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Device-measured physical activity as a predictor of disability among mobility-limited older adults

Robert T. Mankowski, PhD[1], **Stephen D. Anton, PhD**[1], **Robert Axtell, PhD**[2], **Shyh-Huei Chen, PhD**[3], **Roger A. Fielding, PhD**[5], **Nancy W. Glynn, PhD**[6], **Fang-Chi Hsu, PhD**[3], **Abby C. King, PhD**[7], **Andrew S. Layne, MSc**[1], **Christiaan Leeuwenburgh, PhD**[1], **Todd M. Manini, PhD**[1], **Anthony P. Marsh, PhD**[4], **Marco Pahor, MD**[1], **Catrine Tudor-Locke, PhD**[8], **David E. Conroy, PhD**[9], **Thomas W. Buford, PhD**[10], and **LIFE Research Group**

[1]Department of Aging and Geriatric Research, University of Florida College of Medicine, Gainesville, FL, USA

[2]Department of Exercise Science, Southern Connecticut State University, New Haven, CT, USA

[3]Department of Biostatistics, Wake Forest School of Medicine, Winston-Salem, NC, USA

[4]Department of Health & Exercise Science, Wake Forest School of Medicine, Winston-Salem, NC, USA

[5]Tufts University, Jean Mayer USDA Human Nutrition Research Center on Aging, Boston, MA, USA

[6]University of Pittsburgh, Center for Aging and Population Health, Department of Epidemiology, Pittsburgh, PA, USA

[7]Department of Health Research & Policy, and Stanford Prevention Research Center, Department of Medicine, Stanford University School of Medicine, Stanford, CA 94305, USA

[8]Department of Kinesiology, School of Public Health and Health Sciences, University of Massachusetts, Amherst, MA, USA

[9]Department of Kinesiology, The Pennsylvania State University, University Park, PA, USA

[10]Department of Medicine, University of Alabama at Birmingham, Birmingham, AL, USA

Abstract

Background—The utility of wearable devices for objectively monitoring physical activity (PA) and predicting mobility disability in older adults is unknown.

Corresponding Author: Thomas W. Buford, Department of Medicine, University of Alabama at Birmingham, 933 19th Street South, CH19 201, Birmingham, AL 35294, Phone: 205.934.9261, twbuford@uab.edu.

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Objectives—The aim of this analysis was to examine associations between objectively-measured PA and the incidence of major mobility disability (MMD) and persistent MMD (PMMD) among older adults in the Lifestyle Interventions and Independence for Elders (LIFE) Study.

Design—Prospective cohort of individuals aged 65 and older undergoing structured physical activity intervention or health education.

Setting—Eight sites.

Participants—LIFE Study participants (n=1590) had a mean age (SD) of 78.9 (5.2) years, with low levels of PA and measured mobility-relevant functional impairment at baseline.

Measurements—Activity data were collected by hip-worn 7-day accelerometer at baseline and 6, 12, and 24 months post-randomization to test for associations with incident MMD and PMMD (≥ 2 consecutive instances of MMD).

Results—At baseline, every 30 minutes spent being sedentary (<100 accelerometry counts per minute) was associated with higher rate of subsequent MMD (10%) and PMMD (11%) events. Every 500 steps taken was associated with lower rate of MMD (15%) and PMMD (18%). Similar associations were observed when fitting accelerometry-based PA as a time-dependent variable.

Conclusion—Accelerometry-based PA levels were strongly associated with the MMD and PMMD events among older adults with limited mobility. These results support the importance of daily PA and lower sedentary time levels in this population and suggest that accelerometry may be a useful tool for assessing risk for mobility disability.

