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Leisure Time Physical Activity in Relation to Mortality Among African American Women

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Abstract

Introduction: African American women have a life expectancy 2.7 years shorter than that of white women and are less likely than white women to meet national physical activity guidelines. Physical activity has been found to reduce mortality, but evidence concerning African American women is limited.

Methods: In the Black Women's Health Study, a prospective cohort study of African American women begun in 1995, a total of 52,993 participants who were free of cardiovascular disease and cancer at enrollment were followed through 2017. Cox proportional hazards models evaluated the associations of repeated measures of physical activity with mortality, adjusting for demographic, medical, and lifestyle factors. Statistical analyses were last performed in September 2019.

Results: During 22 years of follow-up, 4,719 deaths occurred. Higher levels of physical activity were associated with reduced all-cause, cardiovascular disease, and cancer mortality. Hazard ratios for walking 5 hours/week relative to no walking were 0.69 (95% CI=0.62, 0.77), 0.71 (95% CI=0.57, 0.87), and 0.80 (95% CI=0.67, 0.96) for all-cause, cardiovascular disease, and cancer mortality, respectively. The comparable hazard ratios for vigorous exercise for 5 hours/week versus none were 0.58 (95% CI=0.50, 0.67), 0.66 (95% CI=0.50, 0.87), and 0.52 (95% CI=0.39, 0.72).

Conclusions: Both walking for exercise and vigorous exercise were associated with reductions in mortality among African American women, including deaths from cardiovascular disease and deaths from cancer, both of which are disproportionately high in the African American population. These findings underline the importance of institutional and individual changes that will lead to increased physical activity.

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The Boston University Medical Campus IRB approved the study. Participants of the BWHS study gave informed consent.

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INTRODUCTION

In 2017, African American (AA) women had a life expectancy of 78.5 years at birth, 2.7 years shorter than that of U.S. white women.^{1,2} Numerous studies have provided consistent evidence of the beneficial effects of physical activity (PA) on incidence of cardiovascular disease (CVD) and cancer, and on mortality.^{3–19} The 2018 “Physical Activity Guidelines for Americans,” 2nd edition, recommends that adults engage in at least 150–300 minutes a week of moderate-intensity aerobic PA, or 75–150 minutes/week of vigorous-intensity aerobic PA, or an equivalent combination of moderate and vigorous activities.²⁰ The guidelines state that “virtually everyone benefits: men and women of all races and ethnicities.”²⁰

Compared with white women, AA women are less likely to meet the national PA guidelines,^{21,22} yet the literature on mortality benefits of PA is predominantly based on white populations.^{4–6,8,14–16,23–29} Many AA women face individual, social, and cultural barriers to PA,^{30,31} including living in unsafe neighborhoods^{32–34} and having limited access to parks.^{35,36}

Several studies have provided important evidence on PA with mortality among AA.^{14,15,17–19,28,37–40} However, they were limited by lack of long-term repeated assessment of PA. Associations based on a one-time baseline PA assessment^{17,18,37–40} or a 7-day accelerometer measurement^{19,28} may not accurately reflect long-term activity. Furthermore, because healthy participants are able to perform more PA, associations between one-time baseline measurement of PA with mortality could be affected by reverse causation bias.⁴¹ Data on repeated measures of PA in AA populations are needed.

The present study prospectively assessed leisure time physical activity (LTPA) in relation to mortality in AA women, using the Black Women’s Health Study (BWHS)^{42–44}: PA information was obtained at eight timepoints across 22 years of follow-up, during which time 4,719 deaths were identified.

METHODS

Study Population

The BWHS is a prospective cohort study of AA women from all regions of the U.S., aged 21–69 (median=38) years at baseline in 1995.^{42–44} Participants were followed through mailed and web health questionnaires biennially. Follow-up was successful for 85% of potential person-years through 11 completed biennial rounds of follow-up. The Boston University Medical Campus IRB approved the study.

