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Indoor and Outdoor Falls in Older Adults are Different: The MOBILIZE Boston Study

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Abstract

OBJECTIVES—To identify risk factors for indoor and outdoor falls.

DESIGN—Prospective cohort study.

SETTING—MOBILIZE Boston, a study of falls etiology among community-dwelling older individuals.

PARTICIPANTS—765 women and men, mainly of age 70 years and older, from randomly sampled households in the Boston MA area.

MEASUREMENTS—Baseline data were collected by questionnaire and comprehensive clinic examination. During follow-up participants recorded falls on daily calendars. A telephone interview queried the location and circumstances of each fall.

RESULTS—598 indoor and 524 outdoor falls were reported over a median follow-up of 21.7 months. Risk factors for indoor falls included older age, being female, and various indicators of poor health. Risk factors for outdoor falls included younger age, being male, and being relatively physically active and healthy. For instance, the age- and gender-adjusted rate ratio (and 95% confidence interval) for having much difficulty or inability to perform activities of daily living relative to no difficulty was 2.57 (1.69–3.90) for indoor falls, but 0.27 (0.13–0.56) for outdoor

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Conflict of Interest:
The authors have no conflicts of interest to report. Dr. Hannan had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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JLK helped conceive and design the study, led the data analyses and the preparation of the manuscript.
SDB helped conceive and design the study, and contributed to the analyses and preparation of the manuscript.
EP-G contributed to the data preparation and analyses as well as preparation of the manuscript.
LQ contributed to statistical analyses and contributed to the preparation of the manuscript.
UN contributed to statistical analyses and contributed to the preparation of the manuscript.
WL led the statistical analytic work and contributed to the preparation of the manuscript.
DPK contributed to the operations of the study, study data collection and contributed to the preparation of the manuscript.
LAL contributed to analytic interpretations and contributed to the preparation of the manuscript. preparation.
MTH helped conceive and design the study, and contributed to the analyses and preparation of the manuscript.
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falls. The rate ratio for gait speed of <0.68 m/sec relative to a speed of >1.33 m/sec was 1.48 (0.81–2.68) for indoor falls, but 0.27 (0.15–0.50) for outdoor falls.

CONCLUSION—Risk factors for indoor and outdoor falls differ. Combining these falls, as is done in many studies, masks important information. Prevention recommendations for non-institutionalized older people should be more effective if targeted differently for frail, inactive older people at high risk for indoor falls and relatively active, healthy people at high risk for outdoor falls.

Keywords

falls; risk factors; elders; aging research; population-based; epidemiology; aged; cohort studies

INTRODUCTION

About 35–40% of community-dwelling adults of age 65 years and older fall each year.[1] Falls are associated with reduced functioning, lack of self-confidence in ability to ambulate safely, hospitalization, premature nursing home admission, and excess mortality.[2] Frequently reported risk factors for falls include muscle weakness, a history of falls, gait and balance deficits, use of assistive devices, visual deficits, arthritis, impaired activities of daily living, depression, cognitive impairment, polypharmacy, psychotropic medications, and age greater than 80 years.[2–3] Most interventions have focused on trying to ameliorate these deficits and on making the home environment less hazardous.[4]

Even though most older people spend the vast majority of their time indoors,[5] most studies have found that at least 50% of falls among community-dwelling older people occur outdoors.[6–11] Previous reports, which have included only small numbers of risk factors, have suggested that while indoor falls indeed tend to occur in frail people with compromised health, outdoor falls tend to occur in active people. [6–11] Nevertheless, most published studies of risk factors and interventions continue to combine all falls regardless of location. Failure to separate indoor and outdoor falls can make it difficult to assess the magnitudes of associations of various risk factors with falls; in fact, associations may be completely missed when all falls are combined. Here we use data from MOBILIZE Boston to compare the associations of a large number of risk factors for falls when all falls are combined, and when falls are divided into those occurring indoors and outdoors.

