

Circumstances and consequences of falls in independent community-dwelling older adults

WILLIAM P. BERG, HELAINE M. ALESSIO, EUGENIA M. MILLS¹, CHEN TONG²

Department of Physical Education, Health and Sport Studies, Miami University, 109 Phillips Hall, Oxford, OH 45056, USA

¹Department of Nursing, Miami University, Oxford, OH, USA

²Scripps Gerontology Center, Miami University, Oxford, OH, USA

Address correspondence to W. P. Berg. Fax: (+1) 513 529 5006. Email: bergwp@muohio.edu

Abstract

Background: knowledge of the circumstances and consequences of falls in older adults is important for understanding the aetiology of falls as well as for effective clinical assessment and design of fall prevention strategies. Such data, however, are relatively scarce, especially in community-dwelling elders.

Method: accidental falls (including their circumstances and consequences) occurring in 96 male and female participants between 60 and 88 years of age were monitored prospectively for 1 year. After the monitoring period, participants were divided into three groups based on fall status: non-fallers ($n = 46$), one-time fallers ($n = 27$) and recurrent fallers ($n = 23$). Frequency distributions were created for selected circumstances and consequences of falls and the prevalence of these consequences were examined.

Results: 50 participants (52%) fell during the 1 year period, amassing 91 falls. Trips and slips were the most prevalent causes of falls, accounting for 59% of falls. Falls most often occurred during the afternoon and while subjects walked on level or uneven surfaces. Fallers most commonly attributed falls to hurrying too much. Fractures resulted from five of the 91 falls and eight other falls resulted in soft tissue injuries that required treatment by a physician. There were no differences between one-time and recurrent fallers in the circumstances and consequences of falls. However, several notable differences were found between men ($n = 20$) and women ($n = 30$) who fell. Falls by men most often resulted from slips whereas falls by women most often resulted from trips. Moreover, women and men differed in the time of the year in which falls occurred, with men falling most often during winter and women during summer.

Conclusions: the results of this study provide insight into the circumstances and consequences of falls among independent community-dwelling older adults and suggest some possible ways of preventing falls. Preventive services, however, should not solely target recurrent fallers, nor should the type of services necessarily differ for one-time and recurrent fallers.

Keywords: *community, falls, old age*

Introduction

Falls are a threat to the health and well-being of older adults. Unintentional injury, which most often results from falls, is the sixth leading cause of death in people age 65 and older [1]. Other consequences of falls include non-fatal injury [2–3], fear [4] and loss of function and independence [5]. Although the identification of underlying risk factors for falls has received considerable attention, relatively little research has addressed what fallers are actually doing at the time of a fall, especially among older adults living independently

in the community. This information is crucial for understanding the aetiology of falls as well as for effective clinical assessment and design of preventive strategies.

Data about how the circumstances of falls differ for recurrent fallers (people who fall two or more times in a given year) and one-time fallers (people who fall once in a given year) are particularly scarce. This is important because it has been recommended that recurrent fallers be targeted for diagnostic and preventive efforts [6–7]. Although some reports have suggested that recurrent fallers are more likely to suffer

fall-related injuries than one-time fallers [7] and that recurrent fallers may be more likely to have underlying neurological and musculo-skeletal problems which predispose them to falling [3], the evidence upon which the prevailing distinction between one-time fallers and recurrent fallers is based is lacking. Exclusive targeting of recurrent fallers for diagnostic and preventive efforts could be problematic if it results in the inappropriate exclusion of individuals who fall less frequently.

The purpose of this study was to investigate the circumstances and consequences of falls in community-dwelling older adults and to compare recurrent and one-time fallers as well as men and women.