Keywords

Accelerometry; mobility disability; physical activity; sedentary time; older adults

INTRODUCTION

Loss of the ability to ambulate (i.e., mobility) is one of the leading causes of decreased quality of life, loss of independence, morbidity and death in older adults [1]. Preventing mobility loss and the onset of mobility disability is an important public health issue given the rapid aging of the population [1]. Physical activity (PA) is one of the most promising interventions to attenuate mobility loss and prevent mobility disability. However, individuals at risk for mobility loss are commonly inactive as evidence indicates that physical inactive individuals tend to be older, less educated, have lower incomes, and have more medical conditions that active individuals [2,3]. We previously reported that a long-term supervised PA program reduced the risk of incident major mobility disability (MMD), defined as loss of the ability to walk 400 m, by 18% among older adults in the Lifestyle Interventions and Independence for Elders (LIFE) study [4]. This work demonstrated that a structured PA intervention was efficacious in preserving mobility and preventing MMD among older adults.

Despite this important finding, data remain sparse regarding how gradations in duration and intensity of PA influence the incidence of MMD. To date, the majority of studies utilizing accelerometry have evaluated PA in younger populations [5,6] or in the evaluation of

cardiometabolic health [7]. Furthermore, data are needed regarding the potential utility of device-measured monitoring of PA in a non-laboratory setting for predicting MMD. We aim to address these gaps in the literature using accelerometry-measured PA data, a non-invasive and objective method for tracking and measuring human physical activity [8], gathered in the LIFE study. To our knowledge, the LIFE Study is the only Phase 3 physical activity intervention trial with data available regarding the incidence of MMD among older adults. Thus, this study provides a novel opportunity to address questions related to objectively-measured PA and associations with MMD.

METHODS

Participants

The LIFE Study was a multi-center randomized controlled trial designed to evaluate the efficacy of a long-term structured physical activity intervention compared with a health education (HE) program for reducing the incidence of MMD among mobility-limited older adults. A total of 1590 sedentary men and women aged 70 to 89 years were recruited across eight clinical sites. Details about specific study design and implementation of the LIFE Study have been reported previously [9].

Physical activity intervention and health education program

Due to publication word limit, full details regarding study interventions are provided in the Supplementary material 4 and have been published previously [10].

Accelerometry

The Actigraph tri-axial accelerometer (Model GT3X; Actigraph Inc., Pensacola, FL) was used to objectively measure sedentary and PA time [4]. PA was divided into three incremental intensity categories identified by accelerometer-detected ranges of 100–499, 500–1039 and > 1039 cpm as published previously [11]. For the data to be included in this study, participants had to wear the accelerometer during at least 3 days for 10 hours per day in free-living conditions. The present study includes longitudinal data collected from a total of 1590 participants in the LIFE Study. Those who did not have valid accelerometry data from at least one visit were removed in the analysis (n=45).

Assessment of major mobility disability

The 400-m walk test served as our criterion indicator of MMD, which was defined as the inability to complete the 400 m walk within 15 minutes without interpersonal assistance or an assistive device other than a cane (e.g., walker, wheelchair). Participants were instructed to walk at their usual pace for 400 m (10 laps of a 20-m course defined by two cones). The maximum time allowed for the test was 15 minutes without sitting and without the help of another person. Participants were allowed to stop and stand to rest for up to 1 minute and could use a cane, but they were not allowed to lean against any object or person to support their weight. Time to complete the 400-m walk was recorded in minutes and seconds and then converted to seconds [1].

Participants were scored with PMMD when the MMD incident was noted at two consecutive time-points [1]. PMMD was defined as two consecutive determinations of MMD at 6-month assessment visits. Death after an initial MMD determination was considered PMMD as well. No participant had MMD at baseline.

Statistical Analysis

Baseline characteristics including demographic characteristics and self-reported disease history, were summarized using means and standard deviations (SDs) for continuous measures and counts (percentages) for discrete measures by randomization groups. A series of Cox proportional hazards regression models were used to evaluate associations with initial incidence of MMD and PMMD. Seven baseline daily accelerometry measures of interest were included in this analysis one at a time: minutes of activity count <100 cpm (per 30 minutes) (for easier interpretation of the coefficients), minutes of activity count >1039 cpm (per 30 minutes), total activity counts (per 10,000 counts), total step counts (per 500 steps), 30 minutes peak cadence (per 10 steps/min), 5-minute bouts (at least 5 consecutive minutes of activity count ≥100 cpm), and 10-minute bouts (also ≥ 100 cpm). The interactions between each accelerometry measure and intervention groups were tested to check whether the accelerometry effects were the same in PA and HE. A separate analysis was also conducted to explore the effects in the HE group alone, which showed no difference in the current results of this analysis in comparison with PA group. Therefore, we did not divide our cohort by randomization arm in this analysis. Considering multiple comparisons, a conservative Bonferroni correction with p value < 0.004 (= 0.05/(7*2) for 7 individual accelerometry measures and 2 outcomes).

