Accelerometer-Measured Moderate to Vigorous Physical Activity and Incidence Rates of Falls in Older Women

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OBJECTIVES: To examine whether moderate to vigorous physical activity (MVPA) measured using accelerometry is associated with incident falls and whether associations differ according to physical function or history of falls.

DESIGN: Prospective study with baseline data collection from 2012 to 2014 and 1 year of follow-up.

SETTING: Women's Health Initiative participants living in the United States.

PARTICIPANTS: Ambulatory women aged 63 to 99 (N = 5,545).

MEASUREMENTS: Minutes of MVPA per day measured using an accelerometer, functional status measured using the Short Physical Performance Battery (SPPB), fall risk factors assessed using a questionnaire, fall injuries assessed in a telephone interview, incident falls ascertained from fall calendars.

RESULTS: Incident rate ratios (IRRs) revealed greater fall risk in women in the lowest quartile of MVPA compared to those in the highest (IRR = 1.18, 95% confidence interval = 1.01–1.38), adjusted for age, race and ethnicity, and fall risk factors. Fall rates were not significantly associated with MVPA in women with high SPPB scores (9–12) or one or fewer falls in the previous year, but in women with low SPPB scores (≤ 8) or a history of frequent falls, fall rates were higher in women with lower MVPA levels than in those with higher levels (interaction $P < .03$ and $< .001$, respectively). Falls in women with MVPA above the median were less likely to involve injuries requiring medical treatment (9.9%) than falls in women with lower MVPA levels (13.0%) ($P < .001$).

CONCLUSION: These findings indicate that falls are not more common or injurious in older women who engage in higher levels of MVPA. These findings support encouraging women to engage in the amounts and types of MVPA that they prefer. Older women with low physical function or frequent falls with low levels of MVPA are a high-risk group for whom vigilance about falls prevention is warranted. **J Am Geriatr Soc 2017.**

Key words: physical activity; falls; older adults; accelerometer; cohort study

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Twenty-nine million older Americans fell in 2014, leading to 2.8 million emergency department visits, 800,000 hospitalizations, 27,000 deaths, and an estimated $31.3 billion in Medicare expenditures.[1] Older women are at highest risk of falling and being injured by falls.[1]

Although there is strong evidence that multicomponent exercise programs focused on balance, gait, and strength reduce risk of falls in older adults,[2–4] evidence on the role of aerobic moderate to vigorous physical activity (MVPA) in reducing risk of falls in older adults is unclear. Some studies suggest a role of MVPA in fall prevention through increased muscle mass[5] and greater cardiorespiratory fitness.[6] Against this hypothesis is the consensus that the improvement in cardiorespiratory fitness that MVPA produces is less important to fall risk than is neuromuscular fitness, specifically balance and muscle strength.[4] In the context of public health guidelines that encourage older adults to engage in 2.5 hours of MVPA per week, or as much as they are able,[7] it is critical to determine whether such activity reduces risk of falls through maintaining mobility and reducing frailty or increases fall risk through accidents or fatigue associated with behaviors requiring more rigorous effort.

The Objective Physical Activity and Cardiovascular Health Study (OPACH), conducted in the Women's Health Initiative (WHI) cohort, was designed to examine associations between accelerometer-measured MVPA and cardiovascular disease and fall incidence in older women. This report examines the following questions: Is MVPA associated with incidence of falling? Do associations between MVPA and fall incidence vary according to level of physical function and past history of falls? Is MVPA associated with falls that are injurious or require medical care?

METHODS

Study Population

Details about the design, recruitment, and data collection for OPACH have been previously published.[8] The parent WHI program, which enrolled postmenopausal women aged 50 to 79 between 1993 and 1998 has also been described.[9,10] Enrollment for OPACH occurred concurrently with the Long Life Study (2012–13), an ancillary study that conducted in-person home visits for phlebotomy and clinical and functional assessments in a subset of older WHI participants. Ambulatory women in the Long Life Study were invited to enroll in OPACH. Informed consent for both studies occurred by mail or telephone. In total, 8,618 women consented to OPACH, of whom 1,361 (16%) subsequently refused participation or could not be contacted, and 219 (3%) were ineligible because of death or inability to walk. An additional 468 (5%) women were excluded because they did not complete the Long Life Study home visit. The remaining 6,570 women were given a 13-month falls calendar, physical activity (PA) questionnaire, sleep log, and triaxial accelerometer (GT3X+, ActiGraph, Pensacola, FL). Of these, 5,545 had sufficient accelerometer and falls calendar data to be included in this analysis (details below). The institutional review board at the Fred Hutchinson Cancer Research Center approved the study protocols for the Long Life Study and OPACH.

