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ORIGINAL RESEARCH

Association of Accelerometer-Derived Physical Activity Pattern With the Risks of All-Cause, Cardiovascular Disease, and Cancer Death

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BACKGROUND: Current guidelines suggest engaging in a minimum of 150 minutes of moderate to vigorous physical activity (MVPA) each week to support overall health. However, the effect of concentrated versus evenly distributed physical activity (PA) on health outcomes remains uncertain. This study aims to investigate the associations of "weekend warrior" pattern, where most MVPA is completed in 1 to 2 days, and a more evenly spread MVPA pattern with mortality risk.

METHODS: Data from the UK Biobank were used, with participants having a full week of device-measured PA data from 2013 to 2015. Three MVPA patterns were defined: inactive, active weekend warrior, and active regular. The relationships between PA patterns and mortality risk were investigated using the Cox proportional hazards model.

RESULTS: During an 8.1-year median follow-up, 3965 adults died from all causes, including 667 from cardiovascular disease and 1780 from cancer. Both the active weekend warrior group (all-cause death: hazard ratio [HR], 0.68 [95% CI, 0.64–0.74]; cardiovascular disease death: HR, 0.69 [95% CI, 0.58–0.83]; cancer death: HR, 0.79 [95% CI, 0.71–0.89]) and the active regular group (all-cause death: HR, 0.74 [95% CI, 0.68–0.81]; cardiovascular disease death: HR, 0.76 [95% CI, 0.61–0.94]; cancer death: HR, 0.87 [95% CI, 0.76–0.99]) demonstrated a lower mortality risk compared with the inactive group after following the recommended 150 minutes of MVPA per week. Furthermore, there was no discernible difference in the mortality risk between the active regular group and the active weekend warrior group.

CONCLUSIONS: Engaging in PA concentrated within 1 to 2 days was related with a similar reduction in mortality risk as more evenly spread activity. Our findings are particularly significant for individuals who find it challenging to engage in regular PA due to time constraints.

Key Words: accelerometer ■ death ■ physical activity pattern ■ prospective study ■ weekend warrior

Physical activity (PA) can help lessen the risk of noncommunicable illness[1,2] as well as death.[3–5] The World Health Organization (WHO) guidelines recommend at least 150 minutes of moderate to vigorous physical activity (MVPA) for adults, highlighting the importance of both duration and intensity.[6] However,

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CLINICAL PERSPECTIVE

What Is New?

- Current guidelines recommend at least 150 minutes of moderate to vigorous physical activity per week to support overall health, but it remains unclear whether concentrated or evenly distributed moderate to vigorous physical activity differentially impacts health outcomes.
- This study found that moderate to vigorous physical activity concentrated within 1 or 2 days per week has similar benefits on all-cause and cause-specific death as more evenly distributed activity.

What Are the Clinical Implications?

- These findings are particularly significant for individuals who find it challenging to engage in regular physical activity due to time constraints.

Nonstandard Abbreviations and Acronyms

MVPA	moderate to vigorous physical activity
PA	physical activity
WHO	World Health Organization
WW	weekend warrior

it remains uncertain whether the "weekend warrior" (WW) pattern, defined by concentrated MVPA over 1 to 2 days,[7] is associated with death.

Millions of adults worldwide prefer to concentrate their exercise primarily within 1 or 2 days per week.[8] However, evidence regarding the relationship between mortality risk and the WW pattern is inconsistent and limited.[7,9–13] While 2 cohort studies reported that the decrease in all-cause death for weekend warriors (WWs) was statistically significant,[10,11] other studies did not observe such benefits.[7,9] According to a new meta-analysis involving 4 prospective cohorts, the mortality benefits of the WW pattern and regularly active PA patterns were similar.[13] However, many of these findings are based on self-reported PA data,[7,9–11,13] which are susceptible to recall bias and measurement inaccuracies, potentially distorting the true association between the WW pattern and death. Wearable devices such as wrist accelerometers,[4,14] increasingly used in health research,[15] provide objective and continuous PA measurements in natural settings, thereby mitigating the biases inherent in self-reported questionnaires.[16,17] To date, only 1 accelerometry-based study has indicated that PA within 1 to 2 days per week is associated with reduced mortality risk.[12] However, this study's sample size was rather small (n<3500) and might have missed activities predominantly involving upper body movements due to accelerometer placement on the right hip.

