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Research Article

A Prospective Study of Back Pain and Risk of Falls Among Older Community-dwelling Men

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Abstract

Background: Musculoskeletal pain is associated with increased fall risk among older men. However, the association of back pain, the most prevalent type of pain in this population, and fall risk is unknown.
Methods: We conducted a prospective investigation among 5,568 community-dwelling U.S. men at least 65 years of age from the Osteoporotic Fractures in Men Study (MrOS). Baseline questionnaires inquired about back pain and its location (such as low back), severity, and frequency in the past year. During 1 year of follow-up, falls were summed from self-reports obtained every 4 months. Outcomes were recurrent falls (≥2 falls) and any fall (≥1 fall). Associations of back pain and fall risk were estimated with risk ratios (RRs) and 95% confidence intervals (CIs) from multivariable log-binomial regression models adjusted for age, dizziness, arthritis, knee pain, urinary symptoms, self-rated health, central nervous system medication use, and instrumental activities of daily living.
Results: Most (67%) reported any back pain in the past year. During follow-up, 11% had recurrent falls and 25% fell at least once. Compared with no back pain, any back pain was associated with elevated recurrent fall risk (multivariable RR = 1.3, 95% CI: 1.1, 1.5). Multivariable RRs for 1, 2, and 3+ back pain locations were, respectively, 1.2 (95% CI: 1.0, 1.5), 1.4 (1.1, 1.8), and 1.7 (95% CI: 1.3, 2.2). RRs were also elevated for back pain severity and frequency. Back pain was also associated with risk of any fall.
Conclusions: Among older men, back pain is independently associated with increased fall risk.

Keywords: Public health—Epidemiology—Cohort studies—Risk factors

Pain is highly prevalent among U.S. adults aged 65 years or older. More than 50% of this population reports pain in at least one part of the body in the past month (1). The most prevalent site of pain among older adults is back pain (1,2), which often leads to restriction in usual activities, reduced physical functioning, and poorer mental health status (3–8). In turn, poor physical and mental functioning are established risk factors for falls (9–11). Because falls constitute a major source of morbidity and mortality in older adults, determining the effects of pain and pain sites on fall risk is of clinical and public health relevance.

Prospective studies demonstrate that pain, especially chronic pain, is associated with risk of future falls among community-dwelling older adults (12–14). Recent meta-analyses confirm that pain is a risk factor for both falls and recurrent falls (15,16). Of the specific pain sites examined, most studies (13,14,17–19), but not all (20), show that self-reported hip pain or knee pain are associated with increased fall risk. In contrast, results of prospective studies about back pain and risk of falls are mixed: Some report no association (13,20) and others report a positive association (19,21). Thus, the extent to which back pain and fall risk are associated still requires investigation.

Although back pain prevalence tends to be higher in women, it is common among both sexes. Specifically, about 30% of older women and about 25% of older men report an episode in the past 1–3 months (1,2). Among community-dwelling older U.S. women, those with a history of back pain at baseline were at higher risk of falls in the subsequent year, especially recurrent falls, compared with women with no back pain (21). To date, comparable data on this association are not available for community-dwelling older U.S. men. Therefore, to determine the associations of back pain with the 1-year risk of falls among U.S. men aged 65 years and older, we used existing prospectively collected data from the Osteoporotic Fractures in Men Study (MrOS). We hypothesized that any observed association of back pain and fall risk would be explained, at least in part, by poor physical functioning, depressive symptoms, or use of central nervous system (CNS) active medications (22,23). Additionally, because fall risk varies by age, previous fall history, and hip or knee pain (9,10,13,14), we conducted stratified analyses to determine if these factors modified associations of back pain and fall risk.

Methods

Participants

From March 2000 through April 2002 5,994 community-dwelling older U.S. men enrolled in MrOS, a nationwide prospective cohort study of risk factors for fractures and falls (24,25). Eligible participants were at least 65 years of age, able to walk without assistance from another person, and had at least one natural hip (required for bone density measurement). Participants completed the baseline questionnaire and in-person visit at one of six U.S. academic medical centers in Birmingham AL, Minneapolis MN, Palo Alto CA, Pittsburgh PA, Portland OR, and San Diego CA. Institutional Review Boards at each site approved the study. All participants gave written informed consent.