METHODS

The MOBILIZE Boston Study has been described in detail elsewhere.[12–13] Briefly, it is a prospective cohort study to identify risk factors and mechanisms of falls among 765 community-dwelling men and women, mainly aged 70 years and older, who live in the Boston, MA area. Other eligibility criteria included ability to read and speak in English, ability to walk twenty feet without the assistance of another person, intention to stay in the Boston area for at least two years, and adequate cognition (scoring at least 18 points on the Mini-Mental Status Examination).[14] Enrollment took place from September 2005 to December 2007, using door-to-door recruitment in randomly sampled households with at least one member aged 70 years and older as recorded in annual town lists required in Massachusetts. From 5,655 sampled households, 4,303 people aged 70 years and older were identified. Of the 4,303, 1,581 were not eligible, and 1,973 either refused to participate or were unable to be contacted. An additional 16 persons in the age group 64–69 years who were spouses or living with a participant were added to the cohort, for a total of 765 participants. The data presented here are based on follow-up through October 2008. The median length of follow-up was 21.7 months, with a range of 0.5 to 38.4 months. This study

was approved by the Institutional Review Board of Hebrew SeniorLife, and all participants signed a consent form.

At baseline participants underwent comprehensive assessments, including a home visit and clinic examination. Demographic characteristics included in these analyses were age, gender, self-reported race/ethnicity, and education. Among lifestyle factors, body mass index was derived from weight measured on a standard balance beam scale and stadiometer-measured height, and was categorized into normal (<25 kg/m^2), overweight (25–29.9 kg/m^2), and obese (≥30 kg/m^2). Typical physical activity level was estimated using the Physical Activity Scale for the Elderly (PASE) questionnaire to measure physical activity in the previous week.[15] The number of stairs in a participant's home was observed during the home visit. Alcohol use was obtained by self-report.

Balance was assessed using the Berg balance scale.[16] The Short Physical Performance Battery (SPPB) of lower extremity function included tandem balance performance, timed chair stands, and gait speed.[17] Inability to perform the chair stands (unable or needed to use arms during the test) was also assessed. Gait speed (m/sec) was the shortest time in two trials for a usual-paced four-meter walk.[18] The Activities of Daily Living (ADL) scale[19–20] was scored according to ability to perform five activities (bathing, dressing, toileting, transferring, eating). Reduced activity because of illness was based on response to the question 'in the past 12 months, did you cut down on the things you usually do, such as going to work or working around the house because of illness or injury?' Distance vision was tested at 10 feet (wearing corrective lenses, if used), with poor vision defined as vision worse than 40/100.

Among illness- or symptom-related factors, bodily pain was assessed from the SF-36.[21] Number of self-reported comorbid conditions (excluding depression) was summed from the participant's response to whether a health care provider had told her/him that she/he had any of several specific major medical conditions.[22] Participants rated their health status as 'good-excellent' or 'fair-poor.' Peripheral neuropathy was assessed using Semmes-Weinstein monofilament testing.[23] Foot pain was based on report of pain, aching or stiffness in one or both feet on most days. Presence of knee osteoarthritis was assessed by trained nurses using the American College of Rheumatology (ACR) clinical criteria for osteoarthritis of the knee.[24] Depression symptoms were assessed using a modification of the 20-item Centers for Epidemiologic Studies Depression (CES-DR) scale.[25–26]

Each participant's prescription and over-the-counter medications used during the previous 2 weeks were coded using the Iowa Drug Information System (IDIS) ingredient codes.[27] Topical medications, vitamins, and herbals were excluded.

The Mini-Mental State Exam (MMSE) was used to assess cognitive function.[14]

Fall-related indicators included the number of self-reported falls in the past year and the Falls Efficacy scale. The Falls Efficacy scale is a summary measure of fear of falling that queries level of confidence on a 1–10 scale in doing certain activities without falling.[28]

A fall was defined as unintentionally coming to rest on the ground or other lower level. During the home visit, interviewers instructed participants on how to use a calendar during follow-up to record whether a fall occurred each day. At the end of each month participants mailed their falls calendar to the study office. Those not returning calendars within ten days of the end of a month or returning an incomplete calendar were called on the telephone by study staff. Information on whether a fall had occurred was obtained for over 99% of follow-up months.

