Predisposing factors for occasional and multiple falls in older Australians who live at home

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This study, which was part of a larger study on the Health Status of Older People conducted in Melbourne, Australia, aimed to identify factors that discriminate between multiple and occasional falls amongst older people living at home. It used a survey of 1000 Australians aged 65 years and over. Subjects were classified as multiple fallers (two or more falls in the past year), occasional fallers (one fall in the past year), or non-fallers. Twenty-nine percent of older people who lived at home reported falling once or more in the previous 12 months. Nearly 20% of older people fell once in the previous 12 months and just under 10% fell more than once. Occasional fallers were more likely to be women (OR 1.75, 95% CI 1.26 to 2.45), to have reported back pain (OR 1.54, 95% CI 1.10 to 2.16) and were nearly twice as likely to have more than three medical conditions compared to non-fallers (OR 1.88, 95% CI 1.22 to 2.90). Multiple fallers were also more likely to be women (OR 1.61, 95% CI 1.03 to 2.51). More multiple fallers (17%) than occasional fallers (9%) reported being very afraid of falling. Intervention strategies should take into account these differing predisposing factors for multiple and occasional falls. **[Morris M, Osborne D, Hill K, Kendig H, Lundgren-Lindqust B, Browning C and Reid J (2004): Predisposing factors for occasional and multiple falls in older Australians who live at home. *Australian Journal of Physiotherapy* 50: 153–159]**

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Introduction

Falls are common amongst older people and affect more than 30% of those over the age of 65 years (Alexander et al 1992; Campbell et al 1989; Tinetti et al 1988). In community-dwelling residents older than 80 years the falls rate can be as high as 50% per year (Campbell et al 1981) and even more for older people who live in institutions (Tinetti 1987). The public health cost of falls has been estimated at more than $20 billion per year in the United States (US) (Englander et al 1996). The direct cost to the Australian health care system for falls at ages 65 and over has been estimated at $498 million per year (Moller 2003). Although there are many international studies on the predictors of falls, few have reported data on large Australian samples.

Falls impact heavily on the health, well-being and quality of life of individuals and their families. They are the main cause of accidental death amongst older people and account for 55% of deaths by injury in people over the age of 75 years (Alexander et al 1992). Approximately one-quarter of all falls result in serious injuries such as fractures or lacerations (Alexander et al 1992) and 10% require hospitalisation (Gabell et al 1985). In addition, American and British studies have shown that many older people who are admitted to hospital following a fall never regain their pre-morbid functional state (Rubenstein et al 1983).

There are many reasons why older people are at a high risk of falling. Age-related changes in the musculoskeletal (Vandervoort 2002) and neurological systems increase the risk of losing balance and falling (Lord et al 2001). Ageing is also associated with changes in visual, proprioceptive, and vestibular systems that slow down the person's ability to detect and respond appropriately to safety hazards (Lord et al 2001). With advancing age medical conditions such as stroke, Parkinson's disease, Alzheimer's disease, glaucoma and osteoarthritis become more common, further increasing the risk of falls (Tinetti et al 1988). In addition environmental hazards, such as cluttered walkways, dim night lighting, loose mats, and uneven pavements contribute to falls in older people (Sattin et al 1998). Fear of falling may also lead to a decrease in physical activity, reduced muscle strength, and a reduction in joint range of movement and physical endurance, thereby further increasing the risk (Tinetti et al 1994b). The majority of these findings are derived from investigations on volunteer samples rather than from large scale random samples.

Because falls are costly to individuals and society, there is a need to better understand their causes and why some people are predisposed to multiple falling episodes. This is particularly the case for people living at home, who represent the greater proportion of older people. Surveys conducted in the US, Canada, United Kingdom and New Zealand show that falls rates and injuries increase with advancing age (Campbell et al 1989, O'Loughlin et al 1993, Prudham and Evans 1981, Tinetti et al 1988). They also show that falls rates are higher in women than men. Two Australian studies have identified increased falls rates with increasing age (Dolinis et al 1997, Lord et al 1993), and an increased rate of injurious falls with age in a sample of community-dwelling older

women (Lord et al 1993). Each of these investigated falls, injurious falls, or both as the outcome variable and focused on the intrinsic factors associated with falls. None of the studies cited above has attempted to identify the factors that discriminate multiple fallers from occasional or non-fallers in Australian community-dwelling samples.

