Prevalence and Related Factors of Falls among the Elderly in an Urban Community of Beijing[1]

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Objective To understand the prevalence, consequences and risk factors of falls among urban community-dwelling elderly in Beijing. **Methods** A cross-sectional study was conducted in Longtan Community, Beijing. A total of 1512 individuals aged 60 years or over were selected by stratified cluster sampling. Data regarding the frequency of falls in the previous year, as well as circumstances, consequence and related factors of falls were collected from the elderly through face-to-face interviews with questionnaires in their home. **Results** The prevalence of falls was 18.0% on the average among 1512 participants, higher in women (20.1%) than in men (14.9%) (P=0.006), and increased with age ($\chi^2_{for\ trend}$=10.37, P=0.001). The total rate of falls-induced injuries among the fallers was 37.7%. Falls usually resulted in soft-tissues bruises (58.7%), fear of repeated episodes of falls (58.8%), loss of independence and confidence in movement (35.7%) and even in hip fracture. In addition to the burden of medical care, falls also generated a big economic burden. Occurrence of falls was significantly associated with both intrinsic and extrinsic factors. The related factors of falls in the elderly included age≥60-70 years, femininity, less physical activities, fear of future falls, living alone, severely impaired vision, health problem-impacted activities of daily living, chronic diseases (diabetes, hypertension, postural hypotension, stroke sequela, cataract, arthritis, dementia and depression), medications (psychoactive, anti-diabetic), gait imbalance, high bed and faintly-lighted stairway. **Conclusion** The prevalence of falls among urban community-dwelling elderly in Beijing is closely associated with significant associated with intrinsic and extrinsic factors. Efforts to prevent falls in the elderly should be made at community level.

Key words: Falls; Prevalence; Old people; Prevention

INTRODUCTION

Falls have severe impacts on the physical and psychological health of the elderly, and are associated with mortality, hospitalization, institutionalization, hip fractures, psychological effects such as fear of another falling and other consequences[1-2]. Fall-induced injuries includ bone fracture, soft tissue bruises and contusions, head injuries, lacerations, *etc.*, which represent one of the most common causes of longstanding pain, functional impairment, disability and death in the elderly. Now, injury is the fifth leading cause of death in the elderly and most of the fatal injuries are related to falls. Falls account for over 80% of hospitalized elderly aged 65 years or over[3]. One third of urban community-dwelling elderly people aged 65 years or over have, on the average, one episode of falls and more than one episode occurs in about half of the fallers[1,4-8].

Although only a few studies are available on the Chinese elderly, falls have become a major health problem among this special population in China. For example, a cross-sectional study conducted in 1999 found that fall occurs in 21%-23% of men and

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43%-44% of women aged over 65 years living in urban communities of China[9]. A follow-up study from 1987 to 1994 reported that fall is the leading cause of injury among the elderly[10]. With the aging of people, fall becomes a greater health problem and even an economic burden in China. Now, 7% of the people in China are at the age of 65 years or over, and this figure will reach up to approximately 20% by 2040[11]. Consequently, special public health policies are needed to allocate more health resources for the prevention of falls among the elderly. The objective of this study was to understand the prevalence, circumstances, consequences, and related factors of falls among the urban community-dwelling elderly in Beijing.

MATERIALS AND METHODS

Definition of Fall

For the purpose of this study, a "fall event" was defined as an unintentional fall to the ground or other lower levels[12]. According to the classification of fall (ICD-10), fall could be classified into the falling from one surface to another surface and falling on the same-level surface[13].

Participants

This cross-sectional study was performed in 51 701 elderly people of Longtan Community in Chongwen District, Beijing, from June to December of 2005. Of them, 8 652 were aged 60 years or over, accounting for 15.4% of the total aged population in Beijing[14]. In terms of types of housing, 5.4%, 74.2%, and 20.4% of community-dwelling elderly were living in bungalows, apartments with or without elevator, respectively.

The research protocol was approved by the Ethics Committee of Beijing Hospital, Ministry of Health. Sample size was estimated given that the prevalence of falls in urban community was 20% irrespective of their types of housing, with the minimum sum of 83 living in single-story houses, 1 140 in apartments without elevators and 313 in apartments with elevators. A stratified cluster sampling method was adopted. Four out of 11 neighborhoods were randomly selected from Longtan Community. Households were randomly selected from each housing type and all eligible participants were invited to participate in the study. A total of 1 613 participants were recruited and 1 536 responded during the household visits, with a response rate of 95.3%. After screening and cleaning of raw data sets, 1 512 copies of questionnaire were valid for data analysis, with a total validity rate of 98.4%.

