Risk Factors for Injurious Falls in Older Adults: The Role of Sex and Length of Follow-Up

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OBJECTIVES: To identify sex-specific associations between risk factors and injurious falls over the short (<4 years) and long (4–10 years) term.

DESIGN: Longitudinal cohort study between 2001 and 2011.

SETTING: Swedish National Study on Aging and Care, Kungsholmen, Sweden.

PARTICIPANTS: Community-dwelling adults aged 60 and older (N = 3,112).

MEASUREMENTS: An injurious fall was defined as a fall that required inpatient or outpatient care. Information was collected on participant and exposure characteristics using structured interviews, clinical examinations, and physical function tests at baseline.

RESULTS: The multivariate model showed that, in the short term, living alone (hazard ratio (HR)=1.83, 95% confidence interval (CI)=1.13–2.96), dependency in instrumental activities of daily living (IADLs) (HR=2.59, 95% CI=1.73–3.87), and previous falls (HR=1.71, 95% CI=1.08–2.72) were independently associated with injurious falls in women. Low systolic blood pressure (HR=1.96, 95% CI=1.04–3.71), impaired chair stands (HR=3.00, 95% CI=1.52–5.93), and previous falls (HR=2.81, 95% CI=1.32–5.97) were associated with injurious falls in men. Long-term risk factors were underweight (HR=2.03, 95% CI=1.40–2.95), cognitive impairment (HR=1.49, 95% CI=1.08–2.06), fall-risk increasing drugs (HR=1.67, 95% CI=1.27–2.20 for ≥2 drugs), and IADL dependency (HR=1.58, 95% CI=1.32–5.97) for women and smoking (HR=1.71, 95% CI=1.03–2.84), heart disease (HR=2.20, 95% CI=1.5–3.24), impaired balance (HR=1.68, 95% CI=1.08–2.62), and a previous fall (HR=3.61, 95% CI=1.98–6.61) for men.

CONCLUSION: Men and women have different fall risk profiles, and these differences should be considered when developing preventive strategies. Some risk factors were more strongly predictive of injurious falls over shorter than longer periods and vice versa, suggesting that it may be possible to identify older men and women at short- and long-term risk of injurious falls. **J Am Geriatr Soc 67:246–253, 2019.**

Key words: falls; gender; injury; Swedish National study on Aging and Care in Kungsholmen (SNAC-K)

Injurious falls in older people are of major public health concern because of their medical and economic consequences. Approximately one-third of people aged 65 and older fall every year, and about 10% of those who fall require medical care.[1]

In recent decades, a number of epidemiological studies have investigated fall-related risk factors. Older age, motor and sensory limitations, cognitive impairment, specific diseases, medication use (fall risk–increasing drugs), lifestyle behaviors, mood disorders, and a previous fall are some of the crucial risk factors.[2,3]

Despite numerous studies on risk factors for falls in older adults, studies examining sex differences are scarce.[4–9] Two recent cross-sectional studies examined sex differences in a wide range of risk factors for falls and found several differences between men and women in the associations between risk factors and falls.[6,7] The few longitudinal studies that have examined differences in fall risk factors between men and women examined only 1 or a few risk factors.[8,10] It is important to investigate whether there are sex-specific risk

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factors for falls so as to establish whether sex should be considered in screening and prevention programs for falls, which may better enable a person-centered approach.

Moreover, some risk factors may be more predictive of injurious falls over shorter than over longer periods of follow-up and vice versa.[11] This suggests that it may be possible to identify groups of older adults at long- and short-term risk of injurious falls, which may help to improve fall-prevention strategies. For instance, those at short-term risk may be optimal targets for multifactorial interventions, whereas early detection of people at long-term risk can help clinicians identify older adults who may benefit from early prevention interventions, such as physical exercise. Possible differences in the importance of different risk factors over the short and long term have rarely been investigated.

We therefore aimed to identify sex-specific risk profiles for injurious falls over short (<4 years) and long (4–10 years) follow-up periods in community-living older adults.

