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Original Contribution

Sex Differences in the Association Between Pain and Injurious Falls in Older Adults: A Population-Based Longitudinal Study

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We investigated whether there are sex differences in the association between pain and incident injurious falls. A total of 2,934 people (ages ≥60 years) from the population-based Swedish National Study on Aging and Care in Kungsholmen (2001–2004) participated. Participants were followed up for 3 and 10 years for falls leading to hospitalization or outpatient care. Data were analyzed with flexible parametric survival models that adjusted for potential confounders. During the first 3 years of follow-up, 67 men and 194 women experienced an injurious fall, and over 10 years of follow up, 203 men and 548 women experienced such a fall. In men, the presence of pain, having pain that was at least mild, having pain that affected several daily activities, and having daily pain all significantly increased the likelihood of incurring an injurious fall during the 3-year follow-up period. The multivariate-adjusted hazard ratios ranged from 1.78 (95% confidence interval: 1.00, 3.15) for the presence of pain to 2.89 (95% confidence interval: 1.41, 5.93) for several daily activities' being affected by pain. Results for the 10-year follow-up period were similar. No significant associations were detected in women. Although pain is less prevalent in men than in women, its impact on risk of injurious falls seems to be greater in men.

aged; falls; injury; pain; sex factors

Abbreviation: SD, standard deviation.

Injurious falls are a major public health concern and are associated with risk of disability, nursing home admissions, and death in older people. They also lead to considerable costs for society (1). Injurious falls have been associated with higher risk of disability and nursing home admissions than other conditions (e.g., diseases) that lead to hospitalization (2). The prevention of injurious falls should therefore be a high priority in society.

Successful preventive interventions depend on identifying and managing risk factors for falls. Pain is common in the older population and is a major cause of mobility limitation and disability (3–5). Studies of older adults have shown that pain also increases the likelihood of falls (4, 6–11). However, few studies have investigated whether the increased risk of falls in older people with pain also translates to an increased risk of fall-related injuries. One study found that pain of at least moderate intensity increased the likelihood of falls but not fractures in older men (12). Another study suggested that widespread pain of moderate-to-high intensity was associated with falls and fractures in older women with disabilities (7).

Previous studies have shown that the incidence of (13), risk factors for (14, 15), and consequences of (16) falls may differ in men and women. For instance, older women fall more frequently than older men and have a higher risk of experiencing injurious falls, possibly because older women have poorer physical function and a higher prevalence of osteoporosis than older men (13, 16). In addition, studies have shown that the prevalence of pain is higher in women than in men (17, 18) and that women may be more likely than men to experience severe pain (19). However, studies have not yet established whether the association between pain and injurious falls differs in older men and women (8). Therefore, our objective in this study was to examine whether there were sex differences in the associations between pain characteristics (location, intensity, frequency, and interference with daily activities) and incident injurious falls in older adults during short (3 years) and long (10 years) periods of observation.

METHODS

Study population

Participants comprised people aged 60 years or older from a population-based study, the Swedish National Study on Aging and Care in Kungsholmen (SNAC-K) (20). The study used stratified sampling. The population of Kungsholmen, an island in central Stockholm, was first stratified by age, and then a random sample of individuals was selected from each age cohort. A total of 11 age cohorts were chosen, with 6-year intervals between the younger cohorts (ages 60, 66, and 72 years) and 3-year intervals between the older cohorts (ages 78, 81, 84, 87, 90, 93, 96, and ≥99 years). Baseline data were collected from 2001 through 2004.

A total of 5,111 people were initially selected to participate. Two hundred died before the start of the study, contact information was unavailable for 262 people, 32 had moved, 23 did not speak Swedish, and 4 were deaf. Of the remaining 4,590 people, 3,363 (73.3%) participated in the baseline examination. In this study, we excluded an additional 349 people who had dementia (diagnosed in accordance with the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*, criteria) or who lived in an institution, because self-reported pain is difficult to measure in these groups (21). Of the remaining 3,014 people, pain questionnaire data were missing for 35 and outcome data for 45. The analytical sample ($n = 2,934$) was significantly younger (mean age = 73.1 (standard deviation (SD), 10.3) years vs. mean age = 86.3 (SD, 10.2) years; $P < 0.01$) than the group of eligible nonparticipants and included fewer women (62.6% women vs. 80.2% women; $P < 0.01$).