Participant Inclusion and Exclusion Criteria

The subjects born before 1945 willing to sign an informed consent and having permanent residence in the neighborhoods for at least one year, were included in the study. Those born after 1945, unwilling to sign an informed consent, were excluded.

Measurement and Instruments

Pretest of the study instruments was conducted in 30 elderly people by interviewing at an interval of 20 days with each of the 30 participants.

A face-to-face interview was carried out with each of the participants at his or her home using a structured questionnaire. When the participants could not answer questions by themselves, their caregivers were asked to to give an answer instead of them. Data collected included socio-economic conditions, general health status[15], knowledge about fall prevention, medication history, activity of daily living (ADL)[16], physical fitness[7], intellectual ability[17], physical activity[18], circumstances and consequences of falls, and costs due to falls. For those who could not remember the situation of fall occurrence or the consequence, interviewers would check their medical records. A physical functional assessment was carried out following the interview.

Statistical Analysis

Data analysis was performed with SPSS version 11.5 for Windows. Descriptive analysis was performed for demographic characteristics, falls and predicted variables. Continuous variables were presented as mean±SD. Categorical variables were analyzed by chi-square test, and Mantel-Haenszel's stratified analysis was used to control the confounding factors. Univariate analysis for predictors of falls and chi-square test for categorical variables were performed. Logistic regression analysis for predictors of falls was performed for variables significant in univariate analysis. Relationship of falls with intrinsically and extrinsically related factors was estimated by deriving odds ratio (*OR*) from logistic regression models with falling at least once in the previous year as a dependent variable. $P<0.05$ (2-tailed) was considered statistically significant.

RESULTS

Descriptive Analysis

Data otained from 619 men and 893 women with a mean age of 70.6±6.5 years were involved in the study. Out of the 1 512 participants, the prevalence

rate of falls was 91.4% in 1 382 suffering from chronic diseases, such as hypertension, cervical vertebrae disease, osteoarthritis, loss of hearing, cataract, diabetes, *etc.*, and 66.6% (992/1382) of them were on meditations.

Prevalence of Falls

The prevalence of falls among the elderly is shown in Table 1. During the previous year, 379 falls occurred in 272 elderly persons, with an incidence of 25.0 % (the number of falls per 100 persons) and a prevalence of 18.0% (persons with falls at least once per 100 persons). The frequency of falls in the previous year was 1.4±0.9 per person, and 20.1% in women and 14.9 % in men, respectively, higher in women than in men after adjustment for the age with Mantel-Haenszel's stratified analysis (χ^2=7.45, P=0.006, 95% CI=1.13-1.97). Linear trend analysis showed that the occurrence of falls increased with age ($\chi^2_{for\ trend}$=10.37, P=0.001). Women and advanced age were the two risk-predicating factors for falls among urban community-dwelling elderly people.

TABLE 1

Occurrence Rate of Falls in the Elderly by Stratified Age and Gender, *n* (%)

Age (yr)	Men		Women		Total	
	Participants	Fall	Participants	Fall	Participants	Fall
60~	92	7 (7.6)	164	30 (18.3)	256	37 (14.5)
65~	184	20 (10.9)	297	54 (18.2)	481	74 (15.4)
70~	173	32 (18.5)	207	42 (20.3)	380	74 (19.5)
75~	103	20 (19.4)	139	29 (20.9)	242	49 (20.2)
80~	52	10 (19.2)	52	14 (26.9)	104	24 (23.1)
85~95	15	3 (20.0)	34	11 (32.4)	49	14 (28.6)
Total	619	92 (14.9)	893	180 (20.1)	1512	272 (18.0)

Note. $\chi^2_{for\ trend}$=10.37, P=0.001.

