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Original Contribution

Risk Factors for Falls Among Seniors: Implications of Gender

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Despite extensive literature on falls among seniors, little is known about gender-specific risk factors. To determine the prevalence of falls by gender and sociodemographic, lifestyle/behavioral, and medical factors, we conducted a cross-sectional study in a nationally representative sample of Canadian adults who were 65 years of age or older (n = 14,881) from the Canadian Community Health Survey–Healthy Aging (2008–2009). Logistic regression models were applied to investigate gender-specific associations between potential risk factors and falls. In men, stroke (odds ratio (OR) = 1.91), nutritional risk (OR = 1.86), post-secondary school degree (OR = 1.68), eye disorder (OR = 1.35), widowed/separated/divorced marital status (OR = 1.28), and arthritis (OR = 1.27) were independently associated with significantly higher odds of falls. In women, significant independent correlates of falls included stroke (OR = 1.53), age of 85 years or older (OR = 1.51), nutritional risk (OR = 1.39), consumption of at least 1 alcoholic drink per week (OR = 1.39), use of 5 or more medications (OR = 1.36), arthritis (OR = 1.36), diabetes (OR = 1.31), and osteoporosis (OR = 1.22). Higher physical activity levels were protective in both genders, and higher household income was protective in women. Gender should be considered when planning fall prevention strategies.

aged; Canada; falls; gender; risk factors

Abbreviations: CCHS-HA, Canadian Community Health Survey–Healthy Aging; CI, confidence interval; OR, odds ratio.

Falls among seniors are a major public health concern. Approximately 1 in 3 persons 65 years of age or older falls at least once each year (1–3). In Canada, falls account for 85% of all injury-related hospitalizations among seniors, with an average stay lasting 21 days (4). Fall-related injuries are associated with significant disability, reduced mobility and independence, and increased risk of premature death (5, 6). Even in the absence of physical injuries, falls might have long-term psychological consequences, including depression and fear of falling, that subsequently lead to restrictions in daily and social activities and contribute to declines in health and function, as well as increased risk of future falls (7, 8).

In recent decades, the body of literature on the epidemiology of and risk factors for falls among seniors has grown considerably (8–12). Many factors, including female gender, advancing age, gait and balance deficits, chronic disease, and medication use, have been associated with a higher risk of falling. Furthermore, gender differences have been observed across several populations, with the majority of studies reporting higher rates of falling in elderly women than in elderly men (4, 13–16). Gender disparities in fall rates might reflect differences in underlying health conditions, as well as lifestyle and behavioral factors (17). For example, significant reduction in bone mineral density after menopause has been frequently suggested to predispose women to a higher risk of falling and bone fracture (15, 17). However, despite the numerous studies on falls among seniors, research incorporating gender-specific analyses is relatively scarce and limited in terms of generalizability and range of factors examined. While investigators in several studies noted gender differences in the associations between falls and certain risk factors, such as diabetes (18), bone/joint diseases (19), sleep deprivation (20), and vitamin D deficiency (21), few have provided a fuller picture of gender-specific correlates. Moreover, earlier studies in New Zealand (22, 23), Finland (24–26), and Japan (27, 28) revealed distinct fall risk profiles by gender, but most were limited by small sample sizes and consisted of populations representative of smaller communities or geographic areas.

Given the devastating effects of falls on the health and well-being of seniors, identification of risk factors for falling and a

better understanding of potential gender differences can provide important information to guide targeted prevention strategies. Therefore, the purpose of the present study was to address the research gap in gender differences in risk factors for falls in a large, population-based sample of Canadian seniors. Specifically, we sought to estimate the prevalence of falls by gender and various sociodemographic, lifestyle/behavioral, and medical factors and to identify gender-specific correlates of falls.

METHODS

Study population

The present study analyzed nationally representative data from the Canadian Community Health Survey–Healthy Aging (CCHS-HA). Details of the CCHS-HA, including background and methodology, have been published previously (29). Briefly, using a multistage stratified sampling design, the CCHS-HA targeted adults 45 years of age or older who lived in private residences in the 10 provinces of Canada. Excluded from the sampling frame were residents of the 3 territories, persons living on Indian reserves or Crown lands, persons who were institutionalized, full-time members of the Canadian Armed Forces, and residents of certain remote regions. Data were collected between December 2008 and November 2009 using computer-assisted interviewing. The household- and person-level response rates were 80.8% and 92.1%, respectively, yielding an overall response rate of 74.4% and a total of 30,865 respondents.

We obtained the study sample from the CCHS-HA share file, which contained records of all respondents who agreed to share their data with the Public Health Agency of Canada ($n = 28,307$; 91.7%). Distributions of key variables, including gender and age, were similar for subjects in the share file and the full sample (29). We restricted our analyses to persons 65 years of age or older ($n = 14,887$) who completed the falls module of the questionnaire, leaving a final sample of 14,881 respondents.