Therefore, we used data from a subcohort of the UK Biobank comprising >90 000 participants who had valid device-measured PA data, to investigate the association of PA patterns with death from all causes, cardiovascular disease (CVD), and cancer. We further compared the mortality outcomes between participants with the WW pattern and those with a regular active PA pattern. Moreover, we explored modifying factors that might have an impact on these links.

METHODS

Data Availability

The data that support the findings of the current study are available from the corresponding author upon reasonable request. The data analyzed in this study are available from the UK Biobank website with approved access. Data could be obtained upon direct application to the UK Biobank study.

Ethics Approval and Consent to Participation

Each participant in the UK Biobank studies completed a written informed consent form. The UK Biobank study was approved by the multicenter Research Ethics Committee, the National Information Governance Board for Health and Social Care in England and Wales, and the Community Health Index Advisory Group in Scotland.

Study Design and Participants

The UK Biobank, a large prospective cohort with almost 500 000 people aged 37 to 73 years, provided data for this study. Previous research has provided a detailed population and study design for the UK Biobank.[18–20] In brief, between 2006 and 2010, participants were recruited from 22 UK centers, and biological samples as well as lifestyle and health data were collected. The UK Biobank data are openly accessible to approved applicants (www.ukbiobank.ac.uk). For this analysis, we excluded individuals without valid accelerometer data or with relevant prevalent diseases as per cause-specific mortality criteria. Specifically, individuals who withdrew from the study (n = 14), those with unavailable daily MVPA data (n=8166), or measurements shorter than 7 days (n=2070) were excluded. Ultimately, 93 409 participants were included for the analysis of all-cause death. For CVD mortality analysis, participants with prevalent CVD were excluded, resulting in 89 709

participants; and for cancer mortality analysis, prevalent cancer cases were excluded, leaving 86 522 participants (Figure S1).

Definition of PA Patterns

More than 230 000 individuals in the accelerometer subcohort were invited via email to wear an accelerometer on their wrist for 7 days from February 2013 through December 2015.[21] A total of 103 659 participants accepted the invitation and received an Axivity AX3 accelerometer,[22] which continuously collected data for 7 days. After calibration, elimination of sensor noise and gravity, and identification of wear/nonwear episodes, PA information was retrieved from 100-Hz raw triaxial acceleration data. PA levels were categorized as MVPA using a machine learning–based method, which was developed to classify a wide range of activities, including walking, jogging, stationary cycling, elliptical exercises, and others.[21,23] This method was previously validated in a UK-based sample.[23]

To address ambiguities in appropriate MVPA levels measured by wrist-worn accelerometers, we used the WHO guidelines (MVPA ≥150 min/wk) as a primary criterion while also analyzing the sample's 25th percentile (MVPA ≥115.2 min/wk), median (MVPA ≥230.4 min/wk), and 75th percentile (MVPA ≥345.6 min/wk) to promote stability in results. PA patterns were classified as physically active (at or above the MVPA thresholds) or inactive (below the MVPA threshold). Furthermore, the following physical activities were further sorted: active WW: MVPA at or above thresholds and ≥50% of total MVPA concentrated within 1 to 2 days per week; and active regular: MVPA at or above the thresholds and ≥50% of total MVPA occurring ≥3 days per week.

Ascertainment of Death

The National Health Service England provided death data for individuals in England and Wales, while the National Health Service Central Register provided data for individuals in Scotland. The follow-up data were accessible until December 19, 2022.[24] Follow-up time was calculated from completing an accelerometer assessment to this date or upon death, whichever occurred first. Mortality outcomes were categorized using the *International Classification of Diseases*, *Tenth Revision* (*ICD-10*), focusing on all-cause death, CVD death (I00-99), and cancer death (C00-97).

Covariates

Confounders were selected on the basis of previous research[25,26] and included age (continuous, years), sex (female or male), body mass index (BMI; continuous, kg/m^2), race and ethnicity (White, Mixed, Asian or Asian British, Black or Black British, Chinese, and other ethnic group), education (degree and no degree), Townsend deprivation index (continuous), smoking status (current, previous, and never), drinking status (current, previous, and never), healthy diet pattern[27] (yes or no), employment status (employed or unemployed/retired), sedentary time (categorized into low, moderate, or high on the basis of tertile), and prevalent diabetes (yes or no). Details on the definitions of the covariates can be found in Table S1 and are also obtained on the UK Biobank website (www.ukbiobank.ac.uk). Missing data were estimated through multiple imputation using a chained equation under the assumption of missing data at random.[28]