METHODS

Study Population

We used data from the Swedish National study on Aging and Care in Kungsholmen.[12] The population aged 60 and older in Kungsholmen, Stockholm, was stratified according to age and then randomly sampled from each of 11 age cohorts (60, 66, 72, 78, 81, 84, 87, 90, 93, 96, ≥99). Between 2001 and 2004, 4,590 individuals who were eligible, of whom 3,363 (73.3%) participated in the baseline examination. We excluded those who lived in institutions (n = 191), and 60 declined the researchers' request to gather data about them from national registers, leaving a final analytical sample of 3,112 people. All participants (or a proxy) provided written consent to participate, and the regional ethical board in Stockholm, Sweden, approved the study.

Data Collection

Nurses and physicians collected data through structured interviews and clinical examinations at enrollment.

Demographic and Lifestyle-Related Factors

Participants were divided into 2 groups according to cohabitation status. Those who lived with a spouse or were married were classified as living with someone, and those who were unmarried, divorced, or widowed were classified as living alone. Education refers to the highest level of formal education achieved and was categorized as elementary, high school, or university. Smoking was categorized as nonsmoker, former smoker, and current smoker. Alcohol consumption was categorized as no or occasional consumption, light to moderate consumption, and heavy consumption.[13] Physical activity level was assessed by asking questions about type, quantity, and intensity, and subjects were categorized as inactive (any physical activity <weekly) or active (any physical activity ≥several times per week).[14] Body mass index (BMI) was categorized as underweight (<20.0 kg/m^2), normal weight (20.0–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese (≥30.0 kg/m^2).[15]

Psychological and Medical Factors

The presence of pain was assessed by asking, "In the last four weeks, have you experienced pain (yes or no)?" Depressive symptoms were assessed using the Montgomery-Åsberg Depression Rating Scale (range 0–60). A score of 7 or greater indicated depressive symptoms.[16] Cognitive impairment was assessed using the Mini-Mental State Examination. A cut-off of 28 was chosen because of the high educational level of participants.[17] Chronic diseases were diagnosed on the basis of information from medical records, clinical examination, and history. A disease was defined as chronic if it was of prolonged duration and resulted in residual disability or poor quality of life or required a long period of care, treatment, or rehabilitation.[18] We evaluated specific diseases (stroke, Parkinson's disease, heart disease, rheumatic disease, arthritis, diabetes mellitus) and multimorbidity (defined as having ≥2 chronic diseases).[18] Low systolic blood pressure (SBP) was defined as less than 130 mmHg.[19]

Medication Use

Use of fall risk–increasing drugs (FRIDs)[20] was categorized as 0, 1, or 2 or more.

Dependency and Physical Function

Functional dependency was measured as dependency in 1 or more activities of daily living (ADLs; bathing, dressing, toileting, transferring or moving, feeding or eating) and in 1 or more instrumental ADLs (IADLs; managing finances, using the telephone, grocery shopping, using transportation, preparing meals, cleaning, doing laundry). *Continence* was dichotomized as continent versus incontinent. Vision was assessed by asking participants whether they had problems with their vision (yes or no).[21]

Assessment of physical performance included tests of balance, walking speed, and the Five Times Sit to Stand Test. One-leg stance balance was defined as the time in seconds that a participant could stand on either leg with eyes open. The test was attempted 2 times per leg, and the longest time was used. Walking speed was assessed by asking the participant to walk at a normal pace for 6 or 2.44 m, depending on location of the test and the participant's ability.[22] For the Five Times Sit to Stand Test, participants were asked to rise from a chair 5 times as quickly as possible without using their arms.[22] Previously defined cut-offs with clinical relevance for fall injuries were chosen for all physical tests. Impaired balance was defined as a time of less than 5 seconds for balance, impaired walking speed as walking speed slower than 0.8 m/s, and impaired strength as inability to perform 5 consecutive chair stands.[23–25]

Assessment of Injurious Falls

An injurious fall was defined as a fall causing an injury that required inpatient or outpatient care.[10] We used hospital discharge diagnoses from the date of the baseline examination until the last available date (December 31, 2011). Diagnoses with the external cause codes W00, W01, W05-W10, and W17-W19 from the *International Classification of Diseases, Tenth Revision*, were included. These codes were

chosen to represent low-trauma falls from the same level with no other person involved. The personal identification number of each participant[26] was used to retrieve these data from the National Patient Register and the Local Outpatient Register.[27] Previous falls were defined as injurious falls that had occurred in the 3 years before baseline.

Data about participants' vital status were obtained from the Swedish Cause of Death Register.