Measures

Falls. The CCHS-HA described a fall as one that was serious enough to limit some of the respondent's normal activities. Persons who fell were identified by an answer of "yes" to the question, "In the past 12 months, did you have any falls?" (30, p. 84). Additionally, the CCHS-HA collected information from those who fell on the most serious injury due to a fall, including nature of injury and health-care utilization (i.e., medical attention received within 48 hours, hospitalization).

Independent variables. We selected independent variables based on previous literature about risk factors for falling (8–12) and grouped them into 3 categories: sociodemographic factors, lifestyle/behavioral factors, and medical factors. Sociodemographic factors included gender; age (65–69, 70–74, 75–79, 80–84, or ≥85 years); race/ethnicity (white or nonwhite); marital status (married/common-law, widowed/separated/divorced, or single/never married); highest level of education attained (less than secondary school, secondary school degree, or post–secondary school degree); and household income (<$20,000, $20,000–$39,999, $40,000–$59,999, or ≥$60,000).

Lifestyle/behavioral factors included body mass index (weight (kg)/height $(m)^2$), smoking status, alcohol consumption, physical activity level, nutritional risk, medication use, and behavioral changes. Body mass index was derived from self-reported height and weight and was classified as underweight/normal weight (<25.0), overweight (25.0–29.9), or obese (≥30). Smoking status was separated into 3 categories, as defined previously (31): never smokers (<100 cigarettes during lifetime), former smoker (≥100 cigarettes during lifetime but does not currently smoke), and current smoker (≥100 cigarettes during lifetime and currently smokes). Alcohol consumption was categorized by the frequency of drinking at least 1 alcoholic beverage in the previous 12 months as follows: nondrinker, less than once per month, 1–3 times per month, and at least once per week.

Physical activity was assessed with the Physical Activity Scale for the Elderly, a validated instrument for measuring physical activity levels among older adults, using scores computed based on time spent in various leisure, household, and work/volunteer activities over the past 7 days (32). The scores were categorized into quartiles according to the distribution among the total male or female population, with higher quartiles indicating greater levels of physical activity. Nutritional risk was evaluated using the Seniors in the Community Risk Evaluation for Eating and Nutrition II—Abbreviated, an 8-item questionnaire that collects information on weight change, eating habits (skipping meals, eating with someone), appetite, difficulty swallowing, fruit and vegetable consumption, fluid intake, meal preparation, and meal satisfaction (33, 34). A nutritional risk index (range, 0–48) was derived by summing scores across responses, with higher values indicating lower nutritional risk, and was dichotomized as yes or no using a cutoff of less than 38 for high nutritional risk (34).

We examined medication use based on the number of types of prescription or over-the-counter medications used in the past month (0–1, 2–4, or ≥5). Behavioral changes (yes vs. no) were assessed using the question, "In the past 12 months, did you do anything to improve your health (e.g., lost weight, quit smoking, increased exercise)?" (30, p. 81).

Medical factors included the following 14 chronic conditions: arthritis; osteoporosis; hypertension; heart disease, including angina and/or heart attack; stroke; chronic obstructive pulmonary disease; diabetes; cancer; urinary incontinence; gastrointestinal disorder (intestinal/stomach ulcers and/or bowel disorders); Alzheimer's disease or other dementia; Parkinson's disease; mood or anxiety disorder (e.g., depression, phobia); and eye disorder (cataracts and/or glaucoma). These were defined as "long-term conditions which are expected to last, or have already lasted, 6 months or more and that have been diagnosed by a health professional" (30, p. 14). Each condition was examined as a binary variable (yes vs. no). We also examined the number of comorbid conditions listed above in each subject.

Statistical analyses

We conducted descriptive analyses to estimate the frequency and prevalence of falls. To account for the complex sampling design of the CCHS-HA, including nonresponse and post-stratification adjustments, we used sampling weights

in all the analyses and obtained variance estimates using the bootstrap method (29).

Univariate logistic regression was performed to examine the association between each independent variable and the odds of falling. We then used a forward model-building strategy to identify significant correlates of falls (35). Variables with $P < 0.20$ from the univariate analyses were selected as candidates for inclusion in the multivariate model and were retained in the final model if they were significant at $P < 0.10$ or if they altered any of the other estimates (i.e., odds ratio) by more than 10%. We retained age in the model regardless of statistical significance because it was deemed to be an important confounder. The number of comorbid conditions was fit into a separate model that did not include the individual medical conditions. We performed analyses separately for men and women. All tests were 2-sided. We excluded respondents with missing values for any of the variables (10% of the original sample) from all regression analyses; the exception was household income, for which "missing" was coded as a separate category because of the large percentage of missing data (21%).