To study how different levels of physical activity were associated with MMD and PMMD, minutes of activity with counts of 100–499 cpm (per 30 minutes), 499–1039 cpm (per 30 minutes), and >1039 cpm (per 30 minutes) were included in a model simultaneously. Because the sum of the minutes within all levels equaled to the wear time, to avoid singularity, only three levels were fitted in the model. In addition, the sedentary level [i.e., activitiy minutes of activity count <100 cpm (per 30 minutes)] was highly correlated with the other three activity levels (correlation coefficients > 0.85), so it was not selected to be included in the model. Their pairwise interactions and 3-way interaction were also tested. To avoid collinearity, the variables used in the interaction terms were centered (i.e., variable minus mean of the variable). If the higher-order interaction was not significant, it would be removed from the model.

Each accelerometry measure was also defined as a time-dependent variable and refitted allowing for it as a time-dependent covariate. Time-varying covariate models used accelerometry data at baseline to predict MMD and PMMD events in the interval from 0 to 6 months; 6 month data to predict MMD and PMMD events during 6–12 months; 12 month PA to predict MMD and PMMD events during 12–24 months; and 24 month PA to predict MMD and PMMD events at >24 months. Likelihood ratio tests were used to assess the statistical significance. All Cox model analyses were performed using R version 3.2.3 (survival package) (Therneau T (2015) *A Package for Survival Analysis in S*. version 2.38, http://CRAN.R-project.org/package=survival). Additional analyses included 1) testing of the

interaction between each accelerometry measure and randomization, and 2) a sensitivity analysis was performed to evaluate the influence of prior CVD history on outcomes.

RESULTS

Details of recruitment and baseline characteristics were published previously [12]. The mean (± SD) age of included participants was 78.9 ± 5.2 years, 67.2% were women, and 23.6% were racial/ethnic minorities. Just over a third of participants were married (35.9%), and the majority of participants reported having a college education (63.8%). In general, participants were cognitively intact as evidenced by scores on the 3MS exam (91.7 ± 5.4 points), showed low levels of depressive symptoms according to CESD score (8.5 ± 7.8) and had relatively poor sleep quality according to the(PSQI) score (5.9 ± 3.8). Details of MMD and PMMD event rates in the LIFE Study were published previously [4]. Similar results were observed for the cohort in the present study for both MMD (32.6%) and PMMD (17. 9%). Additional details regarding participant characteristics are provided in Table 1. There were no significant interactions in any of these baseline variables with randomized arm (all ps > 0.05).

At baseline, participants wore accelerometers for a mean of 7.95 ± 3.24 valid wear days and 837.1 ± 111.1 minutes/day (i.e., ≥10 hours/day) on valid days. They spent 647 ± 116 min/day of their baseline wear time (77%) being sedentary (i.e., < 100 cpm). The remaining (non-sedentary) time was spent in activity registering 100–499 cpm (137 ± 43 min/day), with a smaller portion (53 ± 38 min/day) spent performing activities registering 500–1039 cpm (38±23 min/day) and 15±16min/day in activities of >1039 cpm. Participants also accrued 2,682 ± 1,475 steps/day with a 30-min peak cadence of 34.8 ± 17.2 steps/min during the baseline measurement period. Additionally, the participants accumulated 14.1 ± 5.8 and 3.6 ± 2.6 bouts of 5+min (>99 cpm) and 10+min (> 99 cpm), respectively.

The associations of baseline accelerometry variables with MMD and PMMD rate are shown in Table 2. Notably, each 30 minutes of sedentary time was associated with a 10% increase in the rate of MMD. Conversely, every 500 steps taken was associated with reduced rate of MMD (by 15%) and PMMD (by 18%). Activity >1039 cpm was not associated with MMD or PMMD after considering multiple comparisons, however the amount of time spent in this level of activity was small. Peak cadence and number of activity bouts > 5 minutes were also associated with lower rates of mobility disability.