When participants reported a fall, a structured telephone interview was conducted to determine the circumstances. An indoor fall was defined as one said to have occurred inside the participant's home, inside someone else's home, inside another building, or inside, other location. Outdoor falls were those reported to have occurred anywhere outside. Location of the fall was reported for 1,122 (86.4%) of 1,299 reported falls. A fall was considered to have resulted in an injury if the participant answered "yes" to the question "Did you hurt yourself when you fell?" We classified fractures, sprains, dislocations, and pulled or torn muscles, ligaments or tendons as serious injuries.

In the statistical analysis we first compared baseline characteristics of participants who fell indoors only, fell outdoors only, fell both indoors and outdoors, and who did not fall at all within a two-year follow-up period. This particular analysis was limited to the 695 individuals (90.8%) who had at least one year of follow-up to minimize bias from the likelihood of fall frequency being greater among those with longer follow-up. P-values for differences between characteristics of those who fell only indoors and those who fell only outdoors were based on the Wilcoxon rank-sum test for quantitative variables and the chi-square test for categorized variables. Then, rates of falls (average number of falls per person per year of follow-up) by age and gender were computed for all falls, indoor falls, and outdoor falls for all participants through October 2008. We used negative binomial regression models to estimate the effects of baseline characteristics on the rates of all falls, indoor falls, and outdoor falls, adjusting for age and gender. The effect of each characteristic or risk factor is expressed as a rate ratio, which is the average number of falls per person per year of follow-up in people with a characteristic (e.g., male gender), relative to the average number of falls per person per year of follow-up in a referent group (e.g., female gender). Thus, the referent group varies according to the characteristic or risk factor being considered.

The associations of each type of fall with quantitative risk factors were assessed for linearity and potential thresholds; variables with nonlinear associations or thresholds were categorized as needed. Potential interactions between selected combinations of risk factors and rate of falls were examined, but no interactions were evident.

RESULTS

The median age at baseline of the 765 cohort members was 78 years, with a range of 64 to 97 years. Thirty-six percent were male and 64% female. Of the 1122 falls for which location was reported, 598 (53.3%) occurred indoors and 524 (46.7%) outdoors. Seventy-seven percent of indoor falls occurred inside the participant's own home. The locations of outdoor falls were more diverse, but most commonly occurred on sidewalks (23%), yards or gardens (14%), streets or curbs (14%), outside stairs (13%), and parking lots (6%).

Table 1 presents baseline characteristics of those with at least one year of follow-up who fell indoors only, outdoors only, both indoors and outdoors, and not at all during the first two years following baseline. Those who fell only outdoors were somewhat younger than those who fell only indoors, were more likely to be male and better educated, and were somewhat more likely to be white. Those who fell only outdoors had lifestyle characteristics indicative of better health, while those who fell only indoors had substantially more physical disabilities, and were more likely to have characteristics classified as illness-related. They were taking somewhat more medications, including psychotropic medications, and had somewhat lower cognitive function. They had fallen somewhat more in the previous year and were much more likely to have a low score on the Falls Efficacy scale than those who fell only outdoors. For many attributes, those who had fallen both indoors and outdoors

during the two-year period had values intermediate between those who fell indoors only and those who fell outdoors only.

Also of note in Table 1, those who fell outdoors only were generally at least as healthy, if not more so, than those who did not fall at all, whereas those who fell indoors only were less healthy and more disabled than those who did not fall at all.

Table 2 gives rates of falls (average number of falls per person per year) by age and gender for the entire cohort. If all falls are considered, a slight increase in rate of falls with age and a somewhat higher rate of falls among males than females are seen. However, the increase in fall rates with age was limited to indoor falls; outdoor fall rates decreased with age. Also, there was a higher rate of indoor falls among females than males, and a markedly higher rate of outdoor falls among males than females.

