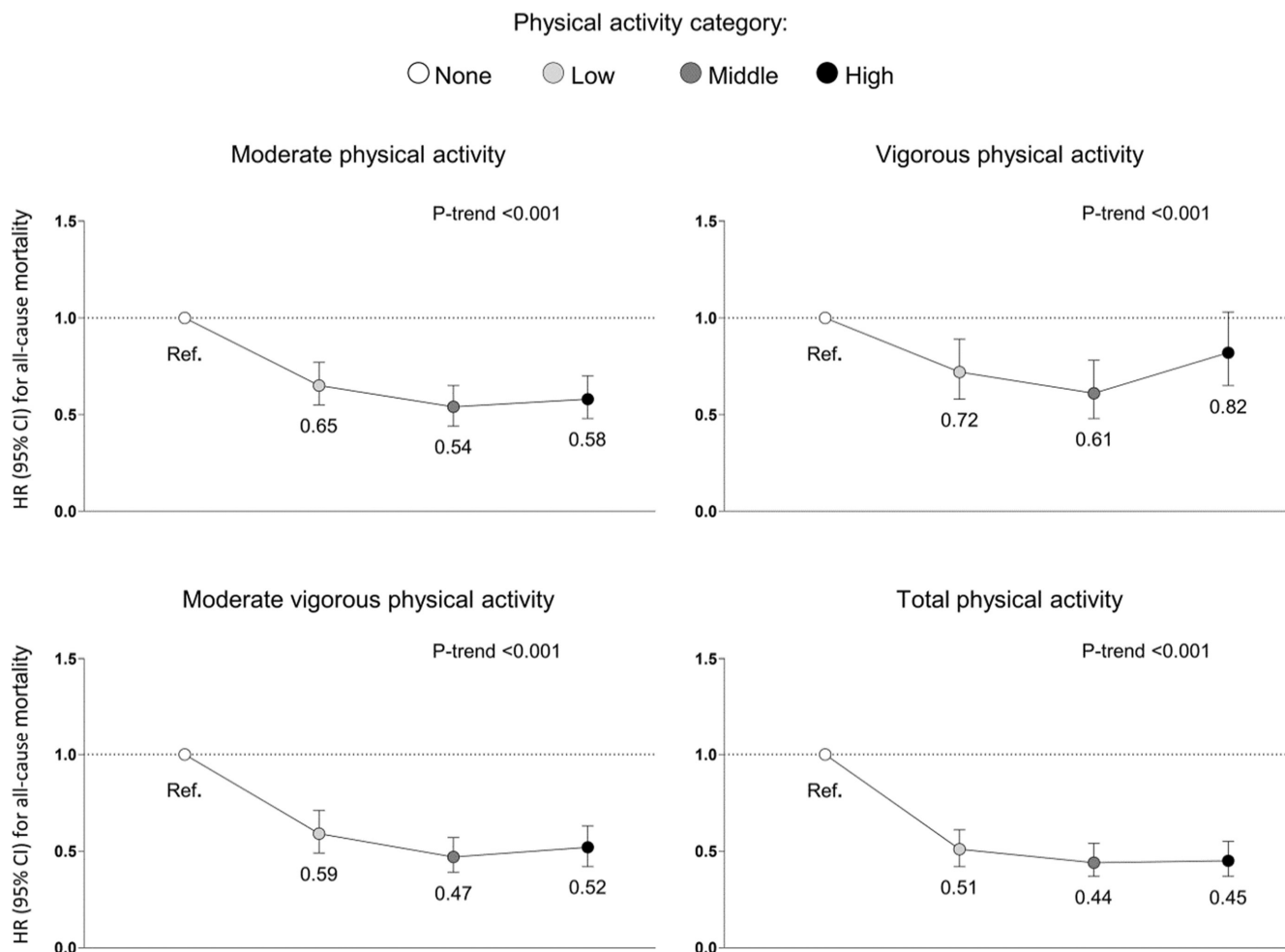


FIGURE 3 Associations between different intensities of physical activity at baseline and all-cause mortality in the pooled Seniors-ENRICA 1 and 2 cohorts ($n = 6645$). Values are HRs (95% CI). PA categories: none (0 h/week), low (Tertile 1), middle (Tertile 2), high (Tertile 3). For total PA the reference group is “Very Low (<7 h/week)”. Moderate and vigorous PA were mutually adjusted. Moderate PA: Gardening, DIY, and housework. Vigorous PA: Cycling and sports. Total PA: Walking, cycling, gardening, DIY, sports, and housework. Model adjusted for sex, age, educational level, smoking status, alcohol status, BMI status, cardiovascular disease, cancer, diabetes mellitus, hypertension, cohort, and sum of time spent in all other physical activities.

baseline were those associated with the greatest reductions in death risk. Time accumulated in MPA, MVPA, and total PA at baseline was also associated with lower mortality. Furthermore, participants maintaining PA levels between baseline and Wave 1, in all intensities and in total PA, as well as walking, sports, or housework, had lower mortality than those with consistently no or very low participation in the specific activity type at both examinations.

Among older adults participating in the present study, walking and housework were the most common activities, as in a previous study in Spain.⁴ Therefore, light or low to moderate intensity activities may be highly relevant in this population. Several reports have shown an association of individual PA and lower mortality. For example, Landi et al.¹⁰ found that older people who walked ≥ 1 h/day were less likely to die than those walking <1 h/day.

Martinez-Gomez et al.¹⁹ demonstrated that household PA was associated with reduced mortality in older women and in sedentary older men. Additionally, in the study by Watts et al.,⁹ older adults who spent 7.5 to <15 MET-hour per week in racquet sports, running, walking for exercise, other aerobic activities, golf, swimming, and cycling, had a lower risk of all-cause death than those with nonparticipation in each activity. In our results, at least one of the groups (low, medium, or high) for walking, gardening, sports, and housework had a lower mortality than the group with no participation, regardless of the time spent in other activities. A possible explanation for not finding associations between cycling or DIY with mortality could be that participants overall reported very low time spent in these activity types.

Previous studies have also investigated the relationship between PA intensity and mortality. Even though