The Swedish National Study on Aging and Care in Kungsholmen was approved by the Regional Ethical Review Board in Stockholm, Sweden. Written informed consent was collected from participants. If the person could not answer (e.g., was cognitively impaired), consent was obtained from a proxy (usually a close family member).

Data collection

Data on demographic, health, and lifestyle factors were collected at our research center via interviews, clinical examinations, and testing by trained staff. Home visits were conducted with persons who agreed to participate but were unable or unwilling to come to the center.

An injurious fall was defined as hospitalization for or receipt of outpatient care because of a fall (22). *International Classification of Diseases, Tenth Revision*, discharge diagnoses assigned from the date of the baseline examination to the last available date (December 31, 2011) were used. These included the external-cause codes W00, W01, W05–W10, and W17–W19: falls on the same level (codes W00, W01, and W18); falls from furniture, wheelchairs, etc. (codes W05–W09); falls from one level to another (e.g., from stairs) (codes W10 and W17); and unspecified falls (code W19). We did not include injurious falls caused by other people or by falling from heights, because these were considered extreme events (e.g., code W12: falling from scaffolding). Information on falls was retrieved from the National Patient Register, which includes data from inpatient care and specialized outpatient care, and from the Local Outpatient Register, which includes data from primary care given in the Stockholm County Council area (23). Outcome status was determined by linking each participant's personal identification number to the registers. Because of the personal identification number, these data are highly reliable (24). Previous injurious falls were defined as falls occurring up to 3 years before the baseline examination. Information about the vital status of the participants up to December 31, 2011, was obtained from the Swedish Cause of Death Registry.

We assessed pain characteristics that have been described as important in the assessment of pain by the American Geriatrics Society, including the location, intensity, and frequency of pain and its interference with daily activities (25). Pain characteristics were determined with a questionnaire that asked about pain experienced during the previous 4 weeks (26). The presence of pain was assessed with the question, "In the last 4 weeks, have you experienced pain?". Response alternatives were "yes" and "no." The location of pain was determined with a 9-item question that ascertained whether the person had pain in the head, neck, back, joints, shoulders/upper extremities, lower extremities/feet, chest, abdomen, or genitals. We classified pain location by the number of pain sites: no pain, pain at a single location, and pain at 2 or more locations (6, 27). People with pain in their joints were classified as having pain at 2 or more locations. The intensity of pain was assessed with the question, "In the last 4 weeks, how much pain have you had?". Response options were "none," "very mild," "mild," "moderate," "severe," and "very severe" (6). In the analyses, we categorized pain intensity as no pain ("none") or very mild pain, mild-to-moderate pain, and severe or very severe pain. Interference with daily activities/conditions was determined via the 6-item question, "In the last 4 weeks, how much did pain interfere with: 1) mood, 2) mobility, 3) sleep, 4) normal work (including housework), 5) leisure activities, and 6) the joy of living?". For each item, response options were "not at all," "a little bit," "moderately," "quite a bit," and "extremely." Interference was categorized as moderate or more than mild interference with 0, 1–2, or 3 or more activities/conditions (12). Frequency of pain was assessed by asking, "In the last 4 weeks, how often have you had pain?". Response options were "once or twice," "a few times," "quite often," "very often," "daily," or "almost daily." For the analyses, we categorized the answers as almost never (once or twice), sometimes (a few times, quite often, very often), or daily/almost daily (11).

Demographic factors included data on age, sex, and level of education. Education was measured as the highest level of formal education completed and was categorized as elementary school, high school, or university and above. Medical conditions assessed included diabetes, chronic obstructive pulmonary disease, cardiovascular disease, cerebrovascular disease, and musculoskeletal disease. Information on medical conditions was ascertained on the basis of self-reported medical history, clinical examination (including an electrocardiogram), laboratory tests (e.g., a glycosylated hemoglobin level of 5.4% or higher for diabetes) (28), medication data, and the National Patient Register. Cardiovascular disease included ischemic heart disease, atrial fibrillation, and heart failure. Musculoskeletal disease included arthrosis, arthritis, and osteoporosis.