This paper presents the results of a survey on the frequency and predictors of falls in a random sample of 1000 community-dwelling Australian men and women. The major risk factors for falls that were examined included age, gender, lifestyle factors, health and medical conditions, prescribed medication, pain, mobility, and function. The main purpose was to document the views of older people on reasons why older people fall, and to profile the characteristics of fallers by 1) documenting co-existing medical conditions reported by fallers, 2) comparing multiple fallers with occasional fallers, and 3) examining the predictors of multiple and occasional falls using non-fallers as a reference. It was considered important to discriminate occasional from multiple fallers, given the distinction between the community profile of all fallers, who are mainly women with the majority having fallen just once in the previous year, and the profile of those at high recurrent falls risk, such as those presenting to emergency departments after a fall (Bell et al 2000).

Method

Subjects Participants were drawn from the Health Status of Older People survey of 1000 Australian people aged 65 and older living in the community (Kendig et al 1996). This was part of the baseline survey for the Melbourne Longitudinal Studies on Healthy Ageing Program. The Lincoln Gerontology Centre together with the Australian Bureau of Statistics (ABS) obtained a representative sample of people from the Australian electoral rolls. There is a legal requirement for all citizens (over 18 years) to be registered on the electoral rolls in Australia and it is estimated that 95% of Australians over 80 years old are on electoral rolls. The eligible population comprised residents of private dwellings in metropolitan Melbourne thus excluding people who lived in non-private accommodation such as nursing homes, hostels, or hospitals. Individuals were also excluded if they did not speak basic English, were cognitively impaired, severely ill, or deaf. The response rate was 70% of the eligible population. The mean age of participants was 73.4 years (range 65–94 years, median 72 years). Participants comprised 533 women and 467 men.

Field procedures and apparatus Face-to-face interviews were conducted by trained interviewers in each participant's home between May and December in 1994. On average the interviews were 90 minutes in duration and involved administration of the Health Status of Older People (HSOP) questionnaire (Kendig et al 1996). The questionnaire included items on health status, disability, impairments, well-being, and social conditions in older people including mobility, falls and injuries, cardiovascular health, pain, continence, medication use, and a broad range of other psychosocial issues. This report focuses on the following outcome measures from the questionnaire:

- falls in the last 12 months (number)
- whether any falls required medical attention (yes/no).

The independent variables that were examined to establish predictors of falls included:

Table 1. Perceptions of older people on why they fall.*

Self-perceived causes of falls	N	% of responses
Loss of balance	288	17.2
Not paying attention	173	10.4
Poor eyesight or use of bifocals	148	8.9
Dizziness	138	8.3
Hazardous environment	113	6.8
Weakness	100	6.0
Trips/Stumbles	98	5.9
Slower reflexes	73	4.4
Legs giving way	56	3.4
Fractures	55	3.3
General poor health	49	2.9
Other specific conditions	44	2.6
Blood pressure	41	2.5
Ageing	34	2.0
Psychological/disorientation	33	2.0
Blackouts	26	1.6
Incorrect footwear	13	0.8
Inactivity	13	0.8
Foot and leg problems	12	0.7
Overweight	4	0.2
Poor diet	2	0.1
Other	26	1.6
Don't know	132	7.9
Total	1671	100.0

*Respondents could give up to three responses.

Frequency of physical activity Based on the method used in the Australian Risk Factor Prevalence Study (Risk Factor Prevalence Management Committee 1990), respondents were asked to list up to three types of energetic or moderate physical activity engaged in over the previous two weeks. Frequencies ranged from 'not done' to 'more than once a day', with 7 levels of response. Scores were derived by summing energetic and moderate activity sub-scales. Scores were converted into an ordinal scale by dividing into tertiles.

Health and medical conditions Medical conditions and risk factors were modified from the method used in the Established Populations for Epidemiologic Studies of the Elderly (Cornoni-Huntley et al 1993). Respondents were shown a list of medical conditions and asked to indicate which conditions they had at the time. The list included high cholesterol; diabetes; intestinal problems such as ulcer or hernia; problems with feet or legs; cataracts; kidney or bladder problems; prostate trouble; eczema, dermatitis or psoriasis; skin cancer; other cancers; arthritis; bronchitis, emphysema or asthma; any other condition specified by respondents. Aspects of cardiovascular health including risk factors (high blood pressure), osteoporosis, and emotional or psychiatric problems were measured using the Health and Retirement Survey format. Respondents were asked, 'Has a doctor ever told you that you had [*name of condition*]?' Each risk factor was rated as *yes* or *no*. The sample was divided according to whether they reported 'one or none', 'two or

Table 2. Number of falls by age group and gender.

| No. of falls | Age 65–79 years | | Age 80–94 years | | All |
	Men	Women	Men	Women	N (%)
0	313 (79%)	273 (66%)	44 (68%)	72 (66%)	702 (71%)
1	59 (15%)	95 (23%)	10 (16%)	23 (21%)	187 (19%)
2 or more	26 (6%)	45 (11%)	10 (16%)	14 (13%)	95 (10%)
Total	398 (100%)	413 (100%)	64 (100%)	109 (100%)	984 (100%)

Table 3. Falls status by location of the most serious fall.