Measures

The study outcomes were all-cause and cause-specific mortality. Deaths after baseline in 1995–2017 were identified by yearly searches of the National Death Index for study participants who did not return the biennial questionnaire and were not previously known to be deceased. Reports of deaths were also obtained from next of kin, the Social Security Administration Death Master File, and the U.S. Postal Service. Cause of death information (underlying and immediate cause) was obtained from the National Death Index Plus or a

state-issued death certificate. Women were classified as having died from cancer if cancer was listed as the underlying cause of death based on the ICD codes (C00–C97 for cancer) and as CVD if the underlying cause of death was codes I00–I09, I11, I13, I20–I51.⁴⁵

Participants reported information on walking for exercise and vigorous exercise at baseline in 1995 and on biennial questionnaires in 1997, 1999, 2001, 2007, 2009, 2011, and 2015. Participants were asked to report the number of hours/week in the previous year spent in *walking for exercise* and *in vigorous exercise (such as basketball, swimming, running, aerobics)*. The exact wording changed slightly over time. Walking for transportation (to and from church, store, school, work) was ascertained in 1995, 1997, 1999, 2001, 2009, and 2011. Information on usual pace of walking was collected on the 2003 and 2005 questionnaires.

The investigators multiplied the estimated MET values of walking for exercise and vigorous exercise by the number of hours per week spent for that activity and summing to estimate total PA energy expenditure in MET hours/week. MET values of 3 and 7 were used for walking for exercise and vigorous exercise, based on the compendium of PA tracking guide.^{46,47} After filling out the 1997 questionnaire, 1,183 women filled out a duplicate questionnaire. The Spearman correlation coefficient for the reports of exercise on the two questionnaires was 0.59 ($p<0.0001$) for walking for exercise, and 0.68 ($p<0.0001$) for vigorous exercise.

Covariates to be included were chosen a priori based on the literature, updated with each questionnaire cycle, and modeled as time-varying covariates. Age, calendar year (indicated by questionnaire cycle), neighborhood SES (based on Census block group data),^{48,49} years of education, BMI (kg/m^2), cigarette smoking, alcohol consumption, diet quality (measured by the 2010 Alternative Healthy Eating Index),^{50,51} hypertension, and diabetes were included.

Participants were considered to have hypertension if they reported physician-diagnosed hypertension together with use of an antihypertensive medication or diuretic. In a validation study of 139 participants, 99% self-reported hypertension were confirmed by medical record.^{52,53} Women with reported diabetes diagnosed after age 30 years were considered to have type 2 diabetes. In a validation study of 229 women, 95% self-reported diabetes were confirmed by medical record.⁵⁴

Several additional covariates (total energy intake, experiences of racism, geographic region, marital status, hypercholesterolemia, height, family history of myocardial infarction [MI], family history of cancer) were considered but were not included, because their inclusion did not materially alter effect estimates.

Statistical Analysis

The analytic sample consisted of 52,993 women who were free of CVD and cancer at enrollment in 1995, and who had provided information on PA (Appendix Figure 1). Follow-up time was from 1995 until death, loss to follow-up, or the end of the study period (December 31, 2017), whichever occurred first.

Cox proportional hazard models were used for time-varying analyses of PA measures (walking for exercise, vigorous exercise, MET hours/week from walking and vigorous exercise, and walking for transportation) in relation to mortality. For analyses of trends, medians of each quintile were fit as a continuous variable.^{27,55} For missing data on covariates (<2%), the missing indicator method was used.⁵⁶ The proportional hazards assumption was tested by modeling multiplicative interaction terms between time and the primary exposure variable. No violations of the assumption were observed ($p=0.70$ for walking for exercise, and $p=0.37$ for vigorous exercise).

Potential effect modification by age, geographic region, neighborhood SES, BMI, smoking, and chronic conditions were examined using the likelihood ratio test. The authors evaluated the joint effect of walking for exercise and walking pace with mortality.

Several sensitivity analyses were conducted to assess the possibility of reverse causation and potential biases: (1) a lagged analysis; (2) an analysis that stopped updating PA when participants self-reported developed MI, stroke, cancer, diabetes, or end-stage renal disease⁵⁷; and (3) an analysis that used baseline activity in 1995 as the exposure measure. Analyses were performed in September 2019, using SAS, version 9.4.