Statistical Analysis

For continuous variables, the baseline characteristics were expressed as means±SDs, and for categorical variables as numbers (percentages). To compare baseline characteristics according to various PA patterns, we used the χ^2 test for categorical variables and ANOVA for continuous variables. Multivariable Cox proportional hazards models were used to examine the associations between PA patterns and death from all causes, CVD, and cancer. Quantifying these associations involved the calculation of 95% CIs and hazard ratios (HRs). The fully adjusted model was adjusted for age, sex, BMI, ethnicity, education, Townsend deprivation index, smoking status, drinking status, healthy diet pattern, employment status, diabetes at baseline, and sedentary time. Schoenfeld residuals were used to assess the proportional hazard assumption, and no breaches of this assumption were found.[29]

We further examined associations for active WW compared with active regular participants to determine relative effects on the mortality rate. Subgroup analyses were conducted to explore potential modifying factors, including sex (female, male), age (<65, ≥65 years), obesity (yes, BMI ≥30 kg/m^2; no, BMI <30 kg/m^2),[30] employment status (employed, unemployed/retired), diabetes status (yes, no), and healthy diet pattern (yes, no). Interaction effects between stratified factors and PA patterns on mortality rate were assessed using likelihood ratio tests.[31]

To guarantee that the results were robust, several sensitivity analyses were carried out. First, recognizing the variability in defining the WW pattern,[7,25,32] we considered multiple WW pattern definitions based on the guideline-based minimum of 150 min/wk. Second, we incorporated baseline blood pressure and antihypertensive medication use into the fully adjusted model. Third, we repeated the analyses using the unimputed data set. Fourth, based on the guidelines from the WHO and the American Heart Association,[6,33] we classified PA into 4 strata: <150 min/wk (inactive), from 150 to 300 min/wk, from 300 to 600 min/wk, and >600 min/

wk, according to the duration of MVPA. The multivariable Cox model, as described earlier, was then applied to examine the associations between PA patterns and death within each MVPA group. Finally, deaths in the first 2 years of the follow-up were excluded. To further quantify the robustness of our findings, we computed E-values to evaluate the potential impact of unmeasured confounding. A higher E-value implies that a more substantial unmeasured confounding factor would be necessary to invalidate the observed association, thereby offering an estimation of the resilience of the identified relationships.[34]

For all statistical analyses, R software version 4.3.1 (R Foundation for Statistical Computing, Vienna, Austria) was used. The definition of statistical significance was a 2-sided *P* value <0.05. We used the Bonferroni adjustment to account for multiple testing in the interaction analyses, which led to a significance criterion of *P*<0.0028 (0.05/18).[35,36]

RESULTS

Baseline Characteristics

Our study sample for all-cause mortality outcome included 93 409 participants (mean±SD age, 62.4±7.9 years; 56.4% women; 97.0% White race). A total of 39 787 (42.6%) participants were classified as active WW, 22037 (23.6%) as active regular, and 31 585 (33.8%) as inactive. Compared with the inactive participants, active WW counterparts were more likely to be men, younger, more educated, not current smokers, current drinkers, and less sedentary, with lower BMI and prevalence of diabetes (Table).

The density plot displayed the distribution of MVPA between the active WW and active regular groups. Individuals in the active regular group had more uniformly distributed MVPA, while those in the active WW group had a more concentrated distribution of MVPA. Additionally, those in the active WW group had higher MVPA in the top 2 days compared with the remaining 5 days (Figure 1).

PA Patterns and Mortality Risk

During an 8.1 (interquartile range, 7.5–8.6)-year median follow-up, 3965 adults died from all causes, including 667 from CVD and 1780 from cancer. The active PA group had lower risks of all-cause, CVD, and cancer death compared with the inactive group (Figure 2; Figure S2). In comparison with the inactive individuals, the HRs for all-cause death were 0.74 (95% CI, 0.68–0.81) for the active regular individuals and 0.68 (95% CI, 0.64–0.74) for the WWs. For CVD death, the HRs were 0.76 (95% CI, 0.61–0.94) for the active regular individuals and 0.69 (95% CI, 0.58–0.83) for the WWs. Regarding cancer death, the HRs were 0.87 (95% CI, 0.76–0.99) for the active regular individuals and 0.79 (95% CI, 0.71–0.89) for the WWs (Figure 2B). The findings were consistent across different MVPA thresholds (25th, 50th, and 75th percentiles) (Figure 2A, 2C, and 2D). Notably, active WW and active regular participants did not vary significantly in their risk of all-cause, CVD, and cancer death (Figure 3).

