A Cross-Sectional Study of the Prevalence, Correlates, and Costs of Falls in Older Home Care Clients 'At Risk' for Falling*

Maureen Markle-Reid, Gina Browne, Amiram Gafni, Jacqueline Roberts, Robin Weir, Lehana Thabane, Melody Miles, Vida Vaitonis, Catherine Hecimovich, Pamela Baxter, and Sandra Henderson
McMaster University

RÉSUMÉ

Cette étude a examiné la prévalence pendant 6 mois, à l'aide des services de soutien à domicile, des facteurs de risque et des coûts de chutes de personnes âgées qui sont à risque de chute. Des 109 participants, 70,6 pour cent ont indiqué une chute dans les six mois précédents et 27,5 pour cent ont éprouvé plusieurs chutes. Bien qu'il n'y avait aucune différence statistiquement significative dans n'importe quel facteur de risque lié à la chute parmi ceux qui sont tombés (1+ chutes) et ceux qui ne sont pas tombés (0 chutes), ceux qui sont tombés ont montrés des tendances de plus en plus évidentes de fonctionnement réduit sur le plan physique, social et psychologique. Dans le coût total par personne d'utilisation des services de santé au cours des 6 derniers mois, il n'y avait aucune différence statistiquement significative entre ceux qui sont tombés et ceux qui ne sont pas tombés; toutefois, il y avait des différences significatives entre les groupes dans certains types de services de santé. L'analyse multivariable a révélé la présence de cinq facteurs de risques de chutes: troubles neurologiques (p. ex., diminution cognitive, maladie de Parkinson), l'âge ≥85 ans, risques environnementaux, glissade ou trébuchant précédente et déficience visuelle.

ABSTRACT

This study examined the six-month prevalence, risk factors, and costs of falls in older people using home support services who are at risk of falling. Of the 109 participants, 70.6 per cent reported ≥ one fall in the previous six months, and 27.5 per cent experienced multiple falls. Although there was no statistically significant difference in any fall-related risk factor between fallers (1+ falls) and non-fallers (0 falls), fallers had clinically important trends towards lower levels of physical, social, and psychological functioning. There was no statistically significant difference between fallers and non-fallers in the total per-person costs of use of health services in the previous six months; however, there were significant differences between groups in specific types of health services. The multivariate analysis revealed the presence of five risk factors for falls: neurological disorder (e.g., cognitive impairment, Parkinson's disease), age ≥ 85 years, environmental hazards, previous slip or trip, and visual impairment.

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Correspondence concerning this article should be addressed to / La correspondance concernant cet article doit être adressées à:
Maureen Markle-Reid, RN, Ph.D.
McMaster University, School of Nursing
1200 Main Street West, HSC 3N28H
Hamilton, Ontario L8N 3Z5.
(mreid@mcmaster.ca)

Introduction

Despite knowledge that most falls are both predictable and preventable, falls and fall-related injuries continue to negatively impact older adults' quality of life and health care resources. Thirty per cent of community-dwelling adults over 65 years of age fall at least once a year, and the proportion increases to 50 per cent by age 80 (O'Loughlin, Robitaille, Boivin, & Suisa, 1993). In people aged 65 years and older, falls are the leading cause of injury-related admissions to acute care hospitals and in-hospital deaths (Canadian Institute for Health Information [CIHI], 2002) and explain 40 per cent of nursing home admissions (Wilkins, 1999). Many older people who fall need ongoing assistance at home from community services. The costs of health care associated with fall-related injuries are staggering. The 1999–2000 costs of fall injuries to seniors in Canada were estimated to be $2.4 billion (CIHI, 2002). With an aging population and an associated increase in the number of falls and fall-related injuries, these cost estimates are projected to rise as high as $240 billion by 2040 (SmartRisk, 2006).

Aside from the cost, the negative impact of a fall on health and related quality of life should not be underestimated. Fall injuries often result in fear of falling (Fletcher & Hirdes, 2004; Sjösten, Vaapio, & Kivelä, 2008), leading to self-imposed restriction of activity and loss of confidence (Myers, Powell, Maki, Holliday, Brawley, & Sherk, 1996), low self-esteem, depression (Sjösten et al.), chronic pain, and functional deterioration (Tinetti, Speechley, & Ginter, 1988). Falls and fall-related injuries and complications are the leading cause of death among seniors (CIHI, 2004). A fall affects not just the individual who falls: 35 per cent of caregivers reported having to deal with extra expenses, and 32 per cent needed to change their social activities, 26 per cent their vacation plans, and 20 per cent their work arrangements (Cranswick, 2002). Little, however, is known about the rate of falls and fall-related injuries among community-dwelling seniors receiving home support services.

Most falls are associated with one or more identifiable risk factors, and studies have shown that attention to these risk factors can reduce rates of falling (SmartRisk, 1998). Extensive research has been carried out to identify the most common risk factors for falls in both institutional and community settings. There are over 400 potential risk factors for falling; these can be broadly divided into "intrinsic" and "extrinsic" factors (Kenny, Rubenstein, Martin, & Tinetti, 2001; Masud & Morris, 2001). Demographic and biological factors are intrinsic, whereas environmental and behavioral factors are extrinsic (Bueno-Cavanillas, Padilla-Ruiz, Jiménez-Moleón, Peinado-Alonso, & Gálvez-Vargas, 2000; Speechley & Tinetti, 1991).

Intrinsic risk factors for falling among the community-dwelling population include history of falls (Prudham & Grimley-Evans, 1981; Tinetti et al., 1988), female gender (Prudham & Grimley-Evans; Tinetti, Doucette, Claus, & Marottoli, 1995), advanced age (Campbell, Reinken, Allan, & Martinez, 1981; Prudham & Grimley-Evans), reduced lower-limb strength, gait and balance impairment (Gunter, White, Hayes, & Snow, 2000; Oliver, Hopper, & Seed, 2000), previous slips or trips (Steinberg, Cartwright, Peel, & Williams, 2000; Tinetti et al., 1988), difficulty in activities of daily living (ADLs), functional impairment (Campbell et al., 1981; O'Loughlin et al., 1993), certain chronic diseases (e.g., arthritis, Parkinson's disease, diabetes, or stroke) and co-morbidity, cognitive impairment (Campbell et al., 1981; Nevitt, Cummings, Kidd, & Black, 1989; Tinetti et al., 1988; Van Dijk, Meulenberg, Van De Sande, & Habbema, 1993), depression, poor nutrition, underweight or unintentional weight loss, visual impairment or hearing loss (Kenny et al., 2001; Lord, Ward, Williams, & Anstey, 1994), and urinary incontinence or nocturia (Stewart, Moore, May, Marks, & Hale, 1992).

Extrinsic risk factors for falling include taking four or more prescription medications daily or taking sedative or hypnotic medications (Campbell, Borrie, & Spears, 1989; Cumming, Miller, Kelsey, Davis, Arfken, Birge et al., 1991; Liu, Topper, Reeves, Gryfe, & Maki, 1995), environmental hazards (Close, Ellis, Hooper, Glucksman, Jackson, & Swift, 1999; Fletcher & Hirdes, 2002; Hornbrook, Steven, Wingfield, Hollis, Greenlick, & Ory, 1994), fear of falling, inactivity, inappropriate clothing or footwear, low income and education levels, excess alcohol use, and social isolation (Feder, Cryer, Donovan, & Carter, 2000; Kenny et al., 2001; Lord et al., 1994; O'Loughlin et al., 1993; Teno, Kiel, & Mor, 1990; Tinetti et al., 1988; World Health Organization [WHO], 2007). Although no single factor causes all falls, the risk of falling increases with the number of risk factors present (Lawlor, Patel, & Ebrahim, 2003; Nevitt et al., 1989).