The *F*-adjusted mean residual test, which is a modified Hosmer-Lemeshow goodness-of-fit test accounting for survey design (36), was used to assess the fit of the final models. We conducted analyses using SAS, version 9.3 (SAS Institute Inc., Cary, North Carolina) and Stata/SE, version 11.0 (StataCorp LP, College Station, Texas).

RESULTS

Table 1 presents the prevalence of falls and outcomes of fall-related injuries. Overall, 20.1% of Canadian seniors had experienced a fall during the previous year. Fall prevalence was significantly higher among women (22.4%) than in men (17.3%). Notably, the prevalence of fall-related fractures in women (2.4%) was approximately 2.6 times greater than that in men (0.9%). Falls that required medical attention (7.2% vs. 4.2%) and hospitalization (1.9% vs. 1.2%) were also more common among women than men.

Tables 2 and 3 present sociodemographic and lifestyle/behavioral correlates of falls, respectively. Fall prevalence increased with age for both genders, reaching 30.5% and 23.2%, respectively, in women and men who were 85 years of age or older. In univariate analyses, older age, widowed/separated/divorced marital status, lower physical activity levels, high nutritional risk, and higher number of medications used were significantly associated with falls in both genders; single/never-married status, post–secondary school degree, and obesity were significantly associated with falls in men; and lower household income was significantly associated with falls in women.

Table 4 shows prevalence and crude odds ratios for falls by medical condition. Of the 14 conditions examined, 7 were associated with falls among men, with the strongest associations observed for Alzheimer's disease/dementia (odds ratio (OR) = 3.06, 95% confidence interval (CI): 1.38, 6.79) and Parkinson's disease (OR = 3.00, 95% CI: 1.20, 7.51). On the other hand, with the exceptions of cancer, Alzheimer's disease/dementia, and Parkinson's disease, all conditions were associated with falls in women, with odds ratios ranging from 1.21 for hypertension to 2.20 for stroke. Additionally, for both genders, the odds of falls increased as the number of comorbid conditions increased, with a more pronounced dose-response relationship in women.

Tables 5 and 6 display results from the final multivariate models for men and women, respectively. Among men, widowed/separated/divorced marital status, post–secondary school degree, nutritional risk, arthritis, stroke, and eye

Table 1. Prevalence of Falls and Outcomes of Fall-Related Injuries in Adults 65 Years of Age or Older, Canadian Community Health Survey–Healthy Aging, 2008–2009

Outcome	Total (n = 4,365,112)[a]			Men (n = 1,969,493)[a]			Women (n = 2,395,619)[a]		
	No.[a]	%[b]	95% CI	No.[a]	%[b]	95% CI	No.[a]	%[b]	95% CI
All falls	878,688	20.1	19.1, 21.1	341,385	17.3	16.0, 18.7	537,303	22.4	21.0, 23.8
Nature of most serious injury									
No serious injury	305,565	7.0	6.4, 7.6	127,385	6.5	5.7, 7.3	178,180	7.4	6.6, 8.3
Bruises/cuts	234,545	5.4	4.8, 5.9	98,259	5.0	4.2, 5.8	136,286	5.7	5.0, 6.4
Sprain/strain	89,432	2.0	1.7, 2.4	37,095	1.9	1.3, 2.4	52,337	2.2	1.7, 2.7
Fracture	76,185	1.7	1.5, 2.0	18,259	0.9[c]	0.6, 1.3	57,927	2.4	2.0, 2.8
Head injury	25,415	0.6	0.4, 0.7	8,901	0.5[c]	0.3, 0.6	16,515	0.7[c]	0.4, 0.9
Discomfort	76,821	1.8	1.4, 2.2	26,577	1.3	0.9, 1.8	50,244	2.1	1.4, 2.8
Other injury	70,656	1.6	1.3, 1.9	24,900	1.3	0.9, 1.6	45,756	1.9	1.5, 2.3
Received medical attention for injury	255,298	5.8	5.3, 6.4	82,530	4.2	3.5, 4.9	172,768	7.2	6.5, 8.0
Hospitalized for injury	70,071	1.6	1.3, 1.9	23,613	1.2[c]	0.8, 1.6	46,459	1.9	1.6, 2.3

Abbreviation: CI, confidence interval.

[a] Estimated number in the population after applying sampling weights.

[b] Weighted prevalence of falls or outcomes of fall-related injuries expressed as a proportion of Canadian adults 65 years of age or older.

[c] Estimate is associated with high sampling variability and should be interpreted with caution.

