Epidemiology of Falls Among the Elderly Community Dwellers in Singapore

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ABSTRACT

Aim: Falling is a serious medical problem for elderly persons. This study was done to look at prevalence and risk factors for falls in community dwelling elderly in Singapore.

Method: A random sample of 3,000 persons aged 60 years and above was chosen from a database based on the 1990 population census. Letters were sent out to 2,582 subjects who had local and complete addresses. In the letter, they were informed about the purpose of the survey, and invited to participate in a questionnaire and clinical health screening at an appointed date at a polyclinic. Participants were reminded the day before their appointment by telephone, and a new appointment could be given at the subject's convenience.

Results: We found a prevalence rate of falls of 17.2%. Two-thirds of these had single falls, while one-third had recurrent falls, defined as having more than one fall within the previous one year. The following factors were found to be significantly associated with increase falling in the elderly: age ≥ 75 years (O.R.=1.82, 95% C.I. 0.95-3.50), female sex (O.R.=2.5, 95% C.I. 1.40-4.48), Malay race (O.R.=2.66, 95% C.I. 1.21-5.86), poor vision (O.R.=1.7, 95% C.I. 0.99-2.90), Barthel's score of less than 20 (O.R.=1.76, 95% C.I. 0.94-3.28), those taking 2 or more drugs daily (O.R.=2.1, 95% C.I. 1.22-3.72) and the presence of hypertension (O.R.=1.78, 95% C.I. 1.06-3.01).

Fall rate is also twice as high in women as in men. At the same time, we found that women in the group we studied also tend to exercise less than the men. Fallers also had significantly more mobility and activities of daily living (ADL) disabilities (reflected by a lower Barthel's score) and this is consistent with other results. The only factor that reduced the risk of falling was regular exercise (O.R.=1.64, 95% C.I. 0.93-2.93).

Conclusion: In our study, we found differences between the group with single and recurrent falls. In the group with single falls, the fall tend to occur outdoors (O.R.=2.97, 95% C.I. 1.03-8.60) and during the day (O.R.=3.47, 95% C.I. 1.20-10.0), tend to be accidental (O.R.=3.16, 95% C.I. 1.05-9.50) and tend to seek medical attention (O.R.=3.68, 95% C.I. 1.23-11.0). Overall, 32 persons (46.4%) seek medical treatment after their falls, and of these, 65.6% were women. Risk factors for falls should be screened for all elderly.

Keywords: elderly, falls, recurrent falls, risk factors

INTRODUCTION

Falling is a serious medical problem for elderly persons. Some studies[1,2] reported up to 30% of community-dwelling individuals over the age of 65, fall each year. About 5% of falls in home dwelling older people result in serious soft tissue injury leading to medical treatment, and 5% to 6% had fractures[2]. There are also economic and social consequences resulting from fall injuries that require hospitalisation[3]. The average length of stay for those who have fallen is 43 days and 25 days for those who have not. About 47% of patients admitted to hospital for falling become long-term care patients[4]. The psychological damage following a fall can lead to loss of self-esteem, fear of falling and to self-protective immobility.

Objectives

There are no known data on falls among elderly people in Singapore. Therefore, the objectives of this study were to establish the prevalence and factors associated with falls among the elderly living in the community.

Study design

This was a cross-sectional random sample survey of elderly persons aged 60 and older who are living in the community in Singapore. A sample of 3,000 names was obtained from the database of the Ministry of Home Affairs, based on the 1990 population census. This database comprise unselectively of, among other data, names, addresses and age of all Singapore citizens.

A community-based polyclinic (Hougang Polyclinic) was chosen to be the base for this survey. Letters of invitation were sent to 2,582 subjects who had local and complete addresses. Purpose of the invitation was explained clearly and they were invited to participate in a questionnaire and clinical examination at an appointed date at the polyclinic. This was followed-up by a telephone reminder the day before the appointment. A new appointment could be given at the subject's convenience.