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Most studies on risk factors for falling have relied on surveys of well-functioning, community-dwelling seniors. Few studies pertain to frail older people receiving home support services who represent 75–80 per cent of home care users (Roos, Stranc, Peterson, Mitchell, Bogdanovic, & Shapiro, 2001). Such individuals are typically medically unstable, over age 75, have severe mobility or cognitive impairments, or need assistance with ADLs, the same conditions that are associated with increased risks of falling and being injured (Scott, Votova, & Gallagher, 2006). To our knowledge, only two published studies have examined risk factors for falling among community-dwelling seniors receiving home care services. Fletcher and Hirdes (2002), in a cross-sectional study of 2,304 community-dwelling seniors receiving home care services, found that gender, gait, environmental hazards, changes in health, end-stage disease, medical problems, cognitive limitations, Parkinson's disease, and poor self-rated health were associated with falling. Lewis, Moutoux, Slaughter, and Bailey (2004), in a retrospective study of 196 seniors receiving home care services, determined that history of falls, neurological and cardiovascular impairments, and use of antipsychotic phenothiazines and tricyclic antidepressants were predictive of falling.

Although these studies provide insight into fall prevalence and risk factors for falls in a general population of community-dwelling seniors receiving home care services, the relevance of these factors specifically to seniors receiving home support services is unclear. In addition, neither study dealt with the issue of differences in risk factors for falls based on fall risk status. Little is known about fall prevalence and risk factors for falls among at-risk seniors receiving home support services or more specifically at-risk seniors who have not yet fallen versus those who have had a fall. Categorizing individuals into different levels of risk is important from both clinical and economic perspectives because it is the seniors with the highest risk of falling who will benefit most from preventive efforts and from avoiding the negative consequences of falls (Gillespie, Gillespie, Robertson, Lamb, Cumming, & Rowe, 2003; Tinetti, Baker, McAvay, Claus, Garrett, Gottschalk et al., 1994). The best approach to preventing falls in any group of older persons requires knowledge of where that group sits on the risk spectrum, because this will determine the type and amount of services required as well as the program's effectiveness (Tinetti et al., 1988). Finally, to our knowledge no study has examined the costs of use of health services associated with falls and fall-related injuries in seniors receiving home support services.

Home care programs make up the largest component of community-based care for older people. These services enable clients who are incapacitated to live in their home environment. In contrast to other home care recipients, older people with chronic conditions and continuing care needs require non-medical home support services more than they do medical services to enable them to live independently in their own homes and maintain their quality of life (Carrière, 2006). Hollander (2003) reported that home support services represented approximately 90 per cent of the expenditure for long-term home care services (e.g., beyond three months) for older people with non-acute needs, with only 10 per cent spent on professional services (Hollander). Home support services consist of supervision, psychosocial support, personal assistance (bathing and dressing), basic nursing tasks (medication administration and simple wound or bowel care), and instrumental ADLs (housekeeping and meal preparation) (Cohen, McLaren, Sharman, Murray, Hughes, & Ostry, 2006).

The purpose of the present study was to examine the six-month prevalence, correlates, and costs of falls among older home care clients receiving home support services who were deemed to be at risk of falling. Because fall risk is continuous and older adults have an annual fall risk of at least 10 per cent with no recognized risk factors, it is important to define the use of the term at risk. In this study, individuals were deemed to be at risk of falling if he/she had recognized risk factors that included a fall within the past 12 months, a fear of falling, or unsteadiness on his/her feet (Kenny et al., 2001). Efficient allocation of scarce home care resources for the prevention of falls and related injuries requires enhanced knowledge of the problem's prevalence as well as the factors that increase the risk of falls in this at-risk population. This study reports the results of a secondary analysis of baseline data from a randomized controlled trial, the aim of which was to determine the effects and costs of a multifactorial and interdisciplinary team approach to falls prevention compared with usual home care services for older home care clients at risk of falling (Markle-Reid, Miles, Vaitonis, Henderson, Anderson, Baxter et al., 2008).

Research Questions

The specific research questions follow. Among older home care clients at risk for falling, (1) what is the six-month prevalence of falls; (2) what are the circumstances and consequences of falls; (3) what are the characteristics that distinguish fallers (1 or more falls) from non-fallers (0 falls); and (4) what are the six-month costs of use of health services for fallers compared with non-fallers?

Methods

This study was conducted in accordance with the Tri-Council Policy Statement, "Ethical Conduct for Research Involving Humans" (Canadian Institutes of

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Health Research, Natural Sciences and Engineering Research Council of Canada, Social Sciences and Humanities Research Council of Canada, 1998). Ethics approval for the study was obtained from the McMaster University Research and Ethics Board and renewed yearly as required (# 05-279). All participants provided written informed consent for participation. The methods and results are presented according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies (von Elm, Altman, Egger, Pocock, Gotzsche, & Vandenbrouck, 2008).

Study Design

This was a cross-sectional study that examined the prevalence, correlates, and costs of use of health services associated with falls in home care clients aged 75 years and over who were at risk for falling. The study was a secondary analysis of baseline data from an efficacy trial on falls prevention (Markle-Reid et al., 2008). The sample was divided into two groups based on their fall status in the six months preceding enrolment in the study: zero falls or one or more falls.

Participants and Setting

This was a collaborative project between researchers in the McMaster University System-Linked Research Unit (SLRU) and decision makers, managers, and practitioners in the Hamilton Niagara Haldimand Brant and Mississauga Halton Community Care Access Centres (CCAC) and two direct care provider agencies (Halton Region Health Department, Community Rehab) in Ontario, Canada. The SLRU has extensive experience conducting community-based randomized trials. The CCAC provides publicly funded home care using a contractual model of service delivery, wherein case managers contract out home care services to agencies that provide care.

Study participants were adults aged 75 years and over, newly referred to and eligible for home support services through the CCAC, living in the community (not in a nursing home or other long-term care facility), mentally competent to give informed consent, and competent in English or with a translator available. Individuals were eligible for home support services if they required assistance with personal care, which could be provided by either a caregiver or a personal support worker contracted by the CCAC. With verbal consent, clients meeting these criteria were screened for risk for falls. An older person was deemed to be at risk for falls and thus eligible for the study, if he/she answered "yes" to any of the following questions (Kenny et al., 2001): Have you fallen in the past 12 months; do you have a fear of falling; or are you unsteady on your feet? To validate their informed consent to enrolling and continued participation in the study, participants needed to score 24 or more on the Standardized Mini-Mental State Examination (SMMSE) (Kukull, Larson, Teri, Bowen, McCormick, & Pfanschmidt, 1994) or have a substitute decision maker to provide consent and complete the questionnaires on their behalf.

Variables and their Measures

Trained interviewers, blinded to the study's purpose, assessed participants through a structured in-home interview. The interviewers were experienced health professionals, primarily nurses, with previous experience working in home and community-based settings. They underwent intensive training, standardization, and inter-rater reliability assessment in all interview and data collection procedures. Overall agreement for categorical variables was very good (Kappa statistic = 0.80, CI: 95% 0.76, 0.84). Overall agreement for continuous variables was also very good (ICC = 0.96, CI: 95% 0.92, 0.99) (Streiner & Norman, 2005).

The *dependent variable* was fall status. Specifically, individuals were asked whether they had fallen in the previous six months. The outcome was dichotomized as zero falls or one or more falls. Additional data on the circumstances and activity at the time of the fall as well as the consequences of falls were obtained using the Falls Surveillance Report, which was created by the research team (Markle-Reid et al., 2008). For the purposes of this study, a fall was defined as unintentionally coming to rest on the ground or floor or other lower level, regardless of whether the fall resulted in injury (Registered Nurses Association of Ontario [RNAO], 2005). Self-report is an essential source of data because many falls among older community-dwelling adults are not witnessed and do not require medical attention (Lightbody, Watkins, Leathley, Sharma, & Lye, 2002; Steinberg et al., 2000). Based on previous studies, six months was considered to be a reliable span of recall (Gallagher & Brunt, 1996; Lightbody et al.; Robson, Edwards, Gallagher, & Baker, 2002; Scott et al., 2006; Yates & Dunnagan, 2001).