Table 2. Prevalence and Crude Odds Ratios for Falls by Sociodemographic Factors and Gender in Adults 65 Years of Age or Older, Canadian Community Health Survey–Healthy Aging, 2008–2009

Characteristic	Men				Women			
	No.[a]	%[b]	OR[c]	95% CI	No.[a]	%[b]	OR[c]	95% CI
Age, years								
65–69	99,011	15.8	1.00	Referent	123,724	17.8	1.00	Referent
70–74	75,481	14.4	0.89	0.66, 1.21	112,911	20.1	1.07	0.82, 1.40
75–79	73,383	19.1	1.23	0.90, 1.68	117,567	24.3	1.50	1.16, 1.93
80–84	53,354	20.4	1.32	0.95, 1.83	86,211	25.6	1.57	1.20, 2.06
≥85	40,156	23.2	1.63	1.21, 2.20	96,891	30.5	1.95	1.51, 2.51
Race/ethnicity								
White	310,549	17.6	1.00	Referent	485,138	22.5	1.00	Referent
Nonwhite	27,539	14.4	0.79	0.53, 1.18	48,328	21.2	0.88	0.64, 1.20
Marital status								
Married/common-law	255,666	16.2	1.00	Referent	243,233	20.3	1.00	Referent
Widowed/separated/divorced	73,350	22.5	1.61	1.32, 1.96	268,340	24.5	1.31	1.09, 1.57
Single (never married)	12,369	19.8	1.51	1.02, 2.24	25,730	25.0	1.32	0.86, 2.02
Highest educational level								
Less than secondary school	113,865	15.7	1.00	Referent	234,148	22.9	1.00	Referent
Secondary school degree	57,254	16.0	1.07	0.82, 1.39	117,786	22.5	0.96	0.76, 1.20
Post–secondary school degree	167,720	19.4	1.36	1.11, 1.67	178,850	21.6	0.91	0.75, 1.10
Household income, CAN$								
<$20,000	27,812	17.7	1.00	Referent	114,032	27.0	1.00	Referent
$20,000–$39,999	102,963	17.0	0.89	0.65, 1.24	151,615	22.2	0.75	0.61, 0.92
$40,000–$59,999	69,091	17.7	0.96	0.68, 1.36	69,187	18.6	0.59	0.46, 0.76
≥$60,000	85,534	18.5	1.00	0.70, 1.44	59,254	18.6	0.62	0.44, 0.86

Abbreviations: CI, confidence interval; OR, odds ratio.

[a] Weighted number of men or women who fell during the past 12 months.

[b] Weighted prevalence of falls expressed as a proportion of Canadian adults 65 years of age or older within each category.

[c] Crude odds ratio from univariate logistic regression analyses.

disorder were independently associated with a higher odds of falls, whereas higher physical activity levels were protective. In particular, the strongest associations were found for stroke (OR = 1.91, 95% CI: 1.33, 2.74) and nutritional risk (OR = 1.86, 95% CI: 1.50, 2.31). Among women, older age, more frequent alcohol consumption (at least once per week), nutritional risk, use of 5 or more medications, arthritis, osteoporosis, stroke, and diabetes were independently associated with a higher odds of falls, whereas higher household income and higher physical activity level were protective. Stroke (OR = 1.53, 95% CI: 1.03, 2.27) was also the strongest correlate in women, followed by an age of 85 years or older (OR = 1.51, 95% CI: 1.14, 2.00). Furthermore, in a separate multivariate model in which we excluded individual conditions (data not shown), the number of comorbid conditions was significantly associated with falls in women only, with an OR increasing from 1.59 for 1 condition to 3.24 for 5 or more conditions (vs. none).

We performed a sensitivity analysis with "missing" coded as a separate category for body mass index, nutritional risk, and behavioral change because the exclusion of persons with missing data on these variables would automatically exclude all subjects with proxy respondents (3% for both genders). The results were similar to those from the original analyses except that Alzheimer's disease/dementia was additionally identified as an independent correlate of falls among men (OR = 2.21, 95% CI: 1.25, 3.92). We did not observe any notable differences from the original model for women. Lastly, goodness-of-fit tests performed on the main multivariate models indicated no significant departure of model prediction from observed data for men ($P = 0.68$) or women ($P = 0.29$).

DISCUSSION

To our knowledge, this study provides the first detailed examination of gender-specific prevalence and correlates of falls among a large, population-based sample of Canadian seniors. Our results confirm previous findings that older women were more likely to fall or suffer from fall-related injuries

Table 3. Prevalence and Crude Odds Ratios for Falls by Lifestyle/Behavioral Factors and Gender in Adults 65 Years of Age or Older, Canadian Community Health Survey–Healthy Aging, 2008–2009