The questionnaire and health screening was conducted by a team of six geriatricians. Training was provided to standardise administration of the questionnaire and measurements during clinical examination. Components of the questionnaire included basic personal data, knowledge of own health and illness, exercise, function, mental and continence

Table I - Comparison of age, sex and race between group with falls (n=69) and group without falls (n=332)

Characteristics of surveyed group	Fallers		Non-fallers		Odds ratio of association	95% confidence interval
Age ≥75	15		44		1.82	0.95 - 3.50
Age <75	54		288			
	Mean	70.2 years	Mean	68.4		
	Range	60-89 years	Range	60 - 95		
Gender	Female	46 (67%)	Female	147 (44.6%)	2.50	1.40 - 4.48
	Male	23 (33%)	Male	184 (55.4%)		
Race	Chinese	57 (83%)	Chinese	276 (83%)	1.00	
	Malay	11 (16%)	Malay	20 (6%)	2.66	1.21 - 5.86
	Indian	1 (1.5%)	Indian	23 (6.9%)	0.21	0.03 - 1.59
	Others	0 (0%)	Others	12 (3.6%)		

status, history and pattern of falls (if present), living arrangement and medication usage. Components of the clinical examination included height and weight measurements, supine and standing blood pressures and examination of the feet.

Definitions

In this study, we surveyed persons who were 60 years or older. Regular exercise was defined as exercising at least 3 times a week, with each session lasting at least 20 minutes. Falls is defined according to the International Classification of Diseases (ICD-9) and excluded falls due to: (1) a violent blow; (2) loss of consciousness; (3) a sudden onset of paralysis, as in a stroke, and (4) an epileptic seizure. History of falls is defined as having at least one fall during the previous one year and recurrent falls implied falling more than once. Accidental falls is defined as falls due to an external hazard.

Measurements and assessment instruments

Blood pressure was measured with a conventional mercury sphygmomanometer. Standing blood pressure was measured 3 minutes after achieving the upright posture and with the right arm resting by the subject's side. The diastolic pressure was taken at Korsakoff fifth sound and pressures were read to the nearest 2 mmHg. Functional status of the person was assessed using the Barthel's score. Mental status of the person was assessed using a modified Abbreviated Mental Test (AMT). All measurements were made to the nearest one decimal place.

Statistical analysis

Data were collected in Microsoft Access format, and analysed with SPSS 6.1 for Windows. Odds ratios of association (O.R.) and their 95% confidence intervals (95% C.I.) were calculated using Mantel-Haenszel procedure.

Response rate

The survey was conducted over 16 months between September 1992 and December 1993. Of the 2,582 invitations sent out, 669 (25.9%) could not be reached because of wrong address (377 persons) or

had died (292 persons). One thousand, five hundred and twelve declined the invitation. A total of 401 patient-data were obtained from the survey at the polyclinic. This represented a response rate of 21%. There was no significant difference between responders and non-responders with regards to sex and ethnic group. This response rate could be affected by various reasons: 1) Those sampled, being elderly, are dependent on their children or caregivers to bring them; since this is just a survey, they may not be too keen to take leave for this purpose; 2) Some of those sampled may not be able to attend because of ill health or immobility; 3) As all screening was done at Hougang Polyclinic, those staying far away, for example, in the western part of Singapore, may not want to go, and 4) Problem of ageism, where the elderly or their caregivers may not see the value of health screening. This response rate was, however, compatible to the 1992 Singapore National Health Survey when compared by age group (our survey returned a 10.5% response rate compared with 7.8% in the 1992 survey for the 60-69 years age range.)

RESULTS

Demography

The age group ranged from 60 to 90 years old. Mean age was 68.8 years and median age was 66 years. There was a fairly equal distribution of sexes - 51.7% were male, 48.3% were female. The number of Chinese stood at 82.8%, followed by Malays (7.7%), Indians (6.2%) and Others (3.3%). These results were consistent with the estimated national figures in 1994.

Prevalence and epidemiology of falls

In this survey, 17.2% (69 elderly) had at least one fall during the previous one year.

Differences between fallers and non-fallers

The group with falls had a significantly higher mean age than the non-fallers (mean age of fallers and non-fallers was 70.2 years and 68.4 years respectively). They also had a significantly higher proportion of women (66.6% of fallers, O.R.=2.5, 95% C.I. 1.45-4.32).

Table II - Comparison of age, sex, race and pattern of falls between those with single (n=46) and recurrent (n=23) falls.

