ABSTRACT

Objective: To identify risk factors for falls and injuries among seniors living in a long-term care facility.

Method: Case-control study of 335 residents living at St. Joseph's Villa, Dundas, Ontario. Cases were defined as residents who fell between July 1, 1996 and June 30, 1997; controls were those who did not fall. To identify risk factors for injury, cases were defined as those with completed incident injury forms and controls as those without.

Results: The most important risk factors for falls included: having fallen in the past three months; residing in a secured unit; living in the facility for two or more years; having the potential to cause injury to others; and having an illness, disease or behaviour that may cause a fall. The most important risk factor for injury among those who fell was altered mental state.

Conclusion: The risk factors identified may be helpful to those planning falls prevention initiatives within long-term care settings.

ABRÉGÉ

Objectif : Définir les facteurs de risque de chute et de blessure chez les personnes âgées vivant dans un établissement de soins de longue durée.

Méthode : Étude cas-témoin de 335 résidents de l'établissement St. Joseph's Villa de Dundas (Ontario). Les sujets étaient les résidents ayant fait une chute entre le 1^{er} juillet 1996 et le 30 juin 1997, et les témoins, les autres résidents. Pour cerner les facteurs de risque de blessure, nous avons choisi comme sujets les personnes ayant rempli un rapport de blessure, et pour témoins, ceux qui ne l'avaient pas fait.

Résultats : Les principaux facteurs de risque de chute étaient d'avoir fait une chute au cours des trois mois précédents, d'habiter un logement protégé, de vivre dans l'établissement depuis au moins deux ans, d'être susceptible de causer des blessures à autrui et d'avoir une maladie ou un comportement pouvant entraîner une chute. Parmi les personnes ayant fait une chute, le principal facteur de risque de blessure était la perturbation de l'état mental.

Conclusion : Les facteurs de risque cernés peuvent être utiles aux planificateurs de mesures de prévention des chutes dans les établissements de soins de longue durée.

Risk Factors for Falls and Injuries in a Long-Term Care Facility in Ontario

Paul D. Krueger, PhD,^{1,3} Kevin Brazil, PhD,^{1,2,4} Lynne H. Lohfeld, PhD^{1,2,5}

Falls are a common problem in old age. Each year, one fourth of all community-dwelling persons age 65 to 74 and one third or more of those age 75 and older report having fallen.¹ Falls are a significant source of disability and death to the older person as well as a source of psychological distress. Falling itself is not a diagnosis but rather may be a symptom of multiple underlying diseases, and/or environmental hazards or obstacles that interfere with safe mobility.¹⁻³

The frequency of falling is considerably higher in the elderly who are hospitalized or are living in long-term care facilities, compared to those who live in the community.^{3,4} In nursing homes, up to 50% of residents fall each year, and over 40% have more than one fall each year. Even with these high statistics, the rate of falls may still be under-reported.³ The risk factors for falls that have been identified among the elderly in long-term care include: high age, ambulatory status, history of falls, dementia, polypharmacy and poor vision.^{2,5}

The characteristics of elderly residents in long-term care facilities vary by country, which explains much of the variation found in the risk factors for falls between different studies.⁴ The purpose of this case-control study was to identify risk factors for falls and injuries among the elderly living in a long-term care facility in a Canadian setting.

METHODS

The setting for this study was St. Joseph's Villa ("The Villa"), a long-term care facility in Dundas, Ontario (population 23,125). Dundas is one of six municipalities in the Hamilton-Wentworth Region (population 467,799), of Central West Ontario.⁶ The Villa has been in operation for over 100 years. During the study period (July 1, 1996 through June 30, 1997), the Villa provided various levels of care (residential/light care, medium care, heavy care or secured unit) to 335 residents.

Residents' potential for falling was assessed using the "Falls Risk Assessment Form" (a modified Wood's Fall Risk Protocol and Nursing Care Plan⁷). These forms were to be completed by registered nurses or registered practical nurses: 1) at the time of admission (when completing the nursing admission assessment); 2) yearly (prior to the annual resident review); and 3) at any time that a resident has experienced a major change in his or her condition. These forms consisted of nine items (see Table I for specific items) and were maintained in residents' charts.