Characteristic	Men				Women			
	No.[a]	%[b]	OR[c]	95% CI	No.[a]	%[b]	OR[c]	95% CI
Body mass index[d]								
Underweight or normal weight	123,736	17.2	1.00	Referent	231,032	22.1	1.00	Referent
Overweight	122,917	15.1	0.88	0.71, 1.08	160,790	20.3	0.90	0.76, 1.08
Obese	76,429	21.1	1.30	1.01, 1.65	105,402	24.7	1.21	0.95, 1.52
Smoking status								
Never smoker	96,975	15.5	1.00	Referent	287,965	21.4	1.00	Referent
Former smoker	208,644	18.2	1.14	0.92, 1.42	205,499	25.1	1.19	1.00, 1.42
Current smoker	35,508	18.2	1.24	0.90, 1.69	43,839	19.3	0.91	0.70, 1.19
Alcohol consumption								
Nondrinker	79,733	17.4	1.00	Referent	198,534	23.9	1.00	Referent
Less than once per month	49,460	18.6	1.14	0.80, 1.63	111,749	20.9	0.86	0.68, 1.08
1–3 times per month	50,280	20.0	1.23	0.88, 1.72	65,004	21.2	0.87	0.68, 1.11
At least once per week	161,804	16.3	0.99	0.75, 1.30	161,580	22.4	0.98	0.78, 1.24
Quartile of PASE score								
First (lowest)	120,246	24.4	1.00	Referent	189,964	31.1	1.00	Referent
Second	92,077	17.7	0.68	0.53, 0.88	127,426	21.7	0.66	0.53, 0.82
Third	61,786	13.4	0.51	0.38, 0.67	118,891	19.6	0.57	0.45, 0.73
Fourth (highest)	66,469	13.6	0.50	0.39, 0.66	100,435	17.0	0.48	0.38, 0.60
Nutritional risk								
No	182,509	13.8	1.00	Referent	257,965	18.2	1.00	Referent
Yes	142,700	25.2	2.12	1.71, 2.61	247,071	27.7	1.68	1.44, 1.97
No. of medications used in the past month								
0–1	83,285	13.8	1.00	Referent	87,874	16.6	1.00	Referent
2–4	198,812	17.2	1.23	0.98, 1.55	309,960	21.5	1.39	1.11, 1.75
≥5	53,997	27.6	2.13	1.55, 2.92	133,497	32.9	2.39	1.85, 3.09
Behavioral changes								
No	206,852	17.1	1.00	Referent	310,138	21.4	1.00	Referent
Yes	122,149	17.4	1.03	0.85, 1.24	202,953	23.1	1.11	0.94, 1.31

Abbreviations: CI, confidence interval; OR, odds ratio; PASE, Physical Activity Scale for the Elderly.
[a] Weighted number of men or women who fell during the past 12 months.
[b] Weighted prevalence of falls expressed as a proportion of Canadian adults 65 years of age or older within each category.
[c] Crude odds ratio from univariate logistic regression analyses.
[d] Weight (kg)/height $(m)^2$.

than are older men (4, 13–16). However, it should be noted that while women are at greater risk for falls, mortality rates from falls are known to be higher among men, which is likely related to the circumstances of falls (4, 15, 17, 37). As with previous studies, we found that fall prevalence increased with age among both genders. This might be attributed to age-induced declines in physical, sensory, and cognitive function, as well as an increase in the number of comorbid conditions (12, 37). The greater influence of age on the risk of falling in women has been reported elsewhere (4, 6, 22) and might be due to a higher prevalence of age-related risk factors among women.

Our results indicate that being widowed/separated/divorced is related to a higher odds of falling. Similar findings were reported by others (3, 16, 24, 38) and might be explained by the benefits of marriage with regard to health behaviors, such as diet and physical activity level (39). However, even after accounting for a number of lifestyle/behavioral factors, marital status remained significantly associated with falls in men but not in women. This corresponds to previously observed gender differences in the effect of marital status, particularly widowhood and divorce, on health (39) and risk of mortality (40). It has been suggested that spouses/partners are a more important source of social support and

Table 4. Prevalence and Crude Odds Ratios for Falls by Medical Factors and Gender in Adults 65 Years of Age or Older, Canadian Community Health Survey–Healthy Aging, 2008–2009

Characteristic	Men				Women			
	No.[a]	%[b]	OR[c]	95% CI	No.[a]	%[b]	OR[c]	95% CI
Arthritis								
No	197,622	15.5	1.00	Referent	204,609	17.4	1.00	Referent
Yes	143,763	20.8	1.44	1.18, 1.75	330,567	27.3	1.67	1.42, 1.98
Osteoporosis								
No	322,192	17.3	1.00	Referent	353,200	20.7	1.00	Referent
Yes	18,861	17.3	0.93	0.62, 1.40	181,308	26.5	1.42	1.18, 1.71
Hypertension								
No	174,385	16.6	1.00	Referent	232,154	20.9	1.00	Referent
Yes	166,973	18.2	1.14	0.95, 1.36	304,598	23.8	1.21	1.01, 1.45
Heart disease								
No	232,730	16.3	1.00	Referent	401,907	20.7	1.00	Referent
Yes	107,576	20.1	1.18	0.97, 1.42	134,593	30.0	1.67	1.38, 2.03
Stroke								
No	310,633	16.6	1.00	Referent	496,500	21.6	1.00	Referent
Yes	30,428	33.0	2.36	1.66, 3.34	38,397	40.3	2.20	1.52, 3.21
COPD								
No	305,434	17.0	1.00	Referent	474,077	21.8	1.00	Referent
Yes	34,415	20.5	1.17	0.88, 1.56	61,710	28.6	1.51	1.17, 1.95
Diabetes								
No	266,074	16.9	1.00	Referent	435,978	21.4	1.00	Referent
Yes	75,312	19.2	1.11	0.88, 1.39	100,987	28.4	1.42	1.15, 1.76
Cancer								
No	310,200	16.9	1.00	Referent	511,898	22.3	1.00	Referent
Yes	29,990	22.3	1.37	0.89, 2.12	25,237	24.4	1.16	0.81, 1.64
Urinary incontinence								
No	300,206	16.8	1.00	Referent	430,237	20.9	1.00	Referent
Yes	40,776	22.1	1.39	1.03, 1.87	107,066	31.5	1.74	1.41, 2.14

