Epidemiology of Falls in Older Age

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RÉSUMÉ

Les chutes chez les personnes agées sont une préoccupation de la santé publiquedans le monde entier en raison de leur fréquence et les conséquences néfastes en terms de morbidité, mortalité et de la qualité de vie, ainsi que leur impact sur les services et les coûts du système de santé. Cette étude épidémiologique décrit la charge de la santé publique de chutes et de blessures liées aux chutes et l'impact sur les chutes du vieillissement de la population. L'ampleur du problème est décrit en termes du classement des chutes et la mesure des résultats, y compris l'incidence des chutes et des blessures liées dans tous les milieux, les déterminants socio-démographiques, les tendance internationales, et le coût des chutes et des blessures liées aux chutes. Enfin, des approches de santé publique afin de minimiser les risques de chutes et la demande conséquente sur les ressources de soins de santé sont récommandés.

ABSTRACT

Worldwide, falls among older people are a public health concern because of their frequency and adverse consequences in terms of morbidity, mortality, and quality of life, as well as their impact on health system services and costs. This epidemiological review outlines the public health burden of falls and fall-related injuries and the impact of population aging. The magnitude of the problem is described in terms of the classification of falls and measurement of outcomes, including fall incidence rates across settings, sociodemographic determinants, international trends, and costs of falls and fall-related injuries. Finally, public health approaches to minimize falls risk and consequent demand on health care resources are suggested.

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Introduction

Public Health Burden of Falls and Fall-Related Injuries

Data show that among people aged 65 years and older, falls are the leading cause of both fatal and non-fatal unintentional injuries (Stevens, Mack, Paulozzi, & Ballesteros, 2008; Scott, Pearce, & Pengelly, 2005; Pointer, Harrison, & Bradley, 2003), accounting for 40 per cent of all injury-related deaths (World Health Organization, 2007) and over 80 per cent of all injury admissions to hospital (Kannus, Khan, & Lord, 2006; Peel, Kassulke, & McClure, 2002). In this age group, falls are the presenting complaint for 18 to 40 per cent of emergency department attendances (Bell, Talbot-Stern, & Hennessy, 2000; Davies & Kenny, 1996), with hip fractures accounting for a high proportion of injury presentations (Ingarfield et al., 2009). Falls are also the commonest adverse clinical incident in older hospital patients, accounting for 32 per cent of reported adult patient safety incidents in the United Kingdom (Oliver, Killick, Even, & Willmott, 2008). In those aged 75 and older and especially in females, falls are among the

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leading causes behind the burden of disease and injury, as measured by Disability Adjusted Life Years (DALYs) (Begg et al., 2007).

Although falls occur at any age and even in healthy people (Hill, Schwarz, Flicker, & Carroll, 1999), the risk of falling increases with age, and the outcomes take on greater significance. The concern is not simply the high incidence of falls in older people, but rather the combination of high incidence and susceptibility to injury (Rubenstein, 2006). Although most falls produce no serious injury, about 10 to 15 per cent result in serious injuries including fractures and head injuries. It is estimated that about 0.2 to 1.5 per cent of falls result in a hip fracture, which in terms of morbidity and mortality is one of the most serious consequences of a fall (Australian Commission on Safety and Quality in Health Care, 2009a). Falls are also the most common cause of traumatic brain injuries, accounting for 46 per cent of fatal falls among older adults (Stevens, Corso, Finkelstein, & Miller, 2006).

In addition to physical injuries, falls can produce other serious consequences for older people. Post-fall anxiety syndrome (fear of falling) is recognized as a negative outcome from falls. The resultant self-imposed activity restrictions and loss of confidence in the ability to ambulate safely can lead to further functional decline, depression, feelings of helplessness, and social isolation (Rubenstein, 2006), all of which can impact on perceived health and quality of life (Vaapio, Salminen, Ojanlatva, & Kivela, 2009). This, in turn, is likely to place an individual at higher risk of another fall. Along with cognitive impairment and incontinence, repeated falls and instability are common precipitators of premature nursing home admission (Rubenstein, 2006; Karmel, Lloyd, & Anderson, 2008). Since any loss of ability to continue to live independently has detrimental effects, quality of life is profoundly threatened by falls and fall-related injuries (Salkeld et al., 2000).

Impact of Population Aging

The extent of the public health impact of falls is likely to worsen with population aging, since the frequency of falls and fall-related injuries increases with age and frailty level (World Health Organization, 2007). Worldwide, the population is now aging at an unprecedented rate (Kinsella & He, 2009). The United Nations, for purposes of demographic projections, defines "elderly" as those aged 60 years and older. However, in developed countries with rapidly increasing life expectancies, it has traditionally been accepted that 65 years of age is the entry point for "old age". Because of the diversity of older age, covering as it does a span of some 40 years, the group is further categorized as young-old (65 to 74 years), old-old (75 to 84 years), and oldest-old (85 years and older).

Currently, the numbers and proportions of older people (especially the oldest-old) are rising rapidly in most developed countries (U.K., Europe, parts of the former Soviet Union, North America, Japan, Australia, and New Zealand), but also in many developing countries (Kinsella & He, 2009). Although the percentage of the population aged 65 and older ranged from 13 to 21 per cent in 2008 in most developed countries, 62 per cent of all people aged 65 and older now live in developing countries where health in older age may be neglected because of lack of resources (World Health Organization, 2007).

With aging comes an increase in incidence of chronic disease and disability, now the major cause of death among older people in both developed and developing countries (Kinsella & He, 2009). To reduce the public health burden due to increased falls and fall-related injuries associated with demographic changes, it is imperative that effective preventive strategies are put in place. Implementing evidence-based fall prevention programs could appreciably decrease the incidence and health care costs of fall injuries, as well as greatly improve the quality of life for older adults (Stevens et al., 2008).

The Scope of Falls

Definition of a Fall

For epidemiological and intervention studies measuring the magnitude of falls, the adoption of a standardized definition is necessary for consistency and comparison of outcome measures. Although the meaning of a "fall" seems intuitive, older people, health professionals, and researchers can interpret a fall in different ways (Zecevic, Salmoni, Speechley, & Vandervoort, 2006; Haines, Massey, Varghese, Fleming, & Gray, 2009; Hauer, Lamb, Jorstad, Todd, & Becker, 2006; Lamb, Jorstad-Stein, Hauer, & Becker, 2005). Moreover, although there have been diverse definitions in the literature (Zecevic et al., 2006), the most widely accepted definition is that of inadvertently coming to rest on the ground, floor, or lower level. The definition excludes intentional change in position to rest on furniture, or against a wall or other structure (World Health Organization, 2007). Ascertainment should consider lay perspectives so that participants are asked about falls, including slips or trips, causing loss of balance to land on the ground, floor, or lower level (Lamb et al., 2005). For coding purposes in injury surveillance systems, accidental falls may be classified as falls on the same level (e.g., from slipping or tripping) or from different levels (e.g., from stairs, from ladder, bed, or other structure).