Measures

Women were asked to wear the accelerometer on their right hip for 7 days, 24 hours per day, and to remove the device only for bathing or other water-based activities.

The accelerometer was initialized to collect raw data at 30 Hertz on three orthogonal axes. Using the manufacturer's software (ActiLife Firmware version 2.4, ActiGraph), activity counts at each axis were calculated per 15-second interval (epoch). Vector magnitude (VM) counts were calculated by taking the square root of the sum of each axis squared. A computer-based automated algorithm was used to identify the window with the maximum amount of wear over the 7-day wear period.[11] Wear time during sleep was removed using the information provided in the sleep logs or from imputed sleep log data when sleep logs were incomplete or missing (12%). Nonwear was defined using the Choi algorithm.[12,13] Any nonzero counts (except the allowed short intervals) were considered wear time. An adherent day was defined as 10 or more hours of wear while out of bed, and only data from adherent days were analyzed. Participants with fewer than four adherent days were excluded from analysis. Time spent in total PA included all minutes with more than 18 VM counts per 15-second epoch. Based on the OPACH Calibration Study, MVPA was defined as VM counts of more than 518 per 15 seconds (using 1 metabolic equivalent (MET) = 3 mL/kg per minute, median MET value 3.3, interquartile range (IQR) 2.7–4.0) and light-intensity PA was defined as VM counts of 19 to 518 per 15 seconds (median MET value 2.0, IQR 1.6–2.4).[14] The MVPA cutpoint was equivalent to a walking speed of 2.2 miles per hour (IQR 2.0–2.5).[14]

Incident falls were captured using a 13-month falls calendar starting with the month the accelerometer was worn. Women were instructed to report a fall if they lost balance and fell to the ground or a lower level or if they had to use a wall, rail, or other object to prevent themselves from falling to the ground. Participants reporting falls were interviewed by telephone about the circumstances of the fall, whether they had an injury, the type of injury, where the injury occurred on their body, and level of medical care received. Women could be interviewed for multiple falls over the course of a year. To conserve resources while ensuring adequate representation for the most-active women, after April 2013, fall interviews were conducted for all reported falls in the most physically active women (WHI PA Questionnaire[15] reported PA ≥21 MET-hours per week; top 20%) and one in five randomly selected falls that other women reported.

The OPACH PA questionnaire captured the number of falls in the past year, fall injuries, falls self-efficacy,[16] self-assessed walking ability, and self-reported PA.[15] Number of chronic conditions was calculated based on a list of 10 conditions from a multimorbidity study in WHI participants.[17] Information on lower limb physical function, assessed using the Short Physical Performance Battery (SPPB),[18,19] and clinically measured height and weight was collected at the Long Life Study home visit. Body mass index (BMI) was calculated as weight (kg) divided by height (m) squared.

Statistical Methods

Participants were grouped according to quartile of minutes spent in accelerometer-measured MVPA. For completeness, the main findings are also reported for quartiles of accelerometer-measured total and light PA. Differences between MVPA quartiles in baseline characteristics were evaluated using chi-square tests for categorical variables and analysis of variance for continuous variables. Incident fall rates were calculated as the number of falls reported from the calendar pages divided by the number of person-months of calendar pages received. Because fall incidence is highly right-skewed, negative binomial regression models were used to examine the association between PA quartiles and the incidence rate of falling. Covariates were entered into models, adjusting for accelerometer wear time, age, race and ethnicity, education, and fall risk factors. These parametric negative-binomial regression models assumed a linear relationship between the incidence rate ratios (IRRs) and covariates. These analyses were performed using SAS version 9.3 (SAS Institute, Inc., Cary, NC). Hypothesis tests were conducted at alpha .05 with two-sided P<.05 considered statistically significant.