Diseases were categorized in accordance with the *International Classification of Diseases, Tenth Revision*.

Medications that increased the risk of falls were defined in accordance with the Swedish National Board of Health and Welfare's guidelines (29). They included Anatomical Therapeutic Chemical codes C01D, C02, C03, C07, C08, C09, G04CA, N04B, N05A, N05B, N05C, and N06A (29). In the analyses, we categorized the number of fall-risk-increasing drugs as 0, 1, or 2 or more. Analgesic medications included opioids and nonopioid pain medications. Fatigue was assessed via the question, "In the past 3 months, have you been bothered by fatigue?". Depressive symptoms were assessed with the Montgomery-Åsberg Depression Rating Scale (30). The scale has a maximum score of 60, and a score of 7 or more indicates depressive symptomology (31).

Mobility was assessed with tests of balance (one-leg-standing), self-selected walking speed (measured for 6 m, or over 2.4 m if the participant reported walking quite slowly), and the ability to stand up from a sitting position (32, 33). Mobility limitation was defined as at least one of the following: inability to balance on 1 leg for 5 seconds, a walking speed of less than 0.8 m/second, or inability to stand 5 times without using one's arms (34–36). Vision was assessed by asking participants if they experienced vision problems (even if they wore glasses). Cognitive function was examined using the Mini-Mental State Examination (37), and persons with scores of 27 or less were categorized as having cognitive impairment. This cutoff is more clinically useful than the traditional cutoff of 24 for identifying cognitive impairment and dementia in highly educated people (38). Physical exercise was divided into 3 categories on the basis of intensity and frequency of physical exercise during the past 12 months (39): 1) inadequate—less than weekly light and/or intensive activity; 2) health-enhancing—light exercise several times per week; and 3) fitness-enhancing—moderate/intense exercise several times per week. Body mass index (weight (kg)/height $(m)^2$) was divided into the categories underweight (<20), normal weight (20–24.9), overweight (25–29.9), and obesity (≥30) (40). Smoking status was categorized as never, former, or current smoking. Alcohol consumption was categorized as none or occasional, light-to-moderate (1–14 drinks/week for men or 1–7 drinks/week for women), or heavy (≥15 or more drinks/week for men or ≥8 or more drinks/week for women) (41).

Statistical analyses

Baseline characteristics were compared by sex using the χ^2 test for categorical variables and Student's *t* test for continuous variables. Incidence rates of injurious falls and associated 95% confidence intervals were estimated per 1,000 person-years. Flexible parametric survival models were used to estimate hazard ratios and 95% confidence intervals for the association between pain and injurious falls separately for each pain characteristic. Participants were considered at risk for an injurious fall from the date of the baseline examination to the date of the injurious fall, death, or the end of the follow-up period, whichever came first. The likelihood of injurious falls was analyzed for 2 different follow-up periods: 3 years after baseline and 10 years after baseline. A total of 243 participants (100 men and 143 women) died within 3 years of baseline, and 904 (354 men and 550 women) died within 10 years. The first model (model 1) adjusted for demographic factors (age and education). In the second model (model 2), in addition to the covariates included in model 1, the following covariates were entered using a backward selection procedure: diabetes, chronic obstructive pulmonary disease, cardiovascular disease, cerebrovascular disease, musculoskeletal disease, fatigue, use of fall-risk-increasing drugs, use of analgesics, depressive symptomology, mobility limitation, vision problems, cognitive impairment, physical exercise, body mass index, smoking status, alcohol consumption, and previous injurious falls. Covariates with *P* values of 0.2 or more were excluded from the final model. Statistical interactions were tested by simultaneously including the independent variables and their cross-product variables in the same model.

Finally, to confirm the results of the main analyses, we also conducted analyses with a serious injurious fall (fracture, dislocation, or intracranial injury or other severe injury (e.g., nerve injury)) as the outcome. Statistical analyses were performed with Stata, version 14 (StataCorp LP, College Station, Texas).