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Measuring Falls Outcomes

Falls data is collected by three main methods: (a) retrospective reporting systems using telephone interview, face-to-face interview, or postal questionnaire; (b) prospective reporting systems using postcards, calendars, or diaries; and (c) routine surveillance systems or abstraction from health care records (Hauer et al., 2006). More recently, fall detection devices have been developed (Noury et al., 2007), and wearable devices such as accelerometers have been used to monitor falls in clinical settings (Culhane, O'Connor, Lyons, & Lyons, 2005). Such methods, however, are unsuitable for large-scale population monitoring.

Several issues confront researchers when collecting falls data, including accuracy of self-reporting and retrospective recall of previous falls (Ganz, Higashi, & Rubenstein, 2005; Mackenzie, Byles, & D'Este, 2006; Peel, 2000), as well as differing perceptions of what constitutes a "fall" (Zecevic et al., 2006; Hauer et al., 2006). Depending on the length of the recall period, falls may be forgotten (Wijlhuizen, Hopman-Rock, Knook, & van der Cammen, 2006; Cummings, Nevitt, & Kidd, 1988). Falls are often unwitnessed and unreported, and there may even be disincentives on the part of the older person for reporting falls, including embarrassment, perceptions that a fall will be seen as a marker of aging, and fear of consequences, such as loss of independence and risk of institutionalization (Allen, 2004; Peel, Bell, & Smith, 2008). Data on falls in institutional settings may also be of questionable quality as staff time pressures, perception of blame, and other factors are thought to contribute to under-reporting (Haines, Cornwell, Fleming, Varghese, & Gray, 2008).

Strategies are required to increase reporting of falls by older people by increasing their awareness of the value of reporting (e.g., for the early detection of risk and implementing strategies to reduce future risk). Also needed are health professional initiatives to encourage asking all older people at least once each year whether they have had a fall (American Geriatrics Society, British Geriatrics Society, American Academy of Orthopaedic Surgeons Panel on Falls Prevention, 2001). Providing training to institutional staff regarding the purpose of incident reporting and the usefulness of such reports for preventing future falls may improve incident reporting practices (Haines et al., 2008), and is seen as a necessary step in changing a culture of blame.

Many falls go undetected until after injury and disabilities have occurred. Falls resulting in injury are more likely to be recorded in administrative data sets, such as hospital records and institutional incident reports. The injury experience of a population has been described as a pyramid. The apex represents the relatively small number of fatal cases, and the broader, lower parts of the pyramid represent the more numerous injuries of lesser severity. Injury data availability is in direct proportion to case *severity*, and in inverse proportion to case *frequency*. Quite a lot is known about the relatively small number of injury deaths, less about hospital in-patient cases, and still less about cases resulting in neither death nor hospital admission. Fewer than half of fall events are reported to a health practitioner (Hauer et al., 2006; Shumway-Cook et al., 2009), and the percentage is likely to be much lower in cases where a fall occurs and does not require treatment (Allen, 2004).

In epidemiological studies, the most-frequent methods of summarizing fall outcomes include (a) reporting data on number of participants sustaining a fall or multiple falls (usually two or more); (b) number of falls; (c) fall rates; and/or (d) time to first fall (Hauer et al., 2006). The focus may be on falls causing injury or requiring medical care. In calculating rates, the number of falls, fallers, or fall-related injuries is the numerator, while the denominator may be number of people at risk or number of occupied bed (patient) days per unit of time. As an example, annual national reporting on indicators for safety and quality in the Australian health care system requires measurement of falls resulting in patient harm in hospitals and residential aged-care facilities (RACF). The numerator is the number of in-hospital fall separations (or number of RACF falls) in which the fall resulted in harm, and the denominator is the total number of hospital separations (or RACF residents) (Australian Institute of Health and Welfare, 2009).

Incidence of Falls and Fall-Related Injuries

The incidence of falls and fall-related injuries varies among settings and populations

Community Settings The variation in study designs, study population characteristics, and methods of falls data ascertainment and reporting make comparison of studies difficult. Table 1 outlines a number of studies in older people in community settings selected to represent a range of recent research across different countries. The majority of studies showed that between 20 per cent and 33 per cent fall each year. The relative rates increased approximately 5 per cent per year with cohort aging (Anstey, Burns, von Sanden, & Luszcz, 2008) and were highest in the old-old (Speechley et al., 2005) and oldest old (Fleming, Matthews, Brayne, & CC75C Study Collaboration, 2008; Iinattiniemi, Jokelainen, & Luukinen, 2009; Formiga, Ferrer, Duaso, Olmedo, & Pujol, 2008) wherein up to 60 per cent fell over a 12-month follow-up period (Fleming et al., 2008). The lowest rates were recorded in Hong Kong Chinese (Chu, Chi, & Chiu, 2005). These studies also showed

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Table 1: Community studies of fall incidence

Author, Year	Country	Study Methodology	Population Characteristics	Incidence/Prevalence of Falls	Incidence/Prevalence of Injuries
Shumway-Cook et al. (2009)	United States	Cross-sectional survey; retrospective recall of falls over past 12 months	12,669 Medicare beneficiaries aged ≥ 65 years	• 22.1% fell in past 12 months • 10% of population experienced 2 or more falls	• 33% of fallers reported injury requiring medical attention for at least 1 fall in past 12 months
Iinattiniemi et al. (2009)	Finland	Prospective study with bimonthly telephone monitoring of falls	555 persons aged ≥ 85 years	• 49% fell in 11 months of follow-up • Incidence 1.03 falls/PY	
Gribbin et al. (2009)	United Kingdom	Cohort study; falls presenting to primary care practices and coded on primary care database 2003–2006	> 500,000 primary care patients aged ≥ 60 years		Falls presenting to primary care: • Incidence rate of falls 3.6/100 PY • Incidence rate of recurrent falls 0.67/100 PY
Kojima, Furuna, Ikeda, Nakamura, & Sawada (2008)	Japan	Cross-sectional survey; retrospective recall of falls over past 12 months	849 persons aged ≥ 65 years	• 32.6% fell in past 12 months • 56% of fallers had ≥ 2 falls	
Anstey et al. (2008)	Australia	Longitudinal cohort study; falls in past year assessed retrospectively on 3 assessments (waves 1, 3, & 6) over 8 years	787 persons aged ≥ 70 years	• Waves 1, 3, & 6: 24.9%, 34.4%, & 40.2% respectively fell in previous 12 months • Relative rates increased by approx. 5% per year over 8 years	
Fleming et al. (2008)	United Kingdom	Cohort study; falls assessed prospectively by calendar & telephone follow-up for 12 months.	110 persons aged ≥ 90 years (62 community dwelling; 48 in supported accommodation)	• 60% fell in 12 months follow-up • 75% of fallers fell more than once • Incidence 2.8 falls/PY	
Formiga et al. (2008)	Spain	Cohort study; falls assessed by retrospective recall of falls over past year	137 persons aged ≥ 90 years	•48.1% fell in previous 12 months •20% had ≥ 2 falls	• 5.7% of falls resulted in fracture
Chan et al. (2007)	United States	Prospective cohort; falls assessed by questionnaires for recall over previous 4 months	5,867 men aged ≥ 65 years	•25.4% fell in first year of follow-up	
Reyes-Ortiz, Al Snih, & Markides (2005)	Barbados, Argentina, Cuba, Mexico, Uruguay, Chile, and Brazil	Survey; retrospective recall of falls over past 12 months	9,755 people in 7 cities aged ≥ 60 years	•21.6 to 34% fell in previous 12 months • 8.7 to 20.3% had ≥ 2 falls	