The *independent variables* representing known risk factors for falls included (1) self-reported slip or trip frequency measured by the Falls Surveillance Report; (2) functional health status and related quality of life measured by the SF-36 health survey (Ware, Snow, Kosinski, & Gandek, 1993); (3) nutritional status measured by the Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II (SCREEN II) (Keller, Goy, & Kane, 2005); (4) gait and balance measured by the Performance-Oriented Mobility Assessment (POMA) (Tinetti, 1986); (5) depressive symptoms measured by the Centre for Epidemiological Studies in

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Depression Scale (CES-D) (Radloff, 1977); (6) cognitive function measured by the SMMSE (Folstein, Folstein, & McHugh, 1975); (7) confidence in performing ADLs without falling measured by the Modified Falls Efficacy Scale (MFES) (Hill, Schwartz, Kalogeropoulos, & Gibson, 1996); and (8) number of environmental hazards measured by the Minimum Data Set Home Care (Morris, Fries, Steel, Ikegami, Bernabei, Carpenter et al., 1997). For the purpose of this study, a slip or trip was defined as regaining balance without a fall (Steinberg et al., 2000). The thresholds for these outcomes are identified in Table 1. All measurement tools have established reliability and validity. In addition to these data, we also collected basic socio-demographic data and information on health status.

The costs of use of all types of health services in the previous six months were determined using the Health and Social Services Utilization Inventory (HSSUI), which assesses costs from a societal perspective (Browne, Gafni, & Roberts, 2006). A societal perspective implies collecting all costs, regardless of who bears them. The wider the perspective taken, the more applicable the study is to social policy decisions (Drummond, O'Brien, Stoddart, & Torrance, 1997). It is difficult to distinguish whether use of health services is attributable to a fall or to other health conditions or circumstances because falls and fall-related injuries can lead to other health problems, and our study population are noted to have a high number of chronic conditions. Therefore, the costs of use of all types of health services was obtained to reflect more accurately the costs of use of health services associated with falls in this population. The HSSUI consists of questions about the respondent's use of six categories of direct health care services: (1) primary care; (2) emergency department and specialists; (3) hospital days; (4) seven types of other health and social professionals; (5) medications; and (6) lab services. Inquiries were restricted to the reliable duration of recall: six months for remembering a hospitalization, two weeks for a visit to a physician, and two days for use of a prescription medication (Browne et al.; Petrou, Murray, Cooper, & Davidson, 2002). The six-month cost data were derived from "quantity" data reported on the HSSUI and 2006 "price" data. Total cost is the product of number of units of service (quantity) and unit cost (price). Questions to assess out-of-pocket costs (indirect costs, cash transfer effects of illness) were included (Browne et al.). Price data for both direct and indirect costs were obtained from multiple sources that are reported in detail elsewhere (Browne et al.). Cost data were analyzed in relation to fall status.

Statistical Methods and Sample Size

All analyses were performed using SPSS version 15.0 for Windows. The first research question on the prevalence of falls was addressed using descriptive statistics expressed as mean (standard deviation [*SD*]) for continuous variables and count (per cent) for categorical variables. The second research question examining the circumstances and consequences of falls was also addressed using descriptive statistics. The third research question examining the characteristics distinguishing fallers and non-fallers was addressed using descriptive statistics, Chi-square tests, and independent t-tests. Multivariate analysis was conducted using a Poisson regression model to model the outcome variable appropriately (i.e., the total number of falls in the previous six months). The results are reported using the incidence rate ratio that was obtained by taking the exponents of the coefficients of the Poisson regression model, corresponding 95 per cent confidence interval, and associated *p* value. Covariates used for adjustment in the regression model represented known risk factors for falls: female gender; falls in the past six months; balance and gait; cognitive status; use of four or more prescription medications; use of three or more prescription medications affecting the cardiovascular or central nervous systems; depression; visual impairment; nutritional risk; fear of falling; unsteadiness on feet; four or more co-morbid health conditions; age; living arrangement; slips or trips in the past six months; admission to acute care hospital in the past six months; hearing impairment; environmental hazards; cardiovascular, neurological, or musculoskeletal disorder; limitations in ADLs; and functional health status and related quality of life. These variables were determined a priori. We assessed multicollinearity by investigating associations among the independent variables. For linear models, we used the variate inflation factor (VIF) to assess collinearity. Variables having VIF greater than 10 were considered collinear (Kline, 2004). The fourth research question examining the mean costs of use of health services for fallers compared with non-fallers was addressed using Kruskal–Wallis non-parametric tests because cost data are usually non-normally distributed and right skewed. The average six-month-per-person costs of use of individual health services were compared, as well as total costs. All statistical tests were performed using two-sided tests at the 0.05 level of significance. For regression analyses, we checked the residuals and found no major violations of model assumptions. The sample size calculation was based on the primary measure of effect in our efficacy trial on falls prevention and is reported in detail elsewhere (Markle-Reid et al., 2008).

Results

Recruitment and Participants

Recruitment was conducted over a nine-month period between May 2006 and February 2007. A total of 525

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Table 1: Comparison of fall-related risk factors between fallers and non-fallers in the six months before enrolment in study

Fall-Related Risk Factors	Group				Test Statistic		Difference in Proportions (95% CI)
	No Fall ($n = 32$)		1 or More Falls ($n = 77$)				
	n	%	*n*	%	χ^2	*p* value	
Gender							
Female	22	68.80	55	71.40	0.08	0.780	0.03
Male	10	31.30	22	28.60			(–0.15, 0.22)
Age (Years)							
85 & Up	12	37.50	39	50.60	1.57	0.210	0.13
75–84	20	62.50	38	49.40			(–0.07,0.31)
Type of Accommodation							
House or apartment	24	75.00	55	71.40	0.15	0.704	0.04
Seniors home	8	25.00	22	28.60			(–0.16,0.20)
Income							
< $40,000	18	56.30	47	61.00	0.59	0.746[c]	0.02
> $40,000	3	9.40	9	11.70			(–0.20,0.17)
Unknown	11	34.40	21	27.30			
Living Arrangement							
Live Alone	19	59.40	44	57.10	0.05	0.830	0.02
Live with Others	13	40.60	33	42.90			(–0.18,0.21)
SMMSE Cognitive Status (0–30)[a]							
18-25 (Mild to severe impairment)	3	9.70	16	21.1	1.96	0.16[c]	0.11
26-30 (No impairment)	28	90.30	60	78.90			(–0.06,0.27)
Slip/Trip in Previous Six Months							
≥1	6	18.70	22	28.60	1.14	0.285	0.10
None	26	81.30	55	71.40			(–0.09,0.245)
Number of High Risk Medications[b]							
≥3 medications	15	46.90	39	50.60	0.13	0.720	0.04
0-2	17	53.10	38	49.40			(–0.16,0.23)
CES-D Depression Score (0–60)							
Depressed: (≥ 21)	5	15.60	15	19.50	0.22	0.636	0.04
Not Depressed: (< 21)	27	84.40	62	80.50			(–0.14,0.17)
SCREEN II Nutritional Risk Score (0–64)							
Medium to High Nutritional Risk (0–53)	28	87.50	65	84.40	0.17	0.68[c]	0.03
No Nutritional Risk (≥ 54)	4	12.50	12	15.60			(–0.14,0.15)
Fear of Falling							
Yes	17	53.10	33	42.90	0.96	0.327	0.10
No	15	46.90	44	57.10			(–0.10,0.29)
Visual Impairment							
Yes	8	25.00	18	23.40	0.03	0.856	0.02
No	24	75.00	59	76.60			(–0.14,0.21)
Hospital Admission in Previous Six Months							
Yes	24	75.00	60	77.90	0.11	0.741	0.03
No	8	25.00	17	22.10			(–0.13,0.22)
Cardiovascular Disorder							
Cerebrovascular accident	8	25.00	22	28.60	0.15	0.704	0.04 (–0.16,0.20)
Congestive heart failure	5	15.60	13	16.90	0.03	0.872	0.01 (–0.16,0.14)
Coronary artery disease	5	15.60	12	15.60	0.87	0.996	0.00 (–0.13,0.17)
Hypertension	18	56.30	43	55.80	0.00	0.969	0.00 (–0.20,0.20)
Arrhythmia	9	28.10	11	14.30	2.89	0.089	0.14 (–0.02,0.32)
Peripheral vascular disease	7	21.90	8	10.40	2.51	0.113	0.11 (–0.02,0.29)
Neurological Disorder							
Dementia	3	9.40	4	5.20	0.66	0.418 [c]	0.04 (–0.05,0.19)
Head trauma	0		6	7.80	2.64	0.104 [c]	0.08 (–0.04,0.16)
Hemiplegia/hemiparesis	1	3.10	4	5.20	0.22	0.638 [c]	0.02 (–0.11,0.10)
Parkinsonism	0		5	6.50	2.18	0.140 [c]	0.06 (–0.05,0.14)