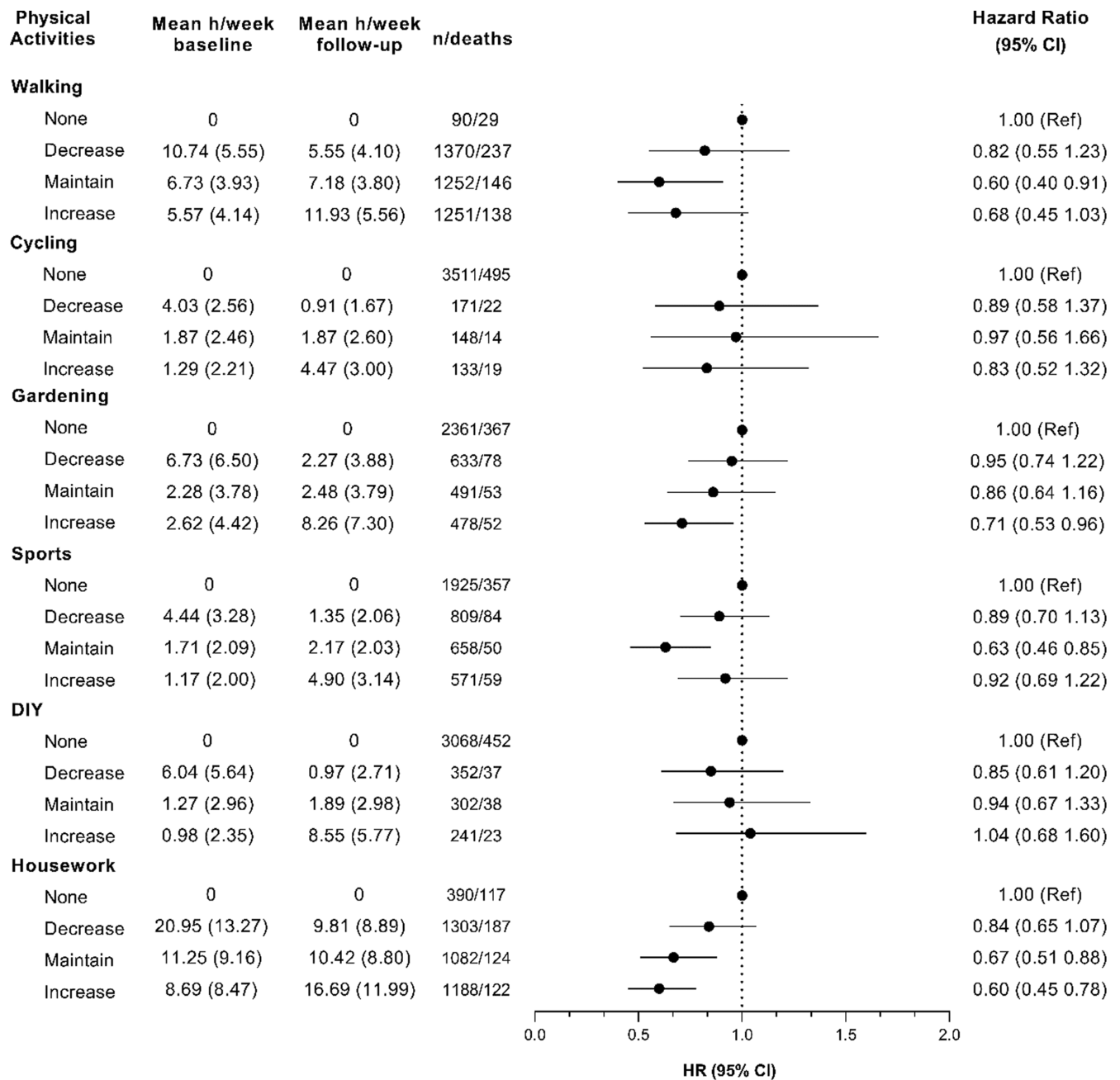


FIGURE 4 Associations between changes in different physical activities and all-cause mortality in the pooled Seniors-ENRICA 1 and 2 cohorts ($n = 3963$). Changing categories of PA: None (0 h/week at baseline and Wave 1), Decrease (lowest tertile of change, T1), Maintain (middle tertile of change, T2), and Increase (highest tertile of change, T3). Model adjusted for sex, age, educational level, smoking status, alcohol status, BMI status, cardiovascular disease, cancer, diabetes mellitus, hypertension, cohort, and sum of change over time in all other physical activities. DIY: Do-it-yourself.

the main PA recommendations focus on MVPA,^{2,20} evidence suggests that all PA intensities could lower mortality. For example, in a systematic review and harmonized meta-analysis on the dose–response associations between PA and all-cause mortality, Ekelund et al.⁵ found a similar reduction in mortality risk associated with LPA and MVPA, however, time spend in LPA was substantially higher. In our study, we found a 46% reduction in mortality in the middle MPA group, with a mean of 14.8 h/week

on MPA, and 39% in the middle VPA group, with a mean of 3.0 h/week on VPA. In addition, the greatest reductions in mortality risk were found in the middle and high total PA groups (56% and 55%) with a mean of 23.9 and 39.3 h/week of total PA, respectively. This suggested that both MPA and VPA intensities decrease the risk of mortality; however, it seems that a considerably longer time accumulated performing MPA compared to a shorter performance of VPA is required to achieve a similar mortality