Table 3 shows age- and gender-adjusted rate ratios for all falls, indoor falls, and outdoor falls according to the other attributes in Table 1. For all falls, rate ratios of greater than 1.50 occurred for white race/ethnicity, being highly educated, having three or more flights of stairs in the home, having little or some difficulty with activities of daily living, having recently reduced activity because of illness, and being depressed. Also, the greater the number of falls in the year before baseline, the higher the rate ratio. All other attributes had rather low levels of association with all falls combined.

When indoor falls were considered separately, rate ratios of greater than 1.50 were seen for a high level of education; most indicators of physical disability and illness; medication use; and low score on the Falls Efficacy scale. There were fairly strong associations with number of comorbid conditions and number of falls in the year before baseline. We also computed rate ratios for indoor falls that occurred specifically in a participant's own home. These results (not shown) were similar to those for all indoor falls, except that several of the rate ratios were slightly higher than for all indoor falls.

When outdoor falls were considered, a different picture emerged. Rate ratios of greater than 1.50 were seen for white race/ethnicity, high educational level, having three or more flights of stairs in the home, high or moderately high alcohol consumption, and being depressed. Rate ratios of 0.67 or less were found for high body mass index, physical inactivity, poor balance score, slow or moderate gait speed, much difficulty or inability with activities of daily living, and taking five or more medications. Each additional fall during the year before baseline was associated with a higher rate ratio.

About 9.5% of all falls were classified as resulting in serious injury, including 10.2 percent of indoor falls and 9.0 percent of outdoor falls (p=0.46). Because the numbers of serious fall injuries were much smaller than numbers of all falls, confidence intervals were much wider and conclusions therefore less certain. However, the same overall picture emerged of physical disability, illness, medication use, and a low falls efficacy score being predictors of higher rates of serious injurious indoor falls, and, with a few exceptions, predictors of lower rates of serious injurious outdoor falls (data not shown). When all injurious falls were considered, the same trends were seen.

DISCUSSION

Older people at high risk for indoor falls were very different from older people at high risk for outdoor falls. Indoor falls were associated with disability, indicators of poor health, and an inactive lifestyle. Outdoor falls were associated with an active lifestyle and average or better than average health. Only a few attributes, including a history of falls in the past year, depression, and high educational level, were associated with both indoor and outdoor falls.

These findings of numerous differences between risk factors for indoor and outdoor falls are consistent with the few other studies that have examined this issue.[6–11] Most of these studies considered only a small number of risk factors. We examined a large number of potential risk factors, and ascertained falls using fall calendars, thus providing more definitive evidence that risk factors for indoor and outdoor falls are different in many ways.

There are at least four important implications of these results. First, a fall is not necessarily a marker of existing or impending poor health. Almost half of all falls in this study occurred outdoors, and people who fall outdoors tended to have the same as or better health than those who do not fall at all. Bath and Morgan[10] reported an approximately 70% higher 8-year mortality rate following indoor falls compared to no falls, but no increased mortality following outdoor falls. Manty et al.[11] found that indoor falls were predictive of future mobility limitation in Finnish women, whereas outdoor falls were not.

Second, epidemiologic studies aimed at identifying risk factors for falls in older people will be hampered when all falls are combined. Associations of risk factors with either indoor or outdoor falls may be missed, or the magnitudes of associations considerably diluted. Third, study populations consisting of people who stay indoors most of the time will have different associations between risk factors and falls than will study populations with people who spend more time outdoors. Fourth, intervention programs to prevent falls need to be targeted and evaluated differently for people likely to fall indoors and outdoors.