No. of falls	Inside home	Outside home	Away from home
One	45 (24.5%)	45 (24.5%)	94 (51.0%)
Two or more	25 (27.2%)	35 (38.0%)	32 (34.8%)
Total	70 (25.4%)	80 (29.0%)	126 (45.6%)

three', or 'more than three' medical conditions or risk factors.

Frequency of pain was measured on a 5-point scale ranging from never to every day, subsequently collapsed into three categories 'never' 'sometimes', and 'frequent'. Respondents were asked if they had felt pain that was persistent, bothersome, or had limited their activities in the last 12 months, and about the presence of back pain (Yes/No response).

Medication use was measured by recording the number of prescribed medications taken by respondents in the last two weeks.

Mobility was assessed as the self-rated degree of difficulty walking one kilometre on a flat surface. This was measured on a 5-point scale ranging from 'no difficulty' to 'cannot do it at all'.

Functional ability was assessed as the self-rated need for assistance with instrumental activities of daily living (IADL) measured using the Multi-level Assessment Instrument developed by the Philadelphia Geriatric Centre (Lawton et al 1982). The items included gardening, home maintenance, shopping for groceries, preparing own meals, and getting to places within walking distance. A dichotomous variable was derived — 'independence in IADL' versus 'dependence in IADL'.

Visual impairment refers to self-reported eyesight measured on a 4-point scale ranging from excellent to poor, subsequently dichotomized into 'excellent or good' and 'fair or poor'.

Fear of falling was measured by asking respondents to rate their fear of falling on a 4-point scale 'not at all, somewhat afraid, fairly afraid, very afraid'.

In interpreting the results, it is important to keep in mind that the sample reported falls retrospectively. Therefore some under-reporting would be expected and the findings would not include people who had experienced serious falls resulting in deaths or ongoing residence in hospital or residential care settings.

Statistical analysis Chi-square analyses tested direct relationships between independent variables, and the circumstances and consequences of falls. Predictors of multiple and occasional falls were investigated in logistic regression using non-fallers as a reference and adjusting for age and gender. The independent variables tested were: physical activity, health and medical conditions, mobility, visual impairment, and functional ability. To avoid zeros in cells in the logistic regression analyses, some variables were collapsed into fewer categories. The cut off points were chosen to maintain conceptually meaningful differences between categories. The strengths of the associations obtained from the logistic regression analyses were quantified by odds ratios and 95% confidence intervals. Finally a refined set of factors associated with multiple fallers and occasional fallers was obtained by backward stepwise logistic regression.

Results

Self-perceived causes of falls For the entire sample, perceptions of the causes of falls in older people included factors such as hazardous environment, trips, stumbles, loss of balance, weakness, dizziness, legs giving way, blackouts, and inattention. Participants reported up to three responses and these were combined in a multi-response frequency table (Table 1). Table 1 shows that loss of balance was by far the reason cited most frequently for falling, followed by not paying attention, poor eyesight/use of bifocals, and dizziness. A hazardous environment was reported less often as a perceived cause, with only 7% of responses attributing cause to environmental factors.

Profile of fallers In this study 71% of the sample reported having no falls in the year before interview and 282 participants (29%) reported falling once or more in the previous 12 months. One hundred and eighty-seven people reported one fall (occasional fallers), and 95 people reported two or more falls (multiple fallers). Data on the number of falls were missing for 16 subjects. Table 2 summarises the number of falls by age group and gender. It shows that most falls occurred in women, for both age groups.

Table 4. Falls status by fear of falling.

No. of falls	Not at all afraid	Somewhat/Fairly afraid	Very afraid
One	120 (64.5%)	49 (26.3%)	17 (9.2%)
Two or more	51 (53.7%)	28 (29.5%)	16 (16.8%)

Table 5. Falls status by severity of fall.

Number of Falls	Medical treatment for injuries	No medical treatment
One	64 (34.4%)	122 (65.6%)
Two or more	30 (31.6%)	65 (68.4%)

Comparison of occasional and multiple fallers for circumstances and consequences of falls

Location of falls Participants were asked to report whether they were inside the home, outside, or away from the home when they had their most serious fall. Around two-thirds of the most serious falls experienced by recurrent fallers occurred at home and more of these falls occurred outdoors than inside the home (Table 3). Occasional fallers were more likely to report their most serious fall occuring away from home (51%) and had identical rates for inside the home and outside (25%) (Table 3). For the entire sample, the majority of the most serious falls occurred away from home (46%) rather than outside the home (29%) or inside the home (25%).