Back Pain and Other Baseline Assessments

On the baseline questionnaire, men reported if they had any back pain in the past 12 months. Those with back pain marked on a drawing of the posterior torso where their back pain usually occurred. Horizontal lines on the drawing delineated the possible locations as neck, upper (thoracic) back, mid (thoracic) back, low (lumbar) back, or buttocks. We categorized number of back pain locations as 1, 2, or 3–5. Those reporting back pain were asked about its severity (mild, moderate, or severe) and frequency (rarely, some of the time, most of the time, or all of the time), and if they limited usual activities because of back pain (yes or no).

Other self-reported baseline information included a variety of demographic, lifestyle, and health factors including history of physician-diagnosed conditions (Parkinson's disease, stroke, and osteoarthritis). Men also reported if in the past 12 months they had any falls, trouble with dizziness, hip pain, or knee pain. Difficulty with an instrumental activity of daily living (IADL) was coded as self-reported difficulty with at least one of the following activities: walking 2–3 blocks, climbing 10 steps, preparing meals, doing heavy housework, and shopping for groceries or clothes. Men completed the Short Form 12 (26) from which depressive symptoms were coded (27). Lower urinary tract symptoms (LUTS), which have been associated with increased risk of falls in this cohort (28), were coded from the American Urological Association Symptom Index.

Current prescription medications were inventoried by study staff at the study visit. Medications were matched to ingredients based on the Iowa Drug Information Service IDIS Drug Vocabulary (College of Pharmacy, University of Iowa, Iowa City, IA) (29). For this analysis, we coded CNS-active medications as inventory recording of antieileptics, benzodiazapenes, antidepressants, opioids, or sedatives. Participants underwent four physical performance measures: usual walking pace (m/s), ability to complete a narrow walk (a measure of dynamic balance), chair stand time (s), and grip strength (kg) with a handheld dynamometer (Sammons Preston, Bollingbrook, IL). Body mass index (kg/m^2) was calculated from height and weight measured by study staff. Prevalent vertebral fracture was determined from the baseline lumbar and thoracic spine radiographs (30).

Fall Outcomes

Every 4 months (tri-annually) after baseline, participants received a one-page questionnaire to report endpoints including new falls. To facilitate recall, the main questionnaire items listed each of the past 4 months. For example, on questionnaires mailed in July, fall reports were obtained with the question: "Have you fallen in the past 4 months (March, April, May, or June)?" Participants who reported a fall also marked the number of times they fell in the past 4 months using response categories of "1," "2," "3," "4," or "5 or more times." Nonresponders were telephoned to obtain their questionnaire responses. In each tri-annual interval, more than 99% provided complete fall information.

Each participant was followed for falls through his first three tri-annual questionnaires, or about 12 months. Each man's number of falls was summed across the three questionnaires. The primary outcome measure was 1-year risk (cumulative incidence) of recurrent falls, defined as ≥2 falls during follow-up (vs 0–1 fall). The secondary outcome measure was 1-year risk of any fall, defined as ≥1 falls during follow-up (vs 0 falls).

Analytic Cohort

Of the 5,994 baseline participants, we excluded 297 (5%) missing at least one other independent variable deemed necessary for this analysis and 46 (<1%) reporting Parkinson's disease. During follow-up, complete data on falls were available for 5,568 men on any fall and for 5,556 on recurrent falls, representing 93% of the baseline cohort.

Statistical Analysis

Analyses were conducted using SAS software version 9.4 (SAS Institute, Cary, NC). Baseline characteristics in the analytic cohort were compared according to back pain severity using one-way analysis of variance for continuous variables or chi-square tests for categorical variables. Risk ratios (RRs) and 95% confidence intervals (CIs) were estimated as the measure of association between back pain and fall risk from multivariable log-binomial regression models with a robust variance estimator (31), using no back pain as the referent.

Our modeling and variable selection strategy is fully described in Supplementary Methods. Briefly, we built separate models for each fall outcome using well-established variable selection procedures (32,33). First, we constructed base models adjusted for age and other confounders. Baseline variables (exclusive of possible intermediate factors listed below) that were associated with at least one back pain variable, one fall outcome, or both in descriptive analyses were assessed as potential confounders. Of these, we retained those that met the 10% change in estimate definition for confounding when added to the model (32,33) in order to avoid unnecessary adjustments (34). Confounding variables are shown in the footnotes of Table 2. Next, we assessed the extent to which the RRs for back pain and fall risk from the base models were attenuated by adjustment for possible intermediate factors including each physical performance measure, IADL difficulty, depression, and CNS medication use. From this assessment, adjustment for CNS medication use and IADL difficulty resulted in the largest attenuation of the RRs, and these variables were retained in the final models. We present RRs before (Table 2) and after adjustment (Figure 1) for possible intermediate variables to facilitate inference about their effects (33).