Nonparametric negative binomial generalized additive models that allow flexible modeling of nonlinear relationships without specifying the functional form were used to plot fall incidence rates (number of falls per 13 person-months) according to MVPA on a continuous scale. These models investigated differences in falls incidence between women with high (SPPB 9–12) and low (SPPB 1–8) physical function scores and separately for women with and without a history of two or more falls in the year before baseline. Stratum-specific *P*-values were calculated to test the overall association between MVPA and incident falls while accounting for potentially nonlinear effects. Then potential interactions between MVPA and SPPB or past fall history were tested using models fitted with interaction terms. These analyses were performed using the mgcv package in R version 3.2.2 (R Foundation for Statistical Computing, Vienna, Austria).

Finally, associations between MVPA and falls injury events (the unit of analysis) were tested using weighted negative binomial regression with inverse probability weighting to account for sampling of fall interviews.

Ethics Approval

The Fred Hutchinson Cancer Research Center institutional review board (Protocol 3467-EXT), Seattle, Washington, reviewed and approved the study.

RESULTS

Study Population and Baseline Characteristics

Five thousand five hundred forty-five participants with four to seven adherent wear days of accelerometer data (average wear time 14.9 h/d, median 15.0 h/d, IQR 1.7 h/d) were included. During up to 13 months of falls follow-up (average 11.1 calendar months, median 13 calendar months, IQR 2 calendar months), women recorded 5,464 falls. Participants had an average age of 78.8 ± 6.7, range 63–99) and were racially and ethnically diverse (50% white, 33% African American, 17% Hispanic). Older age, white race, high school education or less, use of an assistive device for walking, higher level of multiple morbidity, and higher BMI were all strongly associated with less time spent in MVPA (Table 1).

PA Levels and Incident Falls

Table 2 shows results of multivariable-adjusted negative binomial regression analyses relating accelerometer-measured MVPA, light PA, and total PA to fall incidence rates. IRRs according to quartile of time spent in MVPA and after adjustment for age, race and ethnicity, education, and accelerometer wear time (Model 1), revealed a higher falls rate in the lowest quartile than in the highest (IRR = 1.43, 95% confidence interval (CI) = 1.24–1.65; *P*-value for trend <.001). This association was weaker, but remained significant, after additional adjustment for falls risk factors (IRR = 1.18, 95% CI = 1.01–1.38; *P*-value for trend = .04). The association between total PA and fall risk was similar to that observed for MVPA after adjustment for fall risk factors (IRR = 1.20 for lowest vs highest quartiles, 95% CI = 1.03–1.40). No significant association with fall risk was observed for light PA (Table 2).

Consideration of Functional Status and Fall History

Stratification according to physical function (high (SPPB 9–12) vs low (SPPB ≤8)) and number of falls (≤1 vs ≥2) revealed that incidence rates of falls were not significantly associated with MVPA in women with high physical function or one or fewer falls in the previous year (Figure 1). However, in women with low physical function, incidence rates of falls were significantly higher (IRR = 1.33, 95% CI = 1.19–1.58) in those with low MVPA levels compared to those in the middle MVPA quartiles, whereas the risk of falls was not greater with high MVPA levels (*P*-interaction = .03). Incidence rates of falls were also higher in women with low MVPA who had two or more falls (IRR = 1.71, 95% CI = 1.28–2.26) than in similar women with MVPA in the middle quartiles, again the risk of falls was not greater with high MVPA levels (Figure 1; *P*-interaction <.001).

MVPA and Fall Injuries

In the 2,495 interviews completed with women who reported falls on monthly calendars, 763 (30.6%) falls were reported to have caused some type of injury. Women with MVPA below the median were significantly more likely to sustain an injury requiring medical treatment (13.0%, 167/1,280) than those with higher MVPA levels (9.9%, 120/1,215, *P* < .001) (Table 3). Fractures were reported for 63 falls in women with lower MVPA (4.9%) and for 45 falls in women with higher MVPA (3.7%) (Table 3).

DISCUSSION

This prospective study shows that the rate of incident falls in older, community-dwelling, ambulatory women is higher in those with low MVPA than in those with higher MVPA, as measured using accelerometry. The higher risk of falls in the lowest quartile of MVPA was apparent only in women with low levels of objectively measured physical function or a history of frequent falling in the 12 months before baseline, and tests for interaction were statistically significant. Low levels of light PA were not associated with significantly greater risk of falling. Higher levels of MVPA also did not affect risk of falling in these older women regardless of physical function or fall history. Injurious falls requiring medical attention were significantly more common in women with low than with higher MVPA.