When fitting different levels of activities (30 minutes/day of activity 100–499 cpm, 500–1039 cpm, and >1039 cpm) in the same model, only moderate time activity (100–499 cpm) was significantly associated with MMD (hazard ratio (HR) = 0.89) and no levels of activities were associated with PMMD (Table 3). None of the tested interactions reached significance in the final model, though the interaction between activity of 500–1039 cpm and > 1030 cpm was significantly associated with MMD in Models 1 to 3 (Model 4: p = 0.0971).

Accelerometry data across study visits are shown by randomization arm in Supplementary Table 3. Across all data collection visits, participants spent 648 ± 114 min/day (mean ± SD) of their wear time (78.2%) being sedentary. The remaining time was spent in activity

registering 100–499 cpm (131 ± 44 min/day), 500–1039 cpm (32 ± 22 min/day) and in >1039 cpm (15±16 cpm). Participants also accrued 2625 ± 1545 steps/day with a 30-min peak cadence of 35.2 ± 18.9 steps/min. Additionally, the participants accumulated 13.3 ± 5.9 and 3.3 ± 2.5 bouts of 5+min and 10+min, respectively.

Associations of time-dependent accelerometry (collected at 0, 6, 12, 24 months) variables with incident MMD and PMMD are shown in Supplementary Tables S1 and S2. The results are consistent with the results for baseline associations. In particular, every 30 minutes spent sedentary was associated with a 17% increase in the rates of both MMD and PMMD. Most indices of PA were also significantly associated with a reduced rate of MMD and PMMD. When fitting differing levels of activity jointly, minutes/day 100–499 cpm was negatively associated with MMD and PMMD (both HR = 0.81) after adjusting for 500–1039 cpm and >1039 cpm and covariates. Minutes/day > 1039 cpm was also negatively associated with MMD and PMMD (HR=0.53 and 0.48, respectively) after adjusting for lower levels of activities (100–499 cpm and 500–1039 cpm).

DISCUSSION

The primary finding of this study is that accelerometry-based indices of PA and sedentary behavior were associated with increased rate of MMD and PMMD among mobility-limited older adults. Specifically, every 30 min increase in sedentary time was significantly associated with higher rate of MMD. These findings were consistent when using either a single baseline assessment or serial longitudinal assessments across a 24-month period.

The findings of the present study expand upon the main LIFE Study results by demonstrating that a single baseline assessment of PA can be predictive of subsequent MMD events. This shows the potential added value of accelerometry in this older population as a clinical tool for assessing PA levels. Individual counseling based on accelerometry-derived PA levels may reduce inactivity levels and further reduce risk of MMD. For example, amount of steps/day was associated with lower event rate of MMD (15%) and PMMD (18%) in the LIFE study participants. Increasing daily number of steps may be a motivating and easily achievable outcome that could decrease risk of MMD in older adults with mobility impairments. These results are particularly notable given some concerns expressed by researchers in the field related to the reliability and sensitivity of such accelerometry-derived information in adults with slowed or uneven gait or similar mobility impairments [13]. Importantly, the present results showed that PA levels of 100–499 cpm were associated with a significantly lower (11%) MMD event rate. Higher levels of PA (500–1039 and >1039) were not associated with a lower MMD and PMMD event rate. Although the current PA guidelines suggest higher levels of PA (MVPA – moderate to vigorous physical activity) for health benefits (760–1952 cpm) [14], these findings suggest important impacts of more achievable light PA (100–499) on MMD.