Consequence of Falls

The consequences of falls among the elderly are shown in Table 2. Among the 272 elderly persons who had falls in the previous year, 131 (48%) reported fall-related injuries, including 84 with soft-tissue injuries. Among the 379 episodes of falls, 143 (37.7%) resulted in fall-related injuries, 67 on the lower limbs (46.9%), 39 on the upper limbs (27.3%), 27 on the head (18.9%) and 19 on the face (13.3%), respectively. As a result of falls, 16 elderly persons were hospitalized, including 5 with hip fracture (2 became crippled due to the fracture, and the other 3 recovered after they confined to bed for more than three months), 4 with cerebral hemorrhage, 3 with rib fracture, 2 with lumbar vertebra fracture and 2 with severe soft-tissue bruise (one with head hematoma and the other with dislocation of the right knee joint). Falls also imposed severe economic burden on the elderly, with a direct cost of 741.82 Yuan (650.77 Yuan for medical care) for each episode of fall, including the costs for drugs, operation, nutritional support , days of hospitalization and in-hospital and home medical care. Direct cost for hip fracture was 16 500 Yuan and 82 500 Yuan for cerebral hemorrhage caused by falls. Among the 272 fallers, falls also had impacts on their activity of daily living and led to their psychological changes 97 (35.7%) reduced their daily physical activities, 160 (58.8%) were fear of falling again and 82 (30.1%) felt frustration, anxiety, recalcitrance, depression, or loss of confidence.

Related Factors of Fall

All factors were grouped into eight categories: demographic variables, health and physical conditions, functional assessment, disease, medication, behavioral and psychological status, socio-economic status and environmental factors. Logistic regression analysis was preformed for each category. After adjustment for potential confounding factors, logistic regression analysis found significant predicators of fall ($\alpha_{inclusion}$= 0.05, $\alpha_{exclusion}$=0.10) as listed in Table 3.

TABLE 2

Consequences of Fall

Presence/absence of Injury	Frequency	Percentage (%)
Injured	143	37.7
Not Injure	236	62.3
Nature of Injury*		
Abrasion	57	39.9
Soft-tissue Bruise	84	58.7
Laceration	9	6.3
Fracture	20	14.0
Cerebral Concussion	7	4.9
Other	4	2.8
Consulting a Doctor*		
Yes	64	44.8
In Hospitals	52	36.4
In Clinics	12	8.4
No	79	55.2
Fear of Future Falls among Fallers		
Yes	160	58.8
No	112	41.2
Activity of Daily Living		
Reduced	97	35.7
Not Reduced	175	64.3

Note. *Percentage for 143 episodes of fall due to fall-related injuries.

Intrinsic Factors

Age and gender were the factors of fall (*OR*=1.19, 1.48).The incidence of falls was higher in women (20.1%) than in men (14.9%) (*P*=0.006), and increased with age ($\chi^2_{for\ trend}$=10.37, *P*=0.001). Fear of future falls was an independent factor of fall (*OR*=2.57), and one of the consequences of fall. Clinical factors included diabetes (*OR*=1.48), hypertension (*OR*=1.75), postural hypotension (*OR*=1.92), stroke sequela (*OR*=1.87), cataract (*OR*=1.41), arthritis (*OR*=1.39), dementia (*OR*=4.82), depression (*OR*=4.27) and the total number of medical diagnoses (*OR*=1.36). This study showed that psychoactive agents (*OR*=2.04) and anti-diabetic drugs (*OR*=1.68) were the falls-related factors. The functional predictors of fall were abnormal balance and gait (both *OR*=1.58). Reduced physical activity was a fall-related factor (*OR*=0.56).

Extrinsic Factors

The bad indoor and outdoor environments would increase the incidence of fall. This study showed that height of bed and lights on the stairways were two environmental risk factors of fall (*OR*=2.10, 1.49).

DISCUSSION

Prevalence of Fall

This study showed that the prevalence of falls during the previous year was 18% among the elderly aged 65 years or over living in urban communities of Beijing, which was 20.1% in women and 14.9% in men, as compared to the previously published prevalence of 43%-44% in women and 2%-23% in men[9]. A population-based prospective cohort study of falls in Hong Kong community-dwelling elderly aged 65 years or over reported a prevalence of 19.3%[19]. It was reported that falls occur in 33% of community-dwelling elderly people aged 65 years or over[1,4-8]. Such a large discrepancy in prevalence of falls might be explained by the recall bias in cross-sectional studies due to a poor memory of the interviewees. However, age is an important factor related to falls. Age of the interviewees should be considered when comparing with other studies. All the participants in this study were 60-year old or over with a mean age of 70.6 years. But all the study subjects in Hong Kong were 65-year old or over with a mean age of 72.2 years[19]. Our study revealed that the incidence of falls in elderly people increased with age, and episodes of falls were more common in women than in men. These findings are consistent with the previosuly reported data[7,20-21].