Table continues

control for men than for women in terms of chronic disease management (41), which might also apply to fall prevention.

The finding that men with higher levels of education were more likely to fall is surprising and contradicts results from other studies (3, 24, 42). Hanlon et al. (43) also found a significant association between post–secondary school education and falls in a large sample of seniors in the United States. The reasons for these findings are unclear and warrant further investigation, for example, in terms of behavioral or reporting differences by educational level and gender. Furthermore, higher household income was protective against falls in women only. Other studies have also noted an inverse relationship between income (3, 16) or socioeconomic status (44) and falls. Lower income is associated with poor living environment, poor health behavior, and barriers to healthcare services, which might in turn affect health status and increase the risk of falling (37). Our findings are consistent with those from a Canadian study in which a significant relationship between income and self-rated health was reported in women but not men, which suggests that financial resources have greater importance with regard to health maintenance among women (45).

As in previous studies (46, 47), we found that seniors who were more physically active were less likely to fall. In addition to its numerous health benefits, physical activity might reduce the risk of falling by improving muscle strength, gait, and balance (46). Moreover, consistent with a recent longitudinal study in Taiwan (48), our results highlight the impact of nutritional risk on falls among both genders. Malnutrition due to poor diet and inadequate fluid intake could result in physical weakness, leading to an increased risk of falling (4).

Previous studies examining the association between alcohol use and falls among seniors produced mixed results (2, 47, 49–51). For example, having 14 or more drinks per week was associated with a higher risk of falling in one study (49), whereas daily alcohol consumption was protective in others (2, 47). In our study, drinking alcohol at least once per week was independently associated with falls in women. This finding

Table 4. Continued

Characteristic	Men				Women			
	No.[a]	%[b]	OR[c]	95% CI	No.[a]	%[b]	OR[c]	95% CI
Gastrointestinal disorder								
No	310,705	17.1	1.00	Referent	442,055	21.3	1.00	Referent
Yes	30,668	20.2	1.26	0.92, 1.72	94,201	29.8	1.56	1.24, 1.95
Alzheimer's disease/dementia								
No	329,275	17.0	1.00	Referent	522,053	22.1	1.00	Referent
Yes	12,031	37.9	3.06	1.38, 6.79	15,052	41.5	1.77	0.76, 4.16
Parkinson's disease								
No	334,700	17.2	1.00	Referent	533,417	22.4	1.00	Referent
Yes	6,685	35.5[d]	3.00	1.20, 7.51	3,859	25.3[d]	1.05	0.34, 3.23
Mood/anxiety disorder								
No	311,373	16.8	1.00	Referent	464,654	21.5	1.00	Referent
Yes	30,012	26.9	1.76	1.18, 2.65	72,536	31.5	1.61	1.24, 2.08
Eye disorder								
No	236,384	15.8	1.00	Referent	343,104	20.9	1.00	Referent
Yes	103,573	21.9	1.49	1.18, 1.89	194,004	25.9	1.37	1.16, 1.63
No. of comorbid conditions[e]								
0	37,864	11.7	1.00	Referent	26,787	11.0	1.00	Referent
1	72,739	14.6	1.21	0.86, 1.71	79,727	16.7	1.70	1.10, 2.63
2	82,348	17.2	1.47	1.04, 2.09	103,141	18.9	1.99	1.38, 2.87
3	60,275	18.6	1.59	1.12, 2.26	116,705	23.9	2.65	1.83, 3.84
4	47,227	25.5	2.26	1.50, 3.42	89,288	29.5	3.37	2.25, 5.04
≥5	36,020	25.2	2.27	1.52, 3.40	110,415	35.9	4.66	3.12, 6.96