Continued

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Table 1: Continued

Fall-Related Risk Factors	Group				Test Statistic		Difference in Proportions (95% CI)
	No Fall (*n* = 32)		1 or More Falls (*n* = 77)				
	n	%	*n*	%	χ^2	*p* value	
Musculoskeletal Disorder							
Arthritis	26	81.30	56	72.70	0.88	0.348	0.09 (–0.10,0.23)
Hip fracture	10	31.30	18	23.40	0.73	0.392	0.08 (–0.09,0.27)
Other fractures	11	34.40	33	42.90	0.68	0.411	0.08 (–0.12,0.26)
Osteoporosis	13	40.60	27	35.10	0.30	0.583	0.06 (–0.13,0.25)
Hearing Impairment							
Yes	5	15.60	15	19.50	0.22	0.636	0.04
No	27	84.40	62	80.50			(–0.14,0.17)
Number of Health Disorders							
≥ 4 disorders	20	62.50	41	53.20	0.79	0.375	0.09
0–3 disorders	12	37.50	36	46.80			(–0.11,0.28)
POMA Score (0–28)[a]							
Medium to high fall risk (< 24)	25	78.10	67	89.30	2.34	0.13	0.11
Low fall risk (25–28)	7	21.90	8	10.70			(–0.03,0.29)
Unsteady on Feet							
Yes	28	87.50	55	71.40	3.22	0.073[c]	0.16
No	4	12.50	22	28.60			(–0.02,0.29)
Number of Risk Factors for Falls (fall in previous 12 months, fear of falling, unsteady on feet)							
≥ 2	17	53.10	56	72.70	3.93	0.05	0.20
1	15	46.90	21	27.30			(0.00,0.38)
Physical Discomfort Limiting Activities of Daily Living							
Yes	24	75.00	65	84.40	1.34	0.247	0.09
No	8	25.00	12	15.60			(–0.06,0.28)
	M	*SD*	*M*	*SD*	t-test	*p* value	Difference in means (95% CI)
Age	83.14	5.32	84.35	4.77	–1.17	0.243	–1.22 (–3.28, 0.84)
SF-36 Physical Function Score (0–100)	27.81	16.01	22.21	19.56	1.43	0.155	5.60 (–2.15, 0.84)
SF-36 Role-Physical Score (0–100)	23.05	27.61	17.21	20.68	1.21	0.228	5.84 (–3.71, 15.39)
SF-36 Bodily Pain Score (0–100)	53.63	33.00	54.04	31.05	–0.06	0.950	–0.41 (–13.60, 12.77)
SF-36 General Health Perception Score (0–100)	59.56	18.80	60.08	22.55	–0.11	0.910	–0.52 (–9.49, 8.46)
SF-36 Vitality Score (0–100)	37.30	17.43	41.15	21.80	–0.89	0.377	–3.85 (–12.45, 4.75)
SF-36 Social Functioning Score (0–100)	57.42	26.35	45.94	29.14	1.93	0.057	11.48 (–0.34, 23.30)
SF-36 Role Emotional Score (0–100)	78.65	29.09	68.07	35.34	1.49	0.138	10.57 (–3.46, 24.60)
SF-36 Mental Health Score (0–100)	70.94	18.25	72.21	17.02	–0.35	0.729	–1.27 (–8.52, 5.98)
SF-36 Health Transition Score (0–100)	39.06	30.41	34.42	19.04	0.80	0.427	–4.65 (–14.20, 4.91)
SF-36 Physical Health Component Summary Score (0–100)	40.19	16.89	37.29	13.77	0.93	0.353	2.90 (–3.25, 9.04)
SF-36 Mental Health Component Summary Score (0–100)	61.05	13.63	58.70	18.00	0.66	0.508	2.35 (–4.67, 9.38)
Modified Fall Efficacy Scale Score (0–10)	5.56	2.07	4.82	2.14	1.66	0.099	0.74 (–0.14, 1.63)
Number of Environmental Hazards (0–9)	1.41	1.13	1.44	1.31	–0.13	0.895	–0.04 (–0.56, 0.49)

CES-D = **Centre for Epidemiological Studies in Depression Scale**
CI = **confidence interval**
M = **mean**
POMA = **Performance-Oriented Mobility Assessment**
SD = **standard deviation**
SMMSE = **Standardized Mini-Mental State Examination**
[a] Numbers do not add to 109 as a result of missing scores (*n* = 2)
[b] High-risk medications include these: antidepressant, anti-psychotic, anti-histamines, anticonvulsants, anti-Parkinson's, benzodiazepines, non-steroidal anti-inflammatory, cardiovascular medicines, opioid analgesics
[c] The cell counts is less than 5. Chi-square results may be invalid.

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consecutive CCAC clients were screened for the study, and 267 (50.9%) were considered eligible. The most common reason for ineligibility (36.8%) was not being at risk for falls (no fall within the previous 12 months, fear of falling, or unsteadiness on their feet). Other reasons included refusal to participate (18.6%), inability to contact (16.7%), non-English speaking with no translator available (16.3%), living outside the study region (7.0%), and failing the SMMSE with no substitute decision maker available (3.9%). In total, 109 (40.8%) of the 267 eligible home care clients consented and were randomized to the two arms of the ongoing randomized controlled trial. Information on the baseline characteristics of the 158 (59.2%) non-consenters was not available owing to their refusal to provide informed consent to participate in the study.

Characteristics of Study Participants

To fulfill the study eligibility criterion of being at risk for falls, 77 (70.6%) of the 109 participants reported at least one fall in the 12 months preceding the study, 46 per cent reported a fear of falling, and 76 per cent indicated that they were unsteady on their feet. Most participants (67%) had two or more of these risk factors for falls that defined the target sample for the study.

The participants were predominantly women (71%), with a mean age of 84 years. The majority were widowed, separated, or single (60%) and had annual incomes of less than $40,000 (60%). Most participants (82%) reported that they were limited to some degree in basic ADLs (bathing or dressing), and, although 43 per cent lived alone, almost all reported receiving help from an unpaid family caregiver. Most seniors were fairly ill: 77 per cent reported one or more hospital admissions in the six months preceding the study, 56 per cent suffered from at least four chronic health conditions, 18 per cent were depressed (CES-D $\geq$ 21), 18 per cent had mild (SMMSE 18–25) to severe cognitive impairment (SMMSE $\leq$ 0–17), 85 per cent were at nutritional risk (SCREEN II $\leq$ 53), 85 per cent were taking at least four prescription medications daily, and 50 per cent were taking at least three prescription medications known to increase the risk of falls. Almost the entire sample (92%) had a musculoskeletal disorder, 79 per cent had a cardiovascular disorder, and 22 per cent had a neurological disorder. Twenty-eight participants (25.7%), 22 fallers and six non-fallers, reported at least one slip or trip in the six months preceding the study.