Materials and methods

Ninety-six male and female volunteers between the ages of 60 and 88 years participated in this study. Participants were residents of Oxford, OH, USA (population 9000) and the surrounding area and were recruited by posting announcements at various locations in the community, advertising in local newspapers and contacting former faculty and staff of Miami

University by letter. To qualify for participation, volunteers had to be at least 60 years of age, live independently in the community and be able to walk unaided. The mean age of participants was 71.9 years ($SD = 6.6$). All participants who began the study completed the study. Characteristics of the participants are presented in Tables 1 and 2.

Participants visited our laboratory and performed tests and completed questionnaires addressing health status, vision, physical activity and performance and fall history. The extent to which these factors distinguished recurrent fallers from non-fallers is described in a previous report [8]. Accidental falls experienced by participants were monitored prospectively for a period of 1 year. A fall was defined as 'losing your balance such that your hands, arms, knees, buttocks or body touch or hit the ground or floor'. Individuals completed and returned a report card every 2 weeks, whether or not a fall had occurred. Those who failed to return report cards on the designated date were contacted by telephone and reminded to do so. The report card return rate was 100%. When a fall occurred, participants recorded the date and time of the fall on the card. Individuals who reported falls were contacted via telephone to verify the report. Information about the circumstances and consequences of each fall was then collected via a questionnaire promptly mailed to the participant. The questionnaire was adapted from a fall survey developed by the Center for Health Research (Kaiser Permanente-Northwest Region, Portland, OR, USA). Participants were asked to describe the fall itself as well as, for example, where and when the fall occurred, the activities that preceded the fall, physical sensations immediately prior to the fall, reasons the fall occurred, any resulting injury, thoughts about whether the fall could have been prevented, etc.

Table 1. Participant characteristics: age, height and weight

	Mean value (\pm SD)	
	Women ($n = 58$)	Men ($n = 38$)
Age (years) ^a	71.5 \pm 6.9	72.5 \pm 6.1
Height (cm)	162.0 \pm 6.8	175.6 \pm 6.2
Weight (kg)	65.7 \pm 12.0	80.5 \pm 12.8

^aCollected via self-report.

Table 2. Participant characteristics: health and experience of falling

	n (%)	
	Women ($n = 58$)	Men ($n = 38$)
Recalled falling at least once in past year	29 (50%)	21 (55%)
Smoker	3 (5%)	5 (13%)
Taking prescription medication	43 (74%)	23 (61%)
Present/recent health problems		
Hypertension	11 (19%)	6 (16%)
Chest pain	3 (5%)	2 (5%)
Palpitations	5 (9%)	2 (2%)
Balance problems	9 (16%)	3 (8%)
Back pain	20 (34%)	10 (26%)
Swollen, stiff or painful joints	21 (36%)	8 (21%)
Diabetes mellitus	2 (3%)	3 (8%)
Discomfort, shortness of breath or pain with moderate exercise	21 (36%)	7 (18%)

All information was collected via self-report.

Circumstances and consequences of falls

Following the monitoring period, participants were divided into three groups based on fall status: non-fallers ($n = 46$), one-time fallers ($n = 27$) and recurrent fallers ($n = 23$). Frequency distributions were created for selected circumstances and consequences of falls and the prevalence of these were examined. Where sample sizes were sufficient (i.e. at least five observations per cell) contrasts were drawn between one-time fallers and recurrent fallers, as well as male ($n = 20$) and female ($n = 30$) fallers, using a χ^2 test. The 0.05 level was chosen to indicate statistical significance.

Results

Falls

Fifty of the 96 participants (52%) fell during the 1 year monitoring period, amassing a total of 91 falls. Recurrent fallers recorded an average of 2.8 falls per person. The mean ages of fallers and non-fallers were 71.7 years ($SD = 6.4$) and 72.2 years ($SD = 6.9$), respectively, $F(1, 94) = 0.132$, $P > 0.05$. The rate at which men (53%) and women (52%) fell was virtually identical, $\chi^2(1, n = 96) = 0.008$, $P > 0.05$. Younger and older participants were also equally likely to fall. Fall rates for individuals in their sixth ($n = 38$), seventh ($n = 46$) and eighth ($n = 12$) decades of life were 55, 48 and 58%, respectively, $\chi^2(2, n = 96) = 0.676$, $P > 0.05$.