Finally, we conducted analyses stratified to determine if baseline age (<75 year, ≥75 years), any fall in the year before baseline (yes, no), or history of pain or knee pain in the year before baseline modified the associations of back pain and fall risk. To assess effect modification, tests of multiplicative interaction were performed.

Results

Back pain in the past 12 months was reported by 67% of the participants. Among those with back pain, 62% had pain only in the low back, 9% reported that pain was severe when they had it, 20% reported being bothered most of the time/all of the time by pain, and 30% reported that they limited usual activities because of back pain. Participants reporting severe back pain differed from those who reported no back pain on most characteristics examined, except for height and stroke history (Table 1).

During the ensuing 1 year, 634 (11%) had recurrent falls (≥2 falls) and 1,388 (25%) had any fall (≥1 fall). After adjustment for age and confounders (the base model), RRs were significantly elevated for any back pain in relation to recurrent falls (Table 2). Compared with men without back pain, men with any back pain were at 1.4-fold increased risk of recurrent falls. Recurrent fall risk increased consistently with increasing number of back pain sites, back pain severity, and back pain frequency and was strongly elevated for back pain that limited usual activities. Similarly, back pain and risk of any fall were positively associated, although the RR estimates tended to be somewhat smaller than those for recurrent falls. When back pain was categorized by location, fall risk remained elevated and RRs were consistent with those for number of back pain sites (see Supplementary Table 1).

We planned to retain in the final model any potential intermediate variables whose inclusion in the base model attenuated the RRs by at least 10%. However, the largest attenuation observed resulted from adjustment for CNS medication use, which reduced the RR for severe back pain by −9.8%, and for IADL difficulty, which reduced

Table 1. Distributions of Baseline Characteristics According to Back Pain Severity Among 5,568 U.S. Men Aged 65 Years or Older: The Osteoporotic Fractures in Men (MrOS) Study

		Back Pain Severity			
	No Back Pain	Mild	Moderate	Severe	
Number (% in cohort)	1,861 (39%)	1,591 (17%)	1,778 (35%)	338 (9%)	
Baseline Characteristic		Mean (*SD*) or %			*p* Value
Age (y)	73.7 (5.9)	73.1 (5.8)	73.4 (5.7)	74.5 (5.8)	<.001
Height (cm)	174 (7)	174 (7)	174 (7)	174 (6)	.14
BMI (kg/m^2)	27.2 (3.7)	27.1 (3.7)	27.8 (3.9)	28.0 (4.1)	<.001
College education	78	81	71	70	<.001
Cigarette smoking					<.001
Never	40	40	34	31	
Past	56	57	62	66	
Current	4	3	4	3	
Alcohol consumption					<.001
None	35	31	38	45	
1–7 drinks/week	47	52	46	38	
>7 drinks/week	18	18	16	17	
Fair/poor/very poor self-rated health	7	9	18	32	<.001
Depressive symptoms	12	14	18	28	<.001
Stroke history	5	5	7	6	.11
Arthritis history	35	44	57	71	<.001
Hip pain in past year	13	21	34	43	<.001
Knee pain in past year	25	30	39	44	<.001
Dizziness in past year	16	22	32	39	<.001
Fell in the past year	18	19	23	25	<.001
Prevalent vertebral fracture	2	3	5	12	<.001
Moderate/severe LUTS	39	43	51	57	<.001
Usual walking pace (m/s)	1.2 (0.2)	1.2 (0.2)	1.2 (0.2)	1.1 (0.3)	<.001
Chair stand time (s)	10.7 (3.1)	10.7 (3.1)	12.6 (4.7)	14.3 (7.1)	<.001
Grip strength (kg)	38 (8)	39 (8)	39 (8)	37 (8)	<.001
Unable to complete narrow walk	7	7	9	12	.007
≥ 1 IADL difficulty	11	14	26	47	<.001
CNS medication use	9	11	15	25	<.001

Note: BMI = body mass index; CNS = central nervous system; IADL = instrumental activities of daily living; LUTS = lower urinary tract symptoms.