There has been concern that the higher-intensity movements of MVPA, including walking, might increase the risk of falling.[20] The majority of the evidence on

Table 1. Participant Characteristics According to Quartile of Minutes of Accelerometer-Measured Moderate to Vigorous Physical Activity (MVPA) Per Day

Characteristic	Quartile 1 (<25.1)	Quartile 2 (25.1–44.0)	Quartile 3 (44.1–69.2)	Quartile 4 (≥69.3)	*P*-Value
Age, n (%)					
63–74	182 (13.1)	324 (23.3)	501 (36.2)	688 (49.6)	<.001
75–79	196 (14.2)	313 (22.5)	278 (20.1)	274 (19.8)	
80–84	461 (33.3)	442 (31.8)	382 (27.6)	309 (22.3)	
85–89	401 (29.0)	266 (19.2)	189 (13.7)	102 (7.4)	
≥90	145 (10.5)	44 (3.2)	35 (2.5)	13 (0.9)	
Race and ethnicity, n (%)					
White	832 (60.1)	705 (50.8)	643 (46.4)	617 (44.5)	<.001
Black	411 (29.7)	495 (35.6)	493 (35.6)	422 (30.5)	
Hispanic	142 (10.3)	189 (13.6)	249 (18.0)	347 (25.0)	
College graduate, n (%)	507 (36.9)	550 (39.9)	589 (42.8)	601 (43.5)	.01
Alcoholic drinks per week in prior 3 months, n (%)					
0	574 (46.0)	510 (39.9)	431 (33.8)	393 (29.9)	<.001
<1	422 (33.8)	448 (35.1)	444 (34.9)	427 (32.5)	
≥1	251 (20.1)	320 (25.0)	399 (31.3)	493 (37.6)	
Excellent or very good vision, n (%)	598 (48.2)	646 (50.8)	662 (52.0)	759 (58.0)	<.001
No or very mild body pain, n (%)	420 (33.7)	491 (38.6)	590 (46.2)	702 (53.8)	<.001
Depressive symptoms, n (%)	99 (8.3)	68 (5.6)	73 (6.0)	66 (5.2)	.007
Uses sleep aid ≥1 times/week, n (%)	233 (18.9)	230 (18.0)	201 (15.7)	206 (15.8)	.08
Number of chronic conditions, n (%)					
0	171 (13.1)	199 (15.4)	297 (22.9)	378 (28.9)	<.001
1	408 (31.4)	508 (39.2)	503 (38.8)	548 (42.0)	
2	400 (30.8)	366 (28.3)	343 (26.5)	275 (21.1)	
≥3	322 (24.8)	222 (17.1)	152 (11.7)	105 (8.0)	
Number of falls in past year, n (%)					
0	836 (63.5)	921 (68.3)	970 (72.1)	964 (70.7)	<.001
1	281 (21.3)	283 (21.0)	255 (19.0)	269 (19.7)	
≥2	200 (15.2)	144 (10.7)	121 (9.0)	131 (9.6)	
Injured from fall in past year, n (%)[a]	239 (40.7)	192 (37.7)	183 (40.4)	181 (38.7)	.72
BMI, kg/m^2, mean ± standard deviation	28.6 ± 6.0	28.9 ± 6.0	28.0 ± 5.5	26.8 ± 4.9	<.001
Obese (BMI ≥30.0 kg/m^2), n (%)	486 (35.4)	523 (37.9)	415 (30.2)	300 (21.8)	<.001
Short Physical Performance Battery score, n (%)[b]					
1–4	230 (19.0)	98 (7.8)	51 (4.0)	38 (3.0)	<.001
5–8	611 (50.6)	610 (48.3)	491 (38.3)	373 (29.3)	
9–12	367 (30.4)	556 (44.0)	741 (57.8)	864 (67.8)	

[a]Of those reporting a fall in the past year.
MVPA cutpoint is vector magnitude counts ≥519 per 15-seconds.
Percentages may not sum to 100 because all variables except age and race and ethnicity had some missing data.
[b]Higher score indicates better physical function; scores of 0 were excluded.
BMI = body mass index.