Fear of falling Multiple fallers were more likely to express greater fear of falling than were occasional fallers ($p = 0.035$, Mantel-Haenszel linear trend test) (Table 4). More multiple fallers (17%) than occasional fallers (9%) reported being very afraid of falling and multiple fallers were less likely than occasional fallers to report that they were not afraid at all. Multiple fallers were more likely to cut down their activities because of fear of falling but this trend failed to reach significance.

Severity of falls There was no difference in the severity of falls between occasional and multiple fallers ($\chi^2 = 0.23$, $p = 0.63$) (Table 5). Approximately one-third of all falls required medical treatment for injuries. Thirty-four percent of occasional fallers and 32% of multiple fallers required medical treatment for their injuries. This is important as it indicates that each fall comes at a substantial risk of injury.

Predictors of occasional and multiple falls

Relationship between falls, gender and other intrinsic risks Table 6 shows women were more than twice as likely as men to fall occasionally. Women were also likely to have multiple falls. For occasional fallers physical activity, medication use, pain, self-reported eyesight, walking difficulty, use of an aid, and functional dependency did not have a significant effect on the likelihood of falling. People with back pain and people with more than three medical conditions were more likely to fall occasionally (Table 6). Multiple medical conditions and back pain remained as predictors after backward stepwise regression, although back pain was of borderline significance. Table 6 also shows that for multiple fallers intrinsic risk factors played a more prominent role. Backward stepwise logistic regression revealed that age, back pain, count of medical conditions, self-reported eyesight, and mobility

problems remained as independent predictors for multiple falls. Multiple fallers were more likely to be older and have multiple medical conditions and to report some difficulty walking. They were twice as likely to have poor self-rated eyesight and three times as likely to report back pain as non-fallers. Interestingly, once these factors were included in the multivariate analyses, gender was no longer significant in predicting multiple falls. That is, women were no more likely than men to experience multiple falls after controlling for age, eyesight, mobility, back pain, and count of medical conditions.

Discussion

The results showed that 29% of older Australians who live at home fall one or more times over a 12 month period. This is in close agreement with US findings reported by Tinetti et al (1988), Canadian results reported by O'Loughlin et al (1993) and New Zealand results reported by Campbell et al (1989), as well as with other Australian studies (Dolinis et al 1997). These similar results across a number of countries have been derived from both retrospective falls recall, as in our study and those by Dolinis et al (1997) and Lord et al (1993), as well as prospective designs incorporating self-completion diaries and follow-up phone calls (Campbell et al 1989, Tinetti et al 1988). They indicate that the magnitude of the problem of falls remains high in many Western countries.

Nineteen percent of people in this sample were occasional fallers, and 10% were multiple fallers. Occasional fallers and multiple fallers appeared to represent two distinctive groups. Occasional fallers were more likely to be women who frequently had multiple medical conditions and often had a past history of back pain. They attributed the main cause of falls amongst older people to be intrinsic (person centered) factors, although some reported extrinsic factors, such as a hazardous environment, as their reason for falling. For the occasional fallers, the main intrinsic risk factors were perceived to be loss of balance, not paying attention, and dizziness.

Multiple fallers were predominantly older women and only 10% of multiple fallers reported extrinsic factors as the reason for falling. As well as advanced age, loss of balance, not paying attention, and dizziness, they also reported poor eyesight and mobility problems as contributory factors. Multiple fallers were much more likely to fall at home outdoors than were occasional fallers. Outdoor settings

Table 6. Intrinsic risk factors as predictors of falls status.