To date most fall prevention programs have emphasized prevention of indoor falls, particularly through strength, balance, and gait training; use of assistive devices; treatment of medical conditions; reduction in use of certain medications; improvement in vision; and elimination of home hazards.[2–3] Recent systematic reviews of fall interventions have grouped interventions into those among community-dwelling persons and those in institutions.[29–30] Our findings suggest that, in addition, interventions among community-dwelling individuals should take into account the health status, activity level, and other characteristics of those for whom the interventions are planned. Healthy, active older people should be cautious, especially when walking outdoors.[9] More attention needs to be paid to the elimination of outdoor environmental hazards involving sidewalks, curbs, and streets, such as by repairing uneven surfaces, removing debris, installing ramps at intersections, and painting curbs.[8–10]

Strengths of this study include its longitudinal design, its sampling from the general population, its relatively large sample size, its careful measurement of many risk factors for falls, and detailed documentation of where falls occurred. On the other hand, although it is known that most older people spend only a small amount of time outdoors,[5] individual participants in this study were not asked how much time they spent indoors and outdoors. Future studies should find out how much time each participant spends indoors and outdoors so that rates for indoor and outdoor falls can take time at risk into account. Some of the data, including the occurrence of falls, is based on self-report, and undoubtedly some inaccuracy is present. For instance, it is possible that the higher fall rates in better educated participants are partly the result of better reporting. Results of other studies suggest that our findings are generalizable to a variety of geographic areas, but it should be kept in mind that this study was carried out in only one area, Boston, Massachusetts USA. Finally, it will be important to examine risk factors for falls resulting in serious injury when larger numbers of these events have occurred as well as in other studies.

In conclusion, both indoor and outdoor falls are important. However, people at high risk for indoor falls are different in many ways from those at high risk for outdoor falls. Failure to separate indoor and outdoor falls can mask important information on risk factors. Prevention

programs and studies of risk factors among non-institutionalized older people are likely to be more effective if they are targeted differently for frail, inactive older people who are at high risk for indoor falls and for active, relatively healthy older people who are at high risk for outdoor falls.

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Table 1

Baseline Characteristics Of People Who Fell Indoors Only, Outdoors Only, Outdoors And Indoors, And Not At All During The First Two Years Of Follow-Up [*]

Characteristics	Fell Indoors Only (N=135) Mean±S.D or frequency(%)	Fell Outdoors Only (N=129) Mean±S.D. or frequency(%)	P Value For Indoor Only versus Outdoor Only [†]	Fell Indoor And Outdoors (N=113) Mean±S.D. or frequency(%)	Did Not Fall (N=318) Mean±S.D. or frequency(%)
Demographic					
age (years)	79.9±5.5	77.7±4.9	0.002	77.9±6.1	77.5±5.2
male gender	31 (23.0)	59 (45.7)	<0.001	41 (36.3)	114 (35.8)
Education			0.03		
high school graduate or less	47 (34.8)	33 (25.6)		31 (27.4)	129 (40.7)
some college or college graduate	54 (40.0)	44 (34.1)		34 (30.1)	113 (35.6)
graduate studies	34 (25.2)	52 (40.3)		48 (42.5)	75 (23.7)
White race / ethnicity	106 (78.5)	111 (86.7)	0.08	95 (84.1)	226 (71.1)
Lifestyle					
body mass index (kg/m^2)					
<25	33 (25.2)	38 (30.2)	0.001	46 (40.7)	95 (30.4)
25–29.9	46 (35.1)	65 (51.6)		45 (39.8)	127 (40.7)
30+	52 (39.7)	23 (18.2)		22 (19.5)	90 (28.9)
Physical activity (bottom quartile, PASE<55)	37 (28.0)	22 (17.0)	0.03	31 (27.9)	71 (22.3)
3 or more flights stairs in home	12 (8.9)	19 (14.7)	0.14	21 (18.6)	26 (8.2)
Use of alcohol			0.10		
not at all	60 (44.4)	40 (31.0)		43 (38.1)	133 (41.8)
1–3 drinks/month	28 (20.7)	26 (20.2)		24 (21.2)	73 (23.0)
1–6 drinks/week	33 (24.4)	44 (34.1)		30 (26.6)	73 (23.0)
every day use	14 (10.4)	19 (14.7)		16 (14.2)	39 (12.3)
Physical Disability					
balance (Berg score)			<0.001		
51+	48 (35.6)	83 (64.3)		56 (49.6)	190 (59.8)
48–51	34 (25.2)	29 (22.5)		34 (30.1)	71 (22.3)