Characteristics of surveyed group	Single fall n=46	Recurrent falls (>1) n=23	Odds ratio	95% confidence interval
Age ≥ 75	10	10	0.36	0.11 - 1.21
	Mean 68.7 year	Mean 68.8 year		
	Range 61 - 89 year	Range 60 - 88 year		
Gender	Male 15	Male 8	0.91	0.31 - 2.61
	Female 31	Female 15		
Race	Chinese 36	Chinese 18	1.00	
	Malay 7	Malay 4	0.87	0.23 - 3.38
	Indian 3	Indian 0	1.50	0.15 - 15.5
	Others 0	Others 1		
Place:				
Outside house	26 (56.5%)	7 (30.4%)	2.97	1.03 - 8.60
Inside house	20 (43.5%)	16 (69.6%)		1.00
Time:				
Day	35 (76.1%)	11 (47.8%)	3.47	1.20 - 10.0
Night	11 (23.9%)	12 (52.2%)		1.00
Cause:				
Accidental	37 (80.4%)	13 (56.5%)	3.16	1.05 - 9.50
Non-accidental	9 (19.6%)	10 (43.5%)		1.00
Medical attention:				
Seek	26 (56.5%)	6 (26.1%)	3.68	1.23 -11.0
Did not seek	20 (43.5%)	17 (73.9%)		1.00

The data also suggested that Malays were more prone to falling than the other races (O.R.=2.66, 95% C.I. 1.21-5.86). A significant proportion of fallers had poor vision (63.8%, O.R.=1.7, 95% C.I. 0.99-2.90), impaired functional status where Barthel's score was <20 (24.6%, O.R.=1.76, 95% C.I. 0.94-3.28), hypertension (52.2%, O.R.=1.78, 95% C.I. 1.06-3.01) and were taking more than 2 types of medications daily (56.5%, O.R.=2.13, 95% C.I. 1.26-3.59). Non-fallers tend to exercise regularly (46.7%, O.R.=1.64, 95% C.I. 0.93-2.93). Table I summarises the characteristics between the group with and without falls.

Differences between single and recurrent fallers

Among the fallers, there were no significant differences in age, gender or race between single and recurrent fallers. Characteristics of these 2 groups are summarised in Table II. In the group with single falls, 56.5% of the falls occurred outside the house (O.R.=2.97, 95% C.I. 1.03-8.60). The falls also tend to happen during the day (76.1%, O.R.=3.47, 95% C.I. 1.20-10.0) rather than at night. Most of them attributed their fall to being 'accidental' (80.4%, O.R.=3.16, 95% C.I. 1.05-9.50) and most of them seeked medical attention after their fall (56.5%, O.R.=3.68, 95% C.I. 1.23-11.0). Recurrent falls tend to take place inside the house and in the night, tend to be non-accidental and most did not seek medical attention after their falls.

Factors associated with falls

Table III summarises the various factors and its association with falls. Regular exercise was the only factor detected that was associated with reduced falling. Only 36.9% of the exercise group were female and this sex difference was statistically significant (O.R.=2.29, 95% C.I. 1.50-3.50). In this group, 75.7% exercised daily, 14% did so regularly ie. at least 3 times per week, 8.5% at least once a week (but less than 3 times). The remaining 1.8% did so infrequently at less than once a week. Most of them exercised by taking walks (62%) or doing calisthenics and stretching exercises (19%) and *tai chi* (13.4%) a form of ancient Chinese martial arts. Poor vision, history of hypertension, a Barthel's score of less than 20 and taking more than 2 different types of drugs were significantly associated with falls.

Factors not associated with falls

We could not find any significant association between the following and falls:
1. Recent admission to hospital
2. Requiring regular follow-up
3. Musculo-skeletal problems including arthritis
4. Foot problems - whether they complaint of it or detected on physical examination
5. Postural hypotension
6. History of diabetes
7. History of stroke
8. Low mental test score
9. Living alone
10. Needs help in ADL
11. Needs to use stairs
12. Urinary incontinence

Table III - Characteristics of group with falls (n=69) vs group without falls (n=332)