Data Analysis

Because some risk factors were too rare in the study population to provide enough power for the statistical analysis, we included only risk factors with a prevalence of 5% or greater.[28,29] Cox proportional hazards models were used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) of injurious falls for each potential risk factor. Risk factors with more than 1 category were dichotomized when only 1 category was significantly associated with injurious falls. The follow-up time was divided into 2 intervals (<4 years, 4–10 years after baseline examination). Participants were censored at the date of the first injurious fall, death, or the end of the follow-up period, whichever came first. All models were stratified according to sex and follow-up time. First, each potential risk factor was entered separately, adjusting for age and education. Second, all risk factors associated with injurious falls with $p < .20$ in the first model were entered in multivariate models using a backward selection procedure.[6] The goal of the backward selection procedure was to obtain sex-specific risk profiles for long- and short-term risk factors; a significance level of .05 was chosen for the final multivariate models. Finally, we performed joint regression analyses with all the final risk factors and their interaction with sex, to determine whether the differences between men and women were statistically significant. Statistical analyses were performed using Stata version 15 (StataCorp, College Station, TX).

RESULTS

Of the 3,112 participants, 1,981 were female (mean age 75.2 ± 11), and 1,131 were male (mean age 71.5 ± 9.9). During the first follow-up period (<4 years), 229 (11.6%) of the women and 70 (6.2%) of the men experienced an injurious fall. During the second follow-up period (4–10 years), 369 (21.1%) of the women and 140 (13.2%) of the men experienced their first injurious fall after baseline. Distribution of type of injury is presented in Supplementary Table S1. The baseline characteristics of the study participants are presented according to sex in Table 1. Parkinson's disease, rheumatic disease, ADL dependency, and incontinence were not included in the regression models because they were present in a too small a proportion of men and women (<5%). Underweight was excluded only for men.

Tables 2 and 3 shows the association between each risk factor and injurious falls for men and women during the 2 time periods (<4 years and 4–10 years after baseline examination), adjusted for age and education.

The results of the fully adjusted models showed that, for women, during the short follow-up period, living alone (HR=1.83, 95% CI=1.13–2.96), having 1 or more IADL dependencies (HR=2.59, 95% CI=1.73–3.87), and having had a previous fall (HR=1.71, 95% CI=1.08–2.72) were independently associated with injurious falls. For men, sex-specific risk factors were low SBP (HR=1.96, 95% CI=1.04–3.71), impaired strength (HR=3.00, 95% CI=1.52–5.93), and previous falls (HR=2.81, 95% CI=1.32–5.97) (Table 4). During long-term follow-up, risk factors for women were being underweight (HR=2.03, 95% CI=1.40–2.95), being cognitively impaired (HR=1.49, 95% CI=1.08–2.06), consuming fall risk–increasing drugs (1: HR=1.50, 95% CI=1.11–2.03; ≥2: HR=1.67, 95% CI=1.27–2.20), and IADL dependency (HR=1.58, 95% CI=1.32–5.97). Risk factors for men were current smoking (HR=1.71, 95% CI=1.03–2.84), heart disease (HR=2.20, 95% CI=1.50–3.24), impaired balance (HR=1.68, 95% CI=1.08–2.62), and having had a previous fall (HR=3.61, 95% CI=1.98–6.61) (Table 4). Only risk associated with previous falls in long-term follow-up was significantly different between men and women (p for interaction=.01) (results not shown).

DISCUSSION

To the best of our knowledge, this is the first large-scale prospective cohort study to examine sex-specific risk factors for injurious falls over different lengths of follow-up. Our results suggest that men and women have different risk profiles for injurious falls. This is in line with findings of previous cross-sectional studies, that men and women differ not only in incidence and consequences of falls, but also in risk factors for falls.[6,7] Furthermore, our results suggest that some risk factors were predictive of injurious falls over only shorter or longer periods, suggesting that it may be possible to identify groups of older men and women at short- and long-term risk. By considering sex and different time periods, we may be able to better identify older adults at risk of injurious falls and provide a more person-centered care.

In line with previous research, we found that more women than men experienced injurious falls,[4,5] possibly because of poorer physical function and higher prevalence of osteoporosis, but men and women did not differ in the proportion of falls that resulted in serious injury.