Circumstances of falls

The causes of falls were determined from participants' descriptions of their falls. A summary of the findings is presented in Figure 1. Trips and slips were by far the most prevalent causes, accounting for 59% of falls. Misplaced steps (e.g. stepping into a hole) and loss of balance were the 3rd and 4th most common causes of falls. Findings regarding the location of falls are presented in Figure 2. Falls were more likely to occur at home than away from home (58 and 42%, respectively). Falls at home more often occurred outdoors than indoors. In addition, 63% of falls

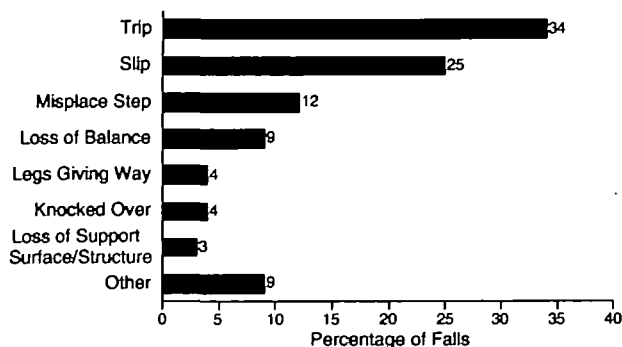


Figure 1. The causes of falls.

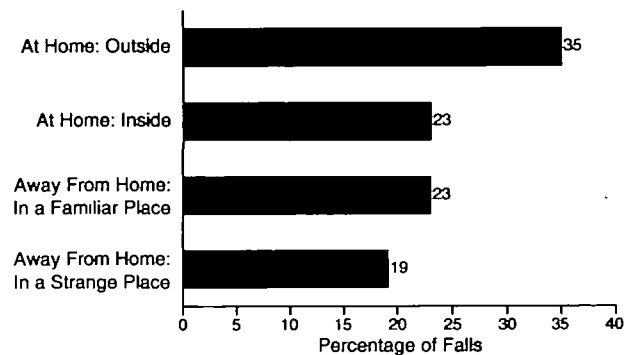


Figure 2. The location of falls.

happened while participants were alone. As illustrated in Figure 3, most falls (52%) occurred in the afternoon, followed by morning, evening and night (30, 14 and 4%), respectively. The largest proportion of falls (34%) took place during the winter months of December, January and February (see Figure 4). There was little difference in the frequency of falls across the other three seasons.

Fallers were requested to select all applicable choices from a list of 32 options to indicate the activities in which they were engaged at the time of a fall. A summary of the findings is presented in Figure 5. Walking on level ground or floor and walking on uneven, bumpy ground or floor tied for the highest ranked activity. Hurrying to get work done, working in the yard or garden and carrying something heavy or bulky completed the top five activities. Fallers were also requested to select all applicable choices from a list of 16 reasons why a fall had occurred. The most frequently cited reasons are summarized in Figure 6. Thirty-one percent of falls were attributed to hurrying too much and approximately 20% of falls were considered the result of not looking where one was going, slipping on a wet or slippery surface or tripping over something.

Several other circumstances of falls warrant reporting. In five (5%) of the 91 falls, fallers indicated that they had stood up or sat up quickly or rose from their

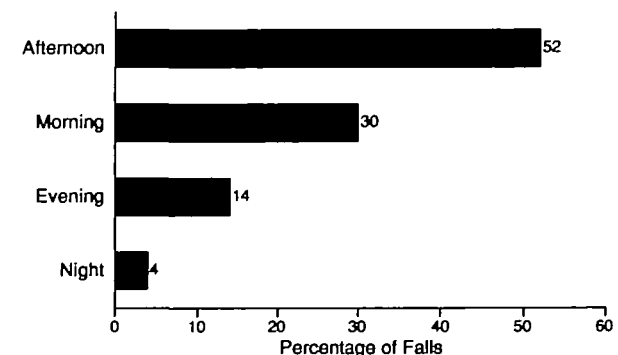


Figure 3. The time of day at which falls occurred.