Continued

Table 1: Continued

Author, Year	Country	Study Methodology	Population Characteristics	Incidence/Prevalence of Falls	Incidence/Prevalence of Injuries
Chu et al. (2005)	Hong Kong	Prospective cohort; falls assessed twice monthly by telephone over 1 year follow-up	1,517 persons aged ≥ 65 years	• 19.3% fell in 1 year follow-up • 24.5% of fallers had recurrent falls (≥ 2 falls) • Incidence 270 falls/1,000 PY; 198 fallers/1,000 PY	• 75.2% of fallers suffered injury – mainly minor • 7.2% of fallers suffered serious injury including fractures
Speechley et al. (2005)	Canada	Cross-sectional survey: retrospective recall of number of falls and injurious falls in past year	1,913 veterans (96% male; mean age 81 years [*SD*: 4.2]) 1,398 caregivers (7% male; mean age 78 years [*SD*: 4.8])	• 39.8% of veterans fell in past 12 months • 24.4% of veterans had ≥ 2 falls in past 12 months • 29.7% of caregivers fell in past 12 months • 16.6% of caregivers had ≥ 2 falls in past 12 months	• 13.6% of veterans had an injurious fall in past 12 months (serious enough to see a doctor) • 11.9% of caregivers had an injurious fall in past 12 months (serious enough to see a doctor)
Lach (2005)	United States	Prospective cohort; falls recorded on monthly postcard with telephone follow-up of recorded falls over 2 years	890 persons aged ≥ 65 years	• Baseline: 28% had falls in past year • Year 1: 22% fell • Year 2: 23% fell	• Baseline: 5.8% had fall-related injuries in past year • 5% of subjects had serious injuries over 2 years
Salva, Bolibar, Pera, & Arias (2004)	Spain	Prospective cohort; fall and injury ascertainment by falls diary and monthly telephone follow-up over 1 year.	448 persons aged ≥ 65 years	• 32.1% fell during follow-up period • 8% of sample had ≥ 2 falls during follow-up period • Incidence rate was 46.0 falls/100 PY	• 21.7% of falls required medical aid • 7.7% of falls resulted in fractures
Morris et al. (2004)	Australia	Cohort study; fall and injury ascertainment by retrospective recall in the past 12 months	1,000 persons aged ≥ 65 years	• 29% reported falling at least once in the past year • 10% reported ≥ 2 falls	• 33% of falls required medical treatment
Tromp et al. (2001)	Netherlands	Prospective cohort: falls and fractures assessed by weekly calendars returned quarterly over 1 year follow-up	1,285 persons aged ≥ 65 years	• 33.3% fell during 1st year of follow-up • 11.4% of participants classified as recurrent fallers (≥ 2 falls)	• 1.6% reported fall-related fractures over 1st year of follow-up

PY = person-years
***SD* = standard deviation**

that a quarter to half of fallers experienced multiple falls (2 or more), with higher rates of recurrent falling (75%) in the oldest-old (Fleming et al., 2008). Fall rates were higher in older community-dwelling women than men (not tabulated). Up to a third of fallers reported an injury requiring medical attention, with less than 10 per cent having serious injury such as fractures or head injury. Broadly, the findings of the recent studies reflect those of previously published epidemiological studies in the 1980s and 1990s (Masud & Morris, 2001; Lord, Sherrington, Menz, & Close, 2007), despite a generational change.

Care Settings Because of a high prevalence of clinical diseases, functional disability, and age-related physiological changes, older people in care settings are particularly vulnerable, resulting in an increased incidence of falls and fall-related injury (Rubenstein, 2006). High rates of falls (27% to 35.9% over a 90-day assessment period) have been shown in studies of older people in receipt of home care services (Fletcher & Hirdes, 2002; Cesari et al., 2002). Hip fracture incidence in home care clients of 24.4 per 1,000 (24.4/1,000) person-years of follow-up (Stolee, Poss, Cook, Byrne, & Hirdes, 2009) was much higher than that reported in other community-dwelling populations (5.7/1,000 person-years) (Sugarman et al., 2002).

For older people in residential care facilities, the rates of falls and fall-related injuries are even higher (Rubenstein, 2006), with residents experiencing an incidence of falls nearly five times more than community-dwelling people of the same age (Australian Commission on Safety and Quality in Health Care, 2009c). Rates between one and five falls per resident per year have been reported (Australian Commission on Safety and Quality in Health Care, 2009c), although fall and injury rates vary according to the case-mix of the institution and are likely to be different for mobile people with dementia compared with dependent people with high care needs (Australian Commission on Safety and Quality in Health Care, 2009c). An Australian study (Chen et al., 2009) showed a higher crude hip fracture rate (4.6% vs. 3.0% per person-year) for residents living in intermediate-care hostels compared to those living in high-care facilities (nursing homes), suggesting that exposure to risk was a factor. Similarly, in a study in Wales, age-standardized hip fracture rates per 1,000 per year in residents in the community, sheltered accommodation (group housing), residential homes (low care), and nursing homes (high care) were 5.0, 11.3, 36.1, and 17.2 respectively (Brennan et al., 2003).

In acute care settings, accidental falls in hospitalized patients accounted for 30 to 40 per cent of reported safety incidents, and occurred at a frequency of 4 to 14 per 1,000 bed-days (Oliver & Healy, 2009). Incidence rates varied between wards and departments in hospitals (Australian Commission on Safety and Quality in Health Care, 2009b). In a geriatric patient cohort, prior to implementing falls prevention strategies, a rate of 10 falls per 1,000 hospital-days was recorded. Of the falls, 49.1 per cent were recorded as a single fall and the remainder as two or more falls (von Renteln-Kruse & Krause, 2007). In the sub-acute or rehabilitation hospital setting, more than 40 per cent of patients with specific clinical problems, such as stroke, experience one or more falls during their admission (National Ageing Research Institute, 2004). Falls in hospitals lead to injury in about 30 per cent of cases with one to five per cent leading to serious injury (Healey et al., 2008).