RESULTS

During 22 years of follow-up from 1995 through 2017, a total of 4,719 deaths were identified, including 1,697 cancer deaths, 1,256 CVD deaths, and 1,766 deaths from other causes. Median age at death was 63 years. At baseline, 18.6% of the women reported no walking for exercise and 32.7% of the women performed no vigorous exercise (Table 1). Participants who walked for exercise or exercised vigorously tended to live in neighborhoods of higher SES, have a higher educational level, be less likely to smoke, and be more likely to eat a higher-quality diet. All participants provided PA information for two measurements, 99% for three, and 97% for four or more measurements.

Walking for exercise was associated with lower all-cause and cause-specific mortality, with a weaker association observed for cancer mortality (Table 2). Hazard ratios (HRs) for <1 hour/week relative to no walking for exercise and 5 hours/week versus no walking for exercise were 0.83 (95% CI=0.76, 0.90) and 0.69 (95% CI=0.62, 0.77; $p<0.0001$ for trend). In an analysis restricted to women who reported no vigorous exercise, HRs were similar: 0.81 (95% CI=0.74, 0.89) for walking for exercise <1 hour/week versus none, and 0.65 (95% CI=0.57, 0.75) for 5 hours versus none ($p<0.0001$ for trend). The reduction in all-cause mortality was greatest for walking at a brisk pace and least for walking at a casual pace (Figure 1). Results were similar when the analysis was restricted to women who did not exercise vigorously.

Walking for transportation was associated with reduced mortality in a manner similar to that for walking for exercise (Appendix Table 1).

Vigorous exercise was associated with lower all-cause and cause-specific mortality (Table 2, Appendix Figure 2). Relative to no vigorous exercise, HRs for <1 hour/week and 5 hours/week were 0.74 (95% CI=0.68, 0.81) and 0.58 (95% CI=0.50, 0.67; $p<0.0001$ for trend).

Total exercise in MET hours/week (the sum of METs for walking for exercise and for vigorous exercise) was inversely associated with all-cause and cause-specific mortality (Table 3). For all-cause mortality, HRs were 0.75 (95% CI=0.69, 0.81) for expenditure of >0 to <7.5 MET hours/week and 0.46 (95% CI=0.41, 0.51) for ≥30 total MET hours/week.

Likelihood ratio tests showed no significant interaction by subgroups. Reductions in mortality associated with exercise were consistently observed across subgroups (Appendix Table 2). The reductions associated with exercise were smallest among current smokers. Stronger associations were observed among women without comorbidities, those in the highest quintile of neighborhood SES, highest level of education, and lowest BMI. Vigorous exercise was not associated with mortality in women with MI and stroke: For ≥5 hours/week versus no vigorous activity, the HR was 1.14 (95% CI=0.36, 3.66) among women with MI, and 0.19 (95% CI=0.02, 1.42) among women with stroke (Appendix Table 2).

Several sensitivity analyses were carried out to assess the potential influence of reverse causation—that is, that illness affected subsequent PA. Results were similar from a lagged analysis to those in Table 2: In comparisons of highest to lowest categories of each exposure variable, HRs were 0.67 (95% CI=0.60, 0.74) for walking for exercise, 0.54 (95% CI=0.46, 0.64) for vigorous exercise, and 0.60 (95% CI=0.53, 0.68) for total MET hours/week. In analyses that stopped updating PA level when participants developed conditions such as MI, stroke, cancer, diabetes, and end-stage renal disease ($n=6,214$), the comparable HRs were 0.48 (95% CI=0.40, 0.59) for walking for exercise, 0.44 (95% CI=0.33, 0.59) for vigorous exercise, and 0.37 (95% CI=0.30, 0.46) for total MET hours/week.