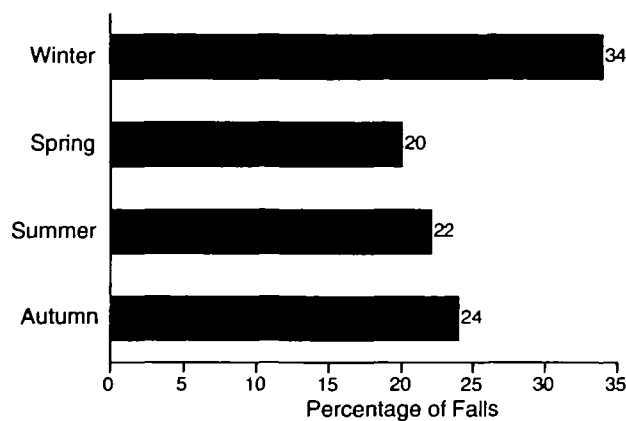


Figure 4. The time of the year during which falls occurred (winter = December, January and February; Spring = March, April and May; summer = June, July and August; autumn = September, October and November).

bed immediately before the fall. However, when fallers were asked whether their heart was beating fast or whether they felt light-headed just before a fall, not once was the answer affirmative. Thus, postural hypotension was probably not an important cause of falls among the participants in this study. Prior to three falls (3%), however, participants did report sudden attacks of numbness, tingling or loss of feeling in the feet or legs. At no time did fallers indicate that they experienced a sudden impairment of vision or hearing immediately before a fall.

Consequences of falls

Fractures resulted from five (5%) of the 91 falls: two of the hip and one each of the elbow, foot and ribs. All fractures occurred in women. Eight other falls (9%) resulted in soft tissue injuries (e.g. cuts, gashes or bruises) that required treatment by a physician. Those suffering fractures or soft tissue injuries as a result of

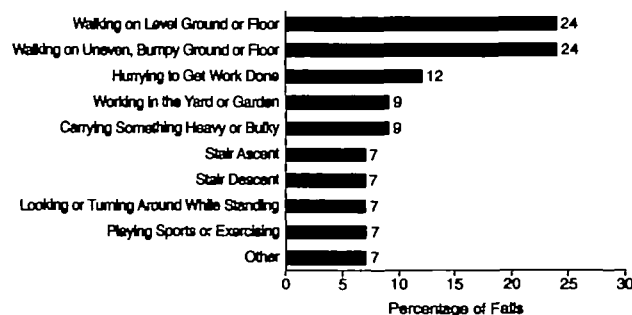


Figure 5. Activities in which fallers were engaged at the time of a fall. The total exceeds 100% because fallers were requested to select all applicable choices from a list of 32 options.

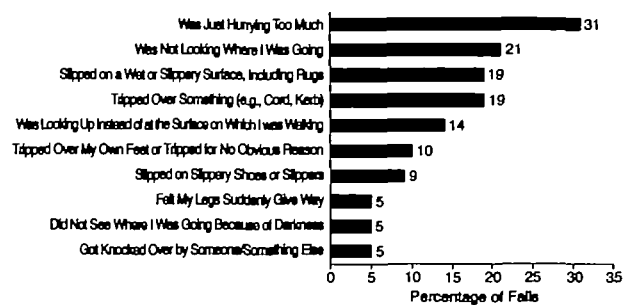


Figure 6. Fallers' reasons why falls occurred. The total exceeds 100% because fallers were requested to select all applicable choices from a list of 16 reasons.

falling were, on average, significantly older than fallers who were not injured: 76.3 years (SD = 6.4) and 69.8 years (SD = 5.8), respectively, $t(1, 49) = 3.36$, $P > 0.01$. Six of the eight fallers who suffered soft tissue injuries that required treatment by a physician were women. Thirty-one percent of falls resulted in pain that lasted 2 days or more and 21% of falls resulted in pain that lasted 5 days or more.