Subgroup and Sensitivity Analyses

Subgroup analyses showed no significant differences in associations across age, sex, obesity status, employment status, diabetes status, and healthy diet pattern (Figure S3 through S5). Sensitivity analyses revealed no discernible difference when redefining the WW pattern in terms of the distribution of exercise concentration time (Table S2); when further adjusting for baseline blood pressure and antihypertensive medication use (Table S3); when excluding participants with missing covariates (Table S4); when excluding deaths in the initial 2 years of follow-up (Table S5); and when examining the associations between PA patterns and mortality outcomes within different duration of MVPA group (Tables S6 through S8). Moreover, the E-values in the analysis strengthened the robustness of the relationships between the PA patterns and the mortality risk. The E-values ranging from 1.26 to 2.45 in this study suggest that unmeasured confounding variables are less likely to be the cause of the observed effect, as the correlation strength of 1.26 to 2.45 is relatively high (Tables S2 through S5 and S9).

DISCUSSION

Involving >93 000 individuals with accelerometer-measure PA data, this large prospective cohort study revealed that both the WW and active regular patterns were associated with lower risks of all-cause, CVD, and cancer death compared witih the physically inactive group. These correlations persisted even after accounting for various possible confounders and conducting multiple sensitivity analyses. Notably, the comparable mortality rates between the WW and active regular patterns suggest that increasing PA, even if concentrated into 1 to 2 days weekly, may effectively decrease the mortality risk.

Our results are in line with a number of studies that demonstrate that people who are active are less likely than inactive participants to die from all causes.[4,5,37] Interestingly, our study demonstrated a protective effect on mortality risk even when MVPA did not reach the WHO recommended levels. This is in line with a meta-analysis that showed a startling 22% lower risk of death in adults with just 15 minutes of daily MVPA.[38] While the majority of research to date focuses on the preventive effect of PA length

Table. Baseline Characteristics of the Study Participants Stratified by Physical Activity Patterns

Characteristics	Overall (n=93 409)	Active WW (n=39 787)	Active regular (n=22 037)	Inactive (n=31 585)	*P* value*
Age, y, mean±SD	62.38±7.85	62.28±7.74	61.19±7.91	63.34±7.83	<0.001
Female sex	52 638 (56.4)	20 310 (51.0)	11 243 (51.0)	21 085 (66.8)	<0.001
Race or ethnicity					
Asian	871 (0.9)	285 (0.7)	200 (0.9)	386 (1.2)	<0.001
Black	790 (0.8)	259 (0.7)	202 (0.9)	329 (1.0)	
Chinese	214 (0.2)	83 (0.2)	72 (0.3)	59 (0.2)	
Mixed	515 (0.6)	193 (0.5)	140 (0.6)	182 (0.6)	
Other ethnic group	503 (0.5)	195 (0.5)	158 (0.7)	150 (0.5)	
White	90 516 (97.0)	38 772 (97.4)	21 265 (96.6)	30 479 (96.5)	
Education					
Degree	40 535 (43.4)	18 638 (46.8)	10 965 (49.8)	10 932 (34.6)	<0.001
No degree	52 874 (56.6)	21 149 (53.2)	11 072 (50.2)	20 653 (65.4)	
Townsend deprivation index, mean±SD	−1.73±2.82	−1.92±2.71	−1.31±3.00	−1.77±2.79	<0.001
Body mass index, kg/m^2, mean±SD	26.72±4.54	26.16±3.96	25.79±4.01	28.06±5.21	<0.001
Smoking status					
Never	53 390 (57.1)	23 407 (58.9)	12 739 (57.8)	17 244 (54.6)	<0.001
Previous	33 585 (36.0)	14 096 (35.4)	7926 (36.0)	11 563 (36.6)	
Current	6434 (6.9)	2284 (5.7)	1372 (6.2)	2778 (8.8)	
Drinking status					
Never	2736 (2.9)	881 (2.2)	578 (2.6)	1277 (4.0)	<0.001
Previous	2569 (2.8)	903 (2.3)	587 (2.7)	1079 (3.4)	
Current	88 104 (94.3)	38 003 (95.5)	20 872 (94.7)	29 229 (92.6)	
Healthy diet pattern	55 589 (59.5)	23 806 (59.8)	13 409 (60.8)	18 374 (58.2)	<0.001
Employment status					
Employed	57 670 (61.7)	25 047 (63.0)	14 818 (67.2)	17 805 (56.4)	<0.001
Unemployed/Retired	35 739 (38.3)	14 740 (37.0)	7219 (32.8)	13 780 (43.6)	
Blood pressure					
Systolic, mm Hg, mean±SD	136.57±18.19	136.38±18.07	135.33±18.04	137.68±18.39	<0.001
Diastolic, mm Hg, mean±SD	81.67±10.00	81.54±9.95	81.24±10.01	82.15±10.05	<0.001
Antihypertensive medication use	15 890 (17.0)	5902 (14.8)	2930 (13.3)	7058 (22.3)	<0.001
Diabetes at baseline	3252 (3.5)	966 (2.4)	568 (2.6)	1718 (5.4)	<0.001
Sedentary time, h/d, mean±SD	9.41±1.81	9.26±1.70	9.03±1.78	9.87±1.87	<0.001
Sedentary time†					
Low	30 986 (33.2)	14 110 (35.5)	8916 (40.5)	7960 (25.2)	<0.001
Moderate	31 140 (33.3)	13 827 (34.7)	7256 (32.9)	10 057 (31.8)	
High	31 283 (33.5)	11 850 (29.8)	5865 (26.6)	13 568 (43.0)	
MVPA, min/wk, mean±SD	288.54±242.49	349.00±186.44	486.57±268.24	74.21±44.95	<0.001

