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# Circumstances of clinical fracture events with advancing age in older men

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## Abstract

To characterize fracture circumstances by age at time of fracture among community-dwelling older men, we analyzed incident clinical fractures in the Osteoporotic Fractures in Men study. Participants were contacted every 4 mo to identify fractures confirmed by radiographic reports. Fractures were classified as fall- or non-fall-related and further categorized by degree of trauma: minimal (fall from  $\leq$  standing height), moderate (fall on stairs, steps or curb), or severe (fall from  $>$  standing height) for fall-related fractures; and minimal (eg, coughing), moderate (eg, collisions with objects during normal activity without falling), or severe (eg, motor vehicle accident) for non-fall-related fractures. Of 2351 clinical fractures in 1424 men during an average follow-up of 9.9 yr, 12.7% occurred at age  $<75$  yr, 15.7% at age 75-79 yr, 26.1% at age 80-84 yr, and 45.5% at age  $\geq 85$  yr. A total of 1891 fractures (80.4% of all fractures) were the result of a fall. The proportion of fall-related fractures steadily rose with increasing age at time of fracture, ranging from 65.8% in men  $<75$  yr rising to 84.7% in men  $\geq 85$  yr ( $p < .001$ ). Most fall-related fractures (76.4%) were due to minimal trauma; the proportion of all fractures due to a fall with minimal trauma steadily rose with increasing age ( $p < .001$ ). In contrast, approximately half of non-fall-related fractures (53.5%) were due to severe trauma. The proportion of all fractures due to severe trauma (whether fall-related or not) declined with advancing age ( $p < .001$ ). In conclusion, the most frequently occurring fracture circumstance in older men was a fall from  $\leq$ standing height. This circumstance was increasingly common with advancing age occurring in 7 of every 10 fractures in men  $\geq 85$  yr, while a fracture (fall-related or not) due to severe trauma was less common with advancing age. Findings have implications for development of fracture prevention strategies in older men.

**Keywords:** older men, fracture circumstances, falls, degree of trauma, epidemiology

## Lay Summary

This study characterized fracture circumstances by age at time of fracture in 5994 community-dwelling older men. Of 2351 fractures occurring during 10 yr, 80% were due to a fall. Three-quarters of fall-related fractures were due to minimal trauma, while half of non-fall-related fractures were due to severe trauma. The proportion of fractures that were fall-related with minimal trauma rose with increasing age, while the proportion of fractures with severe trauma (whether fall-related or not) declined with advancing age.

## Introduction

Fall prevalence in older adults is modestly higher among women compared with men, but fall rates rise with advancing age in both sexes.<sup>1-3</sup> Among a nationally representative sample of 149 319 non-institutionalized US adults  $\geq 65$  yr,<sup>4</sup> 30.3% of women and 26.5% of men reported falling at least once in the preceding 12 mo; fall prevalence rose in a graded manner with older age from 26.7% among those age 65-74 yr, to 29.8% among those age 75-84 yr, to 36.5% among those age  $\geq 85$  yr. Similarly, among a representative sample of 4365 community-dwelling Canadian adults age  $\geq 65$  yr,<sup>5</sup>

fall prevalence steadily rose from 15.8% in men and 17.8% in women age 65-69 up to 23.2% in men and 30.5% in women age  $\geq 85$  yr. Most falls result in no injury, but 30% of falls result in an injury requiring medical attention or activity restriction and 10%-15% of falls result in fractures.<sup>1,6</sup> While previous studies have reported higher rates of injurious falls in both sexes with advancing age,<sup>4,7</sup> it is uncertain whether the proportion of fall-related fractures rises with increasing age, especially among older men who have a lower prevalence of fractures.<sup>8</sup> Of additional importance, while the percentage of fractures due to severe trauma in older adults is higher in

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men versus women,<sup>9,10</sup> it is unknown if degree of trauma in fractures in men varies with increasing age.

Thus, to better characterize fracture circumstances among community-dwelling older men according to age at time of fracture, we analyzed incident clinical fractures experienced by participants enrolled in the Osteoporotic Fractures in Men (MrOS) study.

## Materials and methods

### Study population

A total of 5994 community-dwelling men  $\geq 65$  yr old were enrolled in MrOS between 2000 and 2002.<sup>11</sup> Participants were recruited from population-based listings in 6 US regions.<sup>12</sup> The study was approved by institutional review boards.

### Clinical fractures

Participants were contacted tri-annually after the baseline examination (over 98% of follow-up contacts completed in active survivors) to ask about fractures. Self-reported fractures were confirmed by radiographic reports.<sup>13</sup> For self-reported spine fractures, the community spinal imaging study was also obtained. Incident clinical vertebral fractures were confirmed by the study radiologist using the Genant method<sup>14</sup> to establish that the community study showed a new deformity of a higher grade than was present in the same vertebra on study spine films obtained prior to the self-reported event.<sup>15</sup>

### Fracture circumstances

When a fracture was reported, clinic staff interviewed the participant and completed a fracture report form. The fracture was classified as fall- or non-fall-related and coded according to degree of trauma. For fall-related fractures, degree of trauma was classified: minimal (fall from  $\leq$  standing height), moderate (fall on stairs, steps or curb), or severe (fall from  $>$  standing height). For non-fall-related fractures, degree of trauma was considered: minimal (eg, coughing), moderate (eg, collisions with objects during normal activity without falling), or severe (eg, motor vehicle accident).