In analysis that used baseline PA only, the multivariate HRs relative to none for walking for exercise in relation to all-cause mortality were 0.89 (95% CI=0.81, 0.97) for <1 hour/week, 0.90 (95% CI=0.83, 0.98) for 1–2 hours/week, 0.79 (95% CI=0.71, 0.87) for 3–4 hours/week, and 0.87 (95% CI=0.79, 0.96) for ≥5 hours/week. The corresponding HRs for vigorous exercise relative to none were 0.84 (95% CI=0.77, 0.91) for <1 hour/week, 0.79 (95% CI=0.72, 0.86) for 1–2 hours/week, 0.78 (95% CI=0.70, 0.87) for 3–4 hours per week, and 0.73 (95% CI=0.65, 0.81) for ≥5 hours/week. These HRs were appreciably closer to the null than those derived with updating of PA throughout follow-up (Table 2).

DISCUSSION

In 22 years of follow-up, walking for exercise and vigorous exercise were inversely associated with all-cause, CVD, cancer, and other mortality among AA women, a population that experiences earlier mortality. The reductions were apparent at all ages and across various comorbidities and behaviors. LTPA in the range of 7 to <15 MET hours per week was associated with a 33% (95% CI=24%, 40%) reduction in all-cause mortality. These results support the current guidelines in that levels of moderate- and higher-intensity PA confer substantial benefits for mortality reduction among AA women.

Data from numerous longitudinal studies, conducted predominantly among whites, with differing definitions of PA and differing control for confounders, have provided strong evidence of reductions in mortality from moderate and vigorous PA.^{3–15,24,58,59} For

example, in a pooled analysis of individual data from six cohort studies in the National Cancer Institute cohort consortium, leisure time moderate-to-vigorous PA was associated with lower mortality, and there was a 20% lower mortality risk for even low levels, <7.5 MET hours/week.¹⁴ The National Health and Nutrition Examination Survey and Women's Health Initiative also indicated that light-intensity PA may reduce mortality: There was a 12% reduced mortality with each 30 minute/day increment in the Women's Health Initiative²⁸ and 23% reduced mortality comparing 5 hours/day of light activity with <3 hours/day in the National Health and Nutrition Examination Survey.¹¹ In addition, walking more steps/day has been associated with reduced mortality rates, regardless of stepping intensity,^{8,19} and walking below the minimum recommended level was still associated with lower mortality compared with inactivity.

The pooled analyses by Moore et al.¹⁵ provided important evidence for AAs, with an AA-specific HR of 0.54 (0.46–0.65) for >22.5 MET hours/week versus none. Power was insufficient in that study to assess associations with intermediate levels of activity or associations with cause-specific mortality. Several other smaller longitudinal cohort studies have also provided evidence on PA in relation to mortality in AA men and women.^{17–19,27,36–39} As only baseline PA was assessed, there are concerns about reverse causation bias (e.g., individuals who become ill may exercise less)^{41,60} and misclassification, as activity changes over time. Differences between studies, such as definition of the exposure and control for confounders, may explain some of the differences. In the WHI,²⁸ vigorous exercise and walking measured using 7-day accelerometers were associated with reduced mortality in AA women, based on the occurrence of 96 deaths over follow-up. The Dallas Heart Study¹⁸ reported a reduction in CVD mortality for any versus no PA at baseline in AAs, based on 104 deaths. In the Southern Community Cohort Study,^{17,37} the expenditure of 32.3 MET hours/day of PA relative to <9.7 MET hours/day was associated with 24% lower all-cause mortality, 19% lower CVD mortality, and 24% lower cancer mortality, based on 3619 AA deaths.^{17,37} The Southern Community Cohort Study analysis did not update PA over time. In the present study, the associations were considerably stronger: For example, a 54% reduction in all-cause mortality was observed for women in the highest category of MET hours/day for combined vigorous activity and walking, as compared with the 24% reduction observed for approximately the same comparison in the Southern Community Cohort Study. The reductions in mortality in the BWHS were estimated based on repeated measures of PA over 22 years. Analyses of baseline measures only of PA yielded weaker associations than those based on repeated measures over follow-up.