As they occur predominantly to older people with frailty and multiple health problems (Healey et al., 2008), even minor injuries may lead to impaired rehabilitation, deconditioning, loss of confidence, fear of falling, and a longer stay, and are a major factor in patients moving to care homes (Oliver & Healy, 2009). Falls in care settings also lead to caregiver stress and fear of litigation for staff and administration (National Ageing Research Institute, 2004), when falls are seen as a failure of duty of care (Oliver & Healy, 2009). Since not all falls are preventable, there has to be a compromise so as not to delay rehabilitation efforts to establish or maintain independence (Oliver & Healy, 2009).

Causes and Circumstances of Falls

There are many causes of falls in older people stemming from the interaction between environmental hazards (or extrinsic factors) and increased susceptibility to hazards from the accumulated effects of age and comorbidities (intrinsic factors) (Rubenstein, 2006), in association with risk-taking behaviors (Lord et al., 2007). Falls among people younger than 75 years are more likely to be associated with extrinsic factors, while intrinsic factors are more important among people aged 80 and older (Lach et al., 1991; Todd & Skelton, 2004).

The occurrence of falls is strongly related to exposure, in that they occur where older people are undertaking their usual daily activities (Lord et al., 2007). For older community-dwelling people, about 50 per cent of falls occur within their homes and immediate surroundings, with most falls occurring in commonly used rooms such as the bedroom, living area, or kitchen (Lord et al., 2007). The remaining falls occur in public places where commonly reported environmental hazards are cracked pavements, curbs, uneven ground, and slippery surfaces (Li et al., 2006), particularly in places where ice and snow may contribute to slipping (Bulajic-Kopjar, 2000). In acute and residential aged-care settings,

ambulatory patients are more at risk than non-ambulatory patients of fall-related injury (Bradley, Karani, McGinn, & Wisnivesky, 2010; Thapa, Brockman, Gideon, Fought, & Ray, 1996). The majority of falls occur in the patient's room (Thapa et al., 1996; Butler, Kerse, & Todd, 2004; Corsinovi et al., 2009; Krauss et al., 2007), often from the bed (Corsinovi et al., 2009), while sitting, or during transfers (Thapa et al., 1996). Environmental hazards are implicated in approximately 15 per cent of falls in residential aged-care settings (Thapa et al., 1996; Butler et al., 2004).

Sociodemographic factors associated with falls include age and gender, ethnicity, and socioeconomic status

Age and Gender The rates of falls,fall-related injuries, and fall-related deaths increase exponentially with age (with the greatest increase after age 80). This is because, with aging, most falls are associated with age-related conditions such as physical frailty, immobility, and reduced functional capacity (Yoshida, 2007). For all age groups aged 65 and older, women are more likely than are men to fall and sustain non-fatal injuries (Stevens & Sogolow, 2005). Some of the disparity may reflect gender differences in levels of physical activity and consequent lower-body strength (Stevens & Sogolow, 2005), or in higher rates of osteoporosis, which make women more likely to sustain a serious fracture from a fall (Yoshida, 2007). However, rates of fatal falls among men exceed those of women for all age groups, in spite of fewer occurrences of falls among men (World Health Organization, 2007). This is attributed to the fact that men suffer from more co-morbid conditions than do women of the same age (World Health Organization, 2007). Another reason may be that a high incidence of traumatic brain injury is recorded in fatal falls (Henley & Harrison, 2009), and men record higher rates than do women for fall-related head injuries (Bradley & Pointer, 2009).

Ethnicity In the United States, the rate of hospitalization for fall-related injuries is two to four times higher among Whites than Hispanics and Asians/Pacific Islanders, and about 20 per cent higher than for African-Americans (Ellis & Trent, 2001). There are also clear differences observed in fall rates between Singaporeans of Chinese, Malay, and Indian ethnic origins (Chan, Pang, Ee, Ding, & Choo, 1997), and between native Japanese older community dwellers and Japanese-Americans and Caucasians (Davis, Ross, Nevitt, & Wasnich, 1997).

In Australia, where a high proportion of people aged 65 and older were born overseas (21.3% in non- English-speaking countries and 13.6% from English-speaking countries) (Australian Institute of Health and Welfare, 2007), the rate of hospitalization due to injurious falls conforms to the "healthy migrant" hypothesis: rates are highest in the Australian-born segment and lowest among older people from culturally and linguistically diverse backgrounds (Bradley & Harrison, 2007). For the Indigenous population, which comprises 0.5 per cent of older Australians (Australian Institute of Health and Welfare, 2007), the effect of an increasing rate of falls with age is observed from an earlier age for Aboriginal and Torres Strait Islander people than for other Australians (Helps & Harrison, 2006). Deaths due to falls are two and a half times higher in this population than for non-Indigenous people (Helps & Harrison, 2006). For minority groups, fall rates may be a reflection of higher risk of chronic disease and lower socioeconomic status.

Socioeconomic Status Four factors – (a) limited accessibility to health and social services, (b) low income, (c) little education, and (d) poor housing environments – are associated with higher risk of chronic disease which may be associated with an increased risk of falling (Yoshida, 2007). In a large cohort study of people aged 60 or older in primary care in the United Kingdom, there was a strong socioeconomic gradient in which incidence of falls increased from least to greatest quintile of deprivation (Gribbin, Hubbard, Smith, Gladman, & Lewis, 2009). Other studies have shown that being unmarried and/or living alone are independent risk factors for fall-related hip fractures, particularly for women (Peel, McClure, & Hendrikz, 2007). Living alone may represent exposure to diminished social networks as well as to greater frailty, both of which are associated with increased fall risk (Peel, McClure et al., 2007; Faulkner, Cauley, Zmuda, Griffin, & Nevitt, 2003).

International Trends

There is a lack of epidemiological data on falls in many parts of the developing world (World Health Organization, 2007), so that aggregated data at the national level for time trends in falls rates are more readily available for developed nations. Data from the United States showed that during the 1993–2003 time frame, the overall rate of fatal falls among persons aged 65 years or older increased (Centers for Disease Control and Prevention, 2006). Despite a decrease in the rate of hospitalizations for hip fractures, during the years 2001– 2005, the change in the overall rate of nonfatal injuries from falls was not statistically significant (Centers for Disease Control and Prevention, 2006). Canada also reported a significant increase in deaths due to falls between 1997 and 2002 (Public Health Agency Canada, 2005). Although fall-related hospitalizations for seniors remained stable over five years from 1998–1999 to 2002–2003 (Scott et al., 2005; Public Health Agency Canada, 2005), Canadian hospitalization data

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for the period 1985–2005 showed age-standardized rates of hip fracture declined significantly by 31.8 per cent in females and by 25.0 per cent in males (Leslie et al., 2009).

In Australia, death rates for persons aged 65 years and older fell by 13 per cent from 1997–1998 to 2004–2005 (Henley & Harrison, 2009), while age-standardized relative rates of hospitalized fall injury cases for both males and females increased during the period 1999–2006 in the order of 2.5 per cent (males) and 1.1 per cent (females) per year (Bradley & Pointer, 2009). However, as observed in North America, the rates of hospitalized cases of hip fracture due to falls in people aged 65 years and older have been decreasing over the same period (Figure 1) (Bradley & Pointer, 2009).