RESULTS

During the 3-year follow-up period (mean duration of follow-up = 2.8 (SD, 0.6) years), 261 people (67 men and 194 women) experienced an injurious fall, and during the 10-year follow-up period (mean duration of follow-up = 6.9 (SD, 2.9) years), 751 people (203 men and 548 women) experienced an injurious fall. The fall rate per 1,000 person-years was 25.8 (95% confidence interval: 22.5, 29.6) for men and 43.8 (95% confidence interval: 40.3, 47.7) for women. The baseline characteristics of the study participants are shown by sex in Table 1. Men were more likely than women to have a university education, to engage in intensive exercise, to be overweight or obese, to be former or current smokers, to be light-to-moderate consumers of alcohol, and to have diabetes or cardiovascular disease. Women were, on average, older than men and more likely to have musculoskeletal disease, fatigue, depressive symptomology, mobility limitation, vision problems, and cognitive impairment. A higher percentage of women than of men used fall-risk-increasing drugs and analgesics and had experienced a previous injurious fall.

Pain was reported by 1,090 participants (37.2%), including 286 (26.1%) of the 1,096 men and 804 (43.7%) of the 1,838 women (Tables 2 and 3). Women were significantly more likely to report pain and to have pain of at least mild intensity than men ($P < 0.001$; not shown). Furthermore, women were nearly twice as likely as men to have pain at several sites (22.8% vs. 11.2%), to have severe or very severe pain (15.9% vs. 8.2%), to have 3–6 daily activities that were at least moderately affected by pain (14.7% vs. 7.3%), and to have daily or almost daily pain (31.0% vs. 17.2%) (Tables 2 and 3).

We detected significant interactions between sex and all pain characteristics in association with injurious falls ($P < 0.05$). Therefore, all results are presented by sex. After adjusting for demographic factors, we found that in men, the presence of pain, pain at several sites, mild-to-moderate and severe or very severe pain, 3–6 daily activities/conditions being at least

Table 1. Baseline Characteristics of Participants in the Swedish National Study on Aging and Care in Kungsholmen, by Sex, Sweden, 2001–2004

Baseline Characteristic	Men (n = 1,096)		Women (n = 1,838)		*P* Value
	No. of Persons	%	No. of Persons	%	
Education					<0.001
Elementary school	145	13.2	305	16.6	
High school	459	41.9	998	54.5	
University	491	44.8	530	28.9	
Medical conditions					
Diabetes mellitus	150	13.7	126	6.9	<0.001
Chronic obstructive pulmonary disease	55	5.0	85	4.6	0.628
Cardiovascular disease	380	34.7	520	28.3	<0.001
Cerebrovascular disease	72	6.6	111	6.0	0.566
Musculoskeletal disease	153	14.0	441	24.0	<0.001
No. of fall-risk-increasing drugs					<0.001
0	569	51.9	786	42.8	
1	212	19.3	424	23.1	
≥2	315	28.7	627	34.1	
Use of analgesic medication	110	10.0	285	15.5	<0.001
Fatigue	64	5.8	207	11.3	<0.001
Depressive symptomology	99	9.3	235	13.2	0.001
Mobility limitation	351	32.3	834	45.7	<0.001
Vision problems	488	44.7	985	54.0	<0.001
Cognitive impairment	143	13.1	308	16.8	0.008
Physical exercise					<0.001
Inactive	289	26.4	545	29.7	<0.001
Moderate exercise	521	47.5	937	51.0	
Intensive exercise	286	26.1	356	19.4	
Body mass index[a]					<0.001
<20 (underweight)	34	3.2	128	7.4	
20–24.9 (normal weight)	379	35.1	765	44.0	
25–29.9 (overweight)	519	48.1	624	35.9	
≥30 (obesity)	148	13.7	220	12.7	
Smoking status					<0.001
Never smoker	379	34.7	962	52.8	
Former smoker	544	49.9	595	32.6	
Current smoker	168	15.4	266	14.6	
Alcohol consumption					<0.001
None or occasional	240	22.1	727	39.8	
Light to moderate	731	67.2	731	40.0	
Heavy	117	10.8	369	20.2	
Previous injurious fall	66	6.0	185	10.1	<0.001
Age, years[b]	71.1 (9.7)		74.2 (10.5)		<0.001