One might hypothesize that the differences in circumstances of falls in men and women may help explain the sex-related differences in risk factors for injurious falls. For instance, one study found that men were more likely to fall outdoors, whereas women were more likely to fall indoors, often while doing household chores.[30] If men and women experience fall injuries in different settings and because of different behaviors, the fall risk profiles are likely to vary as well. More studies are needed to determine possible mechanisms and to make fall risk screening and interventions more effective and individualized.

Being dependent in 1 or more IADLs was an important risk factor for women but not men. The differences in circumstances of falls in men and women might explain this finding (because women more frequently fall inside doing chores, they may rely more on their ability to perform IADLs).

We found that impairments in measures of physical function were independent predictors of injurious falls in men but not in women. Age-related decline in muscle strength is more pronounced in men than women.[31] Because men generally have more muscle mass than women, it is possible that men depend more on their strength to maintain postural control.

Table 1. Baseline Characteristics of Swedish National Study of Aging and Care in Kungsholmen, Sweden, Participants

Characteristic	n (%)		P-Value
	Women, n = 1,981	Men, n = 1,131	
Age			<.001
60–66	716 (36.1)	556 (49.2)	
72–78	576 (28.9)	334 (29.5)	
81–87	410 (20.7)	169 (14.9)	
≥90	282 (14.3)	72 (6.4)	
Education			<.001
Elementary	359 (18.2)	157 (13.9)	
High school	1068 (54.2)	476 (42.1)	
University	544 (27.6)	497 (44.0)	
Living alone	1320 (66.9)	398 (35.2)	<.001
Underweight (body mass index <20.0 kg/m^2)	144 (7.9)	40 (3.6)	<.001
Smoking			<.001
Nonsmoker	1046 (53.5)	394 (35.1)	
Former smoker	629 (32.2)	559 (49.7)	
Current smoker	280 (14.3)	171 (15.2)	
Alcohol consumption			<.001
No or occasional	828 (42.3)	254 (22.6)	
Light to moderate	1128 (57.7)	578 (51.4)	
Heavy	0	293 (26.0)	
Physically inactive[1]	649 (32.8)	316 (27.9)	.005
Vision problems	1058 (54.1)	506 (45.0)	<.001
Pain	842 (43.2)	291 (25.9)	<.001
Depressive symptoms[2]	267 (14.3)	111 (10.2)	.001
Cognitive impairment[3]	355 (18.0)	144 (12.7)	<.001
Multimorbidity[4]	1762 (88.9)	939 (83.0)	<.001
Specific diseases			
Stroke	138 (7.0)	78 (6.9)	.94
Parkinson's disease	20 (1.0)	11 (1.0)	.92
Heart disease[5]	444 (22.4)	314 (27.8)	.001
Diabetes mellitus	136 (6.9)	152 (13.4)	<.001
Rheumatic disease	77 (3.9)	47 (4.2)	.71
Arthritis	293 (14.8)	116 (10.3)	<.001
Systolic blood pressure < 130 mmHg	421 (21.4)	249 (22.1)	.66
Number of fall risk–increasing drugs			<.001
0	801 (40.5)	573 (50.7)	
1	432 (21.9)	214 (18.9)	
≥2	744 (37.6)	344 (30.4)	
Any activity of daily living dependency	77 (3.9)	21 (1.9)	.002
Any instrumental activity of daily living dependency[6]	488 (25.3)	150 (13.5)	<.001
Incontinence	68 (3.5)	11 (1.0)	<.001
Impaired walking speed[7]	547 (29.5)	166 (15.3)	<.001
Impaired balance[8]	716 (39.4)	276 (26)	<.001
Impaired strength[9]	465 (24.5)	152 (13.9)	<.001
Previous falls[10]	231 (11.7)	73 (6.5)	<.001

[1]Physically active ≤1 times/wk.
[2]≥7 points on Montgomery-Åsberg Depression Rating Scale.
[3]Mini-Mental State Examination score <28.
[4]≥2 chronic diseases.
[5]Arrhythmia, bradycardia and conduction disease, atrial fibrillation, ischemic heart disease, heart failure.
[6]Managing finances, using telephone, grocery shopping, using public transportation, preparing meals, cleaning, doing laundry.
[7]<0.8 m/s walking test.
[8]<5 seconds 1-leg balance.
[9]Unable to perform 5 consecutive chair stands without using arms.
[10]Any injurious fall during 3 years before baseline.