To determine risk factors for falls, those who had fallen (cases) were identified from incident (fall) reports filed in residents' charts. Those who had not fallen were selected as controls. To identify risk factors for injury, cases were defined as those with completed incident injury forms and controls as those who had fallen but were not injured (i.e., without incident injury forms).

Selection of potential risk factors for falls and injury

Variables thought to be risk factors for falls and injury were selected after reviewing the literature and considering clinical experience. A data extraction form was then developed and used to collect infor-

1. St. Joseph's Health Care System Research Network, Father Sean O'Sullivan Research Centre, Hamilton, ON
 2. Department of Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, ON
 3. St. Joseph's Hospital, Brantford
 4. St. Joseph's Villa, Dundas
 5. St. Joseph's Hospital and Home, Guelph
- Correspondence:** Dr. Paul D. Krueger, St. Joseph's Health Care System Research Network, St. Joseph's Hospital, 99 Wayne Gretzky Parkway, Brantford, ON N3S 6T6, Tel: 519-753-8641, Fax: 519-753-1468, E-mail: kruegerp@mcmaster.ca

TABLE I

Senior Characteristics and Whether or Not They Had Ever Fallen Between July 1996 and June 1997 at the St. Joseph's Villa (n=335)

Characteristic		Ever Fell		P value*	Unadjusted Odds Ratio†	95% Confidence Interval
		Yes Number (%)	No Number (%)			
Demographic/Background						
Number of years living in the institution (n=335):	One or fewer years	11 (22.9)	37 (77.1)	<0.001	1.00	–
	Two or more years	166 (57.8)	121 (42.2)		4.61 (2.26, 9.41)	
Age of senior (n=335):	65-74	18 (52.9)	16 (47.1)	0.634	1.00	–
	75-84	63 (49.6)	64 (50.4)		0.88 (0.38, 1.99)	
	85-97	96 (55.2)	78 (44.8)		1.09 (0.49, 2.43)	
Gender of senior (n=333):	Female	138 (52.5)	125 (47.5)	0.787	1.00	–
	Male	38 (54.3)	32 (45.7)		1.08 (0.63, 1.83)	
Levels of Care (n=335):	Residential/light, medium or heavy care	110 (45.4)	132 (54.5)	<0.001	1.00	–
	Secured unit	67 (73.6)	24 (26.4)		3.35 (1.97, 5.69)	
Potential for causing injury to others (n=330):	No	60 (39.7)	91 (60.3)	<0.001	1.00	–
	Yes	115 (64.2)	64 (35.8)		2.73 (1.74, 4.26)	
Diagnoses Information						
Cardiovascular-Pulmonary (n=335)	No	75 (52.8)	67 (47.2)	0.995	1.00	–
	Yes	102 (52.8)	91 (47.2)		1.00 (0.64, 1.55)	
Dementia (n=335)	No	101 (48.6)	107 (48.6)	0.045	1.00	–
	Yes	76 (59.8)	51 (40.2)		1.58 (1.01, 2.47)	
Dermatological (n=335)	Yes	3 (37.5)	5 (62.5)	0.483‡	1.00	–
	No	174 (53.2)	153 (46.8)		1.90 (0.36, 12.38)¶	
Endocrine (n=335)	No	149 (52.5)	135 (47.5)	0.748	1.00	–
	Yes	28 (54.9)	23 (45.1)		1.10 (0.61, 2.01)	
GI tract (n=335)	Yes	30 (44.1)	38 (55.9)	0.106	1.00	–
	No	147 (55.1)	120 (44.9)		1.55 (0.88, 2.75)	
GU tract (n=335)	No	157 (52.3)	143 (47.7)	0.590	1.00	–
	Yes	20 (57.1)	15 (42.9)		1.21 (0.60, 2.46)	
Hearing problem (n=335)	Yes	8 (50.0)	8 (50.0)	0.816	1.00	–
	No	169 (53.0)	150 (47.0)		1.13 (0.37, 3.40)	
Hematology/Oncology (n=335)	No	150 (50.8)	145 (49.2)	0.047	1.00	–
	Yes	27 (67.5)	13 (32.5)		2.01 (1.00, 4.04)	
Musculoskeletal (n=335)	Yes	75 (48.4)	80 (51.6)	0.130	1.00	–
	No	102 (56.7)	78 (43.3)		1.39 (0.89, 2.20)	
Neurological (n=335)	Yes	38 (51.4)	36 (48.6)	0.772	1.00	–
	No	139 (53.3)	122 (46.7)		1.08 (0.62, 1.87)	
Psychiatric (n=335)	No	143 (52.0)	132 (48.0)	0.512	1.00	–
	Yes	34 (56.7)	26 (43.3)		1.21 (0.69, 2.12)	
Vision problem (n=335)	No	154 (52.6)	139 (47.4)	0.789	1.00	–
	Yes	23 (54.8)	19 (45.2)		1.09 (0.57, 2.09)	
Other problems (n=335)	No	161 (52.4)	146 (47.6)	0.633	1.00	–
	Yes	16 (57.1)	12 (42.9)		1.21 (0.55, 2.64)	
Information from Latest Falls Risk Assessment Form (n=271)						
Fallen in the past three months (n=271):	No	87 (43.7)	112 (56.3)	<0.001	1.00	–
	Yes	63 (87.5)	9 (12.5)		9.01 (4.25, 19.13)	
Difficulty asking for assistance or refuses to ask for help (n=271):	No	89 (52.7)	80 (47.3)	0.252	1.00	–
	Yes	61 (59.8)	41 (40.2)		1.34 (0.81, 2.20)	
Alteration in mental state: confusion, disorientation, restlessness, poor judgement (n=271):	No	50 (45.9)	59 (54.1)	0.010	1.00	–
	Yes	100 (61.7)	62 (38.3)		1.90 (1.16, 3.11)	
Decreased mobility (n=271):	No	50 (48.5)	53 (51.5)	0.078	1.00	–
	Yes	100 (59.2)	68 (40.5)		1.56 (0.95, 2.56)	
Disturbance in gait or balance (n=271):	No	62 (49.2)	64 (50.8)	0.058	1.00	–
	Yes	88 (60.7)	57 (39.3)		1.59 (0.98, 2.58)	
Decreased visual or hearing ability (n=271):	No	88 (53.7)	76 (46.3)	0.488	1.00	–
	Yes	62 (57.9)	45 (42.1)		1.19 (0.73, 1.95)	
Given medications that would increase risk of falls§ (n=271):	No	38 (49.4)	39 (50.6)	0.211	1.00	–
	Yes	112 (57.7)	82 (42.3)		1.40 (0.83, 2.38)	
Any illness, disease or behaviour that may cause a fall†† (n=271):	No	21 (41.2)	30 (58.8)	0.024	1.00	–
	Yes	129 (58.6)	91 (41.4)		2.03 (1.09, 3.76)	
Incontinent and ambulatory with potential for falls due to the incontinence (n=271):	No	115 (51.6)	108 (48.4)	0.007	1.00	–
	Yes	35 (72.9)	13 (27.1)		2.53 (1.27, 5.03)	
Falls risk assessment score (n=271):	Low (0-3)	30 (38.0)	49 (62.0)	0.001	1.00	–
	Moderate or High (4-9)	120 (62.5)	72 (37.5)		2.72 (1.53, 4.85)	