Seventy-seven (85%) of the 91 falls were deemed by the fallers to have been preventable. Fallers were also questioned about their beliefs concerning the potential recurrence of the specific type of falling episode experienced. Following 33 falls (36%), fallers indicated that they were likely to experience the same type of fall again. When asked about the likelihood of experiencing a fall of any kind again soon, in one-third of cases fallers felt they were less likely to fall again soon because of their fall. In a majority of cases (64%), however, fallers felt their fall would have no effect on the likelihood of falling again soon. Following 58 (64%) of the 91 falls, fallers suggested that, as a result of the fall, they intended to make changes in their behaviour or environment.

Comparisons between men and women and between one-time and recurrent fallers

Data analysis revealed no significant differences between one-time and recurrent fallers on the circumstances and consequences of falls. However, several differences between men and women were discovered. First, falls among men most often resulted from slips (38% of falls compared with 17% for women), whereas falls by women most often resulted from trips (39% compared with 27% for men), $\chi^2(1, n = 52) = 5.82$, $P < 0.05$. Second, women and men differed in the time of the year in which falls occurred. Falls among women were relatively equally distributed over the four seasons (winter 22%, spring 22%, summer 30%, autumn 26%). Conversely, men were far more likely to fall during winter (51% of falls) than spring (22%), summer (5%) or autumn (22%), $\chi^2(3, n = 91) = 12.15$, $P < 0.01$.

Two other differences between men and women approached statistical significance and warrant reporting. First, women and men differed in the location of falls. Women most often fell indoors at home (30% of falls) or outdoors at home (28%). In contrast, men fell outdoors at home (46% of falls) far more often than women and fell indoors at home (5%) far less often than women, $\chi^2(3, n = 91) = 5.28, P = 0.15$. Finally, men intended to make changes in their behaviour or environment as a result of the fall with greater frequency than women—73% of falls to 57%, respectively, $\chi^2(1, n = 89) = 2.19, P = 0.14$.

Discussion

Falls

There is a potential bias in using a volunteer sample, as it may not accurately represent the independent community-dwelling population at large. This must be considered when comparing the results of the present study with others that used representative samples. The fall rate of 52% recorded by this study exceeds the 30% typically reported for representative samples of community-dwelling older adults [9–10], yet it is closer to the 61% reported by Maki *et al.* [11] in a study of postural balance and risk of falling among 96 ambulatory and independent older adults who were volunteers. The distribution of non-fallers, one-time fallers and recurrent fallers in the present study was also similar to that in the study of Maki *et al.* ($n = 37$, $n = 36$ and $n = 23$, respectively). However, Maki and co-workers' sample was an average of 11 years older (mean = 83 years) and had a greater proportion of women (86% compared with 59% in the present study).

Several previous studies have reported higher fall rates for women than men [12–15], yet this was not the case in the present study, where the percentages of men and women who fell were virtually identical. However, there have been reports of rates similar to ours [4, 16]. The finding that younger and older people were equally likely to fall is contrary to many previous studies which have reported that the incidence of falls increases with age [1, 10, 13–14, 16–18]. The similar fall rates among younger and older participants in the present study could be the result of the characteristics of the sample. Robust people may have been more likely than frail to volunteer for participation in the study. If so, the fall rate for the participants may not precisely reflect that of the community-dwelling population at large. Many falls among healthy elderly people are chance events and those who are more active may be presented with even more occasions for falling [19]. Indeed, Speechley and Tinetti [20] found an increased rate of injurious falls among vigorous older adults.