MVPA and falls comes from supervised exercise trials, rather than naturally occurring MVPA in daily life, as typically assessed in observational cohort studies. One meta-analysis reported that fall prevention exercise programs were more effective if the exercise did not include walking,[21] yet recent randomized trials testing MVPA found no greater fall risk[22] even with a walking intervention.[23] A recent systematic review concluded that there was insufficient evidence to determine how walking affects fall risk.[24,25] Most fall prevention trials have tested multicomponent exercise programs, and many have not included MVPA as a component.[2] These trials were not designed to evaluate dose-response relationships relating MVPA to risk of falls.

Cross-sectional, nationally representative U.S. data show an association between leisure-time PA and lower prevalence of falling two or more times in the previous year in middle-aged and older adults, but the association was weaker in participants aged 85 and older.[26] Self-reported leisure-time PA is poorly correlated with accelerometry measurements of MVPA[27] and may be especially inaccurate in older adults and women.[28,29] Accelerometers capture movements during daily life beyond those identified as leisure-time exercise.[27] To the knowledge of the authors, the present study is the only U.S. prospective study of accelerometer-measured PA with careful falls surveillance in a large population of older women, the group at highest risk of falls and fall-related injuries.[26] The results of this observational study support no association between higher levels of MVPA and fall risk in community-dwelling ambulatory women. Consistent with the present study, the ActiFE-Ulm Study, conducted in southern Germany in 1,214 older adults, found no greater risk of falls in older men or women with higher levels of accelerometer-measured PA.[30]

Being in the lowest quartile of MVPA was associated with greater risk of falls, and this association appeared to be present only in women with poor physical function or a

Table 2. Falls Incidence Rate Ratios According to Quartiles of Minutes Per Day of Accelerometer-Measured Physical Activity

	Quartile 1	Quartile 2	Quartile 3	Quartile 4	*P*-Value for Trend
Moderate to vigorous physical activity, minutes (mean ± SD 51 ± 35)	<25.1	25.1–44.0	44.1–69.2	≥69.3	
Falls, n	1,659	1,375	1,240	1,190	
Person-months	14,443	15,365	15,631	16,117	
Crude falls rate per 1,000 person-months	114.9	89.5	79.3	73.8	
Model 1, IRR (95% CI)[a]	1.43 (1.24–1.65)	1.11 (0.97–1.27)	1.05 (0.92–1.19)	Reference	<.001
Model 2, IRR (95% CI)[b]	1.18 (1.01–1.38)	1.01 (0.87–1.16)	0.98 (0.86–1.13)	Reference	.04
Light activity, minutes (mean ± SD 288 ± 77)	<233.2	233.2–286.1	286.2–337.3	≥337.4	
Falls, n	1,535	1,325	1,272	1,332	
Person-months	14,723	15,463	15,631	15,739	
Crude falls rate per 1,000 person-months	104.3	85.7	81.4	84.6	
Model 1, IRR (95% CI)[a]	1.12 (0.98–1.29)	0.92 (0.80–1.04)	0.93 (0.82–1.06)	Reference	.12
Model 2, IRR (95% CI)[b]	1.09 (0.93–1.27)	0.99 (0.86–1.14)	1.02 (0.89–1.17)	Reference	.38
Total activity, minutes (mean ± SD 339 ± 97)	<270.7	270.7–335.6	335.7–401.9	≥402.0	
Falls, n	1,585	1,327	1,305	1,247	
Person-months	14,688	15,267	15,581	16,020	
Crude falls rate per 1,000 person-months	107.9	86.9	83.8	77.8	
Model 1, IRR (95% CI)[a]	1.25 (1.09–1.43)	1.02 (0.89–1.16)	1.03 (0.91–1.18)	Reference	.004
Model 2, IRR (95% CI)[b]	1.20 (1.03–1.40)	1.01 (0.88–1.17)	1.10 (0.96–1.26)	Reference	.07

Cutpoint values are vector magnitude counts of ≥519 per 15 seconds for moderate to vigorous physical activity, 19–518 per 15 seconds for light physical activity, and ≥19 per 15 seconds for total physical activity. Excludes one participant with 327 verified falls.

[a]Adjusted for age, race and ethnicity, education, and wear time.

[b]Adjusted for age, race and ethnicity, education, wear time, vision, body pain, alcohol use, sleep aid use, body mass index, and chronic conditions.