* Chi-square test

† Odds ratios for categorical variables represent comparisons with the referent group (OR=1.00). An odds ratio > 1 indicates an increased risk for having fallen.

‡ Fisher exact test

¶ Exact Confidence Interval

§ Medications that may increase the risk of falls include sedatives, hypnotics, antidepressants, diuretics, vasodilators, antihypertensives, antipsychotics, anti-anxiety agents.

†† Examples of diseases, illnesses or conditions associated with falls: C.V.A., arthritis, hypertension, injury, diabetes, heart disease, generalized weakness, alcohol abuse, Parkinson's Disease, sleeplessness, a seizure disorder.

TABLE II
Final Logistic Regression Model Comparing Characteristics of Those Who Fell to Those Who Did Not Fall Between July 1996 and June 1997 at the St. Joseph's Villa (n=328*)

Risk Factors	Adjusted Odds Ratio†	95% Confidence Interval
Fallen in the past three months:		
No	1.00	—
Yes	7.56	(3.40, 16.81)
Levels of care:		
Unsecured unit	1.00	—
Secured unit	4.49	(2.25, 8.96)
Number of years living in institution:		
One or fewer years	1.00	—
Two or more years	4.75	(2.06, 10.96)
Potential to cause injury to others:		
No	1.00	—
Yes	1.88	(1.12, 3.14)
Any illness, disease or behaviour that may cause a fall‡:		
No	1.00	—
Yes	1.82	(0.99, 3.34)

Final Logistic Regression Model Statistics:
 Rho-square = 0.21 (a pseudo R², values between 0.2 and 0.4 suggest a very good fit)
 Hosmer and Lemeshow Goodness-of-Fit test = 0.93 (values greater than 0.25 indicate good fit)
 70% correctly classified

* Seven residents had missing values for one or more of the variables included in the final model.