Living alone was a significant risk factor for falls in all univariate models. This adds weight to the results of previous studies, which found that it is important to take social factors into account when studying risk factors for falls.[6,32,33] In the final model, living alone was a risk factor only for women, a finding that is in line with those of a previous study showing that social determinants of adverse health outcomes are more important for women than for men.[34]

Previous falls remained a significant risk factor in the short-term multivariate models for men and women. This is

Table 2. Individual Risk Factors for Injurious Falls within 4 Years After Baseline, According to Sex, Controlled for Age and Education

Characteristic	Hazard Ratio (95% Confidence Interval) P-Value	
	Women	Men
Living alone	2.17 (1.43–3.30) <.001	2.23 (1.36–3.67) .001
Underweight (body mass index <20.0 kg/m^2)[1]	1.85 (1.25–2.75) .002	- -
Smoking (reference nonsmoker)		
Former smoker	1.08 (0.80–1.47) .61	0.76 (0.45–1.29) .31
Current smoker	1.43 (0.95–2.17) .09	1.46 (0.71–2.99) .30
Alcohol consumption (reference light to moderate)		
No or occasional	1.65 (1.23–2.23) .001	1.25 (0.72–2.17) .42
Heavy	- -	1.38 (0.72–2.65) .33
Physically inactive[2]	1.66 (1.25–2.20) <.001	2.08 (1.27–3.38) .003
Vision problems	1.10 (0.84–1.45) .49	1.15 (0.71–1.88) .57
Pain	1.10 (0.84–1.43) .48	1.86 (1.15–3.01) .01
Depressive symptoms[3]	1.55 (1.11–2.15) .01	1.69 (0.91–3.12) .10
Cognitive impairment[4]	1.42 (1.05–1.91) .02	0.80 (0.42–1.50) .48
Multimorbidity[5]	1.59 (0.73–3.49) .24	1.42 (0.55–3.67) .47
Specific diseases (reference no)		
Stroke	1.24 (0.82–1.89) .31	0.89 (0.38–2.09) .79
Heart disease[6]	1.56 (1.18–2.07) .002	1.55 (0.94–2.54) .09
Diabetes	1.21 (0.77–1.90) .40	1.19 (0.61–2.34) .61
Arthritis	1.13 (0.79–1.60) .51	1.76 (0.94–3.29) .07
Systolic blood pressure < 130 mmHg	1.69 (1.25–2.28) .001	2.00 (1.21–3.31) .007
Fall risk–increasing drugs (reference 0)		
1	1.14 (0.76–1.72) .53	1.43 (0.75–2.72) .27
≥2	1.60 (1.14–2.23) .006	1.46 (0.83–2.57) .19
Any instrumental activity of daily living dependency[7]	3.34 (2.41–4.64) <.001	2.16 (1.22–3.85) .009
Impaired walking speed[8]	2.24 (1.61–3.13) <.001	1.80 (0.99–3.26) .05
Impaired balance[9]	2.41 (1.63–3.54) <.001	2.75 (1.45–5.23) .002
Impaired strength[10]	1.94 (1.43–2.64) <.001	2.57 (1.43–4.63) .002
Previous falls[11]	1.72 (1.26–2.37) .001	2.39 (1.32–4.36) .004

[1]Data left out for men because of <5% prevalence.
[2]Physically active ≤1 times/wk.
[3]≥7 points on Montgomery-Åsberg Depression Rating Scale.
[4]Mini-Mental State Examination score <28.
[5]≥2 chronic diseases.
[6]Arrhythmia, bradycardia and conduction disease, atrial fibrillation, ischemic heart disease, heart failure.
[7]Managing finances, using telephone, grocery shopping, using public transportation, preparing meals, cleaning, doing laundry.
[8]<0.8 m/s walking test.
[9]<5 seconds 1-leg balance.
[10]Unable to perform 5 consecutive chair stands without using arms.
[11]Any injurious fall during 3 years before baseline.

in keeping with the results of many previous studies showing that people who have fallen previously are at higher risk of recurrent falls,[35] although we found a statistically significant interaction between sex and previous injurious falls over long-term follow-up, suggesting that having experienced a previous injurious fall 4 years or more ago was a risk factor only for men. This indicates that women may recover better from an injury, which is in line with previous research and might reflect a sex difference in physical resilience.[36,37]

Cognitive impairment is an established risk factor for falls.[38] This study extends previous research on falls and cognition by showing that cognitive impairment seems to be a stronger risk factor for women than for men. To the best of our knowledge, no other study has found a similar sex difference in impaired cognition and falls. The potential mechanisms are unclear, and further studies are needed to test this finding and explore potential mechanisms.