It should be noted that the accelerometry cut-points utilized in the present study differ somewhat from some others previously reported in the literature. For instance, one report of older adults aged 65 years and older from the National Health and Nutrition Examination Survey (NHANES) used >1952cpm for MVPA, 760–1951cpm for light physical activity and

101–759 for very LPA [15]. Other authors used a threshold of 760 cpm to characterize MVPA[16]. However, the authors suggested that a 1952 cpm threshold used for MVPA determination lowered a number of participants meeting these levels of PA in comparison with a 760cpm MVPA threshold [16]. Additionally, Rejeski et al. reported that a large percentage of older adults (40%) were unable to engage in MVPA using a 1041 cpm threshold to characterize MVPA [17]. Therefore, lack of clarity remains concerning appropriate count thresholds that will not over- or under-estimate MVPA in older adults of varying age groups and mobility impairment levels. Based on our results, for those individuals who are not able to achieve MVPA intensities, recommending lower levels of PA intensity (up to 500cpm) that are more achievable and effective in lowering incident risk of MMD may increase involvement of moderately functioning older adults in PA interventions and further lower the risk for physical disability.

In addition to tracking activity, accelerometry provides important information regarding inactivity and sedentary behavior. Higher levels of sedentary time are independently associated with metabolic dysfunctions, physical disability and mortality [16,18]. The LIFE Study participants spent 77% of their waking hours being sedentary (Supplementary Table 3). This is in agreement with other studies of older adults [19–21]. The present analysis showed that lower levels of sedentary time were associated with lower (10%) MMD event rates. Similarly, Manns et al. showed that participants in NHANES with mobility disability accumulated not only the highest volumes of sedentary time per day (69%) but also more sedentary time in longer sedentary bouts and shorter active bouts than those without mobility disability [15]. Notably, it has been shown that regular interruption of sedentary time, even with light-intensity activity is associated with health benefits in at least some populations [16]. Therefore, tracking of both PA and sedentary time, in both the form of bouts and total time, may have relevance for predicting MMD. Moreover, PA guidelines for older adults should not focus only on increasing PA levels but also reducing total daily sedentary time in older adults to prevent incident MMD. It is important that these relative benefits are understood by health professionals and patients so the older adults can be counseled according to mobility and health status.

This study had a few limitations worth noting. First, the lack of general agreement on PA intensity thresholds in this population is a limiting factor in generalizing these results to other groups of older adults. Additionally, causal interferences may not be drawn from this longitudinal study. Another aspect of the study which warrants discussion is the inclusion of the PA group in our primary analysis. It is important to note that this approach incorporates a group which was specifically given an intervention designed to affect the primary risk factor. Our rationale for this approach was to capitalize upon all of the data available in the trial and to evaluate the effects of accelerometry in both individuals who did and did not regularly engage in physical activity as this might be seen in everyday settings. Importantly, analyses including an interaction term for randomized arm and analyses conducted separately amongst group did not reveal indication of any differences in the utility of accelerometry between groups. Still the potential confounding of this approach should at least be noted compared to a traditional prospective cohort study.

In conclusion, this study has several important strengths including the multi-site clinical trial study design, large sample size, and the multi-modal physical activity data collection (via accelerometry as well as self-report). These results indicate that accelerometry-based baseline and longitudinal assessment of PA and sedentary time levels were useful for assessing event rate of MMD and PMMD in mobility limited older adults. Of note, the number of steps per day and time spent in lower levels of activity (e.g. 100–499 cpm) were significantly associated with lower MMD event rates. Therefore, public health messages targeting low-level activity and reduced sedentary time may be fruitful in aiding to reduce mobility disability in this population. Moreover, accelerometry may be a potential clinical tool for assessing and preventing MMD risk in older adults, which may help in better counseling of older individuals on required PA levels to prevent MMD. However further studies are warranted to support these findings are further refine recommendations for accelerometry activity thresholds.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Demographic characteristics of study participants