### Analytical sample

A total of 2351 confirmed fractures experienced by 1424 men during a mean (SD) follow-up of 9.9 (5.7) yr comprised the analytical sample.

### Statistical analyses

Fracture (and not participants with versus without incident fracture) was the unit of analysis in our study. Using chi-square tests, the proportion of fall-related (and non-fall-related) fractures and the proportion of all fractures that were fall-related (and non-fall-related) due to a specific degree of trauma were compared across age groups ( $<75$  yr, 75-79 yr, 80-84 yr,  $\geq 85$  yr) at the time of the fracture.

## Results

Of the 2351 fractures, 298 (12.7%) occurred in 221 men age 65-74 yr at the time of fracture; 370 (15.7%) occurred in 299 men age 75-79 yr at the time of fracture; 613 (26.1%) occurred in 454 men age 80-84 yr at the time of fracture; and 1070 (45.5%) occurred in 686 men age  $\geq 85$  yr at the

time of fracture (Table 1). A total of 1891 fractures (80.4% of all fractures) were due to a fall. The proportion of fall-related fractures rose in a graded manner with increasing age at time of fracture, ranging from 65.8% in men  $<75$  yr rising to 84.7% in men  $\geq 85$  yr ( $p < .001$ ). The proportion of non-fall-related fractures steadily declined with older age, ranging from 34.2% in men  $<75$  yr declining to 15.3% in men  $\geq 85$  yr ( $p < .001$ ).

Of the 1891 fall-related fractures, 76.4% were due to minimal trauma, 14.7% were due to moderate trauma, and 8.9% were due to severe trauma. In contrast, of the 460 non-fall-related fractures, 21.3% were due to minimal trauma, 25.2% were due to moderate trauma, and 53.5% were due to severe trauma.

The proportion of all fractures related to a fall and due to minimal trauma rose with increasing age (34.9% of fractures in men  $<75$  yr rising to 70.9% of fractures in men  $\geq 85$  yr [ $p < .001$ ]), whereas the proportion of all fractures related to fall and due to severe trauma declined with advancing age (18.5% of fractures in men  $<75$  yr declining to 3.8% of fractures in men  $\geq 85$  yr [ $p < .001$ ]) (Figure 1).

The proportion of all fractures not related to a fall and due to severe trauma declined with increasing age (19.5% of fractures in men  $<75$  yr declining to 8.4% of fractures in men  $\geq 85$  yr [ $p < .001$ ]). Similarly, the proportion of all fractures not related to a fall and due to moderate trauma declined with advancing age (10.7% of fractures in men  $<75$  yr declining to 2.6% of fractures in men  $\geq 85$  yr [ $p < .001$ ]).

## Discussion

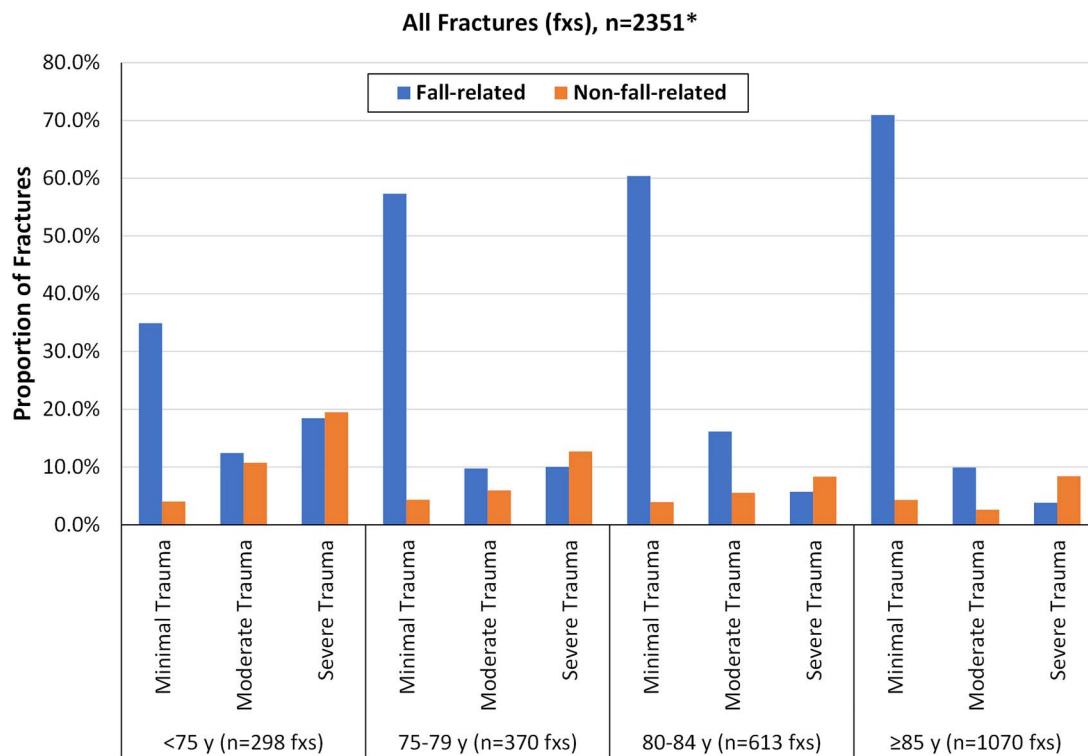
Among this cohort of community-dwelling older men, the proportion of fall-related fractures steadily rose (and the proportion of non-fall-related fractures steadily declined) with increasing age at time of fracture. Fall-related fractures due to minimal trauma were increasingly common with advancing age and comprised an increasing proportion of all fractures. In contrast, the proportion of all fractures due to severe trauma, whether fall-related or not, steadily declined with advancing age.