Abbreviations: CI, confidence interval; COPD, chronic obstructive pulmonary disease; OR, odds ratio.
[a] Weighted number of men or women who fell during the past 12 months.
[b] Weighted prevalence of falls expressed as a proportion of Canadian adults 65 years of age or older within each category.
[c] Crude odds ratio from univariate logistic regression analyses.
[d] Estimate is associated with high sampling variability and should be interpreted with caution.
[e] No. of comorbid conditions is determined based on the 14 conditions listed in the table.

is novel because the aforementioned studies only examined heavier or more frequent drinking. Additionally, this female-specific association is consistent with that reported by Stenbacka et al. (51) and might be explained by gender differences in alcohol metabolism and the extent to which alcohol impairs cognitive (e.g., reaction time, alertness) and physical functions (52). Furthermore, our results are consistent with those from studies that identified polypharmacy (use of multiple medications) as a risk factor for falls (53, 54), especially among women (22, 55), although a dose-response relationship existed in both genders. Others have demonstrated that use of psychoactive drugs, such as hypnotics and sedatives, is associated with falls in women but not in men (22, 51). Because we did not examine specific types of medication in the present study, further research is required to investigate gender differences in the association between medication use and falls.

The relationship between chronic disease and falls among seniors has been well documented (9–12, 55, 56). Our study reaffirms that chronic conditions are important risk factors for falls and offers additional insight from a gender perspective. We identified stroke and arthritis as independent correlates of falls in both genders, likely because of their effects on gait, balance, and mobility (22, 42, 54). Furthermore, eye disorder was associated with falls in men only, although significant crude associations were reported for both genders. Vision problems are known to increase the risk of falling by impairing balance and obstacle avoidance due to diminished perception of distances and spatial relationships (12, 57). Gender disparities in treatment patterns (e.g., cataract surgery) (58) and chronic illnesses that affect vision (59) might have contributed to the observed gender difference in our final models.

The female-specific association between diabetes and falls has been previously reported (18, 60, 61). In addition to differential effects of diabetes on physical performance by gender (61), our results might be explained by gender differences in psychosocial factors associated with diabetes management (18). Compared with diabetic men, diabetic women tend to have less positive coping behavior and greater difficulty adhering to a diabetes regimen and are more likely to restrict their daily and social activities (62, 63). Similarly, our results

Table 5. Independent Correlates of Falls in Men 65 Years of Age or Older, Canadian Community Health Survey–Healthy Aging, 2008–2009

Characteristic	OR[a]	95% CI
Age, years		
65–69	1.00	Referent
70–74	0.88	0.65, 1.21
75–79	1.15	0.84, 1.57
80–84	1.19	0.85, 1.66
≥85	1.32	0.95, 1.84
Marital status		
Married/common-law	1.00	Referent
Widowed/separated/divorced	1.28[b]	1.03, 1.61
Single (never married)	1.37	0.90, 2.09
Highest educational level		
Less than secondary school	1.00	Referent
Secondary school degree	1.27	0.96, 1.67
Post–secondary school degree	1.68[c]	1.36, 2.07
Body mass index[d]		
Underweight or normal weight	1.00	Referent
Overweight	0.93	0.75, 1.15
Obese	1.27	0.99, 1.63
Quartile of PASE score		
First (lowest)	1.00	Referent
Second	0.82	0.64, 1.06
Third	0.65[e]	0.49, 0.87
Fourth (highest)	0.68[e]	0.51, 0.90
Nutritional risk (yes vs. no)	1.86[c]	1.50, 2.31
No. of medications used in the past month		
0–1	1.00	Referent
2–4	1.05	0.82, 1.35
≥5	1.36	0.96, 1.94
Arthritis (yes vs. no)	1.27[b]	1.03, 1.56
Stroke (yes vs. no)	1.91[c]	1.33, 2.74
Eye disorder (yes vs. no)	1.35[b]	1.06, 1.71

Abbreviations: CI, confidence interval; OR, odds ratio; PASE, Physical Activity Scale for the Elderly.

[a] Odds ratio from a multivariate logistic regression model with adjustment for all other variables listed in the table.

[b] $P < 0.05$.

[c] $P < 0.001$.

[d] Weight (kg)/height (m)^2.

[e] $P < 0.01$.