	PA Group (n =790)	HE Group (n =800)	Overall (n = 1590)
Female	525 (66.5%)	544 (68.0%)	1069 (67.2%)
Age	78.7±5.2	79.1±5.2	78.9±5.2
Non-white	200 (25.3%)	175 (21.9%)	375 (23.6%)
Living Alone	371 (47.0%)	409 (51.1%)	780 (49.1%)
Married	288 (36.5%)	283 (35.4%)	571 (35.9%)
Education: College or Higher	497 (62.9%)	518 (64.8%)	1015 (63.8%)
CESD Score	8.3±7.7	8.8±7.9	8.5±7.8
PSQI Score	5.9±3.8	5.9±3.8	5.9±3.8
3MS Score	91.7±5.5	91.7±5.3	91.7±5.4
Self-reported history of prevalent health conditions			
Myocardial infarction	59 (7.5%)	66 (8.3%)	125 (7.9%)
Congestive heart failure	25 (3.2%)	44 (5.5%)	69 (4.3%)
Stroke	55 (7.0%)	51 (6.4%)	106 (6.7%)
Lung disease	124 (15.7%)	122 (15.3%)	246 (15.5%)
Diabetes	187 (23.7%)	210 (26.3%)	397 (25.0%)
Other Self-Reported CVD	150 (19.0%)	161 (20.1%)	311 (19.6%)
Smoking status			
Former	371 (47.0%)	332 (41.5%)	703 (44.2%)
Current	24 (3.0%)	23 (2.9%)	47 (3.0%)

Data expressed as mean + SD or n (%)

Physical Activity (PA) Health Education (HE) Cardiovascular (CV)

Cardiovascular Disease (CVD) Center for Epidemiologic Studies Depression Scale (CESD)

Pittsburgh Sleep Quality Index (PSQI) Modified Mini-Mental State Exam (3MS)

Table 2

Association of individual baseline accelerometry measures with MMD and PMMD separately.

Event		Model 1	Model 2	Model 3	Model 4
MMD	Minutes/day < 100 cpm	**1.24 (1.18, 1.31)**	**1.23 (1.17, 1.29)**	**1.12 (1.07, 1.18)**	**1.10 (1.05, 1.17)**
	Minutes/day > 1039 cpm	**0.31 (0.23, 0.43)**	**0.34 (0.25, 0.47)**	0.65 (0.48, 0.87)	0.69 (0.51, 0.94)
	Activity counts/day	**0.88 (0.85, 0.91)**	**0.89 (0.86, 0.91)**	**0.94 (0.91, 0.97)**	**0.95 (0.92, 0.98)**
	Steps/day	**0.74 (0.71, 0.78)**	**0.75 (0.71, 0.79)**	**0.83 (0.79, 0.88)**	**0.85 (0.80, 0.89)**
	Peak cadence	**0.95 (0.94, 0.95)**	**0.95 (0.94, 0.96)**	**0.97 (0.96, 0.98)**	**0.97 (0.96, 0.98)**
	5+ min bouts	**0.93 (0.91, 0.94)**	**0.93 (0.91, 0.95)**	**0.96 (0.94, 0.98)**	**0.97 (0.95, 0.99)**
	10+ min bouts	**0.85 (0.81, 0.89)**	**0.86 (0.82, 0.90)**	**0.92 (0.88, 0.96)**	0.93 (0.89, 0.98)
PMMD	Minutes/day < 100 cpm	**1.30 (1.22, 1.39)**	**1.29 (1.20, 1.38)**	**1.14 (1.06, 1.23)**	1.11 (1.03, 1.19)
	Minutes/day ≥ 1039 cpm	**0.21 (0.13, 0.34)**	**0.23 (0.15, 0.37)**	0.56 (0.36, 0.87)	0.66 (0.42, 1.03)
	Activity counts/day	**0.85 (0.82, 0.89)**	**0.86 (0.82, 0.89)**	**0.93 (0.89, 0.97)**	0.95 (0.91, 0.99)
	Steps/day	**0.69 (0.64, 0.74)**	**0.69 (0.64, 0.75)**	**0.80 (0.74, 0.86)**	**0.82 (0.76, 0.89)**
	Peak cadence	**0.93 (0.92, 0.94)**	**0.93 (0.92, 0.95)**	**0.96 (0.95, 0.97)**	**0.96 (0.95, 0.98)**
	5+ min bouts	**0.91 (0.89, 0.93)**	**0.92 (0.89, 0.94)**	**0.96 (0.93, 0.98)**	0.97 (0.94, 0.99)
	10+ min bouts	**0.81 (0.76, 0.86)**	**0.82 (0.77, 0.88)**	**0.90 (0.84, 0.96)**	0.92 (0.87, 0.99)