Characteristics of surveyed group	Fallers (% of fallers) n=69	Non-fallers (I% of non-fallers) n=332	Odds ratio of association	95% confidence interval
Exercises regularly	24 (34.7)	155 (46.7)	0.61	0.35 - 1.05
Recent admission	15 (21.7)	57 (17.2)	1.34	0.71 - 2.54
Requires follow-up	45 (65.2)	183 (55.1)	1.53	0.89 - 2.62
Musculo-skeletal problems	35 (50.5)	141 (42.5)	1.39	0.83 - 2.34
Complaint of foot problems	6 (8.7)	29 (8.7)	0.99	0.40 - 2.50
Documented with foot problems	14 (20.3)	56 (16.9)	1.25	0.65 - 2.41
Poor vision	44 (63.8)	169 (50.9)	1.70	0.99 - 2.90
Hypertensive	36 (52.2)	126 (37.9)	1.78	1.06 - 3.01
Postural drop in BP	5 (7.2)	35 (10.5)	0.66	0.25 - 1.76
Diabetic	18 (26.1)	64 (19.3)	1.48	0.81 - 2.70
Stroke	4 (5.8)	16 (4.8)	1.22	0.39 - 3.75
AMT score <10	34 (49.3)	176 (53.0)	0.86	0.51 - 1.45
Stays alone	10 (14.5)	37 (11.1)	1.35	0.64 - 2.87
Needs help in ADL	2 (2.9)	16 (4.8)	0.59	0.13 - 2.62
Barthel's score <20	17 (24.6)	52 (15.7)	1.76	0.94 - 3.28
Needs to use stairs	54 (78.3)	234 (70.5)	1.51	0.81 - 2.80
Taking ≥ 2 types of drugs	39 (56.5)	126 (38)	2.13	1.26 - 3.59
	Mean 2.06	1.45		
	Range 1 - 8	1 - 8		
BMI ≥29	11 (15.9)	55 (16.6)	0.95	0.47 - 1.94
Has urinary incontinence	13 (18.8)	63 (18.9)	0.99	0.51 - 1.92

DISCUSSION

The prevalence of falls detected in this study was 17.2% for those aged 60 years and above. This rate is much lower than those reported in other studies[1,2] which estimated about 30% for those aged 65 years and above. This lower rate might be influenced by the response rate of only 21%. At the same time, because the study required them to go to a polyclinic for the screening, this by itself might have created a bias against the fallers.

Previous studies have examined risk factors for falls in community dwelling elderly. They included decreased vision, illnesses such as Parkinson's disease and arthritis, cognitive impairment[6], psychotropic drug use, muscle weakness, difficulty with one or more ADL and balance and gait abnormalities. Recent hospitalisation is also a risk factor - the acute illness that warranted a hospital stay, prolonged bed-rest, medication changes may adversely affect the cognitive status and psychomotor ability - all contribute towards increasing the risk of falling[7].

In our study, the following factors were found to be significantly associated with increased falling in the elderly:

1. more than 75 years old
2. female
3. Malay race
4. poor vision
5. history of hypertension
6. Barthel's score of less than 20
7. taking 2 or more medications daily.

The rate of fall increases with age of person[8,9]. This is due to age-related physiological changes that predisposes to falls - like slower reaction time, increased body sway and impairment of righting reflexes. Fall rate is also twice as high in women as in men[8]. This is because of an increased sway in elderly women than men. At the same time, we found that women in the group we studied also tend to exercise less than the men, and exercise is known to reduce the risk of falling. We could not explain why Malays were more prone to falling compared with other races. There were also no reports describing ethnic differences and falls. This could result from sampling bias and the small numbers involved. Fallers were also significantly more disabled in their mobility and ADL functions (reflected by a lower Barthel's score) and this is consistent with other results[2]. Those with known hypertension also tend to be associated with falls. The cause could be multifactorial, including its contribution to polypharmacy and postural hypotension. However, postural hypotension, detected by a drop of more than 20 mmHg in systolic pressure at that one point in time, was not significantly associated with falls (O.R.=0.66, 95% C.I. 0.25-1.76). This singular point of assessment may not be representative of the usual blood pressure changes of the person.

The only factor that reduced the risk of falling was regular exercises. Those who exercise regularly is 1.64 times less likely to fall compared to those who do not. A meta-analysis of seven trials of various kinds

of exercise in elderly men and women (including general fitness programmes, flexibility training, and *tai chi*) found a 10% to 17% reduction in falls[10,11]. However, within the group of fallers, regular exercise did not influence whether they had single or recurrent falls. When these risk factors were analysed for independence of association with falls, only gender, drug numbers and poor vision were significant.