Prevalence of Falls

Of the 109 participants who entered the study, 77 (70.6%) reported a total of 201 falls in the previous six months, and 30 individuals (27.5%) fell repeatedly, up to 26 times. This translated into means of 1.8 (*SD* = 3.8) falls per study participant, 2.6 (*SD* = 4.3) falls per faller, and 5.1 (*SD* = 6.1) falls per repeat faller over six months.

Circumstances and Consequences of Falls

Participants were asked to provide details about the circumstances and consequences of the most recent fall event (including slips and trips); results are presented in Table 2. Approximately 80 per cent of fall

Table 2: Circumstances and consequences of the most recent falling event (n = 83; including 74 falls, four slips, and five trips) in the six months before enrolment in study

Circumstances and Consequences of Falls	*n*	%
Location of Fall		
In home	63	76
Outside home	20	24
Time of Fall		
Morning	27	33
Afternoon	25	30
Evening	16	19
Night	13	16
Unknown	2	2
Lighting during Fall		
Lights on	58	70
Lights off	15	18
Glare or transition to bright or dark	8	10
Unknown	2	2
Footwear during Fall		
No footwear/socks	25	30
Loose footwear	16	19
Fitting footwear	42	51
Tripping Hazard at Time of Fall		
Yes	21	25
No	62	75
Activity during Fall		
Walking	48	58
Bending/turning	25	30
Transferring	19	23
Standing	16	19
Reaching	14	17
Rushing	12	14
Stepping up or down	9	11
Other	32	39
Injuries Related to a Fall		
No injury	16	19
Fracture	33	40
Cuts, scrapes, or abrasions	29	35
Bruise	24	29
Other minor injuries	18	22
Hospitalization Related to a Fall		
Yes	45	54
No	38	46
Emergency Room Use Related to a Fall		
Yes	18	22
No	65	78
Use of 911 Related to a Fall		
Yes	44	53
No	39	47

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events resulted in injury including hip or other fracture (40%); cuts, scrapes, or abrasions (35%); and bruising (29%) or other minor injuries (22%). More than one in two (54%) of these incidents resulted in hospitalization with an average length of stay of 32 days, and 22 per cent resulted in use of emergency room services. The majority of fall events occurred in the participant's own home (76%), during the daytime (63%), and while walking (58%). Loss of balance (19%), dizziness (14%), and illness (13%) were involved.

Characteristics Associated with Falls

The characteristics of fallers (n = 77) and non-fallers (n = 32) were compared (Table 1). Although there was no statistically significant difference in any fall-related risk factor between fallers and non-fallers, some clinically important differences are noteworthy. Fallers had trends towards lower mean scores on the SF-36 health survey for physical functioning (difference: 5.6; 95% CI: –2.15, 13.36; p = 0.155), role functioning related to physical health (difference: 5.8; 95% CI: –3.71, 15.39; p = 0.228), social functioning (difference: 11.5; 95% CI: –0.34, 23.30; p = 0.057), and role functioning related to emotional health (difference: 10.6; 95% CI: –3.46, 24.60; p = 0.138) compared with non-fallers. A difference of five points between groups for a domain of the SF-36 is considered clinically and socially important (Ware et al., 1993). In addition, 29 per cent of fallers reported one or more slip or trip, compared with 19 per cent of non-fallers (difference: 0.10; 95% CI: –0.09, 0.27; p = 0.29), and 73 per cent of fallers had two or more risk factors for falls, compared with 53 per cent of non-fallers (difference: 0.20; 95% CI: 0.00, 0.38; p = 0.05).

In the Poisson regression model, neurological disorder (e.g., cognitive impairment, Parkinsonism), aged 85 years or older, number of environmental hazards, slip or trip in the previous six months, and visual impairment were significantly and independently associated with an increased number of falls in the previous six months. Specifically, individuals with a neurological disorder were 2.75 times more likely to experience a fall than those without a neurological disorder (95% CI: 2.07, 3.64; $p < 0.001$). Seniors who had one or more environmental hazards within their homes were 1.34 times more likely to experience a fall (95% CI: 1.20, 1.48; $p < 0.001$), and those who reported a slip or trip in the previous six months (Incidence Rate Ratio [IRR] = 2.14; 95% CI: 1.62, 2.84; $p < 0.001$) were at greater risk of falling. Individuals aged 85 years or older were also more likely to experience a fall (IRR = 1.07; 95% CI: 1.04, 1.10; $p < 0.001$), and those with visual impairment were at greater risk of falling (IRR = 2.21; CI: 1.65, 2.95; $p < 0.001$) (Table 3).

Table 3: Multivariate analysis: risk factors for falls (Poisson regression model: dependent variable = number of falls in the six months before enrolment in study)

Variable	IRR	95% CI	*p* value
Neurological disorder (e.g., cognitive impairment, parkinsonism)	2.75	2.07, 3.64	< 0.001
Visual impairment	2.21	1.65, 2.95	< 0.001
Self-reported slip or trip in previous six months	2.14	1.62, 2.84	< 0.001
Number of environmental hazards	1.34	1.20, 1.48	< 0.001
Age ≥ 85 years	1.07	1.04, 1.10	< 0.001

CI = confidence interval
IRR = incidence rate ratio

Costs of Use of Health Services Associated with Falls

From a societal perspective, there was no statistically significant difference between fallers and non-fallers in the total per-person costs of use of all types of health services in the previous six months (difference: $5,749.58; p = 0.39). However, fallers reported higher mean costs for use of 911 calls (difference: –$11.84; p = 0.001) and ambulance services (difference: $108.80; p = 0.001) compared with non-fallers. Fallers also reported higher costs related to acute hospitalization (difference: $5,534; p = 0.42); however, this difference was not statistically significant. These higher costs among fallers were offset by a lower six-month use of family physician costs (difference: $39.87; p = 0.03), and costs for endocrinologists (difference: $9.43; p = 0.03) and general surgeons (difference: $42.38; p = 0.01). There was no difference between groups in costs of use of other types of health service (see Table 4).

Discussion

The objective of this study was to examine the six-month prevalence, correlates, and costs of falls in older adults who were using home support services and who were at risk of falling. This research has two important innovative aspects. First, to our knowledge, this is the first study that documents the prevalence, correlates, and costs of use of health services associated with falls in seniors with chronic needs and receiving home support services. Such people are considerably frailer than the general population of community-dwelling seniors and are often excluded from community-based studies. Second, it is the first study to investigate the rate and risk factors of falls among at-risk seniors using home support services, as opposed to the general population of seniors using home care services. Stratifying individuals into

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Table 4: Comparison of selected six-month costs of use of health services between fallers and non-fallers at baseline