In Europe, fall-related hospital admissions are reported to be increasing in the Netherlands (Hartholt et al., 2010), while a recent decline in hip fracture rates has been observed in Finland (Kannus, Niemi et al., 2006). The reduction in hip fractures has been attributed to a cohort effect toward a healthier aging population and increased average body weight and improved functional ability (Kannus, Niemi, et al., 2006), as well as to public health measures including wider osteoporosis screening and effective treatments (Yoshida, 2007).

Costs of Falls

Fall-incurred costs are categorized into two aspects. Direct costs encompass health care costs such as medications and health-care-provider consultations in treatment and rehabilitation. Indirect costs are societal productivity losses of activities for individuals and family caregivers (World Health Organization, 2007). A number of studies (Stevens et al., 2006; Scuffham, Chaplin, & Legood, 2003; Hendrie, Hall, Legge, & Arena, 2003) have underscored the substantial economic burden caused by fall-related injuries, regardless of the medical care system. A systematic review of international studies (Heinrich, Rapp, Rissmann, Becker, & Konig, 2009) showed that fall-related costs ranged between 0.85 per cent to 1.5 per cent of the total health care expenditure of countries such as North America, Australia, Europe, and the United Kingdom, equating to 0.07 per cent to 0.20 per cent of the Gross Domestic Product. For comparison purposes, costs were expressed in terms of U.S. dollar (USD) purchasing power parities (PPPs). PPPs are currency conversion rates that both convert to a common currency and equalize the purchasing power of different currencies. The mean costs per fall victim, per fall, and per fall-related hospitalization ranged from $2,044 to $25,955; $1,059 to $10,913; and $5,654 to $42,840 USD PPP respectively (Heinrich et al., 2009).

Policy Implications

A number of approaches across the continuum of care can be adopted for preventing falls by older people. Figure 2 shows a summary of the guiding principles (Peel et al., 2008).

A public health model targets the population as a whole, whereas the personal health model targets the individual. The aim in the personal health or medical model is to identify those at high risk and tailor individual care plans to reduce risk. The public health model of falls prevention, in contrast, aims to shift the whole population's distribution of risk, since small shifts in some risks in the population can translate into major public health benefits (Peel et al., 2008). Both models have a place in falls prevention, depending on setting and target group.

Population health strategies approach falls in older age within the framework of the determinants of healthy, active aging to develop effective interventions and policies (World Health Organization, 2007). The aim of

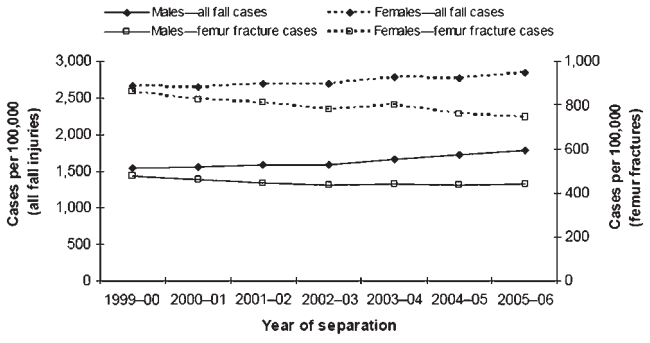

Figure 1: Age-standardized rates for fall injury hospitalizations, Australia 1999–2006.
Source: Bradley and Pointer (2009)

Setting	Community	Community care	Acute; post-acute; residential aged care
Falls risk	Well aged: low risk	Vulnerable: increasing risk	Frail: high risk
Prevention models	Public health Population level	→	Personal health Individual level
Prevention programs	Health promotion for healthy aging	→	Health care assessment and management
Interventions	Multi-strategy, untargeted, multi-factorial	→	Targeted, single, or multi-factorial

Figure 2: Guiding principles for falls prevention

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promoting healthy aging is to ensure the best possible health outcomes for the current generation of older people and also for the cohort of baby boomers about to enter older age, by optimizing opportunities for improving and preserving physical, social, and mental wellness, independence, and quality of life (Peel, Bartlett, & McClure, 2007).

At the individual level, strategies involve risk factor screening, assessment, and management to ensure timely diagnostics and integrated care by addressing existing health problems and ameliorating the risk condition or retarding its progression. A number of guidelines based on reviews of the evidence have been developed that outline interventions for falls prevention across the continuum of care (Australian Commission on Safety and Quality in Health Care, 2009a, 2009b, 2009c; American Geriatrics Society, British Geriatrics Society, American Academy of Orthopaedic Surgeons Panel on Falls Prevention, 2001; National Collaborating Centre for Nursing and Supportive Care, 2004).

For sustainability in preventing falls, evidence must be integrated into practice. This needs to take into account the views, preferences, and experiences of older people and their caregivers (McInnes & Askie, 2004). To improve the likelihood of being adopted strategies should emphasize positive messages that focus on promoting health and maintaining independence (Hughes et al., 2008). Despite the availability of policy and practice guidelines, there are still considerable challenges on many levels for integrating best-practice falls prevention strategies into health service delivery to reduce the public health impact of falls in older age.

References

Allen, T. (2004). Preventing falls in older people: Evaluating a peer education approach. *British Journal of Community Nursing*, *9*(5), 195–200.

American Geriatrics Society, British Geriatrics Society, American Academy of Orthopaedic Surgeons Panel on Falls Prevention. (2001). Guideline for the prevention of falls in older persons. *Journal of the American Geriatrics Society*, *49*(5), 664–672.

Anstey, K.J., Burns, R., von Sanden, C., & Luszcz, M.A. (2008). Psychological well-being is an independent predictor of falling in an 8-year follow-up of older adults. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *63*(4), P249–P257.

Australian Commission on Safety and Quality in Health Care. (2009a). *Preventing falls and harm from falls in older people: Best practice guidelines for Australian community care*. Canberra, Australian Capital Territory: Commonwealth Government.

Australian Commission on Safety and Quality in Health Care. (2009b). *Preventing falls and harm from falls in older people: Best practice guidelines for Australian hospitals*. Canberra, Australian Capital Territory: Commonwealth Government.

Australian Commission on Safety and Quality in Health Care. (2009c). *Preventing falls and harm from falls in older people: Best practice guidelines for Australian residential aged care facilities*. Canberra, Australian Capital Territory: Commonwealth Government; 2009.

Australian Institute of Health and Welfare. (2007). *Older Australia at a Glance*. (Cat. No. AGE 52). Canberra, Australian Capital Territory: Australian Institute of Health and Welfare.

Australian Institute of Health and Welfare. (2009). *Towards National Indicators of Safety and Quality in Health Care*. (Cat. No. HSE 75). Canberra, Australian Capital Territory: Australian Institute of Health and Welfare.

Begg, S., Vos, T., Barker, B., Stevenson, C., Stanley, L., & Lopez, A.D. (2007). *The Burden of Disease and Injury in Australia 2003*. (Cat. No. PHE 82). Canberra, Australian Capital Territory: Australian Institute of Health and Welfare.