Characteristics	Fell Indoors Only (N=135) Mean±S.D or frequency(%)	Fell Outdoors Only (N=129) Mean±S.D. or frequency(%)	P Value For Indoor Only versus Outdoor Only †	Fell Indoor And Outdoors (N=113) Mean±S.D. or frequency(%)	Did Not Fall (N=318) Mean±S.D. or frequency(%)
<48	53 (39.3)	17 (13.2)		23 (20.3)	57 (17.9)
unable to do chair-stand test unless using arms	22 (16.3)	6 (4.6)	0.002	5 (4.4)	17 (5.3)
gait speed			0.005		
>1.33 m/sec	7 (5.2)	11 (8.5)		12 (10.6)	17 (5.3)
0.68–1.33m/sec	97 (71.8)	107 (83.0)		89 (78.8)	267 (84.0)
<0.68 m/sec	31 (23.0)	11 (8.5)		12 (10.6)	34 (10.7)
activities of daily living:			<0.001		
no difficulty	83 (61.5)	109 (84.5)		83 (73.5)	267 (84.0)
little / some difficulty	26 (19.3)	17 (13.2)		25 (22.1)	36 (11.3)
much difficulty / inability	26 (19.3)	3 (2.3)		5 (4.4)	15 (4.7)
short physical performance battery < 10	80 (59.3)	38 (29.5)	<0.001	45 (39.8)	116 (36.5)
reduced activity due to illness	47 (34.8)	39 (30.2)	0.43	45 (39.8)	60 (18.9)
poor vision (worse than 40/100)	11 (8.2)	8 (6.2)	0.54	7 (6.2)	31 (9.7)
Illness-Related					
moderate /severe bodily pain	78 (57.8)	38 (29.7)	<0.001	46 (40.7)	106 (33.4)
number of comorbid conditions	3.2±1.4	2.7±1.5	0.002	3.0±1.4	2.8±1.4
fair /poor self-rated health	28 (20.7)	14 (10.8)	0.03	16 (14.2)	36 (11.3)
peripheral neuropathy	19 (14.3)	16 (12.4)	0.65	16 (14.3)	24 (7.6)
foot pain	47 (34.8)	30 (23.3)	0.04	31 (27.4)	51 (16.0)
knee osteoarthritis	40 (29.6)	31 (24.0)	0.31	32 (28.3)	73 (23.0)
depression	17 (12.6)	10 (7.8)	0.19	14 (12.4)	8 (2.5)
Medication Use					
number of medications			0.10		
0–4	37 (27.4)	45 (34.9)		44 (38.9)	112 (35.2)
5–8	57 (42.2)	59 (45.7)		49 (43.4)	158 (49.7)
9+	41 (30.4)	25 (19.4)		20 (17.7)	48 (15.1)
uses psychotropic medication ‡	39 (28.9)	26 (20.2)	0.10	27 (24.1)	49 (15.6)

Characteristics	Fell Indoors Only (N=135) Mean±S.D or frequency(%)	Fell Outdoors Only (N=129) Mean±S.D. or frequency(%)	P Value For Indoor Only versus Outdoor Only †	Fell Indoor And Outdoors (N=113) Mean±S.D. or frequency(%)	Did Not Fall (N=318) Mean±S.D. or frequency(%)
Cognition					
impaired cognition (MMSE 18–24)	19 (14.1)	10 (7.8)	0.10	10 (8.8)	41 (12.9)
Fall-Related					
number of falls in year before baseline	1.1±1.7	0.9±2.4	0.08	1.7±5.0	0.3±0.8
falls efficacy score <90	34 (25.2)	14 (10.9)	0.003	15 (13.4)	30 (9.5)
Mean Follow-up time (months)	20.3±4.2	21.1±4.0	0.10	21.5±3.6	20.0±4.3

*Participants with at least one year of follow-up are included. All variables had a sample size of 95–100% of full N shown.