Values are numbers (percentages) unless stated otherwise. MVPA indicates moderate to vigorous physical activity; and WW, weekend warrior.

**P* value for ANOVA for physical activity patterns in baseline characteristics where variables were continuous. For categorical variables, *P* value represents unadjusted χ^2 analysis for physical activity patterns in baseline characteristics.

†Sedentary time was categorized into low, moderate, or high on the basis of tertile.

on death, few have specifically assessed the effects of the WW pattern on mortality risk, leading to inconsistent findings.[7,9–13] Our results corroborate previous studies that the WW pattern is linked to a decreased risk of all-cause death compared with inactive participants.[10–12] Furthermore, a meta-analysis involving 426 428 individuals found that WWs have a lower mortality risk.[13] However, several studies reported no significant relationship between the WW pattern and mortality risk.[7,9] Potential explanations for these

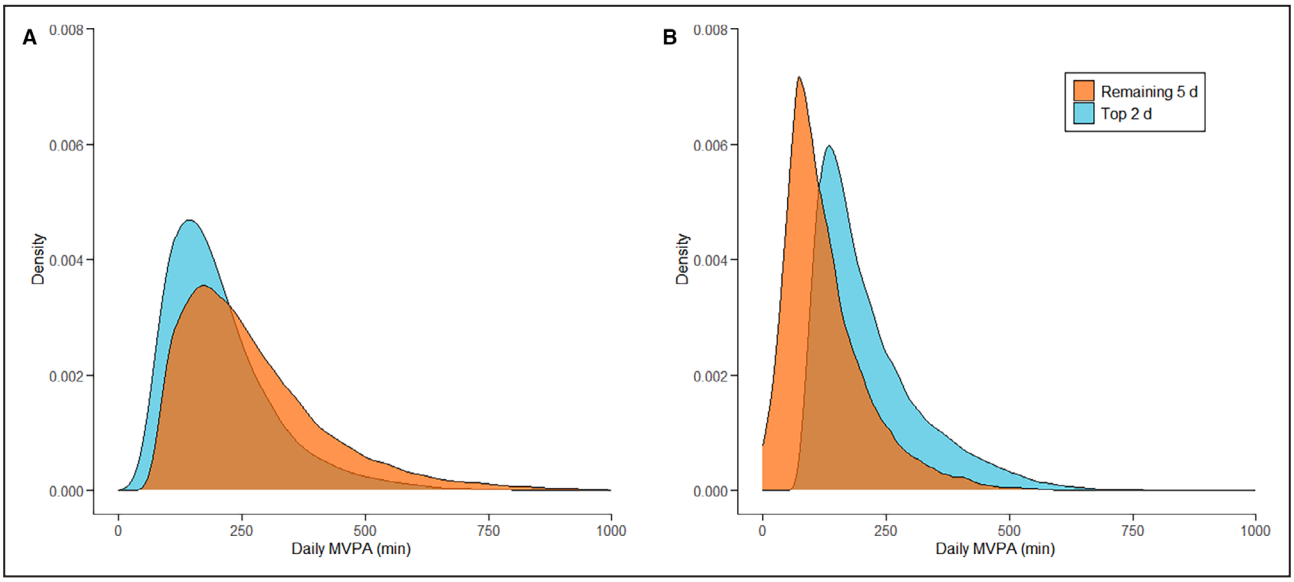

Figure 1. Distribution of daily MVPA on the 2 most active days of the week versus the remaining 5 days using guideline-based activity threshold of ≥150 min MVPA per week.
A, Active regular group. **B**, Active WW group. "Top 2 d" means the sum of the 2 d with the most MVPA time in a wk; "Remaining 5 d" means the total MVPA time for the remaining 5 d. The density of the *y* axis represents the probability density. The *y* axis reflects the relative numbers of people corresponding to each MVPA min. MVPA, moderate to vigorous physical activity; and WW, weekend warrior.

discrepancies could include insufficient sample sizes; for instance, a study that included 8421 men suggested that the WW pattern had no preventive effect against all-cause death.[7] Moreover, methodological variations in measuring PA may contribute to these differences. In contrast to self-reported methods, accelerometry offers a more objective measurement of activity levels, minimizing recall bias and misclassification of PA intensity. For instance, there was no significant correlation found between the WW pattern and all-cause death in the National Health Interview Survey, which used self-reported PA.[9] Conversely, an accelerometry-based study found that the WW pattern was linked to decreased all-cause death, consistent with our results.