Fracture circumstances with advancing age have not been previously investigated in men, but our findings are in general agreement with those from a longitudinal global database of 60 393 postmenopausal women that captured incident fractures with annual questionnaires during 3 yr of follow-up.<sup>16</sup> Among 4122 women reporting first incident fractures, the proportion of hip and non-hip non-vertebral fractures with fall as the cause increased with advancing age and the proportion of these fracture types with severe trauma as the cause declined with increasing age.

Study strengths include prospective long-term follow-up, radiographic confirmation of incident fractures and standardized assessment of circumstances, and degree of trauma. Limitations include the lack of diversity in race/ethnicity in the predominantly non-Hispanic White cohort.<sup>11</sup> In addition, our study was descriptive in design and the unit of analysis was fracture. We did not evaluate characteristics of men with versus without incident fracture or determine whether any association of a candidate risk factor with incident fracture remained after accounting for potential confounders. Previous MrOS publications have identified independent risk factors for clinical fracture outcomes in community-dwelling older

**Table 1.** Fracture category according to age group at time of fracture.

Fracture category	Overall (n = 2351)	Age group at time of fracture			
		65-74 yr (n = 298)	75-79 yr (n = 370)	80-84 yr (n = 613)	≥85 yr (n = 1070)
Fall-related fracture, n (%)	1891 (80.4)	196 (65.8)	285 (77.0)	504 (82.2)	906 (84.7)
Non-fall-related fracture, n (%)	460 (19.6)	102 (34.2)	85 (23.0)	109 (17.8)	164 (15.3)
Degree of trauma, n (%)					
Minimal trauma fall (fall from ≤ standing height)	1445 (61.5)	104 (34.9)	212 (57.3)	370 (60.4)	759 (70.9)
Moderate trauma fall (fall on stairs, steps, or curb)	278 (11.8)	37 (12.4)	36 (9.7)	99 (16.2)	106 (9.9)
Severe trauma fall (fall from > standing height)	168 (7.2)	55 (18.5)	37 (10.0)	35 (5.7)	41 (3.8)
Minimal trauma other than a fall	98 (4.2)	12 (4.0)	16 (4.3)	24 (3.9)	46 (4.3)
Moderate trauma other than a fall	116 (4.9)	32 (10.7)	22 (6.0)	34 (5.6)	28 (2.6)
Severe trauma other than a fall	246 (10.5)	58 (19.5)	47 (12.7)	51 (8.3)	90 (8.4)



**Figure 1.** Proportion of clinical fractures in each age group according to fall relationship and degree of trauma. A total of 298 fractures occurred in 221 men age 65-74 yr at time of fracture, 370 fractures occurred in 299 men age 75-79 yr at time of fracture, 613 fractures occurred in 454 men age 80-84 yr at time of fracture, and 1070 fractures occurred in 686 men age ≥85 yr at time of fracture.

men including any non-vertebral,<sup>13</sup> hip<sup>17</sup> and vertebral<sup>18</sup> fractures.

Our results suggest that fracture prevention strategies in younger old men should focus on minimizing risk-taking behaviors, while those in oldest old men should focus on fall prevention. To better guide development of these strategies, future studies should characterize location (eg, outdoors vs indoors) and specific activity at time of fracture occurrence.

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### Author contributions

Kristine E. Ensrud (Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Writing—original draft),

Sheena Patel (Formal analysis, Validation, Writing—review & editing), Lisa Langsetmo (Conceptualization, Writing—review & editing), Peggy M. Cawthon (Conceptualization, Funding acquisition, Investigation, Writing—review & editing), Howard A. Fink (Writing—review & editing), John T. Schousboe (Writing—review & editing), Douglas C. Bauer (Investigation, Project administration, Writing—review & editing), Jane A. Cauley (Funding acquisition, Investigation, Writing—review & editing), and Eric S. Orwoll (Conceptualization, Funding acquisition, Investigation, Project administration, Writing—review & editing).

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## Conflicts of interest

The authors have nothing to disclose.

## Data availability

Data from MrOS are available via <https://mrosonline.ucsf.edu/>.

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