It is likely that greater risk of fractures due to osteoporosis mediates the association between injurious falls and smoking in men. Our study confirms the results of a Swedish study from 2010.[39] Another study also showed that male smokers had a higher risk of low volumetric bone mineral density and a higher risk of fractures than female smokers.[40]

Our results indicate that use of fall risk–increasing drugs is associated with greater risk of falling. This was more pronounced in women than men and more pronounced over longer follow-up. Medication use, especially polypharmacy, is more common in women.[41]

Heart disease was a risk factor for men, but only in the long follow-up period, and low SBP was a risk factor for men during the short follow-up period. Both conditions have been associated with falls[42,43] and might be mediated by syncope.[42] It is also likely that medication for other conditions, for example heart disease, causes low blood

Table 3. Individual Risk Factors for Injurious Falls 4–10 Years After Baseline, According to Sex, Controlled for Age and Education

Characteristic	Hazard Ratio (95% Confidence Interval) P-Value	
	Women	Men
Living alone	1.31 (1.03–1.68) .03	1.51 (1.07–2.15) .02
Underweight (body mass index <20.0 kg/m^2)[1]	1.84 (1.30–2.62) .001	-
Smoking (reference nonsmoker)		
Former smoker	0.87 (0.68–1.11) .27	1.02 (0.70–1.47) .93
Current smoker	1.11 (0.81–1.54) .51	1.51 (0.90–2.53) .12
Alcohol consumption (reference light to moderate)		
No or occasional	0.99 (0.79–1.24) .95	0.85 (0.55–1.33) .48
Heavy	- -	1.21 (0.80–1.81) .37
Physically inactive[2]	1.37 (1.10–1.71) .007	1.44 (0.99–2.1) .06
Vision problems	1.19 (0.97–1.473.) .10	1.05 (0.74–1.47) .80
Pain	1.18 (0.96–1.45) .12	1.22 (0.83–1.79) .31
Depressive symptoms[3]	1.08 (0.79–1.47) .64	1.87 (1.12–3.13) .02
Cognitive impairment[4]	1.33 (1.00–1.77) .048	1.46 (0.90–2.4) .12
Multimorbidity[5]	1.69 (1.07–2.67) .02	1.11 (0.65–1.89) .70
Specific diseases (reference no)		
Stroke	1.42 (0.97–2.07) .07	0.79 (0.39–1.62) .52
Heart disease[6]	1.47 (1.15–1.88) .002	2.07 (1.46–2.93) <.001
Diabetes	1.18 (0.81–1.72) .39	1.71 (1.08–2.73) .02
Arthritis	1.11 (0.84–1.46) .46	1.11 (0.64–1.95) .70
Systolic blood pressure < 130 mmHg	0.83 (0.61–1.12) .22	1.11 (0.72–1.72) .64
Fall risk–increasing drugs (reference 0)		
1	1.53 (1.16–2.01) .003	1.39 (0.88–2.20) .160
≥2	1.64 (1.28–2.12) <.001	1.84 (1.25–2.72) .002
Any instrumental activity of daily living dependency[7]	1.65 (1.28–2.13) <.001	1.51 (0.90–2.52) .12
Impaired walking speed[8]	1.48 (1.15–1.89) .002	1.72 (1.10–2.68) .02
Impaired balance[9]	1.30 (1.01–1.67) .04	1.94 (1.28–2.92) .002
Impaired strength[10]	1.20 (0.92–1.57) .17	2.02 (1.26–3.24) .003
Previous falls[11]	1.25 (0.89–1.75) .21	2.75 (1.64–4.61) <.001

[1]Data left out for men because of <5% prevalence.
[2]Physically active ≤1 times/wk.
[3]≥7 points on Montgomery-Åsberg Depression Rating Scale.
[4]Mini-Mental State Examination score <28.
[5]≥2 chronic diseases.
[6]Arrhythmia, bradycardia and conduction disease, atrial fibrillation, ischemic heart disease, heart failure.
[7]Managing finances, using telephone, grocery shopping, using public transportation, preparing meals, cleaning, doing laundry.
[8]<0.8 m/s walking test.
[9]<5 seconds 1-leg balance.
[10]Unable to perform 5 consecutive chair stands without using arms.
[11]Any injurious fall during 3 years before baseline.

pressure. The hypothesis that men have poorer orthostatic tolerance than women, as suggested in a previous study[44] might explain the sex difference in importance of low SBP and heart disease for future risk of falls.