† Odds ratios for categorical variables represent comparisons with the referent group (OR=1.00) after adjustment for all other variables in the model.

‡ Examples of diseases, illnesses or conditions associated with falls: C.V.A., arthritis, hypertension, injury, diabetes, heart disease, generalized weakness, alcohol abuse, Parkinson's Disease, sleeplessness, a seizure disorder.

mation from all residents' charts (n=335) for the study period. In an attempt to ensure the reliability of the data extraction process, information was independently extracted by two reviewers (a research assistant and LL) for 10% of the records. The level of agreement was high enough ($\kappa > 0.8$) to permit the research assistant to extract information from the remaining records. Extracted data entered into SPSS's Data Editor included background and demographic characteristics, medical diagnoses, as well as information from falls risk assessment forms, care plans, and incident (fall) reports.

Statistical analysis

Two parallel and complementary statistical analyses were completed separately, to identify risk factors for falls and for injury among those who had fallen. Chi-square analyses or, when appropriate, Fisher's exact tests were used to determine if there were statistically significant associations between potential risk factors and each of these outcomes. Only variables for which information was available and which were hypothesized *a priori* to be potential risk factors were included in these analyses. P-values, odds ratios, and 95% confidence

intervals are reported for each potential risk factor. Two separate multiple logistic regression analyses were used to identify the most important risk factors for falls and injury, after adjusting for all other variables in the model, including effect modifiers. Each of the logistic regression analyses included only those variables for which we found a statistically significant association between potential risk factor and outcome. The logistic regression findings are presented as adjusted odds ratios with corresponding 95% confidence intervals. The goodness of fit of each logistic regression model was assessed using the rho-square statistic.⁸ We used SPSS (version 10 for Windows, SPSS Inc., Chicago, 1998) and Epi-Info (version 6.04c, Centers for Disease Control and Prevention, Atlanta, 1997) for statistical computations and a probability level of ≤ 0.05 to determine statistical significance.

RESULTS

Risk factors for falls

Of the 335 residents, the majority (79.0%) were female. Residents ranged in age from 65 to 97 years (mean 84.2, SD 7.0). During the period of study, 52.8% of

residents fell at least once. Overall, 792 falls were experienced by 177 seniors. The average number of falls was 2.4 for all residents and 4.5 for those who fell at least once. The number of times a resident fell ranged from 1 to 27. Of those who fell, 35.0% fell once, 31.1% fell two to four times, and 33.9% fell five or more times. Additional descriptive information about residents can be found in Table I.

Twenty-seven (27) variables (5 demographic/background, 13 diagnoses, 9 fall risk assessment and a corresponding risk assessment score) were individually assessed as risk factors for falls (Table I). Chi-square analyses revealed that 10 of these 27 variables (3 demographic/background, 2 diagnosis, and 5 fall risk assessment) were statistically associated with falls during the study period ($p < 0.05$). Unadjusted odds ratios and corresponding 95% confidence intervals are presented in Table I for all 27 variables.

Of the 335 residents in our sample, 64 did not have a fall risk assessment completed during the study period. A decision, therefore, had to be made about what to do with the data representing residents with missing values. Rather than exclude all of these seniors (which would reduce the power of subsequent logistic regression analyses), missing values were coded into a "data missing" category for each of the 9 variables (i.e., all fall risk assessment variables were coded as "risk present", "no risk" or "data missing"). Because we later determined that there were no differences between the "no risk" categories and the "data missing" categories for all 9 variables (i.e., the odds ratios were the same for both categories), we collapsed these categories. This decision also made sense from a clinical perspective because patients identified as having any of the risk factors in the fall risk assessment form would very quickly be flagged for a fall risk assessment (i.e., would have had a fall risk assessment completed).