[a] Weight (kg)/height (m)^2.
[b] Values are expressed as mean (standard deviation).

moderately affected by pain, and daily or almost daily pain significantly increased the risk of injurious falls during the short (3-year) and long (10-year) observation periods (Table 2). In the fully adjusted model, these associations were attenuated, but almost all remained statistically significant. The exceptions were the number of pain sites during the 3-year follow-up and the presence of pain during the 10-year follow-up (Table 2). No significant associations between pain and injurious falls were detected in women (Table 3).

We also examined interactions between age groups (<78 years vs. ≥78 years) and all pain characteristics; no differences were detected between the 2 age groups. Of those persons who experienced an injurious fall during the 10-year follow-up period, 132 (65.0%) men and 357 (65.2%) women had a serious injurious fall ($P = 0.975$) (see Web Table 1, available at https://academic.oup.com/aje). The results of the analyses in which the outcome was serious fall injuries were similar to those reported in Tables 2 and 3, although in the fully adjusted model only the intensity of pain remained significantly associated with serious injurious falls in men (Web Table 2).

DISCUSSION

To the best of our knowledge, this was the first study to examine sex differences in the association between pain and injurious falls in a population-based sample of older adults. We found that men with at least mild pain, men who had several daily activities that were affected by pain, and men who experienced daily pain had a significantly increased likelihood of injurious falls in both the 3-year and 10-year follow-up periods. No significant association was observed between pain and injurious falls in women.

Previous studies have found that pain and its location, severity, and interference with daily activities are all associated with fall risk in older adults (6, 7, 12, 27). Most studies on pain and falls have examined men and women as a single group (6, 8, 27), and few have investigated the relationship between pain and injurious falls (7, 12). Our results contradict those of a recent study that did not find an association between pain and fractures in a sample of older men living in the community (12). The results of the current study also contrast with those of 2 other studies, which found that back pain is associated with falls in older women who live in the community (11) and that widespread pain is associated with falls and self-reported fractures in older women with disabilities (7). However, the study sample and the outcome of the present study differ from those of the above-mentioned studies (6–8, 11, 12, 27). Furthermore, the previous studies examined either self-reported falls or fractures. We focused on administratively collected data on injurious falls, which are often more severe than self-reported falls and may have a partly different etiology than fractures, which are strongly associated with osteoporosis.

We found that pain was more prevalent in women than in men, a finding consistent with the findings of previous studies (17–19). This result might be explained in part by sex differences in sensitivity to pain; for example, women generally exhibit a lower pain threshold and less pain tolerance than men (42, 43). There are several possible explanations for our finding of sex differences in the association between pain and

Table 2. Hazard Ratios for Injurious Falls During 3 and 10 Years of Follow-up Among 1,096 Men Who Participated in the Swedish National Study on Aging and Care in Kungsholmen, Sweden, 2001–2004