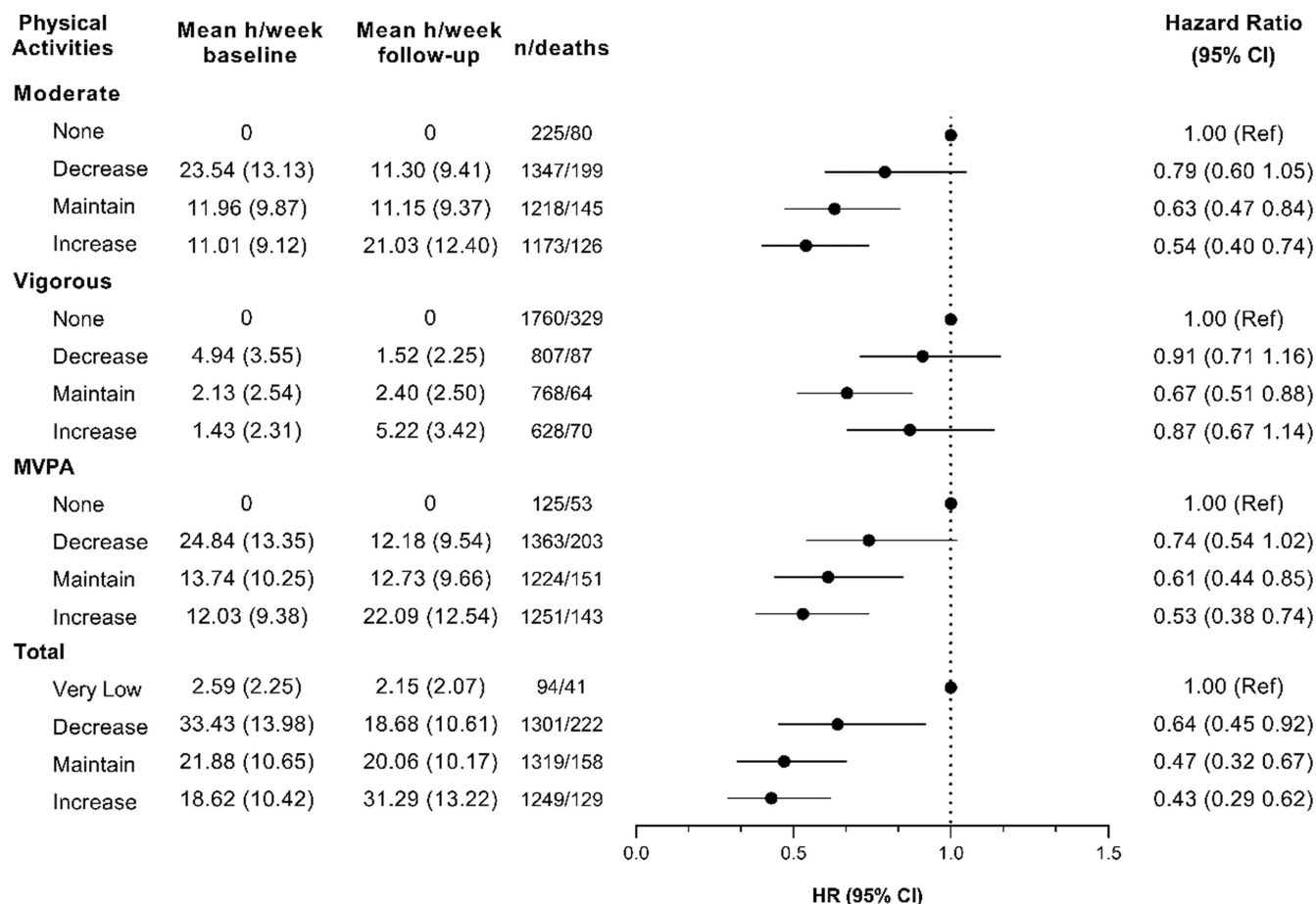


FIGURE 5 Associations between changes in physical activity intensities and all-cause mortality in the pooled Seniors-ENRICA-1 and 2 cohorts ($n = 3963$). Changing categories of PA: None (0 h/week at baseline and Wave 1), Decrease (lowest tertile of change, T1), Maintain (middle tertile of change, T2), and Increase (highest tertile of change, T3). For total PA the reference group is “Very Low (<7 h/week)”. Moderate PA: Gardening, DIY, and housework. Vigorous PA: Cycling and sports. Total PA: Walking, cycling, gardening, DIY, sports, and housework. MVPA: Moderate-to-vigorous PA. Model adjusted for sex, age, educational level, smoking status, alcohol status, BMI status, cardiovascular disease, cancer, diabetes mellitus, hypertension, cohort, and sum of time spent in all other physical activities. Moderate and vigorous PA were mutually adjusted.

risk reduction between the two. Our results are in line with the recommendation that “every move counts”,²¹ because all PA intensities contributed to reduce mortality. Type, volume, and intensity PA, especially in older adults must be aligned to individual capacities.

Regarding changes in PA, Laddu et al.²² investigated the association between patterns of PA change over time and mortality in older men (>65 years old) and identified three PA patterns. The authors report that although all three patterns showed a trajectory of decline in PA levels, participants with higher baseline PA had a lower mortality than the group with low baseline PA. However, PA levels in the second examination attenuated or abolished the associations between PA trajectories and mortality. Authors suggested that the current PA level may be more relevant for mortality in older men, overcoming previous level of PA or changing patterns. This may be a possible explanation for not finding significant results for some types of PA

in our study. For example, the increase group in cycling went from 1.29 h/week at baseline to 4.47 h/week Wave 1, which may not be enough to reduce mortality risk.

Likewise, Aggio et al.²³ evaluated the association between mortality and PA levels at three moments during a 20-year follow-up. They found that participants who became inactive at the third assessment (active-active-inactive) had a similar mortality to those with an inactive pathway (inactive-inactive-inactive), that is 55.7 and 51.5 per 1000 person-years, respectively. In our results for MPA, VPA, and MVPA, we found no associations with mortality for the group decreasing PA levels. That is, these participants did not experience a decreased mortality compared to the reference groups (0 h/week in both examinations). Only in total PA, the decrease group had a lower mortality than the reference group, possibly because even though the total PA had decreased, it was still considerable, averaging 19.26 h/week at the second