Bell, A.J., Talbot-Stern, J.K., & Hennessy, A. (2000). Characteristics and outcomes of older patients presenting to the emergency department after a fall: A retrospective analysis. *The Medical Journal of Australia*, *173*(4), 179–182.

Bradley, C., & Harrison, J. (2007). (Cat. No. INJCAT 97). *Fall-related hospitalisations among older people: Sociocultural and regional aspects*. Adelaide, South Australia: Australian Institute of Health and Welfare.

Bradley, S.M., Karani, R., McGinn, T., & Wisnivesky, J. (2010). Predictors of serious injury among hospitalized patients evaluated for falls. *Journal of Hospital Medicine*, *5*(2), 63–68.

Bradley, C., & Pointer, S. (2009). (Cat. No. INJCAT 122). *Hospitalisations due to falls by older people, Australia 2005-06*. Adelaide, South Australia: Australian Institute of Health and Welfare.

Brennan, J., Johansen, A., Butler, J., Stone, M., Richmond, P., Jones, S., et al. (2003). Place of residence and risk of fracture in older people: A population-based study of over 65-year-olds in Cardiff. *Osteoporosis International*, *14*(6), 515–519.

Bulajic-Kopjar, M. (2000). Seasonal variations in incidence of fractures among elderly people. *Injury Prevention*, *6*(1), 16–19.

Butler, M., Kerse, N., & Todd, M. (2004). Circumstances and consequences of falls in residential care: The New Zealand story. *The New Zealand Medical Journal*, *117*(1202), U1076.

Centers for Disease Control and Prevention. (2006). Fatalities and injuries from falls among older adults–United

https://doi.org/10.1017/S071498081000070X Published online by Cambridge University Press

States, 1993-2003 and 2001-2005. *MMWR. Morbidity and Mortality Weekly Report*, *55*(45), 1221–1224.

Cesari, M., Landi, F., Torre, S., Onder, G., Lattanzio, F., & Bernabei, R. (2002). Prevalence and risk factors for falls in an older community-dwelling population. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *57*(11), M722–M726.

Chan, B.K., Marshall, L.M., Winters, K.M., Faulkner, K.A., Schwartz, A.V., & Orwoll, E.S. (2007). Incident fall risk and physical activity and physical performance among older men: The Osteoporotic Fractures in Men Study. *American Journal of Epidemiology*, *165*(6), 696–703.

Chan, K.M., Pang, W.S., Ee, C.H., Ding, Y.Y., & Choo, P. (1997). Epidemiology of falls among the elderly community dwellers in Singapore. *Singapore Medical Journal*, *38*(10), 427–431.

Chen, J.S., Sambrook, P.N., Simpson, J.M., Cameron, I.D., Cumming, R.G., Seibel, M.J., et al. (2009). Risk factors for hip fracture among institutionalised older people. *Age and Ageing*, *38*(4), 429–434.

Chu, L.W., Chi, I., & Chiu, A.Y. (2005). Incidence and predictors of falls in the Chinese elderly. *Annals of the Academy of Medicine, Singapore*, *34*(1), 60–72.

Corsinovi, L., Bo, M., Ricauda Aimonino, N., Marinello, R., Gariglio, F., Marchetto, C., et al. (2009). Predictors of falls and hospitalization outcomes in elderly patients admitted to an acute geriatric unit. *Archives of Gerontology & Geriatrics*, *49*(1), 142–145.

Culhane, K.M., O'Connor, M., Lyons, D., & Lyons, G.M. (2005). Accelerometers in rehabilitation medicine for older adults. *Age and Ageing*, *34*(6), 556–560.

Cummings, S.R., Nevitt, M.C., & Kidd, S. (1988). Forgetting falls. The limited accuracy of recall of falls in the elderly. *Journal of the American Geriatrics Society*, *36*(7), 613–616.

Davies, A.J., & Kenny, R.A. (1996). Falls presenting to the accident and emergency department: Types of presentation and risk factor profile. *Age and Ageing*, *25*(5), 362–366.

Davis, J.W., Ross, P.D., Nevitt, M.C., & Wasnich, R.D. (1997). Incidence rates of falls among Japanese men and women living in Hawaii. *Journal of Clinical Epidemiology*, *50*(5), 589–594.

Ellis, A.A., & Trent, R.B. (2001). Hospitalized fall injuries and race in California. *Injury Prevention*, *7*(4), 316–320.

Faulkner, K., Cauley, J., Zmuda, J., Griffin, J., & Nevitt, M. (2003). Is social integration associated with the risk of falling in older community-dwelling women? *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *58*(10), M954–M959.

Fleming, J., Matthews, F.E., Brayne, C., Cc75c Study Collaboration CC. (2008). Falls in advanced old age: Recalled falls and prospective follow-up of over-90-year-olds in the Cambridge City over-75s Cohort study. *BMC Geriatrics*, *8*(1), 6.

Fletcher, P.C., & Hirdes, J.P. (2002). Risk factors for falling among community-based seniors using home care services. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *57*(8), M504–M510.

Formiga, F., Ferrer, A., Duaso, E., Olmedo, C., & Pujol, R. (2008). Falls in nonagenarians living in their own homes: The Nonasantfeliu study. *The Journal of Nutrition, Health & Aging*, *12*(4), 273–276.

Ganz, D.A., Higashi, T., & Rubenstein, L.Z. (2005). Monitoring falls in cohort studies of community-dwelling older people: Effect of the recall interval. *Journal of the American Geriatrics Society*, *53*(12), 2190–2194.

Gribbin, J., Hubbard, R., Smith, C., Gladman, J., & Lewis, S. (2009). Incidence and mortality of falls amongst older people in primary care in the United Kingdom. *QJM*, *102*(7), 477–483.

Haines, T.P., Cornwell, P., Fleming, J., Varghese, P., & Gray, L. (2008). Documentation of in-hospital falls on incident reports: Qualitative investigation of an imperfect process. *BMC Health Services Research*, *8*, 254.

Haines, T.P., Massey, B., Varghese, P., Fleming, J., & Gray, L. (2009). Inconsistency in classification and reporting of in-hospital falls. *Journal of the American Geriatrics Society*, *57*(3), 517–523.

Hartholt, K.A., van der Velde, N., Looman, C.W., van Lieshout, E.M., Panneman, M.J., van Beeck, E.F., et al. (2010). Trends in fall-related hospital admissions in older persons in the Netherlands. *Archives of Internal Medicine*, *170*(10), 905–911.

Hauer, K., Lamb, S.E., Jorstad, E.C., Todd, C., & Becker, C. (2006). Systematic review of definitions and methods of measuring falls in randomised controlled fall prevention trials. *Age and Ageing*, *35*(1), 5–10.

Healey, F., Scobie, S., Oliver, D., Pryce, A., Thomson, R., & Glampson, B. (2008). Falls in English and Welsh hospitals: A national observational study based on retrospective analysis of 12 months of patient safety incident reports. *Quality and Safety in Health Care*, *17*(6), 424–430.