In a representative sample of U.S. adults¹⁹ and a study of white women⁸ that relied on 7-day accelerometer data at baseline, walking pace was not associated with reduced mortality. In BWHS, faster walking pace was associated with reductions in mortality. The differences in the findings may have been due to differences in the information on pace. Prior studies^{8,19} were based on 7-day accelerometer data obtained at baseline. In the BWHS, information on “usual pace of walking” was collected through participants' self-report. Associations based on a 7-day accelerometer measurement may not accurately reflect long-term activity. Prior studies^{8,19} were able to examine the association between walking pace and mortality after accounting for total steps, as those who took more steps/day also tended to have a faster walking pace. The present study was unable to account for total steps/day.

This considerably larger study (52,993 AA women) with a longer period of follow-up (22 years) than previous studies of AA women confirms the reductions in mortality associated with greater PA observed in previous studies, while overcoming some methodological limitations of the prior work. AAs have less often reached optimal PA levels compared with whites.²¹ Walking for an hour or so a week may be an attainable goal. This study, together with previous studies, provides encouraging evidence that small amounts may make a difference for AA women.

The strengths of this study include the prospective nature of data collection and analysis, the large sample size of participants and deaths, the long follow-up, and repeated measures of PA. Although the BWHS sample is not a probability sample, the participants come from different geographic regions of the U.S. and live in neighborhoods of varying SES. The results were robust across different regions and neighborhood SES, providing evidence that AA women with diverse socioeconomic backgrounds can benefit from leisure time moderate-to-vigorous PA.

Limitations

The present study has limitations. The estimates of PA were based on participant self-report. Several assumptions were made for converting hours of activity into MET hours/week, as the exact nature of the women's activities or the intensity were not collected. This does not detract from the observation of dose-response relationships, which would have been observed across a range of assigned MET values. The BWHS study did not collect information on specific types of PA (e.g., aerobic activity versus muscle strength training), and thus cannot comment on which activities might be most effective. Further, the BWHS study only captured a portion of PA among AA women. There is some evidence to suggest that older women are more likely to engage in activities such as home/child care that would not be captured in questions about LTPA.⁴⁷ Walking for exercise and walking for transportation were captured in the study, but not other types of walking activities. A wide range of confounders were adjusted and several sensitivity analyses were performed to assess the influence of potential residual confounding, but unmeasured confounding could still have been present. Cox proportional hazards models with time varying exposure and time varying covariates were used, but future studies using more sophisticated methods, such as a latent class trajectory model and methods to account for time dependent confounding, may be more effective.⁴¹ The BWHS participants have a higher level of educational attainment than the general AA female population in the U.S. (83% with a high school education or more nationally⁶¹ vs 97% in the BWHS). However, most AA women are represented in the BWHS, and the underlying pathophysiological mechanisms through which PA reduces mortality would likely be the same. The results should therefore be generalizable to most AA women.

CONCLUSIONS

Both walking for exercise and vigorous exercise were inversely associated with all-cause, CVD, cancer, and other mortality among AA women, a population that experiences earlier mortality. The findings suggest that adherence to current PA guidelines would result in

substantial reduction in mortality among AA women, and that even small amounts of PA, less than guideline recommended levels, are beneficial. It would be desirable for future public policy and research to focus on overcoming barriers to PA for AA women at the individual, community, environmental, and societal levels.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Joint effect of walking for exercise and walking pace, with all-cause mortality.

Notes: Reference group is no walking for exercise. X axis represents joint categories of hours per week of walking for exercise and walking pace. Y axis represents multivariable adjusted hazard ratio for all-cause mortality. Model adjusted for age (continuous, years), calendar year, neighborhood SES (quintiles), education (12, 13–15, 16, 17 years), BMI (<24.9, 25–29.9, 30–34.9, >35 kg/m²), cigarette smoking (never smoker, past smoker with <10 pack years, current smoker with <10 pack years, past smoker with 10 pack years, current smoker with 10 pack years), alcohol consumption (never, current with 1–3 drinks/week, current with 4–6 drinks/week, current with 7 drinks/week), diet quality (Alternative Healthy Eating Index, quintiles), hypertension (yes, no), and diabetes (yes, no). Follow up start from 2003.