Table 2. Risk Ratios for Falls in Relation to Back Pain Among Older Men: Base Model (confounding adjusted) Estimates

			Recurrent (≥2) Falls			Any Fall	
Back Pain Characteristic	*n*	% With ≥2 Falls	Age-Adjusted RR	Multivariable RR (95% CI)[a]	% With any Fall	Age-Adjusted RR	Multivariable RR (95% CI)[b]
No back pain	1,861	8	1.0 (ref.)	1.0 (ref.)	19	1.0 (ref.)	1.0 (ref.)
Any back pain	3,707	13	1.69	1.36 (1.14, 1.63)	28	1.30	1.26 (1.13, 1.40)
Number of back pain sites							
No back pain	1,861	8	1.0 (ref.)	1.0 (ref.)	19	1.0 (ref.)	1.0 (ref.)
1	2,563	11	1.44	1.26 (1.04, 1.52)	26	1.37	1.27 (1.14, 1.42)
2	785	16	1.99	1.50 (1.20, 1.89)	30	1.56	1.33 (1.16, 1.53)
3–5	359	22	2.78	1.85 (1.42, 2.42)	34	1.78	1.40 (1.18, 1.67)
Severity							
No back pain	1,861	8	1.0 (ref.)	1.0 (ref.)	19	1.0 (ref.)	1.0 (ref.)
Mild	1,591	10	1.26	1.15 (0.93, 1.42)	25	1.32	1.26 (1.11, 1.43)
Moderate	1,778	15	1.93	1.50 (1.24, 1.83)	28	1.47	1.28 (1.13, 1.44)
Severe	338	20	2.45	1.64 (1.25, 2.15)	38	1.92	1.56 (1.32–1.84)
Frequency							
No back pain	1,861	8	1.0 (ref.)	1.0 (ref.)	19	1.0 (ref.)	1.0 (ref.)
Rarely/Some of time	2,969	12	1.50	1.30 (1.08, 1.56)	26	1.38	1.27 (1.14, 1.42)
Most of time/All the time	738	19	2.43	1.62 (1.29, 2.04)	34	1.73	1.41 (1.22, 1.62)
Limited by back pain							
No back pain	1,861	8	1.0 (ref.)	1.0 (ref.)	19	1.0 (ref.)	1.0 (ref.)
No[c]	2,591	11	1.37	1.19 (0.98, 1.44)	25	1.30	1.20 (1.07, 1.34)
Yes	1,116	19	2.46	1.79 (1.45, 2.20)	34	1.81	1.54 (1.36, 1.74)

Note: CI = confidence interval; LUTS = lower urinary tract symptoms; ref = referent level; RR = risk ratio.
[a]Adjusted for age, dizziness, history of arthritis, knee pain, LUTS, and self-rated health. [b]Adjusted for age, dizziness, history of arthritis, knee pain, LUTS, and BMI category. [c]Back pain that did not limit usual activities.

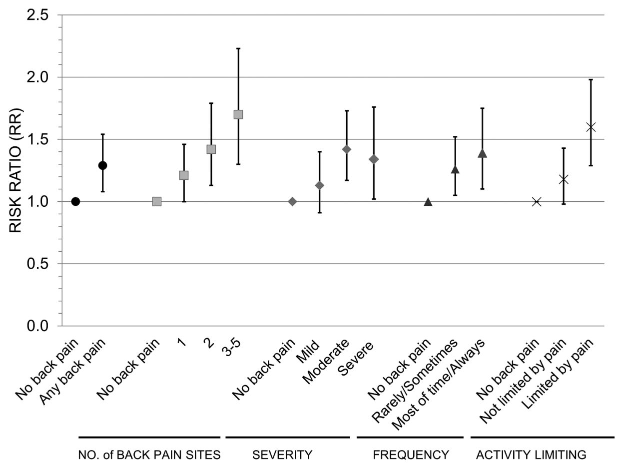

Figure 1. Risk ratios (RRs) for recurrent falls in relation to back pain among older men: final model estimates. RR point estimates are represented as: (●) any back pain in the past 12 months, (■) number of pain sites in the back, (♦) pain severity, (▲) pain frequency, and (×) activity liming back pain. Error bars are 95% confidence intervals. RRs are adjusted for age, dizziness, history of arthritis, knee pain, LUTS, self-rated health, difficulty with ≥ 1 IADL, and CNS-active medication use.

the RR for back pain most or all the time by −9.3%. With IADL difficulty and CNS medication use retained in all the final models, RRs for most back pain categories remained independently associated with recurrent fall risk (Figure 1).