†Wilcoxon rank-sum test was used for age, number of comorbid conditions, falls before baseline and follow-up time; chi-square was used for all other variables.

‡Includes antidepressants, benzodiazepines, antipsychotics, and other sedatives.

Abbreviations: SD = Standard deviation; PASE = Physical Activity Scale for the Elderly; MMSE = Mini-Mental State Exam.

Table 2

Annualized Fall Rates And Rate Ratios, with 95% Confidence Intervals, By Age And Gender: All Falls, Indoor Falls, And Outdoor Falls *

Age and Gender	All Falls	Indoor Falls	Outdoor Falls
mean fall rate by age (years)			
65–69	0.69 (0.43, 1.10)	0.28 (0.14, 0.53)	0.40 (0.23, 0.69)
70–79	0.79 (0.69, 0.91)	0.39 (0.33, 0.47)	0.40 (0.34, 0.48)
80–89	0.85 (0.73, 0.99)	0.50 (0.42, 0.61)	0.34 (0.28, 0.43)
90–99	0.96 (0.57, 1.62)	0.80 (0.43, 1.48)	0.15 (0.06, 0.37)
rate ratio per 5 years of age	1.06 (0.97, 1.16)	1.20 (1.07, 1.34)	0.90 (0.79, 1.01)
mean fall rate by gender			
male	0.87 (0.73, 1.04)	0.38 (0.30, 0.48)	0.49 (0.40, 0.60)
female	0.79 (0.70, 0.89)	0.47 (0.41, 0.55)	0.32 (0.27, 0.37)
rate ratio male versus female	1.11 (0.90, 1.36)	0.81 (0.62, 1.05)	1.55 (1.19, 2.02)

* Fall rates (mean number of falls per person per year) and rate ratios were estimated using negative binomial regression models. The rate ratio is the average number of falls per person per year of follow-up in one group (e.g., males) divided by the average number of falls per person per year of follow-up in a referent group (e.g., females). The referent group is specific for each potential risk factor

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Table 3

Age- And Gender-Adjusted Rate Ratios, with 95% Confidence Intervals, For Associations Between Baseline Characteristics And All Falls, Indoor Falls, And Outdoor Falls *

	All Falls		Indoor Falls		Outdoor Falls	
Characteristics	**Rate Ratio**	**95% CI**	**Rate Ratio**	**95% CI**	**Rate Ratio**	**95% CI**
Demographic						
white race / ethnicity	1.53	(1.19,1.98)	1.23	(0.90,1.68)	2.08	(1.46,2.96)
education level						
high school graduate or less	Referent		Referent		Referent	
some college or college graduate	1.22	(0.96,1.56)	1.19	(0.88,1.61)	1.33	(0.97,1.84)
graduate studies	1.76	(1.37,2.25)	1.53	(1.12,2.09)	2.08	(1.51,2.87)
Lifestyle						
body mass index (kg/m^2)						
<25.0	Referent		Referent		Referent	
25.0–29.9	0.99	(0.78,1.25)	1.12	(0.83,1.50)	0.87	(0.65,1.16)
30.0+	0.79	(0.60,1.03)	1.14	(0.82,1.59)	0.47	(0.32,0.67)
physical activity (bottom quartile, PASE<55)	1.03	(0.81,1.31)	1.43	(1.07,1.90)	0.67	(0.48,0.92)
3 or more flights stairs in home use of alcohol	1.58	(1.17,2.13)	1.17	(0.80,1.72)	1.98	(1.38,2.83)
not at all	Referent		Referent		Referent	
1–3 drinks/month	1.05	(0.80,1.38)	1.05	(0.75,1.46)	1.04	(0.72,1.51)
1–6 drinks/week	1.16	(0.89,1.50)	0.89	(0.64,1.23)	1.53	(1.10,2.12)
every day use	1.39	(1.01,1.91)	1.08	(0.73,1.61)	1.80	(1.21,2.67)
Physical Disability						
balance (Berg score)						
51+	Referent		Referent		Referent	
48 -50	1.33	(1.04,1.69)	1.56	(1.16,2.11)	1.18	(0.87,1.60)
<48	1.44	(1.10,1.89)	2.33	(1.70,3.19)	0.66	(0.45,0.98)
unable to do chair-stand test unless using arms	1.34	(0.92,1.95)	1.85	(1.20,2.86)	0.68	(0.38,1.21)
gait speed						
>1.33 m/sec	Referent		Referent		Referent	