Table 1.

Age-standardized Baseline Characteristics by Highest and Lowest Categories of Physical Activity

Baseline characteristics	Walking for exercise		Vigorous exercise	
	None	5 hours/week	None	5 hours/week
N (%)	9,845 (18.6)	7,297 (13.8)	17,339 (32.7)	7,352 (13.9)
Age, years (SD)	36.8 (10)	39.1 (11)	41.6 (11)	41.6 (11)
Neighborhood SES, %				
Quintile 1, (lowest)	28.4	28.7	31.6	24.2
Quintile 3	18.3	17.6	18.2	17.6
Quintile 5 (highest)	16.3	17.5	13.9	20.5
Geographic region, %				
Northeast	27.8	27.9	28.1	27.0
South	31.4	29.6	32.4	29.1
Midwest	24.9	22.4	23.7	21.5
West	15.6	19.8	15.5	22.1
Education, %				
12 years	21.8	19.1	25.9	14.5
13–15 years	35.3	40.6	37.5	36.7
16 years	42.8	40.1	36.5	48.7
Currently married, %	38.8	37.2	39.9	36.5
BMI, kg/m ² (SD)	28.1 (7)	27.2 (5)	29.2 (7)	29.2 (7)
Smoking, %				
Never	62.2	63.0	63.0	65.1
Current	19.7	15.3	19.1	13.1
Past	17.9	21.5	17.7	21.7
Alcohol, %				
Never	57.8	54.1	57.8	54.4
Past	14.6	14.4	15.3	13.4
Current	27.5	31.4	26.8	32.0
Total caloric intake, kcal/day	1,482.6	1,499.5	1,482.1	1,464.5
Diet quality, AHEI diet score	35.8	41.9	36.1	42.9
Type 2 diabetes, %	4.3	3.9	5.2	2.9
Hypertension, %	17.4	13.8	45.6	10.1

Notes: Values are means or percentages and are standardized to the age distribution of the participants. Age is not age-standardized.

AHEI, Alternative healthy eating index (range from 0 to 100. Higher score indicates better diet quality).

Table 2.

Association of Walking for Exercise and Vigorous Exercise With All-Cause and Cause-Specific Mortality