	One fall			Two or more falls		
	Odds ratio	95% CI	p	Odds ratio	95% CI	p
Gender						
Men	1.00			1.00		
Women	1.75	1.26 to 2.45	0.001	1.61	1.03 to 2.51	0.04
Physical activity						
No vigorous exercise	1.00			1.00		
Vigorous exercise	0.99	0.71 to 1.40	0.98	1.3	0.83 to 2.04	0.25
Analgesic/psychotropic medication						
No medications	1.00			1.00		
1 medication	0.72	0.47 to 1.08	0.11	2.18	1.33 to 3.58	0.002
2+	1.22	0.77 to 1.94	0.39	2.40	1.31 to 4.38	0.004
No. of prescribed medications						
None	1.00			1.00		
1–4	1.21	0.83 to 1.76	0.33	1.24	0.74 to 2.09	0.42
5+	1.49	0.88 to 2.53	0.14	2.11	1.09 to 4.08	0.03
Frequency of pain						
Never	1.00			1.00		
Sometimes	1.52	0.98 to 2.35	0.06	2.52	1.41 to 4.51	0.002
Frequent	1.19	0.80 to 1.77	0.40	2.86	1.74 to 4.71	< 0.001
Back pain						
No	1.00			1.00		
Yes	1.54	1.10 to 2.16	0.01	3.90	2.49 to 6.16	< 0.001
Number of medical conditions						
0–1	1.00			1.00		
2–3	1.33	0.86 to 2.05	0.20	1.47	0.74 to 2.94	0.28
3+	1.88	1.22 to 2.90	0.004	3.86	2.04 to 7.31	< 0.001
Self-reported eyesight						
Good/excellent	1.00			1.00		
Fair/poor	1.14	0.79 to 1.67	0.47	2.61	1.67 to 4.07	< 0.001
Difficulty walking						
Not difficult	1.00			1.00		
Somewhat difficult	1.45	0.93 to 2.27	0.10	2.95	1.74 to 5.00	< 0.001
Very difficult/can't	0.70	0.35 to 1.37	0.30	2.35	1.23 to 4.48	0.009
Use of assistive device for walking						
Not used	1.00			1.00		
Used	0.62	0.37 to 1.05	0.08	0.43	0.23 to 0.79	0.007
IADL dependency						
Independent	1.00			1.00		
Not independent	1.41	0.93 to 2.16	0.10	1.94	1.16 to 3.25	0.01

IADL = instrumental activities of daily living

provide a challenging environment to negotiate, with uneven terrain, different support surfaces, obstacles on the ground and at hip and head height, and unexpected perturbations to the balance system. For people with eyesight, balance, and mobility problems, it is not surprising that environments such as this are hazardous.

For the sample as a whole, the proportion of falls due to environmental factors was low, compared to other studies that have classified up to 55% of falls as being due to extrinsic factors (Lach et al 1991, Nyberg et al 1996). This difference is likely to be related to different methodologies. Subjects in our study were able to list up to three factors that they

considered a cause of falls in older people, instead of just one. This allowed the option of ascribing both intrinsic and extrinsic factors, which have been shown elsewhere often to interact in contributing to falls (Weinberg & Strain 1995). In addition, our analysis included occasional and multiple fallers as well as non-fallers and documented the perceived cause of falls; others have surveyed only fallers on the circumstances of their fall (Lach et al 1991). Perceptions of falls-related risk factors have been shown to differ substantially between what older individuals perceive as their own risk and what they perceive as risk factors for other older people (Braun 1998).

When designing programs to reduce the population

distribution of risk factors for falls it may help to take into account significant independent correlates of falls, such as female gender, age, back pain, poor vision, some difficulty walking, and the presence of concurrent medical conditions. The significant correlates may underlie key intrinsic risk factors identified by older people themselves, such as poor balance, muscle weakness, and dizziness. Intervention strategies need to consider intrinsic factors in addition to external risks (e.g. environmental hazards and ill-fitting shoes.) The intrinsic risks are particularly important to consider in multiple fallers, as they are both common and a major predictor of falling in this group. The needs of occasional fallers should not be under-estimated because each fall carries a similar risk of injury requiring medical treatment.

Some falls prevention programs target muscle strengthening, balance training, and physical fitness programs as a method of preventing future falls (Campbell et al 1997, Day et al 2002, Lord et al 1995). Others place emphasis on improving the safety of the home environment as well as teaching people how to avoid trips and slips (Cumming et al 1999, McMurdo and Johnstone 1995). In addition, multifactorial falls prevention programs such as advocated by Tinetti et al (1994a) and Hornbrook et al (1994) have been shown to have broad success. Close et al (1999) have also shown that when clinicians have access to individual assessment findings and a falls history, they are able to target effectively intrinsic and extrinsic factors found to be of particular risk. Thus, a range of options now exist that have been shown to reduce falls in older people, both as general strategies, or targeted to those identified as at high risk of falling.

Conclusion

Almost one-third of community-dwelling older Australians from a representative survey reported falling in the previous 12 months. Approximately one-third of the fallers were multiple fallers. These were mainly older women, typically with a number of medical conditions, perceived difficulty walking, poor self-rated eyesight, and back pain. Whilst environmental factors are undoubtedly important, preventive programs need particularly to target the management of intrinsic factors that emerge as risks, to some extent for occasional fallers and more strongly for multiple fallers.

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