Characteristics	All Falls		Indoor Falls		Outdoor Falls	
	Rate Ratio	95% CI	Rate Ratio	95% CI	Rate Ratio	95% CI
0.68–1.33m/sec	0.59	(0.41,0.87)	0.95	(0.57,1.57)	0.43	(0.28,0.67)
<0.68 m/sec	0.69	(0.43,1.10)	1.48	(0.81,2.68)	0.27	(0.15,0.50)
activities of daily living						
no difficulty	Referent		Referent		Referent	
little / some difficulty	1.59	(1.21,2.10)	1.98	(1.43,2.74)	1.18	(0.82,1.69)
much difficulty / inability	1.42	(0.97,2.06)	2.57	(1.69,3.90)	0.27	(0.13,0.56)
short physical performance battery <10	1.15	(0.93,1.42)	1.69	(1.30,2.18)	0.68	(0.51,0.90)
reduced activity due to illness	1.57	(1.27,1.95)	1.75	(1.34,2.28)	1.37	(1.03,1.82)
poor vision (worse than 40/100)	0.80	(0.55,1.16)	0.79	(0.50,1.27)	0.86	(0.53,1.40)
Illness-Related						
moderate-severe bodily pain	1.02	(0.83,1.26)	1.37	(1.07,1.77)	0.72	(0.54,0.94)
number of comorbid conditions (per condition)	1.05	(0.99,1.13)	1.17	(1.08,1.27)	0.93	(0.85,1.02)
fair/poor self-rated health	1.29	(0.97,1.71)	1.77	(1.28,2.46)	0.77	(0.52,1.15)
peripheral neuropathy	1.32	(0.97,1.80)	1.51	(1.04,2.19)	1.17	(0.78,1.76)
foot pain	1.34	(1.06,1.69)	1.56	(1.17,2.06)	1.08	(0.79,1.46)
knee osteoarthritis	1.30	(1.03,1.62)	1.28	(0.97,1.70)	1.31	(0.98,1.76)
depression	1.96	(1.37,2.80)	1.81	(1.17,2.82)	2.07	(1.32,3.26)
Medication Use						
number of medications						
0–4	Referent		Referent		Referent	
5–8	0.77	(0.61,0.96)	0.90	(0.68,1.20)	0.66	(0.50,0.88)
9+	1.14	(0.86,1.49)	1.86	(1.34,2.57)	0.60	(0.41,0.87)
uses psychotropic medication	1.36	(1.07,1.74)	1.53	(1.14,2.06)	1.19	(0.86,1.64)
Cognition						
impaired cognition (MMSE 18–24)	1.02	(0.74,1.39)	1.24	(0.85,1.81)	0.77	(0.50,1.18)
Fall-Related						
number falls in past year (per fall)	1.30	(1.21,1.39)	1.31	(1.21,1.42)	1.23	(1.13,1.34)

Characteristics	All Falls		Indoor Falls		Outdoor Falls	
	Rate Ratio	95% CI	Rate Ratio	95% CI	Rate Ratio	95% CI
falls efficacy scale <90	1.33	(0.99,1.77)	1.73	(1.23,2.43)	0.83	(0.55,1.25)

*Rate ratios were estimated using negative binomial regression models. The rate ratio is the average number of falls per person per year of follow-up in one group (e.g., white race/ethnicity) divided by the average number of falls per person per year of follow-up in a referent group (e.g., non-white race/ethnicity). The referent group is specific for each potential risk factor.

Abbreviations: CI = confidence interval; PASE = Physical Activity Scale for the Elderly; MMSE = Mini-Mental State Exam