Majority of falls occurred by day, indoors[12] and on straight, single flight of stairs when the person is descending. In our study, we found that 66.7% of all the falls occurred during the day and 69.5% occurred indoors in the group with recurrent falls. We could not show stair cases to be significantly associated with falls (O.R.=1.51, 95% C.I. 0.81-2.80). This was probably because although subjects claimed that they had stairs to climb, they did not actually use them or they might seek assistance when stairs climbing was needed.

Subjects with only a single fall were probably still physically active and independent, and because of their higher level of activity, the falls tend to occur outdoors, during the day and more likely to be accidental. Those with recurrent falls may be less active and therefore, spend more time within the house. Hence, most of their falls occurred indoors. They are probably the group with more medical problems and functional disabilities, and therefore, the cause of the falls were non-accidental. Thirty-two persons (46.4%) seek medical treatment after their falls, and of these, 65.6% were women. This is consistent with another study which reported that women were twice as likely as men to seek treatment after a fall[14].

The results of this study highlights methods in which we can reduce falls in the elderly:

1. Risk factors for falls should be screened in all elderly persons, especially when they are females and 75 years or older;
2. There should be regular screening for poor vision so that cataracts and glaucomas can be treated early;
3. Those with poor functional status should have more attention paid to environmental modifications and rehabilitation;
4. There should be a constant review of the elderly person's medication list to make sure that he is not taking more drugs than he needs;
5. Since most of the falls are indoors and accidental, it is important to ask about the home environment of the elderly person - like the use of grab bars in bathrooms, types of flooring, adequacy of lighting etc, and
6. Exercise should be encouraged in all elderly persons.

REFERENCES

1. Baker SP, Harvey AH. Fall injuries in the elderly. Clin Geriatr Med 1985; 1:501-8.
2. Tinetti ME, Spechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. N Engl J Med 1988; 319:1701-7.
3. Alexander BH, Rivara FP, Wolf ME. The cost and frequency of hospitalisation for fall-related injuries in older adults. Am J Public Health 1992; 82:1020-3.
4. Kay AD, Tideiksaar R. Falls and gait disorders. In: Abrams WB, Berkow R (eds). The Merck Manual of Geriatrics. MSD Research Lab 1990: Rahway NJ:52-68.
5. National Health Survey 1992, Research & Evaluation Department, Ministry of Health (HQ), 1993.
6. Wild D, Nayak USL, Isaac B. Characteristics of old people who fell at home. J Clin Exp Gerontol 1980; 2:271-87.
7. Mahoney J, Sager M, Dunham NC, Johnson J. Risk of falls after hospital discharge. J Am Geriatr Soc 1994; 42:269-74.
8. Exton-Smith AN. Functional consequences of ageing: clinical manifestations. In: Exton-Smith AN, Evans JG (eds). Care of the elderly: meeting the challenges of dependency. London: Academic Press 1977, 41-57.
9. Prudham D, Evans JG. Factors associated with falls in the elderly: a community study. Age Ageing 1981; 10:141-6.
10. Province MA et al. The effects of exercise on falls in elderly patients. A preplanned meta-analysis of the FICSIT trials. JAMA 1995; 273:1341-7.
11. Wolf SL, Barnhart HX, Kutner NG, McNelly E, Coogler C, Xu T et al. Reducing frailty and falls in older persons: an investigation of *tai chi* and computerized balance training. J Am Geriatr Soc 1996; 44:489-97.
12. Brocklehurst JC, Exton-Smith AN, Lempert Barber SM, Hunt L, Plamer M. Fracture of the femur in old age: a two centre study of associated clinical factors and the cause of the fall. Age Ageing 1976; 7:7-15.
13. Swanstrom L. Falls on stairs: an epidemiological incident study. Scand J Soc Med 1974; 2:113-20.
14. Luukinen H, Koshi K, Honkanen R, Kivela SL. Incidence of injury causing falls among older adults by place of residence: a population based study. J Am Geriatr Soc 1995; 43:871-6.