Health Services	No Fall (n = 32)		1 or More Falls (n = 77)		Kruskal–Wallis Test	
	M	*SD*	*M*	*SD*	χ^2	*p* value
Direct Costs						
Family physician	$162.38	$131.46	$122.51	$126.68	4.87	0.027
Emergency room visit	$175.39	$211.33	$212.84	$212.03	1.21	0.272
911 call	$8.75	$16.49	$20.59	$23.62	10.41	0.001
Ambulance service	$112.50	$182.72	$221.30	$251.61	7.37	0.001
Cardiologist	$37.71	$68.11	$30.56	$61.62	0.19	0.666
Endocrinologist	$9.43	$37.88	$0.00	$0.00	4.86	0.028
Hematologist or oncologist	$11.31	$47.08	$3.13	$16.66	0.33	0.563
Ophthalmologist	$22.54	$40.30	$23.14	$46.45	0.34	0.561
Respirologist	$15.09	$85.33	$5.49	$26.23	0.19	0.666
Surgeon-general	$13.40	$36.03	$2.78	$14.80	4.59	0.032
Surgeon – specialized	$54.39	$157.52	$12.01	$47.20	6.57	0.010
Other specialist	$15.52	$32.40	$11.90	$35.09	1.16	0.282
Chiropractor	$8.38	$32.96	$17.40	$96.24	0.04	0.840
Psychologist	$26.56	$150.26	$9.20	$80.72	0.43	0.510
Physiotherapist	$205.79	$369.32	$210.20	$532.81	0.53	0.468
Occupational therapist	$29.06	$60.05	$57.70	$104.00	1.61	0.204
Podiatrist/ chiropodist	$61.09	$140.31	$33.12	$95.69	0.79	0.373
Visiting nurse	$55.05	$141.79	$169.01	$512.88	0.19	0.663
Private nurse	$9.44	$44.85	$12.08	$89.29	0.06	0.814
Optometrist	$11.88	$31.92	$28.38	$104.60	0.40	0.526
Dentist	$53.04	$118.92	$67.82	$139.87	0.21	0.647
Home support worker	$193.45	$349.80	$461.47	$1,226.97	0.05	0.823
Complementary therapy	$17.03	$79.38	$1.56	$13.68	2.05	0.152
Meals on Wheels	$28.44	$160.87	$1.62	$8.18	0.19	0.666
Medications	$1,381.69	$847.72	$1,228.22	$1,013.44	1.52	0.218
Special treatments	$29.87	$101.61	$59.95	$317.52	0.00	1.000
Supplies, aids, or devices	$103.14	$282.84	$97.86	$260.30	0.50	0.481
Direct cost excluding hospital	$3,126.43	$1,433.51	$3,387.35	$2,287.63	0.06	0.806
Acute care hospital	$14,641.18	$18,606.61	$20,174.84	$24,826.7	0.66	0.416
Day surgery	$165.00	$410.63	$120.00	$297.62	0.02	0.887
Direct cost including hospital	$17,932.61	$19,074.29	$23,682.19	$25,632.3	0.74	0.391
Indirect Costs						
Old-age security	$2,919.36	$894.47	$2,779.10	$1,016.37	0.13	0.723
Canada pension	$2,340.04	$1,649.83	$2,335.00	$1,732.33	0.04	0.838
Canada pension, disability	$0.00	$0.00	$112.66	$694.41	0.84	0.360
Veteran's pension	$75.00	$424.26	$592.03	$1,728.29	2.51	0.113
Survivor's benefits (CPP)	$130.08	$518.22	$328.54	$852.63	1.43	0.232
Other government cheque	$278.25	$1,371.53	$32.23	$139.10	0.00	0.975
Cash transfer cost	$5,742.73	$2,171.77	$6,186.02	$2,841.49	0.63	0.428

M = **mean**
SD = **standard deviation**

different levels of risk is important from a clinical and economic perspective because those at greatest risk are more likely to be targeted and to benefit from preventive efforts (Gillespie et al., 2003; Tinetti et al., 1994).

In our sample of 109 people aged 75 years or over who were at risk for falls and using home support services, 71 per cent reported a fall in the previous six months. This prevalence greatly exceeds the fall rates of 30 per cent reported in several studies for a general population of community-dwelling older adults (e.g., Kenny et al., 2001) and 27 per cent reported by Fletcher and Hirdes (2002) for community-dwelling seniors using home care services. It is noteworthy that 28 per cent of our sample reported recurrent falls in the previous six months, a rate that is also higher than the 10 to 20 per cent rates observed in other studies (Nevitt et al., 1989; Ro, Shadden, Blake, & Powers, 2005). This finding is a cause for concern given that frequent falls have been associated with negative outcomes, such as functional decline and increased risk of institutionalization (Dunn, Furner, & Miles, 1993).

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Variations in prevalence are likely due to differences in population characteristics, such as age, frailty, and level of fall risk. Our study deliberately recruited only seniors who had an increased risk for falling, and two thirds of our sample had two or more of the leading risk factors for falls that defined the target sample: fall within the previous 12 months, fear of falling, or unsteadiness on their feet. Overall, the characteristics of the study participants suggest that they had relatively higher levels of care need than the general population of community-dwelling seniors and thus could have been receiving home care services as a substitute for long-term facility care. Therefore, this cohort of older adults using home support services may be more comparable to seniors who need long-term facility care than community-dwelling seniors. Falls are a common problem among seniors residing in long-term care, with up to 60 per cent of residents falling at least once a year (Hoffman, Bankes, Javed, & Selhat, 2003; Kiely, Kiel, Burrows, & Lipsitz, 1998).

A key issue is not simply the high incidence of falls, but rather the combination of a high incidence and a high susceptibility to injury. Older people who fell had a fourfold increase in fall-related injuries (National Center for Injury Prevention and Control, 2000; WHO, 2007) and 20 per cent more hospital admissions for a fall than the general population of community-dwelling seniors (SmartRisk, 2006). These findings are a cause for concern given that fall-related injuries and complications are the leading cause of accidental death among seniors (CIHI, 2004). Twenty per cent of seniors with hip or other fractures die within a year of their injury (Leibson, Tosteson, Gabriel, Ransom, & Melton, 2002; Magaziner, Lydick, Hawkes, Fox, Zimmerman, Epstein et al., 1997), and half of all older people who fracture a hip never regain their pre-fall level of functioning (Magaziner, Simonsick, Kashner, Hebel, & Kenzora, 1990; Wang & Wollin, 2004). Average hospital costs for a fall have been reported as $18,550 (two times more than for healthy seniors) (CIHI, 2002). These findings suggest that not only is this population more likely to use hospital services, but, when they do so, they typically use more services than the general population of community-dwelling older adults. Our findings are consistent with those of previous studies, which showed that frail seniors are more likely to sustain serious injury when compared to healthy, well-functioning seniors (SmartRisk, 1998).

The magnitude of the problem has the potential to increase because of the rising number of people aged 75 years and over, the associated increase in number of falls, and the escalating demand for home support services (Hollander, 2003). From 1995 to 2000, the demand for home and community care grew by 140 per cent (Romanow, 2002), attributable to several factors, namely technological advancements, changing demographics, patient preference, and the presumed cost-effectiveness of home care (Canadian Home Care Association [CHCA], 2004). With the increasing life expectancy of Canadians, an 80 per cent increase in home care expenditures is expected by 2026 (Coyte & McKeever, 2001).

The results of this study provide insight into the circumstances of falls in clients of home support services who are at risk of falling. The majority of falls occurred at home, during the daytime, and while walking. These findings support those of previous studies (Bath & Morgan, 1999; Berg, Alessio, Mills, & Tong, 1997; Campbell, Borrie, Spears, Jackson, & Brown, 1990; Overstall, 1992; Stalenhoef, Diederiks, de Witte, Schiricke, & Crebolder, 1999). Although we did not examine the effect of health status on the circumstances of falls, (e.g., location of fall, activity during a fall), evidence suggests that older adults who fall indoors may be less healthy and frailer than those who fall outdoors (Bath & Morgan). Moreover, individuals confined to the home may be excessively weak, with poor balance control, low bone density, and reduced walking speed, which are independent risk factors for indoor falls (Marks, 2007). The higher incidence of falls during the daytime may reflect the fact that older people are more active during the daytime. Some studies have shown that increased activity in very old people ($\geq$ 85 years) can mean more falls and injuries (Berg et al.). Our findings suggest that, because two thirds of falls occurred indoors, the home environment is a critical target for falls prevention. The fact that the majority of falls occurred while walking suggests that assessment of fall risk should include some measure of gait and balance (Beauchet, Annweiler, Allali, Berrut, Herrmann, & Dubost, 2008; Kenny et al., 2001).

Older people who fell, 71 per cent of the study sample, had clinically important trends towards lower levels of physical, social, and psychological functioning compared with non-fallers. This finding is consistent with the literature in that poor quality of life and function is one of the most common risk factors associated with falls (Fletcher & Hirdes, 2002; Lawlor et al., 2003; Lin, Wolf, Hwang, Gong, & Chen, 2007; Pavol, Runtz, Edwards, & Pai, 2002; Vellas, Wayne, Garry, & Baumgartner, 1998). It is equally likely that falls contribute to reduced health-related quality of life and functioning. Falls and fall-related injury often lead to ongoing functional problems and reduced quality of life for seniors (Wang & Wollin, 2004). However, our cross-sectional analysis cannot determine the causal direction. Previous studies have focused primarily on self-reported physical health as measures of health-related quality of life and function (Fletcher & Hirdes, 2002; Lin et al.; Vellas et al.). What makes our study unique is that we

measured health-related quality of life and function as a multidimensional construct that encompasses physical, psychological, and social domains.

