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Original Study

Sex Differences in the Circumstances Leading to Falls: Evidence From Real-Life Falls Captured on Video in Long-Term Care

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A B S T R A C T

Objectives: Falls are a major health concern for older adults. Understanding sex differences in fall circumstances may guide the design of fall management plans specifically to men and women. In this study, analyzed real-life falls captured on video to compare scenarios leading to falls between men and women in 2 long-term care (LTC) facilities.
Design: Prospective cohort study.
Participants/Setting: A total of 529 participants residing in 2 LTC facilities in British Columbia, Canada.
Measurements: Between 2008 and 2016, we video-captured 1738 falls experienced by 231 men and 298 women (mean age = 83 ± 9 years). Each video was analyzed to determine the causes of imbalance and the activities at time of falling. Using generalized estimating equation models, we examined how fall circumstances associated with age, sex, and health status.
Results: Men were more likely than women to fall from loss of support with an external object (odds ratio 1.37; 95% confidence interval 1.08−1.73) and less likely to fall from tripping (0.72; 0.54−0.96). Men were more likely to fall while seated (1.42; 1.07−1.87) or while rising (1.49; 1.11−1.99), and less likely to fall while walking (0.61; 0.50−0.75). After adjusting for age and health status, sex remained significantly associated with loss of support and walking. Furthermore, regardless of sex, falls from loss of support were more common among individuals who were less independent in activities of daily living, who used more medications, and who used diuretic. Individuals with independent activities of daily living and intact cognition were more likely to fall while walking, but less likely to fall while seated or while rising.
Conclusions: Our results elucidate differences between older men and women in the scenarios that lead to falls, to inform sex-specific fall prevention strategies in the LTC setting.

In Canada, an increasing frail population of older adults reside in long-term care (LTC) facilities,[1] and more than 50% of them will fall each year.[2] Falls are the leading cause of injury-related death in older adults.[3] Although rates of falls are similar in men and women,[4,5] the rate of fall-related injuries is higher in women while the rate of fatality from falls is 49% higher in men.[6,7] Physiological and behavioral differences between men and women may cause them to fall differently.[8–11] Understanding sex differences in the circumstances that lead to falls in the high-risk LTC environment may inform prevention strategies for men and women.

Ideally, when an older adult in LTC presents with a fall, the care management team would design a personalized fall management plan specific to the circumstances of the fall, including consideration of tailored exercise program, assistive device prescription, or environmental modification that address the perceived cause of the fall.[12,13] Because a personalized approach may be resource intensive, an alternative, and perhaps more feasible strategy, would be to

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customize the program based on factors such as sex, age, and clinical status.

Previous studies have identified age- and sex-based factors associated with propensity to falls. These include decreased muscle strength and age-adjusted rate of decline in lower limb joint range of motion.[8,9,14] When compared with women, older men are more sedentary and have low social participation; both are associated with mobility disability.[10,15] Men more often fall from slipping,[11] while outdoors and at greater levels of activity.[5] Women tend to fall more often because of trips,[11] and more often during standing and walking.[5] However, information on the circumstances that surround falls were mostly based on self-reports or witnessed events, which may lack accuracy.[16–18] In addition, most studies have been community-based. We know relatively little about differences in fall circumstances among frail older men and women in LTC.

In the current study, we compared the mechanisms of imbalance leading to falls between older men and women residing in LTC, based on analysis of video footage of actual fall events.[18–20] Particularly, we analyzed 1738 real-life video-captured falls by 529 residents in 2 LTC facilities. Our specific objective was to test the hypothesis that the circumstances of falls are associated with sex, age, and health status.

Methods

Participants and Settings

Between April 2007 and April 2016, we captured and analyzed 1738 falls by 529 residents (83 ± 9 years; 56% women) in 2 LTC facilities in the Fraser Health Authority, British Columbia. These were Delta View Life Enrichment Center, a 312-bed, for-profit facility and New Vista Society Care Home, a 236-bed, not-for-profit facility. Hours of care/resident day was 2.72 at New Vista and 3.06 at Delta View, on average. Fall rates were 8.9 and 9.2/1000 bed-days, respectively.[18] New Vista had a network of 48 and Delta View had 216 digital cameras. All cameras were located in common areas (eg, dining rooms, lounges, activity rooms, and hallways). Videos were stored at a recording rate of 15 to 30 frames/s with a minimal resolution of 640 × 480.