CI = confidence interval; IRR = incidence rate ratio; SD = standard deviation.

history of frequent falls. Two recent studies showing that fall rates were higher at low levels of walking in older German adults with slow walking speeds or history of falls[30] and with low step counts measured using accelerometry in older British men with mobility limitations[31] support this finding. The higher risk of falls at the lowest levels of MVPA in the present study could reflect a level of severe frailty that prohibits greater amounts of MVPA. Thus, low MVPA may identify a group of older women at exceptionally high risk of falls within two identifiable high-risk subgroups: those with low functional status and those with a history of frequent falls. The association may also reflect a modifiable risk factor for falls—that some of these women can be supported to increase their MVPA levels. The similar rates of falls in women in OPACH in the highest three quartiles of MVPA supports the hypothesis that women need not increase their MVPA to the highest levels to achieve a possible reduction in fall risk. Higher MVPA in women who were capable and chose to do it did not appear to increase falls risk. However, an observational study cannot exclude the possibility that women self-select amounts of MVPA that they perceive to be safe for them and that, for some women, going from low to medium levels of MVPA may increase fall risk. Future randomized trials should focus on determining whether MVPA can be safely increased in such women.

Use of age-appropriate accelerometer cutpoints for classification of MVPA is a major and unique strength of this study. Resting metabolic rate declines with age,[32] and the energy costs of activity increase with age.[33,34] These two factors define the numerator (activity energy expenditure) and denominator (resting metabolic rate) of MET intensity values. The OPACH Calibration Study[14] showed that the typically used National Health and Nutrition Examination Survey cutpoints[35] result in substantial underestimation of MVPA in older women with a range of fitness levels, functional abilities, and chronic disease burdens (12 vs 51 min/d, respectively, in the women in OPACH studied here). Age-specific accelerometer intensity cutpoints are critical for accurate classification of PA in older adults.

This study has strengths beyond accelerometer measurement of PA, including objective measurement of physical function; a large, racially and ethnically diverse study population; prospective ascertainment of falls using monthly calendars; and the ability to adjust for numerous fall risk factors measured at or before baseline. OPACH was nested within WHI and thus did not include men. Two European studies showing higher fall rates at low levels of accelerometer-measured PA in frail older populations that were exclusively[31] or more than half[30] men supports the generalizability of these findings to older men. Although having African-American and Hispanic women constitute half of the study population is a strength, minority women were systematically at the younger end of the age range, necessitating careful adjustment of age, race, and ethnicity in all analyses. Surveillance for falls was conducted over 1 year of follow-up. Although nearly 5,800 falls were reported during this period, it would be informative to study fall incidence rates and their relationship with PA habits over a longer follow-up period. Resources were insufficient to conduct fall interviews for all reported falls, and thus, injurious falls could only be ascertained in a subgroup. Future linkage to Medicare data injury codes