Data expressed as HR (95% CI)

All models adjusted for accelerometer wear time

Model 1 stratifies for site and sex, and adjusts for randomization

Model 2 adjusted for model 1, race, age, and education

Model 3 adjusted for model 2, baseline Short Physical Performance Battery Score, baseline 400 m walking speed, and co-morbidity burden

Model 4 adjusted for model 3, use of anti-hypertensive and lipid-lowering drugs, sleep quality, and depression

Bold if p-value < 0.004 (Bonferroni corrected for multiple accelerometry measures and mobility outcomes)

Table 3

Association of baseline accelerometry measures with MMD and PMMD when fitting different levels of activity jointly.

Event		Model 1	Model 2	Model 3	Model 4
MMD	Minutes/day 100–499 cpm	**0.86 (0.77, 0.95)**	**0.85 (0.77, 0.94)**	**0.88 (0.8, 0.97)**	**0.89 (0.8, 0.98)**
	Minutes/day 500–1039 cpm	0.91 (0.69, 1.19)	0.94 (0.72, 1.23)	0.97 (0.75, 1.25)	1 (0.77, 1.31)
	Minutes/day > 1039 cpm	**0.43 (0.28, 0.65)**	**0.45 (0.3, 0.68)**	0.77 (0.51, 1.15)	0.77 (0.51, 1.17)
	Minutes/day 100–499 cpm	**0.88 (0.8, 0.98)**	**0.88 (0.79, 0.97)**	**0.89 (0.8, 0.98)**	**0.89 (0.81, 0.99)**
	Minutes/day 500–1039 cpm	0.92 (0.71, 1.21)	0.95 (0.73, 1.24)	0.99 (0.77, 1.28)	1.03 (0.79, 1.34)
	Minutes/day > 1039 cpm	**0.31 (0.2, 0.48)**	**0.33 (0.21, 0.51)**	**0.61 (0.39, 0.96)**	0.65 (0.41, 1.04)
	Interaction between Minutes/day 500–1039 cpm and > 1039 cpm	**1.54 (1.3, 1.81)**	**1.51 (1.28, 1.78)**	**1.24 (1.03, 1.48)**	1.18 (0.97, 1.44)
PMMD	Minutes/day 100–499 cpm	**0.86 (0.75, 0.99)**	**0.85 (0.74, 0.98)**	0.89 (0.78, 1.01)	0.9 (0.78, 1.03)
	Minutes/day ≥ 500 cpm	0.79 (0.54, 1.17)	0.85 (0.57, 1.24)	0.9 (0.63, 1.3)	0.96 (0.66, 1.39)
	Minutes/day > 1039 cpm	**0.36 (0.2, 0.67)**	**0.37 (0.2, 0.69)**	0.74 (0.41, 1.34)	0.78 (0.43, 1.43)
	Minutes/day 100–499 cpm	0.89 (0.77, 1.02)	0.88 (0.76, 1)	0.9 (0.78, 1.02)	0.9 (0.79, 1.03)
	Minutes/day 500–1039 cpm	0.82 (0.56, 1.21)	0.87 (0.59, 1.28)	0.92 (0.64, 1.32)	0.97 (0.67, 1.41)
	Minutes/day > 1039 cpm	**0.28 (0.15, 0.54)**	**0.29 (0.15, 0.55)**	0.66 (0.34, 1.27)	0.73 (0.37, 1.43)
	Interaction between Minutes/day 500–1039 cpm and > 1039 cpm	**1.58 (1.23, 2.03)**	**1.55 (1.2, 2)**	1.15 (0.85, 1.57)	1.09 (0.79, 1.51)

Data expressed as HR (95% CI); all models adjusted for accelerometer wear time

Model 1 stratifies for site and sex, and adjusts for randomization ; Model 2 adjusted for model 1, race, age, and education

Model 3 adjusted for model 2, baseline Short Physical Performance Battery Score, baseline 400 m walking speed, and co-morbidity burden

Model 4 adjusted for model 3, use of anti-hypertensive and lipid-lowering drugs, sleep quality, and depression

Bold if p-value < 0.05