Circumstances of falls

The observation that falls most often occurred while individuals were walking (on level or uneven surfaces) is consistent with previous reports [21], as was the fact that trips and slips caused most falls [2, 10, 16, 22]. Trips were the most prevalent cause of falls. Trips that occur during walking are often triggered when the recovery foot strikes an obstacle in its path during the swing phase of gait [23]. Hazardous obstacles are found both indoors and out and vary in height from a few millimetres, in the case of a crack in a pavement, to more than 15 cm for a kerb. Common obstacles include defects in flooring or pavement, carpet edges, electrical cords, door thresholds and exposed tree roots. Depending on a number of factors including illumination, distractions and attention, older people may or may not be aware of the presence of hazardous obstacles which could cause a trip [24–25].

There are at least two age-related changes which could be responsible for the prevalence of trip-induced falls among older adults. A change in walking gait experienced by many older adults is a reduction in the height of the recovery foot during the swing phase of gait [26]. Naturally, this could increase susceptibility to tripping, particularly on uneven surfaces [27]. Although a study by Gehlsen and Whaley [27] did not support the explanation that older adults fall because they do not lift their feet as high as non-fallers, the possibility that reduced recovery foot clearance could explain why older fallers trip more than younger fallers cannot be ruled out.

A second change which could be instrumental in causing trips among older adults occurs in the visual system. Age-related visual field constriction is well documented [28–34] and is known to accelerate in those over 55 years [35]. When full visual capacity is present, individuals engaged in forward walking usually spot obstacles and set a course around them, reflecting the calibration of locomotion against their visible surroundings. However, obstacles occluded from view by visual impairment such as constriction of the visual field could result in trips [8, 36].

According to Overstall [37], older adults tend to fall during the day, which is the time of maximum activity, and fall where they spend the most time [3]. Indeed, 81% of participants' falls took place in the morning or afternoon and 58% of falls occurred at home. Consistent with previous reports [16], very few falls occurred at night. There also appeared to be a seasonal variation in fall rate. In particular, a slightly disproportionate number of falls occurred during winter (December, January and February). It is thought that the winter climate (freezing temperatures, snow and ice, etc.) and its potential for making outdoor surfaces slippery or otherwise hazardous could account for the increased incidence of falls during winter. Data analysis revealed that 13 (42%) of the 31 falls that occurred

during December, January and February were, indeed, the direct result of slips induced by outdoor surfaces made slippery by weather conditions.

Several differences in the circumstances of falls for men and women were revealed. Men were twice as likely as women to fall as a result of a slip. This is believed to be related to the location of falls by men and women and the hazards which are unique to certain environments. Men most often fell outdoors at home, but were far less likely than women to fall indoors at home. Furthermore, over half of falls by men occurred during winter, whereas women fell most during summer (30% of falls). Assuming older men spend more time outdoors than older women, as Overstall has suggested [37], the capacity of the winter climate to make outdoor surfaces slippery could account for the marked difference in the rate of slip-induced falls by men and women. Ten (53%) of the 19 falls experienced by men during December, January and February resulted from slips on outdoor surfaces made slippery by winter weather conditions. However, just three (25%) of the 12 falls experienced by women during these months were similarly classified. It is also possible that fear of falling could help explain these observations. Fear of falling is more prevalent among older women and has been linked to the curtailment of daily activities. One recent study [38] found that 19% of community-dwelling older adults acknowledge that they avoid certain activities because of fear of falling. In short, women may be less likely than men to venture outdoors during winter, especially when support surfaces are hazardous.

Consequences of falls

The 5% fracture rate observed in this study is in agreement with the range of 3.5–6% reported by Overstall [37]. The 9% rate of soft tissue injury requiring medical attention is also consistent with previous reports [9, 37]. Even though relatively few fallers in the present study required medical attention for their injuries, nearly one-third of reported falls produced pain lasting 2 days or more and 21% of falls produced pain lasting 5 days or more. Clearly, falls can be disruptive to the lives of older adults living independently in the community, even when they do not result in injuries severe enough to require medical attention.