Consequences of Fall

Falls in the elderly will become a major health and economic burden. This study showed that the rate of fall-caused injuries in the elderly was 37.7%, and most of the injuries led to soft-tissue bruise and 5% resulted in hip fractures, which is consistent with the reported data[22]. Each episode of falls with hip fracture cost 16 500 Yuan, more than his or her annual average income of local residents in urban (8472.20 Yuan) and rural (2622.20 Yuan) areas of Beijing[23]. This means that if an elderly individual suffers from hip fracture as a result of falls, it will cost more than his annual income, even annual income of a whole family. In this study, the direct cost of every episode of falls was 741.82 Yuan, including 650.77 Yuan for medical care. With 130 million people aged 65 years or over, China is facing a big economic burden resulting from falls other than medical burden. A previously published study in China estimated that economic burden of falls is five billion Yuan for direct medical cost and 16-80 billion Yuan for social cost given that 25 million episodes of

TABLE 3

Logistic Regression Analysis of Falls-related Factors

Variables	Value of Assignment	Participants (*n*)	Fallers, *n* (%)	β-value	Wald X^2	*P*-value	*OR* (95% *CI*)
Demographic Variables							
Gender				0.39	7.11	0.005	1.48 (1.12-1.95)
Male	1	619	92 (14.9)				
Female	2	893	180 (20.2)				
Age (yrs.)				0.17	11.26	0.001	1.19 (1.07-1.31)
60~	1	256	37 (14.5)				
65~	2	481	74 (15.4)				
70~	3	380	74 (19.5)				
75~	4	242	49 (20.2)				
80~	5	104	24 (23.1)				
85~95	6	49	14 (28.6)				
Living alone				0.53	4.87	0.027	1.70 (1.06-2.72)
No	0	1 405	244 (17.4)				
Yes	1	107	28 (26.2)				
Health and Physical Variables							
Vision				0.26	5.55	0.019	1.30 (1.04-1.62)
Normal	1	1 195	194 (16.2)				
Abnormal	2	317	78 (24.6)				
Impacts on Daily Life by Health Problems				0.42	7.66	0.006	1.52 (1.13-2.05)
No	0	636	81 (12.7)				
Yes	1	876	191 (21.8)				
ADL				0.76	26.03	<0.001	2.15 (1.60-2.88)
Independent	1	1 355	209 (15.4)				
Partly Independent	2	126	50 (39.7)				
No	3	31	13 (41.9)				
Doing Physical Activity often				-0.57	11.11	0.001	0.56 (0.40-0.79)
No	0	221	69 (31.2)				

(to be continued)

(continued)

Variables	Value of Assignment	Participants (*n*)	Fallers, *n* (%)	β-value	Wald X^2	*P*-value	*OR* (95% *CI*)
Yes	1	1 291	203 (15.7)				
Fear of Falling again				0.94	39.45	<0.001	2.57 (1.91-3.45)
No	0	778	80 (10.3)				
Yes	1	734	192 (26.2)				
Function							
Balance				0.46	4.24	0.039	1.58 (1.02-2.45)
Normal	1	1 291	196 (15.2)				
Abnormal	2	224	75 (33.5)				
Gait				0.46	4.46	0.031	1.58 (1.04-2.39)
Normal	1	1 152	163 (14.1)				
Abnormal	2	360	109 (30.3)				
Disease							
Diabetes				0.39	5.00	0.025	1.48 (1.05-2.09)
No	0	1 281	215 (16.8)				
Yes	1	231	57 (24.7)				
Hypertension				0.32	5.21	0.022	1.75 (1.05-1.81)
No	0	822	126 (15.3)				
Yes	1	690	146 (21.2)				
Orthostatic Hypotension				0.65	5.56	0.018	1.92 (1.12-3.29)
No	0	1 240	54 (4.4)				
Yes	1	272	21 (7.7)				
Stroke Sequela				0.63	8.89	0.003	1.87 (1.24-2.83)
No	0	1 380	234 (17.0)				
Yes	1	132	38 (28.8)				
Cataract				0.34	4.16	0.041	1.41 (1.01-1.95)
No	0	1 244	208 (16.7)				
Yes	1	268	64 (23.9)				
Osteoarthritis				0.33	4.33	0.037	1.39 (1.02-1.89)
No	0	1 186	197 (16.6)				
Yes	1	326	75 (23.0)				