[12] Additionally, differences in reference group definitions may influence results. Some studies classified participants reporting no PA as the reference group, while others defined the reference as those engaging in <500 kcal/wk of PA or <150 min/wk of MVPA.[7,9] Regarding CVD and cancer death, our findings align with previous studies showing reduced mortality risk associated with the WW pattern.[10,11] Notably, this study is the first to examine the relationships between PA patterns, as assessed by device-measured PA, and both CVD and cancer death. Our results highlight the importance of PA in reducing mortality risk, aligning with the WHO's recognition that physical inactivity puts adults at higher risk of CVD and cancers.[39,40]

Previous studies have revealed potential mechanisms of PA with CVD and cancer death.[41,42] However, the mechanisms through which the WW pattern affects the mortality risk have not been fully elucidated, and limited research indicates the underlying mechanisms may involve the regulations of inflammation, oxidative stress, and lipid metabolism. For instance, an animal study demonstrated that the WW model inhibits inflammatory processes and improves antioxidant capacity,[43] which are the key pathways linking mortality risk.[41,42] Another study found that the WW pattern was associated with increased secretion and expression of interleukin-6, which protects against chronic inflammation.[44] In addition, 1 study found that the WW pattern may improve health by reducing visceral obesity.[45,46] These underlying mechanisms may provide a plausible explanation for the substantial reduction in mortality risk associated with the WW pattern observed in this study. Future research efforts should focus on clarifying the specific mechanisms behind these associations and replicating our findings in different populations.

Considering that the estimated yearly global cost of inaction on PA is $47.6 billion,[47] our findings have substantial public health implications. This study underscores the value of engaging in PA, even when it does not fully adhere to WHO PA recommendations. Furthermore, the finding that MVPA concentrated within 1 or 2 days per week can yield similar mortality