It is noteworthy that fallers had more fall-related risk factors (e.g., a fall in the previous 12 months, fear of falling, unsteady on feet), compared with non-fallers; however, this difference was not statistically significant. This finding is consistent with the literature in that the risk of falling increases with the number of risk factors present (Lawlor et al., 2003; Nevitt et al., 1989). It is equally likely that falls contribute to the development of these risk factors. For example, falls and fall-related injuries often lead to a fear of falling (Fletcher & Hirdes, 2004; Sjösten et al., 2008). However, our cross-sectional analysis cannot determine the causal direction.

Cognitive impairment, Parkinson's disease, age 85 years or older, environmental hazards, slips or trips, and visual impairment were significantly and independently associated with an increased risk of falls in the six months before enrolment in the study. Our findings are consistent with those of previous studies, which showed that age 85 years or older (Hornbrook et al., 1994; Kenny et al., 2001; Vellas et al., 1998), cognitive impairments (Fletcher & Hirdes, 2002; Kenny et al.; Lewis et al., 2004; Shaw, Bond, Richardson, Dawson, Steen, McKeith et al., 2003), Parkinson's disease (Fletcher & Hirdes, 2002; Lewis et al.), environmental hazards (Close et al., 1999; Fletcher & Hirdes, 2002; Hornbrook et al., 1994; WHO, 2007), slips or trips (Steinberg et al., 2000; Tinetti et al., 1988), and visual impairment (Kenny et al.; Lord et al., 1994) are risk factors for falls. All these factors also contribute to poor health and increased risk of functional decline (Stuck, Walthert, Nikolaus, Bula, Hohman, & Beck, 1999) and should be considered when assessing seniors who request home support services. Our finding that cognitive limitations and Parkinson's disease combined was the leading risk factor for falls is noteworthy and highlights the importance of falls prevention for persons with such neurological disorders.

With respect to visual impairment, it is, interestingly, slightly more prevalent in non-fallers than fallers (25% vs. 23.4%) – hence, not statistically significant in the univariate analysis, but emerges in the Poisson regression model as statistically significant. This finding has two main explanations: (1) The two analyses are different in that the first is a univariate χ^2 analysis that treated falls as a binary outcome (0 falls or 1 or more falls), while the second multivariate analysis treated falls as a discrete variable (total number of falls in the previous six months). In fact, individuals with visual impairment reported significantly more falls in the previous six months compared with individuals without visual impairment (difference 1.32; $p = 0.013$). (2) The univariate analysis did not adjust for confounding variables.

Although fallers and non-fallers differed in the expected direction on several variables (e.g., female gender, age 85 years or older, cognitive impairment, previous slip or trip, residing in a seniors' home, depression, taking high-risk medications), there were some oddities in the data directly counter to what would be expected prospectively. Specifically, fear of falling, unsteadiness on feet, nutritional risk, visual impairment, dementia, arthritis, hip fracture, four or more health disorders, and the lower SF-36 vitality score were more prevalent among non-fallers than fallers (see Table 1). One explanation for these findings could be the design – it is capable of identifying some risk factors (e.g., factors that preceded the falls), but it also detects associations with factors that may have changed as a result of a fall (fear of falling) or may not be causally associated at all.

Gender, gait and balance abnormalities, history of falls, and use of sedative or hypnotic medications were not significant risk factors for falls in our study, in contrast to findings in a general population of older people receiving home care services (Fletcher & Hirdes, 2002; Lewis et al., 2004). Older age; poor physical, social, and psychological health; cognitive impairment; Parkinson's disease; and visual impairment are all considered to be "intrinsic" risk factors for falls. These same factors are associated with functional decline or "frailty" (Stuck et al., 1999). Our results suggest that the likelihood of a fall may be influenced more by intrinsic factors that increase the risk of frailty than by extrinsic factors that increase the risk of a fall (Ensrud, Ewing, Taylor, Fink, Stone, Cauley et al., 2007). These findings support those of previous studies. Falls with intrinsic precipitating causes are more likely than the extrinsic ones to involve older persons aged 75 years or older (Lach, Reed, Arfken, Miller, Paige, Birge et al., 1991), with a poorer state of health overall (Bueno-Cavanillas et al., 2000). Thus, targeting prevention of functional impairment rather than extrinsic factors may be a more useful strategy for preventing falls in this population.

Another unique contribution of our study was its focus on both falls and near falls (slips or trips). Although falls among older adults have been studied extensively, data are limited on the prevalence of slips and trips and the prevention of such incidents in this age group (Steinberg et al., 2000). Yet, the most common circumstances leading to falls are slips and trips (Pavol et al., 2002; Steinberg et al.). Our findings suggest that it would be beneficial for the health care system to focus attention on warning signs such as slips or trips.

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Implications

Overall, these findings underscore the potentially important role of the home care setting in early identification and management of falls and fall risk factors in this at-risk population. For example, the difference between the average estimated total annual cost of use of health services between fallers and non-fallers was $11,500 per person; however, this difference was not statistically significant. The sample size may not have been sufficient to detect whether this difference was statistically significant because the effect size to determine study power was based on the primary measure of effect in our trial on falls prevention, not on differences in the cost of use of health services,. Thus, we were unable to determine if the lack of a statistically significant difference is due to insufficient sample size and limited power or a lack of a true difference between groups. Nevertheless, existing strategies have been shown to reduce the incidence of falls among seniors by 30 per cent or more (Gallagher & Brunt, 1996; Gillespie et al., 2003; Lightbody et al., 2002; Robson et al., 2002; Scott et al., 2006; Yates & Dunnagan, 2001). If one assumes that the potential for fall reduction exists, then hypothetically, reducing falls by 30 per cent in our population of at-risk seniors with a falls prevalence of 71 per cent could lead to a cost savings of 71 × 30 × $11,500 = $244,950 for every 100 seniors in a falls prevention program, Previous studies have focused only on the use of institutional care and home care services as measures of cost. Our study is unique in that it measured use and costs of the full range of health services.

Home care providers are well positioned to play a major role in preventing falls in older people. Considerable evidence now documents that the most effective fall reduction programs involve routine and systematic fall risk assessments, followed by targeting of interventions to an individual's risk profile (Gates, Lamb, Fisher, Cooke, & Carter, 2008; Kenny et al., 2001; Perell, Nelson, Goldman, Luther, Prieto-Lewis, & Rubenstein, 2001). This research has been substantiated by meta-analyses of many randomized controlled trials (Gates et al.; WHO, 2007) and by consensus panels of experts who have developed evidence-based practice guidelines for the detection and management of falls risk (Federal/Provincial/Territorial Committee of Officials (Seniors) for the Minister Responsible for Seniors, 2001; Gillespie et al., 2003; Kenny et al., 2001; RNAO, 2005). The importance of this direction cannot be overstated. Reducing just one fall risk factor can have great effect on the frequency and morbidity of falls (Tinetti et al., 1988; Yates & Dunnagan, 2001). Based on the correlates of falls identified in this study, special attention should be given to assessment of age (≥ 85 years), health-related quality of life and function, cognitive limitations, Parkinson's disease, environmental hazards, visual impairment, and slips or trips.