Variable	Case N	Person years	Walking for exercise			Case N	Person years	Vigorous exercise		
			Model 1 HR (95% CI)	Model 2 HR (95% CI)	Model 3 HR (95% CI)			Model 1 HR (95% CI)	Model 2 HR (95% CI)	
All-cause mortality										
None	1,178	194,025	ref	ref	ref	3,203	514,765	ref	ref	
<1 hour/week	1,263	283,272	0.70 (0.64, 0.76)	0.80 (0.74, 0.87)	0.83 (0.76, 0.90)	603	205,583	0.64 (0.59, 0.70)	0.74 (0.68, 0.81)	
1–2 hours/week	1,129	310,397	0.56 (0.52, 0.61)	0.66 (0.60, 0.71)	0.70 (0.64, 0.77)	464	183,049	0.57 (0.51, 0.62)	0.67 (0.60, 0.74)	
3–4 hours/week	568	173,015	0.49 (0.44, 0.54)	0.62 (0.56, 0.69)	0.69 (0.62, 0.77)	236	120,771	0.43 (0.38, 0.49)	0.53 (0.46, 0.61)	
5 hours/week	581	168,619	0.50 (0.45, 0.55)	0.60 (0.54, 0.67)	0.69 (0.62, 0.77)	213	105,160	0.48 (0.42, 0.55)	0.58 (0.50, 0.67)	
<i>p</i> -trend			<0.0001	<0.0001	<0.0001			<0.0001	<0.0001	
Cardiovascular mortality										
None	316	194,600	ref	ref	ref	899	516,356	ref	ref	
<1 hour/week	363	283,901	0.76 (0.65, 0.88)	0.86 (0.73, 1.00)	0.89 (0.76, 1.05)	150	205,904	0.60 (0.50, 0.71)	0.74 (0.62, 0.88)	
1–2 hours/week	300	310,960	0.57 (0.49, 0.67)	0.68 (0.58, 0.80)	0.74 (0.63, 0.88)	92	183,300	0.42 (0.34, 0.52)	0.54 (0.43, 0.68)	
3–4 hours/week	128	173,341	0.42 (0.34, 0.51)	0.54 (0.43, 0.67)	0.61 (0.49, 0.76)	61	120,879	0.42 (0.32, 0.54)	0.57 (0.43, 0.74)	
5 hours/week	149	168,902	0.49 (0.40, 0.60)	0.63 (0.51, 0.77)	0.71 (0.57, 0.87)	54	105,266	0.47 (0.35, 0.62)	0.66 (0.50, 0.87)	
<i>p</i> -trend			<0.0001	<0.0001	<0.0001			<0.0001	<0.0001	
Cancer mortality										
None	358	194,575	ref	ref	ref	1,102	516,217	ref	ref	
<1 hour/week	441	283,851	0.79 (0.69, 0.91)	0.89 (0.77, 1.02)	0.91 (0.79, 1.05)	231	205,849	0.77 (0.67, 0.89)	0.80 (0.66, 0.96)	
1–2 hours/week	428	310,871	0.69 (0.60, 0.79)	0.79 (0.68, 0.91)	0.84 (0.72, 0.97)	182	183,232	0.70 (0.60, 0.82)	0.67 (0.54, 0.84)	
3–4 hours/week	237	173,247	0.65 (0.55, 0.77)	0.77 (0.65, 0.92)	0.85 (0.72, 1.01)	99	120,855	0.49 (0.40, 0.61)	0.48 (0.35, 0.64)	
5 hours/week	233	168,853	0.63 (0.54, 0.75)	0.70 (0.59, 0.83)	0.80 (0.67, 0.96)	83	105,243	0.61 (0.49, 0.76)	0.52 (0.38, 0.72)	
<i>p</i> -trend			<0.0001	<0.0001	0.01			<0.0001	0.0001	
Other mortality										
None	504	194,490	ref	ref	ref	1,202	516,176	ref	ref	
<1 hour/week	459	283,852	0.60 (0.53, 0.68)	0.71 (0.63, 0.81)	0.74 (0.65, 0.84)	222	205,863	0.64 (0.59, 0.70)	0.71 (0.61, 0.82)	
1–2 hours/week	401	310,906	0.47 (0.42, 0.54)	0.56 (0.48, 0.64)	0.59 (0.52, 0.68)	190	183,237	0.57 (0.51, 0.62)	0.71 (0.60, 0.83)	
3–4 hours/week	203	173,284	0.42 (0.36, 0.49)	0.56 (0.48, 0.67)	0.63 (0.53, 0.75)	76	120,877	0.43 (0.38, 0.49)	0.45 (0.36, 0.58)	
5 hours/week	199	168,869	0.41 (0.35, 0.49)	0.52 (0.44, 0.62)	0.61 (0.51, 0.72)	76	105,248	0.48 (0.42, 0.55)	0.54 (0.43, 0.69)	

Variable	Case N	Person years	Walking for exercise			Case N	Person years	Vigorous exercise	
			Model 1 HR (95% CI)	Model 2 HR (95% CI)	Model 3 HR (95% CI)			Model 1 HR (95% CI)	Model 2 HR (95% CI)
<i>p</i> -trend			<0.0001	<0.0001	<0.0001			<0.0001	<0.0001

Notes: Model 1. Adjusted for age (continuous, years) and calendar year. Model 2. Additionally adjusted for neighborhood SES (quintiles), education (<12, 13–15, 16, 17 years), BMI (<24.9, 25–29.9, 30–34.9, >35 kg/m²), cigarette smoking (never smoker, past smoker with <10 pack years, current smoker with <10 pack years, past smoker with 10 pack years, current smoker with 10 pack years), alcohol consumption (never, current with 1–3 drinks/week, current with 4–6 drinks/week, current with 7 drinks/week), diet quality (Alternative Healthy Eating Index, quintiles), hypertension (yes, no), and diabetes (yes, no). Model 3. Additionally adjusted for vigorous exercise (none, <1 hour/week, 1–2, 3–4, 5 hours/week).