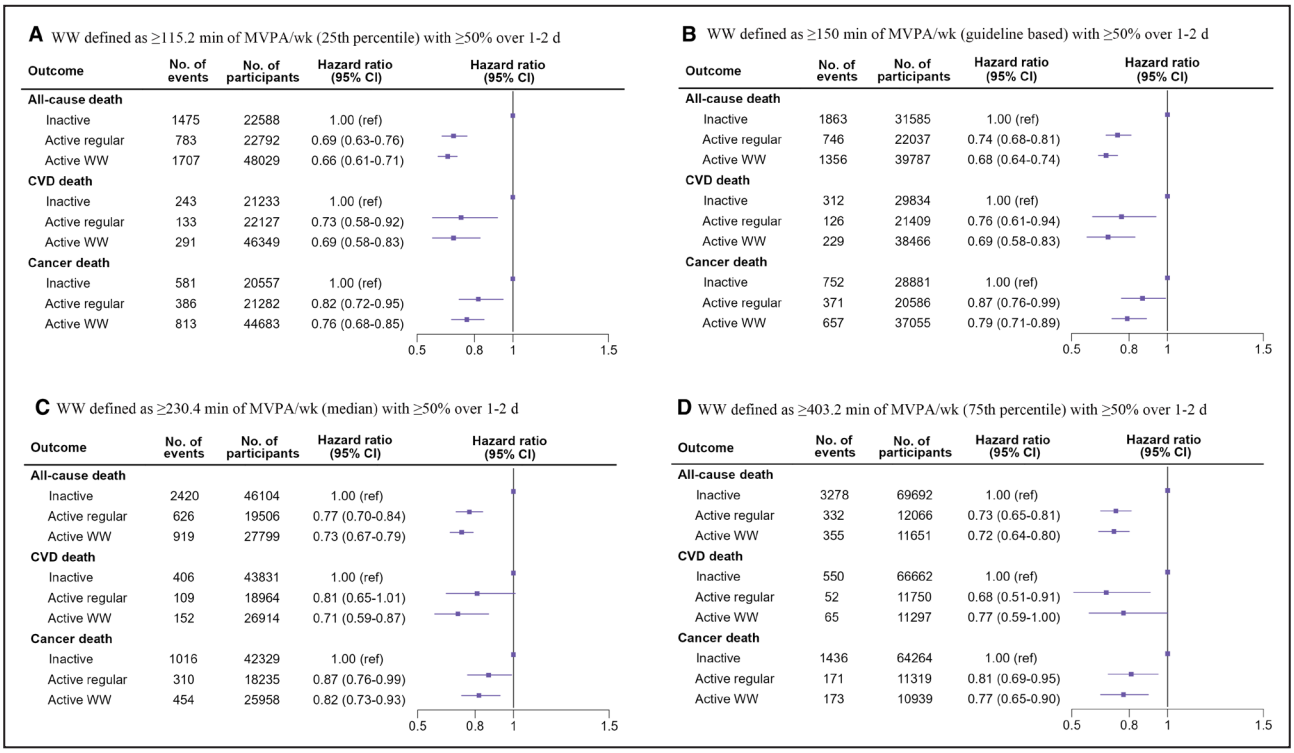

Figure 2. Associations of physical activity pattern with all-cause, CVD, and cancer death.
A, WW was defined as ≥115.2 min of MVPA/wk (25th percentile) with ≥50% over 1 to 2 d. **B**, WW was defined as ≥150 min of MVPA/wk (guideline based) with ≥50% over 1 to 2 d. **C**, WW was defined as ≥230.4 min of MVPA/wk (median) with ≥50% over 1 to 2 d. **D**, WW was defined as ≥403.2 min of MVPA/wk (75th percentile) with ≥50% over 1 to 2 d. Hazard ratios compare inactive group (reference group) to active group (active regular or active WW). Hazard ratios calculated by Cox proportional hazards models adjusted for age, sex, body mass index, ethnicity, education, Townsend deprivation index, smoking status, drinking status, healthy diet pattern, employment status, diabetes at baseline, and sedentary time. CVD indicates cardiovascular disease; MVPA, moderate to vigorous physical activity; ref, reference; and WW, weekend warrior.

benefits to more evenly distributed activity may motivate individuals to adopt PA patterns that better fit their lifestyles. Clinicians and public health practitioners should consider advising individuals that it is feasible to achieve PA, whether spread out over several days or concentrated into fewer days each week, thereby offering comparable health benefits.

There are several notable strengths in this study. First, as far as we know, this is the first large population-based cohort study to explore the relationship between PA patterns and CVD-specific and cancer-specific death using objective accelerometer-measured PA data. Second, the study enrolled nearly 90 000 participants with long-term follow-up of 8.1 years, providing adequate statistical power to explore the relationships between PA patterns and important mortality outcomes. Third, we thoroughly considered multiple confounders and conducted several sensitivity analyses, including the calculation of E-values,[34] to evaluate the influence of potential unmeasured confounders, thereby enhancing the robustness of our results. However, there are some limitations to consider. First, PA information was measured only at baseline, and participants may have altered their PA behavior at follow-up. Second, despite our efforts to control for confounding, there may still be residual confounding due to inaccurate measurement or unknown variables, even though the E-values had been computed to gauge the impact of unmeasured confounders. Third, reverse causality may be a concern, although our results remained stable when we excluded deaths occurring within 2 years of follow-up and further adjusted for underlying conditions such as blood pressure and antihypertensive medication use.[48] Furthermore, the majority of the research population was made up of White people, with little representation from other racial or ethnic groups. Consequently, additional studies including a wider range of ethnicities are required to validate our results and improve their generalizability.