Table 6. Independent Correlates of Falls in Women 65 Years of Age or Older, Canadian Community Health Survey–Healthy Aging, 2008–2009

Characteristic	OR[a]	95% CI
Age, years		
65–69	1.00	Referent
70–74	0.97	0.74, 1.28
75–79	1.26	0.97, 1.64
80–84	1.27	0.96, 1.67
≥85	1.51[b]	1.14, 2.00
Household income, CAN$		
<$20,000	1.00	Referent
$20,000–$39,999	0.83	0.67, 1.03
$40,000–$59,999	0.70[c]	0.53, 0.93
≥$60,000	0.71	0.50, 1.00
Alcohol consumption		
Nondrinker	1.00	Referent
Less than once per month	0.97	0.76, 1.23
1–3 times per month	1.08	0.83, 1.39
At least once per week	1.39[b]	1.09, 1.76
Quartile of PASE score		
First (lowest)	1.00	Referent
Second	0.83	0.66, 1.05
Third	0.79	0.62, 1.02
Fourth (highest)	0.74[c]	0.57, 0.96
Nutritional risk (yes vs. no)	1.39[d]	1.17, 1.66
No. of medications used in the past month		
0–1	1.00	Referent
2–4	1.10	0.87, 1.39
≥5	1.36[c]	1.02, 1.82
Arthritis (yes vs. no)	1.36[d]	1.14, 1.62
Osteoporosis (yes vs. no)	1.22[c]	1.00, 1.48
Heart disease (yes vs. no)	1.22	0.99, 1.51
Stroke (yes vs. no)	1.53[c]	1.03, 2.27
Diabetes (yes vs. no)	1.31[c]	1.05, 1.65
Urinary incontinence (yes vs. no)	1.23	0.98, 1.54
Mood/anxiety disorder (yes vs. no)	1.29	0.96, 1.72

Abbreviations: CI, confidence interval; OR, odds ratio; PASE, Physical Activity Scale for the Elderly.

[a] Odds ratio from a multivariate logistic regression model with adjustment for all other variables listed in the table.

[b] $P < 0.01$.

[c] $P < 0.05$.

[d] $P < 0.001$.

suggest that osteoporosis might have a stronger influence on women, although the association was borderline significant. Osteoporosis has been associated with deficits in postural balance and psychological factors, such as fear of falling (64). For example, a few small studies revealed that women with osteoporosis were more likely to report a fear of falling (65) and that fear of falling among women with osteoporosis was associated with falls (66). Given the public knowledge about the elevated risk of fractures associated with osteoporosis, gender-specific behavior after a diagnosis of osteoporosis and its relationship with falls should be further explored.

Our data also indicate potential gender differences in the relationship between Alzheimer's disease/dementia and falls, with a significant univariate association reported in men only.

Additionally, when proxy respondents were included in the sensitivity analysis, Alzheimer's disease/dementia emerged as an independent correlate of falls in men. The particularly high proportion of proxies among respondents with dementia (men, 43%; women, 41%) likely accounted for the lack of association in the original analyses because subjects with more severe forms of Alzheimer's disease/dementia, who are presumably more likely to fall (67), would have been excluded. Several studies have also suggested that male gender is a risk factor for falling in dementia patients (67, 68). Differential distribution of dementia types by gender and their differential associations with gait and balance (69, 70) might have partially accounted for these findings.

The dose-response relationship observed between the number of comorbid conditions and falls is consistent with that from previous studies (42, 55, 56), including a meta-analysis in which a pooled odds ratio of 1.23 was reported for each additional condition (9). Our findings also suggest that multimorbidity, which is likely an indication of overall frailty, is more strongly associated with falls in women than in men, possibly because of biological and behavioral differences in chronic disease prognosis and management. Also using data from the CCHS-HA, Sibley et al. (56) noted significant associations between certain combinations of chronic diseases and falls, which might be an area of future research in the context of gender differences.

The present study is not without limitations. First, because of the cross-sectional nature of the survey, temporal relationships could not be established. For example, although physical activity appeared to be protective against falls, an alternate conclusion might be that falls lead to decreased physical activity, especially because the assessment of physical activity was limited to the 1-week period before the interview. Second, our analyses relied on self-reported data, which are potentially subject to recall bias and misclassification. It is also possible that the number of falls was underreported because of difficulty remembering, which is a particular concern in an older population (71). Third, gender-specific correlates identified in this study might only apply to falls as defined in the CCHS-HA (i.e., self-reported falls in the general population), as different sets of risk factors might be identified depending on the definition used. Fourth, as in previous research that examined falls using population-based surveys (3, 43, 56), logistic regression models were applied. However, it should be noted that odds ratios might overestimate relative risks when the outcome is common, as in the case of falls. Fifth, our analyses were limited by the variables available in the survey data and could not include other potential correlates or confounders. For example, the CCHS-HA lacked information on physical measures known to be associated with falls, such as gait and balance, as well as details on environmental factors. Lastly, our findings might only be generalizable to a relatively healthy population of seniors living in the community and possibly do not apply to residents of care facilities, who might have different risk profiles for falls compared with the general population (10).

In conclusion, the present study contributes new knowledge on a diverse range of correlates of falls in a nationally representative sample of seniors. Specifically, our findings highlight the differences between men and women in the associations between falls and various sociodemographic, lifestyle/behavioral, and medical factors. Although further research is required to better understand these gender differences and their implications for targeted intervention and risk assessment, this study emphasizes the need to take gender into consideration when designing prevention strategies.

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