Pain Characteristic	Participants With Pain		Fall Rate per 1,000 Person-Years		Duration of Follow-up and Model[a]							
					3 Years[b]				10 Years[c]			
					Model 1[d]		Model 2[e]		Model 1[d]		Model 2[f]	
	No.	%	Rate	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Presence of pain	286	26.1	32.7	25.5, 41.8	1.94	1.15, 3.28	1.78	1.00, 3.15	1.55	1.13, 2.14	1.37	0.98, 1.91
No. of pain sites												
No pain	814	74.3	23.7	20.1, 27.9	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
Pain at 1 site	159	14.5	28.2	19.8, 40.1	1.82	0.94, 3.52	1.65	0.76, 3.57	1.20	0.78, 1.87	1.08	0.68, 1.70
Pain at several sites	123	11.2	38.3	26.9, 54.5	2.00	0.99, 4.06	1.77	0.82, 3.80	2.10	1.43, 3.07	1.79	1.19, 2.69
Intensity of pain[g]												
None or very mild	867	79.4	23.1	19.7, 27.2	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
Mild to moderate	136	12.5	32.6	22.8, 46.6	2.40	1.21, 4.76	2.32	1.08, 4.97	1.70	1.13, 2.55	1.54	0.98, 2.41
Severe or very severe	89	8.2	47.3	32.2, 69.5	2.90	1.45, 5.77	2.85	1.33, 6.08	2.61	1.69, 4.03	2.44	1.53, 3.87
No. of daily activities/conditions at least moderately affected by pain												
0	909	82.9	23.6	20.2, 27.6	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
1–2	107	9.8	27.2	17.4, 42.7	1.56	0.70, 3.50	1.59	0.65, 3.90	1.31	0.78, 2.18	1.21	0.71, 2.01
3–6	80	7.3	53.9	36.7, 79.2	3.05	1.59, 5.85	2.89	1.41, 5.93	2.46	1.62, 3.74	2.22	1.44, 3.41
Frequency of pain[g]												
Never	810	74.2	23.6	20.0, 27.8	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
Sometimes	93	8.5	26.1	16.5, 41.5	1.21	0.53, 2.78	1.04	0.39, 2.81	1.09	0.64, 1.84	0.95	0.54, 1.64
Daily or almost daily	188	17.2	37.2	27.8, 49.9	2.40	1.35, 4.27	2.24	1.19, 4.21	1.90	1.33, 2.71	1.64	1.13, 2.39

Abbreviations: CI, confidence interval; HR, hazard ratio.

[a] Results were derived from separate flexible parametric survival models for pain characteristics.

[b] During the 3-year follow-up period, 67 men experienced an injurious fall and 100 died.

[c] During the 10-year follow-up period, 203 men experienced an injurious fall and 354 died.

[d] Model 1 adjusted for demographic characteristics (age and education).

[e] In model 2 with 3 years of follow-up, additional adjustments were made for chronic obstructive pulmonary disease, cardiovascular disease, cognitive impairment, physical exercise, body mass index, smoking status, alcohol consumption, and previous injurious falls.

[f] In model 2 with 10 years of follow-up, additional adjustments were made for chronic obstructive pulmonary disease, cardiovascular disease, vision problems, cognitive impairment, physical exercise, smoking status, alcohol consumption, and previous injurious falls.

[g] Missing data: intensity of pain, $n = 4$; frequency of pain, $n = 5$.

Table 3. Hazard Ratios for Injurious Falls During 3 and 10 Years of Follow-up Among 1,838 Women Who Participated in the Swedish National Study on Aging and Care in Kungsholmen, Sweden, 2001–2004

Pain Characteristic	Participants With Pain		Fall Rate per 1,000 Person-Years		Duration of Follow-up and Model[a]							
					3 Years[b]				10 Years[c]			
					Model 1[d]		Model 1[e]		Model 1[d]		Model 1[f]	
	No.	%	Rate	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Presence of pain	804	43.7	48.9	43.3, 55.2	1.12	0.83, 1.53	0.94	0.68, 1.30	1.10	0.92, 1.32	0.93	0.76, 1.14
No. of pain sites												
No pain	1,041	56.6	40.2	35.8, 45.1	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
Pain at 1 site	378	20.6	48.7	40.8, 58.3	1.03	0.71, 1.51	0.97	0.66, 1.43	1.03	0.81, 1.29	0.94	0.73, 1.19
Pain at several sites	419	22.8	48.9	41.3, 57.7	1.22	0.84, 1.77	0.91	0.61, 1.36	1.17	0.94, 1.45	0.91	0.71, 1.18
Intensity of pain[g]												
None or very mild	1,159	63.4	38.6	34.6, 43.1	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
Mild to moderate	379	20.7	45.7	38.1, 54.8	1.11	0.75, 1.66	0.98	0.65, 1.47	1.12	0.89, 1.41	0.99	0.77, 1.27
Severe or very severe	291	15.9	63.5	52.8, 76.3	1.28	0.88, 1.86	0.93	0.62, 1.39	1.24	0.98, 1.58	0.98	0.74, 1.31
No. of daily activities/conditions at least moderately affected by pain												
0	1,277	69.5	40.4	36.4, 44.8	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
1–2	290	15.8	47.1	38.3, 57.8	1.14	0.75, 1.72	1.00	0.66, 1.52	1.10	0.85, 1.42	0.95	0.73, 1.25
3–6	271	14.7	58.1	47.6, 70.8	1.29	0.86, 1.92	0.89	0.58, 1.37	1.11	0.86, 1.44	0.86	0.64, 1.14
Frequency of pain[g]												
Never	1,034	56.9	40.0	35.7, 44.9	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
Sometimes	219	12.1	40.4	31.5, 51.8	1.00	0.60, 1.68	0.96	0.57, 1.62	1.03	0.76, 1.38	0.91	0.66, 1.24
Daily or almost daily	564	31.0	51.5	44.6, 59.4	1.15	0.83, 1.60	0.91	0.64, 1.29	1.11	0.91, 1.35	0.92	0.73, 1.15