Research ethics boards at Simon Fraser University and the Fraser Health Authority approved this study. At admission to the LTC facility, each resident or proxy provided permission for the facility to acquire video footage in common areas for safety purposes. Videos were shared as secondary data with our research team.

Video Analysis of Falls

Each fall video was analyzed by 3 raters, who sought consensus on answers to a Fall Video Analysis Questionnaire (FVAQ).[20] We focused on questions related to the primary cause of imbalance leading to the fall, including incorrect shift of body weight, trip/stumble, hit/bump, loss of support with external object, collapse or loss of consciousness, and slip. We also analyzed activities (eg, walking, standing, getting up, sitting down, seated) and use of mobility aids at time of fall. For each primary cause of imbalance and activity at time of fall, raters also selected specific subcategories that best described how the fall occurred (Supplementary Table S1). The FVAQ is a reliable tool for analyzing the mechanisms of falls captured on video.[20] Definitions and examples for fall characteristic categories are available to raters via a comprehensive FVAQ instruction manual.[20] Tests of inter- and intrarater reliability showed more than 87% agreement; Cohen k value was greater than 0.79 for the cause of imbalance, activity at time of fall, and use of mobility aids at time of fall.[20]

Minimum Data Set Health Records

We acquired age and health status data from the Minimum Data Set (MDS 2.0, interRAI Corporation 1999), a comprehensive observational assessment completed quarterly by nursing staff for all residents in LTC.[21] The mean interval between MDS completion and occurrence of a fall averaged 2.2 months (standard deviation = 1.3; range: 0–5.8). We acquired scores on activities of daily living (ADL) from the Self-Performance Hierarchy Scale[22] and the Cognitive Performance Scale[23]; scores ranged from 0 (intact) to 6 (severe impairment). We included vision status, scored between 0 (adequate) and 4 (severely impaired). Using similar categories as previous studies,[24,25] we dichotomized ADL scores as “independent” (0–2) vs “dependent” (3–6), Cognitive Performance Scale scores as “intact to mild impairment” (0–2) vs “moderate to severe impairment” (3–6), vision scores as “adequate” (0) vs “impaired” (1–4), and use of medications (eg, antipsychotic, antianxiety, antidepressant, hypnotic, diuretic, and analgesic) as “≥8 medications” vs “<8 medications.”

Statistical Analysis

Given the likelihood of correlation in falls among repeated fallers, we used the generalized estimating equation model in SPSS v 23 (IBM Corporation, Armonk, NY) to examine whether there were differences between men and women in the odds of falls associated with each primary cause, activity, or use of mobility aids. We also examined differences between men and women in the odds of falls because of each possible combination of causes and activities. We computed estimated odds ratios (ORs) and corresponding 95% confidence intervals (CIs) comparing categories of the explanatory variables. Our significance level was set at $a = 0.05$.

For participants who had MDS data (n = 228, with 858 falls), we examined the association between causes of imbalance, activity at time of fall, and health status using the binary logistic regression option in the generalized estimating equation. Age (a continuous variable) and sex (a dichotomous variable) were included as covariates. We reported ORs and corresponding 95% CIs for all comparisons.

Results

Participant Characteristics

Participants were 231 men and 298 women. Of these, 245 (46.3%) had 1 fall captured on video, 108 (20.4%) had 2, 53 (10%) had 3, 29 (5.5%) had 4, and 94 (17.8%) had 5 or more. There was no difference between men and women for rate of falls documented by incident reports or video capture (Table 1). The 228 participants who provided consent for access to health records were 82 years (standard deviation = 9.2) on average (Table 1). Nearly 70% had moderate to severe cognitive impairment, over 50% were dependent in ADL performance, 25% had Alzheimer disease, and 40% had hypertension. Compared with women, men had a shorter length of stay, and a higher proportion of men suffered a stroke and a lower proportion used analgesics.

Sex Differences in the Circumstances of Falls

The most common cause of imbalance was incorrect shift of bodyweight, accounting for 46.6% of falls for men and 50.2% for women (Table 2). Second ranked was loss of support with external objects, accounting for 23.3% of falls for men and 18.2% for women. Third ranked was a trip or stumble, accounting for 11.3% of falls for men and 15.1% for women. Compared with women, men were more likely to fall because of loss of support (OR 1.37; 95% CI 1.08–1.73) but less likely to fall because of a trip or stumble (0.72; 0.54–0.96). There