Results of the logistic regression analysis (Table II) revealed that the most important risk factors for falls among seniors living in The Villa were previous falls, level of care, length of stay, potential for injuring others, and "risky" illnesses, diseases or behaviours. More specifically, seniors more likely

to fall during the study period: 1) had fallen in the past three months, 2) lived in secured units, 3) were residents of the facility for two or more years, 4) had a potential to cause injury to others (i.e., exhibited aggressive behaviour), and 5) had an illness, disease, or behaviour thought to be a risk factor for falls (see Table II for specific examples). Each of the corresponding odds ratios and associated 95% confidence intervals that are presented in Table II are simultaneously adjusted for all other variables in the final logistic regression model. The addition of first-order interaction terms (representing possible effect modifiers) to the final model did not significantly improve the fit of the model. The final model achieved a rho-square of 0.21, indicating a good overall fit.

Risk factors for injury

Of the 177 seniors who fell during the study period, 109 (61.6%) were injured. Of the 792 falls, 210 (26.5%) resulted in injury. These injuries were recorded as cuts (56), bruises (46), abrasions (43), and unspecified (65). Twenty-three of these injuries (11.0%) were serious enough to warrant hospitalization (15 of which were categorized at the time of the fall as unspecified injuries). One of the 23 seniors was hospitalized twice for injuries that resulted from separate falls.

Each of the 27 potential risk factors for falls were also assessed for being risk factors for injury as a result of a fall during the study period. The following six potential risk factors for injury were identified: 1) age (older seniors were more likely to be injured than younger seniors, with a significant Extended Mantel-Haenszel Chi-Square test for linear trend observed across the three age categories ($p=0.049$); 2) dementia (seniors with dementia were significantly more likely to be injured than those without dementia, OR 2.05, 95% CI 1.09 to 3.86); 3) GI tract diagnoses (seniors without GI tract diagnoses were more likely to be injured in a fall than those with GI tract diagnoses, OR 2.46,

95% CI 1.04 to 5.89); 4) GU tract diagnoses (seniors without GU tract diagnoses were more likely to be injured in a fall than those with GU tract diagnoses, OR 2.71, 95% CI 0.96 to 7.77); 5) prior falls (seniors having fallen in the past three months were significantly more likely to be injured than seniors who had not fallen in the past three months, OR 2.46, 95% CI 1.25, 4.85); and 6) altered mental state (seniors with an altered mental state – confusion, disorientation, restlessness, or poor judgement – were significantly more likely to be injured as a result of a fall than seniors without an altered mental state, OR 2.51, 95% CI 1.35 to 4.68).

For the final logistic regression analysis, we decided not to include the GI and GU tract variables because failing to have these diagnoses did not appear to be meaningful risk factors for injury resulting from a fall. Only one of the four remaining variables – altered mental state – remained as a statistically significant risk factor. Seniors having an altered mental state were 2.51 times more likely to be injured from a fall than seniors without an alteration in mental state (95% CI 1.35 to 4.68). Addition of the other potential risk factors did not improve the fit of the model. Therefore, from the information available, the most important risk factor for injury among seniors who fell is whether or not they had an altered mental state.

DISCUSSION

For both legal and ethical reasons, the number of injurious falls experienced by seniors living in long-term care facilities needs to be monitored and, where possible, reduced. Therefore, universal screening has become a standard practice in long-term care facilities. However, facility staff are still struggling with the issue of which resident characteristics to assess when evaluating the extent of risk for falls and injury. Because most of the literature available to date is based on studies of seniors in either the community or acute care facilities, or

conducted outside of Canada, this study is particularly relevant for health care planners and providers concerned with Canadian long-term care facilities.

Using resident records as a data source for research activities holds several advantages, including ease of access, low costs for data collection, as well as the opportunity to conduct trend studies. However, potential limitations should also be noted – specifically, chart information may be incomplete or in some cases inaccurate. Despite this caution on data quality, this study is notable in that we collected data over a one-year period, documenting a relatively large number of falls ($n=792$) experienced by a unique subset of residents within the facility. By highlighting the key risk factors for falls and injury for residents in a long-term care facility, we have sharpened the focus on what resident characteristics should be included in a falls risk assessment. This, in turn, may increase the accuracy of falls risk assessment whereby falls reduction programs would be more effective in targeting “at risk” residents in a long-term care facility.

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