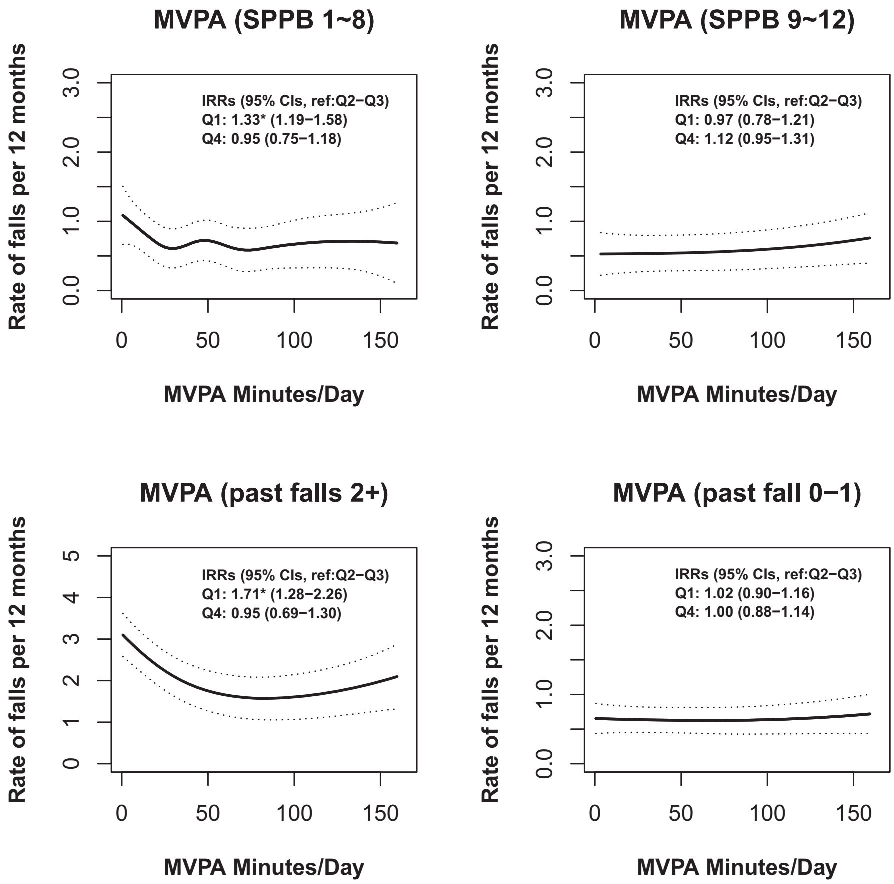

Figure 1. Associations between moderate to vigorous physical activity and incidence rate of falls stratified according to physical function (top panels) and history of past falls (bottom panels).

Table 3. Descriptive Information on Falls Injuries According to Accelerometer-Measured Minutes Per Day of Moderate to Vigorous Physical Activity

Factor	Total	Quartile 1 (<25.1)	Quartile 2 (25.1–44.0)	Quartile 3 (44.1–69.2)	Quartile 4 (≥69.3)
Interviews completed, n[a]	2,495	726	554	579	636
Interview-reported injurious fall, n (% of fall interviews)	763 (30.6)	192 (26.4)	187 (33.8)	183 (31.6)	201 (31.6)
Received medical treatment after injurious fall, n (% of fall interviews)[b]	287 (11.5)	85 (11.7)	82 (14.8)	63 (10.9)	57 (9.0)
Type of medical treatment, n (% medically treated)					
Hospital admission	28 (3.7)	11 (5.7)	8 (4.3)	3 (1.6)	6 (3.0)
Emergency department visit	127 (16.6)	33 (17.2)	41 (21.9)	28 (15.3)	25 (12.4)
Doctor's office visit	98 (12.8)	28 (14.6)	28 (15.0)	23 (12.6)	19 (9.5)
Medically treated by someone other than a doctor	34 (4.5)	13 (6.8)	5 (2.7)	9 (4.9)	7 (3.5)
Self treated or treated by non-medical person	437 (57.3)	98 (51.0)	93 (49.7)	116 (63.4)	130 (64.7)
Seriously injured, n (% of injurious falls)[b,c]	349 (45.7)	98 (51.0)	98 (53.0)	78 (43.1)	75 (37.3)
Type of injury, n (% of injurious falls)[d]					
Fracture	108 (14.2)	27 (14.1)	36 (19.3)	25 (13.7)	20 (10.0)
Sprain	122 (16.0)	31 (16.2)	29 (15.5)	32 (17.5)	30 (14.9)
Bruising	528 (69.2)	138 (71.9)	123 (65.8)	129 (70.5)	138 (68.7)
Cut	145 (19.0)	45 (23.4)	33 (17.7)	28 (15.3)	39 (19.4)
Scrape	268 (35.1)	65 (33.9)	60 (32.1)	68 (37.2)	75 (37.3)
Soreness	620 (81.3)	162 (84.4)	151 (80.8)	140 (76.5)	167 (83.1)

[a]Women could be interviewed multiple times.

[b]$P<.001$.

[c]Defined as fracture or sprain or receiving medical treatment.

[d]Multiple injuries possible.

will be conducted to ascertain rates of injurious falls in this population.

CONCLUSION

Because of its many health benefits, regular aerobic MVPA is strongly recommended for all older adults,[7] yet there has been concern that the body movement of MVPA may increase fall risk, particularly in women with lower levels of physical function or a history of falls. The findings reveal that falls are not more common and do not cause more-serious injuries in community-dwelling women who participate in higher levels of MVPA, regardless of physical function level. These findings support encouraging women to engage in the amounts and types of MVPA that they prefer.

Older women with poor physical function or frequent falls who participate in low levels of MVPA represent a high-risk group that would benefit from participation in effective fall prevention programs.

Trials are warranted to determine the benefits and risks of increasing MVPA in such women.

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