CONCLUSIONS

This large prospective cohort study, which used objective accelerometer data to measure PA, suggests that MVPA concentrated within 1 or 2 days per week has

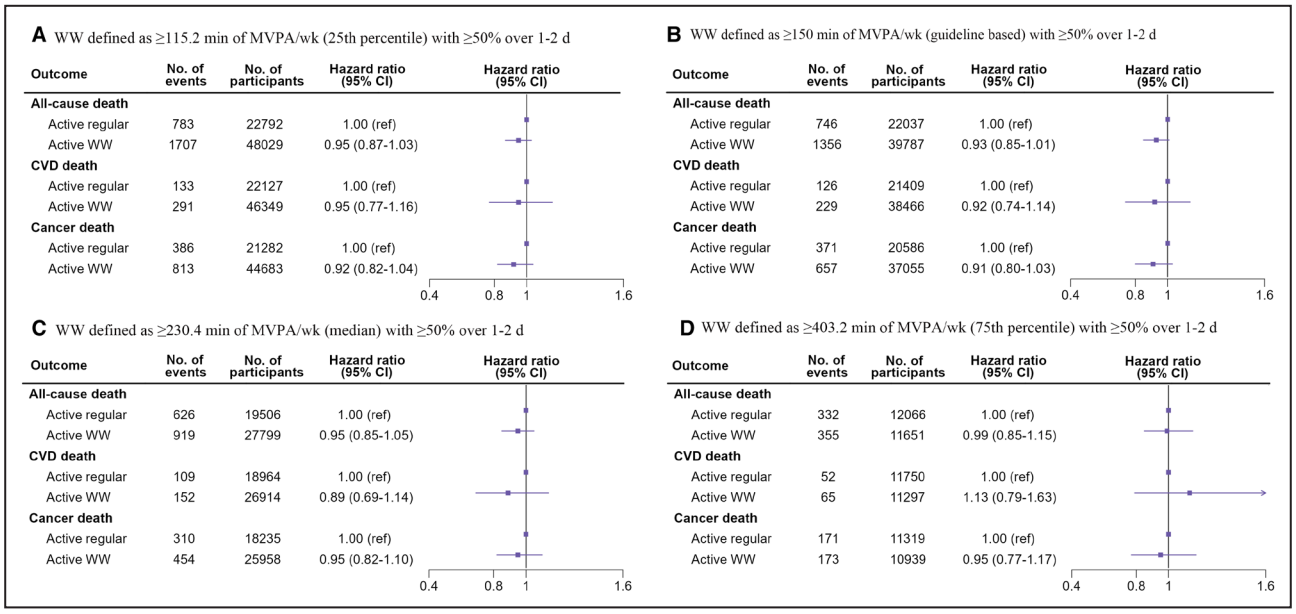

Figure 3. Associations of physical activity pattern with all-cause, CVD, and cancer death, with active regular participants as the reference.

A, WW was defined as ≥115.2 min of MVPA/wk (25th percentile) with ≥50% over 1 to 2 d. **B**, WW was defined as ≥150 min of MVPA/wk (guideline based) with ≥50% over 1–2 d. **C**, WW was defined as ≥230.4 min of MVPA/wk (median) with ≥50% over 1 to 2 d. **D**, WW defined as ≥403.2 min of MVPA/wk (75th percentile) with ≥50% over 1 to 2 days. Hazard ratios compare active regular group (reference group) to active WW group. Hazard ratios calculated by Cox proportional hazards models adjusted for age, sex, body mass index, ethnicity, education, Townsend deprivation index, smoking status, drinking status, healthy diet pattern, employment status, diabetes at baseline, and sedentary time. CVD indicates cardiovascular disease; MVPA, moderate to vigorous physical activity; ref, reference; and WW, weekend warrior.

similar benefits on all-cause and cause-specific death as more evenly distributed activity. Our findings are particularly significant for individuals who find it challenging to engage in regular PA due to time constraints.

ARTICLE INFORMATION

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Disclosures

None.

Supplemental Material

Tables S1–S9
Figures S1–S5

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