HR, hazard ratio.

Table 3.

Association of MET Hours/Week With All-Cause and Cause-Specific Mortality

Variable	All-cause mortality		Cardiovascular mortality		Cancer mortality		Other mortality	
	Case N	HR (95% CI)	Case N	HR (95% CI)	Case N	HR (95% CI)	Case N	HR (95% CI)
MET hours/week from walking for exercise								
None	1,178	ref	316	ref	358	ref	504	ref
0- <7.5 MET hours/week	2,392	0.73 (0.68, 0.78)	663	0.77 (0.67, 0.89)	869	0.83 (0.73, 0.95)	860	0.63 (0.56, 0.71)
7.5- <15 MET hours/week	568	0.62 (0.56, 0.69)	128	0.54 (0.43, 0.67)	237	0.77 (0.65, 0.92)	203	0.56 (0.48, 0.67)
15- <30 MET hours/week	581	0.60 (0.54, 0.67)	149	0.63 (0.51, 0.77)	233	0.70 (0.59, 0.83)	199	0.53 (0.44, 0.62)
<i>p</i> -trend		<0.0001		<0.0001		<0.0001		<0.0001
MET hours/week from vigorous exercise								
None	3,203	ref	899	ref	1,102	ref	1,202	ref
0- <7.5 MET hours/week	603	0.74 (0.68, 0.81)	150	0.74 (0.62, 0.88)	231	0.78 (0.67, 0.90)	222	0.71 (0.61, 0.82)
7.5- <15 MET hours/week	464	0.67 (0.60, 0.74)	92	0.54 (0.43, 0.68)	182	0.72 (0.61, 0.85)	190	0.71 (0.60, 0.83)
15- <30 MET hours/week	236	0.53 (0.46, 0.61)	61	0.57 (0.43, 0.74)	99	0.59 (0.48, 0.73)	76	0.45 (0.36, 0.58)
30 MET hours/week	213	0.58 (0.50, 0.67)	54	0.66 (0.50, 0.87)	83	0.57 (0.45, 0.73)	76	0.54 (0.43, 0.69)
<i>p</i> -trend		<0.0001		<0.0001		<0.0001		<0.0001
MET hours/week from walking and vigorous exercise								
None	1,033	ref	286	ref	308	ref	439	ref
0- <7.5 MET hours/week	1,848	0.75 (0.69, 0.81)	528	0.79 (0.68, 0.92)	653	0.86 (0.75, 0.99)	667	0.66 (0.58, 0.75)
7.5- <15 MET hours/week	618	0.62 (0.56, 0.69)	148	0.57 (0.46, 0.70)	243	0.76 (0.64, 0.91)	227	0.57 (0.48, 0.67)
15- <30 MET hours/week	755	0.56 (0.51, 0.62)	182	0.54 (0.44, 0.65)	304	0.69 (0.58, 0.81)	269	0.49 (0.42, 0.58)
30 MET hours/week	465	0.46 (0.41, 0.51)	112	0.48 (0.38, 0.61)	189	0.54 (0.45, 0.65)	164	0.40 (0.33, 0.48)
<i>p</i> -trend		<0.0001		<0.0001		<0.0001		<0.0001

Notes: Model adjusted for age (continuous, years), calendar year, neighborhood SES (quintiles), education (<12, 13–15, 16, 17 years), BMI (<24.9, 25–29.9, 30–34.9, >35 kg/m²), cigarette smoking (never smoker, past smoker with <10 pack years, current smoker with <10 pack years, past smoker with 10 pack years, current smoker with 10 pack years), alcohol consumption (never, current with 1–3 drinks/week, current with 4–6 drinks/week, current with 7 drinks/week), diet quality (Alternative Healthy Eating Index, quintiles), hypertension (yes, no), and diabetes (yes, no).

HR, hazard ratio.