examination. Thus, our results suggest that consistent levels of PA are important for reducing the risk of death in older adults. It is possible that active older people will not experience additional mortality benefits from increasing levels of PA, but they could increase their death risk if they become inactive.

5 | STRENGTHS AND LIMITATIONS

The strengths of this study are the use of data from two relatively large cohorts of older people, and the assessment of participation in various types and intensities of PA that are prevalent to this population; moreover, the use of repeated measures may give a more reliable estimate of the relationship between long-term PA and mortality. Conversely, some limitations should be acknowledged. This is an observational study and, therefore, evidence of causality cannot be established. Also, the use of questionnaires could induce recall or social desirability biases. We also controlled for the main confounding variables, but some residual confounding may persist. For example, another potential limitation is the possibility of undiagnosed diseases.

6 | PERSPECTIVE

The results of the present study showed that different types, walking, gardening, sports and housework, and all intensities, MPA, VPA, and MVPA, and total PA were associated with lower risk of all-cause death. Moreover, analyses on changes in PA and mortality showed that maintaining PA levels such as walking, gardening, and housework, or at all analyzed intensities, was related to lower mortality. The greatest reductions in mortality risk were observed in older adults with the highest level of total PA and who maintained their PA level throughout follow-up. Then, healthy lifestyle policies addressed to older adults should emphasize the importance of maintaining satisfactory levels of PA.

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CONFLICT OF INTEREST STATEMENT

The authors declare no competing interest.

DATA AVAILABILITY STATEMENT

The datasets used and/or analyzed during the current study may be available from the Principal Investigator of the project (FR-A) upon reasonable request.

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Additional supporting information can be found online in the Supporting Information section at the end of this article.

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