Each of the five fractures occurred in women aged 71 or older. Sattin *et al.* [14] reported fracture rates for women that were 2–3 times the rate for men and suggested that the known lower bone mineral density in older women may play a role in the occurrence of fall-related fractures in women. The results of this study are also consistent with previous findings that fall injuries become more frequent with increasing age [39]. Those suffering injuries as a result of falling were,

on average, 6.5 years older than fallers who were not injured.

Recurrent fallers may be more likely to suffer fall-related injuries than one-time fallers [7] and recurrent fallers may be more likely to have underlying neurological and musculo-skeletal problems which predispose them to falling [3]. As a result, it has been recommended that diagnostic and preventive efforts be targeted at recurrent fallers [6, 7]. In fact, Overstall [37] suggested that “it is better to classify those who have fallen only once during the year as non-fallers and those who have fallen twice or more as true fallers”. However, in the present study, there were no significant differences between one-time fallers and recurrent fallers in the circumstances and consequences of falls. Bearing in mind that there is a potential bias in using a volunteer sample, it still appears that the prevailing distinctions between recurrent fallers and one-time fallers deserve scrutiny, particularly if targeting recurrent fallers for diagnostic and preventive services results in the inappropriate exclusion of one-time fallers.

Conclusion

The results of this study provide insight into the circumstances and consequences of falls among independent community-dwelling older adults and suggest possible ways of preventing falls. Although this study used a volunteer sample, it is fair to recommend that community-dwelling older adults should thoroughly inspect the surroundings in which they spend most of their time for hazards (particularly those which could result in slips or trips) and minimize them whenever possible. Special attention should be directed at slipping hazards that can result from the accumulation of snow and ice on support surfaces during winter months.

Older people should be informed about the likelihood of reduced clearance height of the recovery foot during the swing phase of walking with ageing and how this could influence fall risk by making trips more likely. Preventive strategies for delaying the onset of reduced clearance height of the recovery foot or even increasing it should be explored. Interventions might include exercises to improve lower extremity strength and flexibility, especially hip and knee flexion and ankle dorsiflexion. Moreover, given the rapidity of the compensatory actions required to avoid a fall following a trip, such exercises might also assist in recovery from trip-induced instability.

Older people should also be informed about the likelihood of visual field shrinkage with ageing and how this could influence fall risk by rendering one less sensitive to salient features of the terrain, such as its capability for support or potential obstructions. As the visual field shrinks with age, compensatory head and

eye scanning movements are thought to develop spontaneously and these modifications are said to produce surprisingly good function until quite small fields exist [40]. Nonetheless, older adults could possibly benefit from encouragement to more frequently direct gaze downward toward support surfaces during locomotion to gain more detailed information about the terrain so that stability loss, especially that resulting from trips, slips and mis-steps might be avoided.

Finally, based on the results of this study, preventive services should not solely target recurrent fallers, nor should the type of services necessarily differ for one-time and recurrent fallers. It would also be advisable for older adults in general to adopt safer behaviours (e.g. strategies to avoid hurrying) as well as to attempt to improve their physical and sensory capabilities. Finally, because most falls recorded during this study were believed by the fallers to have been preventable, it would be helpful for fallers to complete a systematic post-fall evaluation to identify individualized preventive strategies that would reduce the likelihood of reoccurrence.

Key points

- Fifty-two percent of community-dwelling older adults fell during a 1 year monitoring period.
- Fractures resulted from five of the 91 falls and eight other falls resulted in soft tissue injuries that required treatment by a physician.
- Trips and slips were the most prevalent causes of falls among community-dwelling older adults.
- Falls by men most often resulted from slips whereas falls by women most often resulted from trips.
- The circumstances and consequences of falls for one-time and recurrent fallers did not differ.

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