Abbreviations: CI, confidence interval; HR, hazard ratio.

[a] Results were derived from separate flexible parametric survival models for pain characteristics.

[b] During the 3-year follow-up period, 194 women experienced an injurious fall and 143 died.

[c] During the 10-year follow-up period, 548 women experienced an injurious fall and 550 died.

[d] Model 1 adjusted for demographic characteristics (age and education).

[e] In model 2 with 3 years of follow-up, additional adjustments were made for chronic obstructive pulmonary disease, cardiovascular disease, fatigue, number of fall-risk-inducing medications, analgesics, depressive symptomology, mobility limitation, physical exercise, body mass index, and previous injurious falls.

[f] In model 2 with 10 years of follow-up, additional adjustments were made for cardiovascular disease, musculoskeletal disease, number of fall-risk-inducing medications, analgesics, cognitive impairment, physical exercise, and previous injurious falls.

[g] Missing data: intensity of pain, $n = 9$; frequency of pain, $n = 21$.

injurious falls. First, women may be more likely to exhibit fear of pain than men (43, 44). This could lead to avoidance of vigorous activities, which could either benefit the women by helping them avoiding further harm or harm them by leading to inactivity and risk of disability (43, 44). Thus, it is possible that the sex differences found in the present study can be partly explained by more careful behavior in women with pain than in men with pain. Second, men may be less likely to accept adaptive devices (e.g., canes, walkers) that may mitigate the risk that pain poses during walking. Third, despite higher pain thresholds, men exhibit higher levels of cardiovascular stress (e.g., increased blood pressure) than women in response to pain (42). A 2015 study found that cardiovascular stress increased fall risk in men but not in women (45). However, the mechanism underlying this association is not clear.

The strengths of our study include the community-based sample of older people, the extensive assessment of pain, and the long follow-up time. Furthermore, the results were confirmed via sensitivity analyses that included only serious injurious falls and were adjusted for a number of important confounders. Importantly, we found that men and women did not differ in terms of the proportion of falls that resulted in a serious injury. We used an objective measure of injurious falls, employing official registers with high coverage (23) that included both fall-related hospitalizations and outpatient care. These registers are generally seen as reliable data sources. For example, one study found that 98.3% of the hospitalizations due to falls were correctly coded (23). Our outcome may reflect underestimation of actual fall rates, however, since less severe falls were most likely not included. Other limitations of the study include the pain questionnaire, which did not allow us to distinguish between musculoskeletal pain and other types of pain. The period of pain assessment (the previous 4 weeks) was shorter than in other studies (4, 6–11), but this may have resulted in more accurate recall and more reliable answers. Finally, the study included a community-dwelling sample of relatively healthy and well-educated people, and more women than men were excluded from the analytical sample. This may have led to underestimation of the association between pain and injurious falls in women. However, the fall rates in this study (25.8 for men and 43.8 for women per 1,000 person-years) were comparable to those of a study that examined the incidence of fall-related hospitalization in a national sample of Swedish adults aged ≥65 years (1,645.6 for men and 2,913.8 for women per 100,000 person-years) (46).

In conclusion, our results suggest that there are significant sex differences in the association between pain and injurious falls in old age. Although pain is less prevalent in men than in women, its impact on risk of injurious falls seems to be greater in men.

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