One might interpret the long-term risk factors as early indicators of a general decline in health that can lead to injurious falls several years later. Heart disease, smoking, low BMI, and polypharmacy are all linked to poor health in older adults and were found to be associated with falls in previous studies.[20,39,42,45] In addition, vascular risk factors (e.g., smoking) can increase risk of physical decline.[46,47] Our results are in line with those of recent meta-analyses that suggest that generic early prevention, such as physical activity,[48,49] may help prevent injurious falls over the long term.

A strength of this study is that we used data from a large community-based sample with a long follow-up time. In addition, our outcome was an objective measure of injurious falls from high-quality register data.[27] This might also be a limitation, because less-severe falls are not registered if individuals do not need to seek health care. Furthermore, we used objective testing of several variables and different sources of medical diagnoses, including direct clinical examination, limiting potential measurement bias, although a few variables were self-reported (e.g., vison impairment). Although a mixture of measured and self-reported risk factors is commonly included in studies on fall risk,[3] the use of self-reported data may be a limitation. A few other factors might influence the interpretation of the results of this study; first, the different cut-offs used for some risk factors are derived from previous literature and might not be equally adequate for both sexes, and second, the difference in power (due to uneven proportions) between men and women makes the magnitude of the risks difficult to compare directly. The possible lack of power may also be the reason for the nonsignificant interactions

Table 4. Results of Multivariate Analyses of Injurious Falls < 4 Years and 4–10 Years After Baseline According to Sex

Characteristic	Hazard Ratio (95% Confidence Interval)			
	<4 years		4–10 years	
	Women	Men	Women	Men
Living alone	1.83 (1.13–2.96)	-	-	-
Underweight (body mass index <20.0 kg/m^2)	-	-	2.03 (1.40–2.95)	-
Current smoker	-	-	-	1.71 (1.03–2.84)
Cognitive impairment[1]	-	-	1.49 (1.08–2.06)	-
Heart disease[2]	-	-	-	2.20 (1.50–3.24)
Systolic blood pressure < 130 mmHg	-	1.96 (1.04–3.71)	-	-
Number of fall risk–increasing drugs (reference 0)				
1	-	-	1.50 (1.11–2.03)	-
≥2	-	-	1.67 (1.27–2.20)	-
Any instrumental activity of daily living dependency[3]	2.59 (1.73–3.87)	-	1.58 (1.19–2.11)	-
Impaired balance[4]	-	-	-	1.68 (1.08–2.62)
Impaired strength[5]	-	3.00 (1.52–5.93)	-	-
Previous falls[6]	1.71 (1.08–2.72)	2.81 (1.32–5.97)	-	3.61 (1.98–6.61)

Final multivariate models from backward elimination with a .05 significance limit. Controlled for age and education in all elimination steps.
[1]Mini-Mental State Examination score <28.
[2]Arrhythmia, bradycardia and conduction disease, atrial fibrillation, ischemic heart disease, heart failure.
[3]Managing finances, using telephone, grocery shopping, using public transportation, preparing meals, cleaning, doing laundry.
[4]<5 seconds 1-leg balance.
[5]Unable to perform 5 consecutive chair stands without using arms.
[6]Any injurious fall during 3 years before baseline.

between the 2 groups. Finally, the relatively healthy and well-educated sample may limit the generalizability of the results.

CONCLUSIONS

Fall risk profiles may differ according to sex, and these differences should be considered when developing preventive strategies. Additional studies are needed to further examine sex differences in fall risk factors and to determine possible underlying mechanisms.

Some risk factors were more strongly predictive of injurious falls over shorter than longer periods and vice versa, suggesting that it may be possible to identify older men and women at short- and long-term risk of injurious falls.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article.

Supplementary Table S1. Type of Injury <4 Years and 4–10 Years After Baseline, According to Sex.