(to be continued)

(continued)

Variables	Value of Assignment	Participants (*n*)	Fallers, *n* (%)	β-value	Wald X^2	*P*-value	*OR* (95% *CI*)
Dementia				1.57	8.59	0.003	4.82 (1.68-13.81)
No	0	1 497	264 (17.6)				
Yes	1	15	8 (53.3)				
Depression				1.45	4.00	0.045	4.27 (1.03-17.71)
No	0	1 504	268 (17.8)				
Yes	1	8	4 (50)				
No. of Medical Diagnoses				0.30	15.37	<0.001	1.36 (1.16-1.58)
No	0	130	9 (6.9)				
1	1	269	35 (13.0)				
2	2	351	62 (17.7)				
3 or More	3	762	166 (21.8)				
Medication							
Anti-diabetic Drugs				0.52	8.18	0.004	1.68 (1.18-2.40)
No		1 320	222 (16.8)				
Yes		192	50 (26.0)				
Sedative/hypnotic Drugs				0.71	5.17	0.023	2.04 (1.10-3.78)
No			256 (17.5)				
Yes			16 (32.0)				
Environment							
Height of Bed				0.74	4.59	0.03	2.10 (1.06-4.13)
Inappropriate	0	40	15 (37.5)				
Appropriate	1	1 472	257 (17.5)				
Lighting for Stairway				0.40	4.54	0.03	1.49 (1.03-2.15)
Insufficient	0	189	47 (24.9)				
Sufficient	1	1 273	221 (17.4)				

falls occur in 20 million elderly people[24].

Fall-related Factors

Fall is a complex event caused by a combination of intrinsic impairments and disabilities with or without accompanying environmental hazards, including increased age, feminine gender, living alone, abnormal gait and balance function, chronic diseases, taking two or more drugs, fear of falls and unsafe status in home environment[3]. These factors should be taken into consideration when strategies are mdae for preventing falls. This study showed that several clinical conditions including diabetes, hypertension, orthostatic hypotension, stroke sequela, cataract, osteoarthritis, dementia, depression, *etc*, were related to falls. Therefore, these medical conditions must be included in any prevention assessment of falls. When medical doctors prescribe the aforementioned medical conditions, warnings or messages for preventing falls should be provided. Additionally, psychotropic medication is one of related factors for falls. One randomized clinical trial showed that gradual withdrawal of psychotropic drugs could reduce risk of falling by 66%[25]. Thus, psychotropic medications should be under the direction of doctors and supervision by caregivers. As compared with clinical predictors, functional factors can predict fall and its recurrence[19]. A meta-analysis and systematic review confirmed that strength and balance training for the elderly can reduce risk of both injury and non-injury- related falls by 15%-50%, with a lower cost-effectiveness ratio[3]. Regular balance and gait assessment and corresponding balance and gait training are the important strategies for public health professionals to prevent falls. Besides, intrinsic factors, indoor and outdoor environments are also fall-related factors. Home hazard assessment and modification prescribed for the elderly people with a history of falling are likely to reduce risk of falls by about 33%[3] . In this study, physical activity was found to be a protecting factor of falls. A similar reduction in the incidence of falls after exercise has been reported[26]. Tailored exercise programs should be for high risk groups.

There are several limitations in this study. First, there may be inaccuracies in participants' recall about their falls in the previous 12 months. Second, there may be response bias because of about 5% of non-responses. Third, there may be survival bias because only those surviving falls were surveyed in this study.

In conclusion, falls occur in community-dwelling elderly people aged 65 years or over, more common in women, and increase with age. With population aging in China, falls are becoming an important medical and economic burden. Occurrence of falls is significantly associated with both intrinsic and extrinsic factors. Therefore, public health policies should allocate more resources to prevent falls in community-dwelling elderly people, and intrinsic and extrinsic factors should be addressed in preventing falls.

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