Heinrich, S., Rapp, K., Rissmann, U., Becker, C., & Konig, H.H. (2009). Cost of falls in old age: A systematic review. *Osteoporosis International*, *21*(6), 891–902.

Helps, Y.L., & Harrison, J.E. (2006). *Hospitalised Injury of Australia's Aboriginal and Torres Strait Islander People 2000–02*. (Cat. No. INJCAT 94). Canberra, Australian Capital Territory: Australian Institute of Health and Welfare.

Hendrie, D., Hall, S.E., Legge, M., & Arena, G. (2003). *Injury in Western Australia: The health system costs of falls in older adults in Western Australia*. Perth, Western Australia: Injury Research Centre, The University of Western Australia.

Henley, G., & Harrison, J. (2009). *Injury Deaths, Australia 2004–05*. (Cat. No. INJCAT 127). Adelaide, South Australia: Australian Institute of Health and Welfare.

Hill, K., Schwarz, J., Flicker, L., & Carroll, S. (1999). Falls among healthy, community-dwelling, older women: A prospective study of frequency, circumstances, consequences and prediction accuracy. *Australian and New Zealand Journal of Public Health*, *23*(1), 41–48.

Hughes, K., van Beurden, E., Eakin, E.G., Barnett, L.M., Patterson, E., Backhouse, J. et al. (2008). Older persons' perception of risk of falling: Implications for fall-prevention campaigns. *American Journal of Public Health*, *98*(2), 351–357.

Iinattiniemi, S., Jokelainen, J., & Luukinen, H. (2009). Falls risk among a very old home-dwelling population. *Scandinavian Journal of Primary Health Care*, *27*(1), 25–30.

Ingarfield, S.L., Finn, J.C., Jacobs, I.G., Gibson, N.P., Holman, C.D., Jelinek, G.A., et al. (2009). Use of emergency departments by older people from residential care: A population based study. *Age and Ageing*, *38*(3), 314–318.

Kannus, P., Khan, K.M., & Lord, S.R. (2006). Preventing falls among elderly people in the hospital environment. *The Medical Journal of Australia*, *184*(8), 372–373.

Kannus, P., Niemi, S., Parkkari, J., Palvanen, M., Vuori, I., & Jarvinen, M. (2006). Nationwide decline in incidence of hip fracture. *Journal of Bone and Mineral Research*, *21*(12), 1836–1838.

Karmel, R., Lloyd, J., & Anderson, P. (2008). *Movement from Hospital to Residential Aged care*. (Data Linkage Series No. 6. Cat. No. CSI 6). Canberra, Australian Capital Territory: Australian Institute of Health and Welfare.

Kinsella, K., & He, W. (2009). *An Aging World: 2008*. (International Population Reports P95/09-1). Washington, DC: US Census Bureau.

Kojima, S., Furuna, T., Ikeda, N., Nakamura, M., & Sawada, Y. (2008). Falls among community-dwelling elderly people of Hokkaido, Japan. *Geriatrics & Gerontology International*, *8*(4), 272–277.

Krauss, M.J., Nguyen, S.L., Dunagan, W.C., Birge, S., Costantinou, E., Johnson, S., et al. (2007). Circumstances of patient falls and injuries in 9 hospitals in a midwestern healthcare system. *Infection Control and Hospital Epidemiology*, *28*(5), 544–550.

Lach, H.W. (2005). Incidence and risk factors for developing fear of falling in older adults. *Public Health Nursing*, *22*(1), 45–52.

Lach, H.W., Reed, A.T., Arfken, C.L., Miller, J.P., Paige, G.D., Birge, S.J., et al. (1991). Falls in the elderley: Reliability of a classification system. *Journal of the American Geriatrics Society*, *39*(2), 197–202.

Lamb, S.E., Jorstad-Stein, E.C., Hauer, K., & Becker, C. (2005). Development of a common outcome data set for fall injury prevention trials: The Prevention of Falls Network Europe consensus. *Journal of the American Geriatrics Society*, *53*(9), 1618–1622.

Leslie, W.D., O'Donnell, S., Jean, S., Lagace, C., Walsh, P., Bancej, C., et al. (2009). Trends in hip fracture rates in Canada. *JAMA*, *302*(8), 883–889.

Li, W., Keegan, T.H., Sternfeld, B., Sidney, S., Quesenberry, C.P., Jr., & Kelsey, J.L. (2006). Outdoor falls among middle-aged and older adults: A neglected public health problem. *American Journal of Public Health*, *96*(7), 1192–1200.

Lord, S.R., Sherrington, C., Menz, H.B., & Close, J.C.T. (2007). *Falls in older people: Risk factors and strategies for prevention* (2nd ed.). Cambridge, MA: Cambridge University Press.

Mackenzie, L., Byles, J., & D' Este, C. (2006). Validation of self-reported fall events in intervention studies. *Clin Rehabil*, *20*(4), 331–339.

Masud, T., & Morris, R.O. (2001). Epidemiology of falls. *Age and Ageing*, *30*(Suppl. 4), 3–7.

McInnes, E., & Askie, L. (2004). Evidence review on older people's views and experiences of falls prevention strategies. *Worldviews on Evidence-Based Nursing*, *1*(1), 20–37.

Morris, M., Osborne, D., Hill, K., Kendig, H., Lundgren-Lindquist, B., Browning, C., et al. (2004). Predisposing factors for occasional and multiple falls in older Australians who live at home. *The Australian Journal of Physiotherapy*, *50*(3), 153–159.

National Ageing Research Institute. (2004). *An Analysis of Research on Preventing Falls and Falls Injury in Older People: Community, residential care and hospital settings*. (Report to the Department of Health and Ageing, Injury Prevention Section). Canberra, Australian Capital Territory: Commonwealth of Australia.

National Collaborating Centre for Nursing and Supportive Care. (2004). *Clinical Practice Guideline for the Assessment and Prevention of Falls in Older People*. London: London Royal College of Nursing. Retrieved May 25, 2009, from http://www.guideline.gov/summary/summary.aspx?view_id=1&doc_id=6118

Noury, N., Fleury, A., Rumeau, P., Bourke, A.K., Laighin, G.O., Rialle, V., et al. (2007, August). Fall detection–principles and methods. *Proceedings of the 29th Annual International Conference of the IEEE EMBS*, 2007, 1663–1666.

Oliver, D., & Healy, F. (2009). Falls risk prediction tools for hospital inpatients: Do they work? *Nursing Times*, *105*(7), 18–21.

Oliver, D., Killick, S., Even, T., & Willmott, M. (2008). Do falls and falls-injuries in hospital indicate negligent care – and how big is the risk? A retrospective analysis of the NHS Litigation Authority Database of clinical negligence claims, resulting from falls in hospitals in England 1995 to 2006. *Quality & Safety in Health Care*, *17*(6), 431–436.