The stratified analyses did not support effect modification of the association between back pain and fall risk by age, fall history, or hip or knee pain (see Supplementary Table 2). The magnitude of the RRs was similar in each level of age and fall history status, although RRs appeared to vary by knee and hip pain history. However, none of the tests of interaction were statistically significant.

Discussion

Back pain emerged as an independent risk factor for falls, especially recurrent falls, in this large cohort of older U.S. men. Moreover, fall risk was significantly elevated for one location of back pain and increased substantially for additional pain locations. Most back pain characteristics, except mild back pain, were also associated with elevated fall risk. Contrary to our hypothesis, these associations were not explained by possible intermediate factors including CNS medication use, IADL difficulty, depressive symptoms, or physical performance. Moreover, associations of back pain and fall risk were consistent in magnitude within strata of baseline age, fall history, and history of hip or knee pain, indicating that these factors were not important effect modifiers.

There are few prospective studies about the association of any back pain and fall risk, especially among older men. Results are mixed, which may be due to differing source populations and methods for ascertaining back pain and fall outcomes. Among older Chinese men, back pain and fall risk assessed 4 years later were not associated (20). Likewise, in older U.S. adults, any chronic back pain and fall rates were not associated, but sex-specific results were not reported (13). However, among Japanese men aged 23–95 years (19), low back pain was associated with 1.6-fold increased risk of falls assessed 3 years later, although this association lost statistical significance after adjustment for walking speed, knee pain, and other factors. The present study among older U.S. men supports a modest association of back pain with risk of falls, especially recurrent falls.

Few investigations have examined the spectrum of back pain characteristics (severity, frequency, or location) in relation to fall risk. Among older Chinese men, back pain which limited usual activities was not associated with increased fall risk (20). Conversely, our results correspond well with associations of back pain characteristics and fall risk reported among older U.S. women. For example, among women, recurrent fall risk was 1.5-fold to 2-fold greater for back pain in more than one location, of greater severity and frequency, and that limited usual activities (21). The consistency of these associations across the spectrum of back pain symptoms indicates that back pain should be considered an important fall risk factor in older adults.

Several mechanisms underlying the association of pain and fall risk have been proposed including poor physical function, fear of falling, or pain interference with cognition function (13,15,16). Consistent with previous reports (13,14,19,21), control for variables such as gait speed, balance, and chair stand ability did not materially affect associations of pain with fall risk. Likewise, adjustment for IADL difficulty did not attenuate the RRs in this study. Similarly, although CNS medications are often used to treat pain and their use is associated with increased fall risk (22,23), statistical adjustment for use of such medications had little impact associations of pain and fall risk observed in this or previous studies (13,14). Thus, evidence for mechanistic roles of physical performance or CNS medication use is not strong. Although fear of falling and activity avoidance were both associated with increased fall risk among community-dwelling older adults (35–37), no studies have examined whether these factors could explain associations of pain and fall risk. Smaller brain volume and poor performance in cognitive tasks was observed in older adults with chronic low back pain compared with those without back pain (38). Thus, links between back pain, impairment in cognition or attention, and fall risk among older adults warrant further study.

This study has several limitations. First, recall of falls over 3–6 months, which is reasonably accurate (39,40), may underestimate fall frequency compared with diaries (41). If any inaccuracies in fall reports were random with respect to back pain, then the observed RRs could be underestimated. Alternatively, if men with back pain subsequently experienced falls that caused worsening back pain, then they may remember and report falls more accurately than those without prior back pain. Such systematic differences in fall reports, if they existed, would have overestimated the RRs. Second, we lacked data on spinal degenerative conditions other than radiographic vertebral fractures. However, back pain prevalence was similar in those with and without spinal degenerative conditions (42,43). Thus, spinal degenerative conditions are unlikely to explain the associations of back pain and fall risk reported here. Finally, MrOS is composed of generally healthy, community-dwelling men, so these results may not be applicable to other populations.

In this large, prospective cohort study among community-dwelling older men, those with a recent history of back pain were at increased risk for falls. Given the high risk of falls, especially recurrent falls, in this populations, clinical assessment of fall risk would be prudent in older men who present with any back pain, especially if they report more than one location of back pain or that their pain limits their usual activities. Whether back pain treatment reduces fall risk in this population should be examined.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences* online.

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