The findings of the current study are consistent with those of previous studies, which showed that falls are caused by multiple interacting factors, some of which are modifiable (Hornbrook et al., 1994; Lawlor et al., 2003; Nevitt et al., 1989; Tinetti et al., 1988). Given the generally weak relations among these risk factors, we conclude that these are distinct factors influencing falls risk. Consequently, an intervention in one area will not necessarily correct the other areas. These findings provide further support for a multiple risk factor modification approach for people at risk of falling as opposed to single strategies such as exercise, education, environmental modifications or clinical assessments (Gillespie et al., 2003). Given the multifactorial nature of falls, screening followed by targeted interventions aimed at multiple factors and provided by an interdisciplinary team will have the greatest effect, specifically among seniors at greatest risk (Gillespie et al., 2003; Tinetti et al., 1994). However, well-designed intervention studies are needed to explore formally the effectiveness of multifactorial and interdisciplinary fall prevention interventions in this population. We have conducted such a randomized trial, the baseline data of which were used for the present study; the results of the trial will be published separately (Markle-Reid et al., 2008).

Awareness of the importance of screening and assessment of falls risk is required at several levels: older adults, their families, their home care providers, and the community. Although older adults appear to be interested in health promotion, they often do not think they are at risk for falls (Zecevic, Salmoni, Speechley, & Vandervoort, 2006), and up to 75 per cent of falls are not reported (Cryer & Patel, 2001). Screening may increase their attentiveness or self-awareness. More importantly, risk assessment can be used to guide the allocation of scarce home care resources to those most likely to benefit from preventive efforts.

Despite the potentially important role of home care in preventing falls, several health care provider and health system barriers continue to impede this direction. The allocation of funding for home care has not kept pace with the increased demand for services (Romanow, 2002). During the past decade, home care programs have been growing at an annual rate of 9.0 per cent, compared with an annual increase of only 2.2 per cent in average health care spending (CHCA, 2004). The result has been a shift in the allocation of scarce home care services away from prevention and health promotion to meet the more pressing need for post-acute care substitution (Soderstrom, Tousignant, & Kaufman, 1999). This emphasis, coupled with the

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sustained biomedical orientation of services, has meant that the focus on prevention and health promotion for seniors with chronic needs is minimal at best (McWilliam, 2008). The result is that clients of home support services who are at risk for falls have limited access to home care services directed toward preventing falls or promoting health (Scott et al., 2006). In addition, there is limited collaboration and communication among home care providers, primary health care providers, and others providing home care services to older people, and a lack of continuity of care provider.

Another barrier is the lack of expertise among home care service providers in fall risk factor screening and management. Assessment of falls risk is challenging because of the complex nature of falls, and providers need support to build capacity. Furthermore, tools used for assessment of falls risk may not be standardized and often lack rigorous reliability and validity testing (Fletcher & Hirdes, 2002; Scott et al., 2006). To be relevant for a diverse group of older community-dwelling adults, falls risk screening instruments need to be reliable and valid, accurately discriminate between levels of risk, and address all of the risk factors for falls. They also need to be acceptable to the individual being assessed and the provider performing the assessment (Perell et al., 2001). A final barrier is the lack of evidence-based practice standards specific to falls prevention in home care for older people. The result of all this is a fragmented and inefficient system of health service delivery instead of a comprehensive and proactive approach to the prevention of falls.

The results of our study, as well as the current literature, show a clear increase in frequency of falls with advancing age and decreasing health-related quality of life and function. In view of these fall trends and the continued aging of the population, it is likely that the prevalence of falls will continue at the current high rate or even worsen in older people receiving home support services unless concerted action is taken to prevent falls and promote health in this population. To address effectively the growing problem of falls in older home care clients, healthy home care policies are needed to provide vision, set priorities, and establish standards. Such policies and standards should support the development of basic competencies for falls prevention among providers, as well as systemic changes within home care organizations to allow the allocation of adequate resources for assessment of fall risk and delivery of prevention strategies. Research and best-practice guidelines should be translated into practice so that risk assessment is implemented and appropriate interventions are tailored to individual needs.

A shift in focus is needed in Canadian home care policy from acute care and treatment of physical disability to more health-oriented, preventive, and comprehensive strategies to minimize the frequency and severity of falls in this at-risk population. Indeed, choosing to emphasize acute care substitution, rather than prevention, is counterproductive and will lead to increased pressures on more costly institutional services because of falls and fall-related injuries.

Limitations of the Study

Several limitations must be considered when examining the results of our study. First, although we approached a representative sample of the general population of older people using home support services, only 41 per cent of eligible clients entered the study. Thus, our study sample might not have been truly representative of the population at risk as defined in this study. Future research is warranted to identify the most effective strategies for recruiting at-risk seniors who are truly in need of falls prevention interventions.

Second, recall bias may have occurred when participants were asked to recall their falls histories before enrolling in the study. Under-reporting of falls might have occurred because of a reluctance to admit to falling among older people. They may fear loss of an independent lifestyle and the associated stigma of aging (Gallagher & Brunt, 1996). Recall and reporting bias due to forgetfulness and memory impairment might also have led to under-reporting (Cummings et al., 1988). Cummings et al. reported that retrospective fall ascertainment resulted in underestimates, and that six-month recall is worse than 12-month recall. Further, it is likely that the consequences of falls were underestimated, as only the most recent fall was queried in detail. Over-reporting of falls could have also occurred, particularly when participants were aware that they were going to participate in a falls prevention program. Such reporting bias is a major limitation of cohort studies in comparing subjects' fall rates before and after intervention (Perell, Manzano, Weaver, Fiuzat, Voss-McCarthy, Opava-Rutter et al., 2006).

Third, the cross-sectional nature of the study limited the conclusions that could be drawn because we were not able to establish a temporal order for factors associated with the outcome variable, the occurrence of falls in the previous six months. This is particularly problematic in falls research because falls at baseline can "cause" some risk factors at follow-up. A longitudinal design would have offered more insight in ascertaining the temporal order of circumstances surrounding a fall event. Further research is needed to study the causal relation between the fall risk factors identified in this study and falls. Evidence is needed regarding the degree to which any particular risk factor

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must be reduced to produce a meaningful change in falls and fall-related injuries, the effect of reducing two or more risk factors simultaneously, and the interplay among risk factors contributing to falls (Federal/Provincial/Territorial Committee of Officials (Seniors) for the Minister Responsible for Seniors, 2001).

Fourth, the finding that there was no significant difference between groups in costs of use of health services may be related to insufficient sample size and limited power to detect differences. The effect size to determine study power was based on the primary measure of effect in our efficacy trial on falls prevention, not on differences in the prevalence of risk factors or in costs. Hence, the sample size may not have been sufficient to address these secondary questions. Finally, the results of our study reflect what happened in two home care programs, which may or may not be representative of other home care environments. The generalizability of the results to the wider population of older people depends on the extent to which the services under study are available and the criteria for service provision are comparable in different areas.

Conclusion

Our study showed that the prevalence of falls and fall-related injuries among clients of home support services who are at risk for falls greatly exceeds the prevalence typically reported in studies of the general population of community-dwelling seniors, including the general home care population. The associations found in this sample support several findings in other studies. In particular, our study suggested that falls may be associated with lower levels of physical, social, and psychological functioning, more fall-related risk factors, and higher cost of use of 911 calls, ambulance services, and acute hospitalization. It was not clear whether these were all fall-related health care services or not. Cognitive limitations, Parkinson's disease, age 85 years or older, environmental hazards, slips or trips, and visual impairment were the predominant risk factors for falls. Any initiative targeting this at-risk group of seniors must address the mix of fall risk factors that can lead to functional decline, negative changes in quality of life, and increased use of expensive health services. A comprehensive and proactive multifactorial approach to address all risk factors for falls is required.

This study makes an important contribution by providing knowledge of the prevalence, correlates, and costs of falls among a much frailer and higher-risk group of seniors than that recruited in previous studies. Our study adds new insight into the association between slips and trips and falls. It also provides information on the costs of use of health services associated with falls from a societal perspective. The findings from this study will help raise awareness of the magnitude of the problem and the critical role of home care in preventing falls in this population. Overall, stratifying individuals into different levels of risk through screening is important from a clinical and an economic perspective because it is the individuals at greatest risk who could benefit most from targeted interventions. An approach that emphasizes falls prevention and health promotion could pay for itself in savings that exceed the present cost of home care services concentrated on acute care substitution and the treatment of physical disability.

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