Peel, N.M. (2000). Validating recall of falls by older people. *Accident; Analysis and Prevention*, *32*(3), 371–372.

Peel, N.M., Bartlett, H.P., & McClure, R.J. (2007). Healthy aging as an intervention to minimize injury from falls among older people. *Annals of the New York Academy of Sciences*, *1114*(1), 162–169.

Peel, N.M., Bell, R.A.R., & Smith, K. (2008). *Queensland Stay On Your Feet® Good Practice Community Guidelines: Preventing Falls, Harm from Falls and Promoting Healthy Active Ageing in Older Queenslanders*. Brisbane, Queensland: Queensland Health. Retrieved May 24, 2009, from http://www.health.qld.gov.au/stayonyourfeet/resources.asp

Peel, N.M., Kassulke, D.J., & McClure, R.J.` (2002). Population based study of hospitalised fall related injuries in older people. *Injury Prevention*, *8*(4), 280–283.

Peel, N.M., McClure, R.J., & Hendrikz, J.K. (2007). Psychosocial factors associated with fall-related hip fractures. *Age and Ageing*, *36*(2), 145–151.

Pointer, S., Harrison, J., & Bradley, C. (2003). *National Injury Prevention Plan Priorities for 2004 and Beyond*. Discussion Paper (Cat. No. INJCAT 55). Adelaide, South Australia: Australian Institute of Health and Welfare.

Public Health Agency Canada. (2005). *Report on seniors' falls in Canada*. Ottawa, Ontario, Canada: Division of Aging and Seniors.

Reyes-Ortiz, C.A., Al Snih, S., & Markides, K.S. (2005). Falls among elderly persons in Latin America and the Caribbean and among elderly Mexican-Americans. *Revista panamericana de salud pública*, *17*(5–6), 362–369.

Rubenstein, L.Z. (2006). Falls in older people: Epidemiology, risk factors and strategies for prevention. *Age and Ageing*, *35*(Suppl. 2), ii37–ii41.

Salkeld, G., Cameron, I.D., Cumming, R.G., Easter, S., Seymour, J., Kurrle, S.E. et al. (2000). Quality of life related to fear of falling and hip fracture in older women: A time trade off study. *BMJ*, *320*(7231), 341–346.

Salva, A., Bolibar, I., Pera, G., & Arias, C. (2004). Incidence and consequences of falls among elderly people living in the community. *Medicina Clínica*, *122*(5), 172–176.

Scott, V., Pearce, M., & Pengelly, C. (2005). *Hospitalizations due to Falls Among Canadians Age 65 and Over. Report on Seniors' Falls in Canada* (Technical report prepared for the Public Health Agency of Canada) Victoria, British Columbia, Canada: Minister of Public Works and Government Services Canada.

Scuffham, P., Chaplin, S., & Legood, R. (2003). Incidence and costs of unintentional falls in older people in the United Kingdom. *Journal of Epidemiology and Community Health*, *57*(9), 740–744.

Shumway-Cook, A., Ciol, M.A., Hoffman, J., Dudgeon, B.J., Yorkston, K., & Chan, L. (2009). Falls in the Medicare population: Incidence, associated factors, and impact on health care. *Physical Therapy*, *89*(4), 324–332.

Speechley, M., Belfry, S., Borrie, M.J., Bray Jenkyn, K., Crilly, R., Gill, D.P., et al. (2005). Risk factors for falling among community-dwelling veterans and their caregivers. *Canadian Journal on Aging*, *24*(3), 261–274.

Stevens, J.A., Corso, P.S., Finkelstein, E.A., & Miller, T.R. (2006). The costs of fatal and non-fatal falls among older adults. *Injury Prevention*, *12*(5), 290–295.

Stevens, J.A., Mack, K.A., Paulozzi, L.J., & Ballesteros, M.F. (2008). Self-reported falls and fall-related injuries among persons aged>or=65 years–United States, 2006. *Journal of Safety Research*, *39*(3), 345–349.

Stevens, J.A., & Sogolow, E.D. (2005). Gender differences for non-fatal unintentional fall related injuries among older adults. *Injury Prevention*, *11*(2), 115–119.

Stolee, P., Poss, J., Cook, R.J., Byrne, K., & Hirdes, J.P. (2009). Risk factors for hip fracture in older home care clients. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, *64*(3), 403–410.

Sugarman, J.R., Connell, F.A., Hansen, A., Helgerson, S.D., Jessup, M.C., & Lee, H. (2002). Hip fracture incidence in nursing home residents and community-dwelling older people, Washington State, 1993-1995. *Journal of the American Geriatrics Society*, *50*(10), 1638–1643.

Thapa, P.B., Brockman, K.G., Gideon, P., Fought, R.L., & Ray, W.A. (1996). Injurious falls in nonambulatory nursing home residents: A comparative study of circumstances, incidence, and risk factors. *Journal of the American Geriatrics Society*, *44*(3), 273–278.

Todd, C., & Skelton, D.A. (2004). *What are the Main Risk Factors for Falls among Older People and What are the Most Effective Interventions to Prevent Falls?* (Health Evidence Network Report). Copenhagen, Denmark: WHO Regional Office for Europe.

Tromp, A.M., Pluijm, S.M., Smit, J.H., Deeg, D.J., Bouter, L.M., & Lips, P. (2001). Fall-risk screening test: A prospective study on predictors for falls in community-dwelling elderly. *Journal of Clinical Epidemiology*, *54*(8), 837–844.

Vaapio, S.S., Salminen, M.J., Ojanlatva, A., & Kivela, S.L. (2009). Quality of life as an outcome of fall prevention interventions among the aged: A systematic review. *European Journal of Public Health*, *19*(1), 7–15.

von Renteln-Kruse, W., & Krause, T. (2007). Incidence of in-hospital falls in geriatric patients before and after the introduction of an interdisciplinary team-based fall-prevention intervention. *Journal of the American Geriatrics Society*.

Wijlhuizen, G.J., Hopman-Rock, M., Knook, D.L., & van der Cammen, T.J. (2006). Automatic registration of falls and other accidents among community dwelling older people: Feasibility and reliability of the telephone inquiry system. *International Journal of Injury Control and Safety Promotion*, *13*(1), 58–60.

World Health Organization. (2007). *WHO Global Report on Falls Prevention in Older Age*. Geneva, Switzerland: World Health Organization. Retrieved May 24, 2009, from http://www.who.int/ageing/publications/Falls_prevention7March.pdf

Yoshida, S. (2007). *A Global Report on Falls Prevention: Epidemiology of Falls*. Geneva, Switzerland: World Health Organization. Retrieved January 13, 2010, from http://www.who.int/ageing/projects/1.Epidemiology%20of%20falls%20in%20older%20age.pdf

Zecevic, A.A., Salmoni, A.W., Speechley, M., & Vandervoort, A.A. (2006). Defining a fall and reasons for falling: Comparisons among the views of seniors, health care providers, and the research literature. *The Gerontologist*, *46*(3), 367–376.