

BMJ Open Cross-sectional study on prevalence and risk factors for falls among the elderly in communities of Guangdong province, China

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ABSTRACT

Objective This study aims to investigate the prevalence and risk factors of falls among the elderly in Guangdong, China.

Methods A cross-sectional study was conducted in six communities of Guangdong province. People over 60 years old were selected with multistage random-cluster sampling. Data on falls within the previous 12 months and fall-related risk factors were collected through a face-to-face interview.

Results The prevalence of falls among older adults was 11.9% (95% CI: 11.0% to 12.8%) among 5374 interviewees. The common injuries caused by falls were bruises/scrapes (40.0%) and fractures (15.5%), and most people fall while doing housework (35.0%). Univariate analysis showed that 14 factors were associated with falls among older adults, including gender, age, residence, occupation, education level, balance ability, situation of cognition, disease, depression, living arrangement, marital status, the behaviour of exercise, drinking and drug use ($p < 0.05$). Multivariate analysis showed that the associated factors of falls among older adults included woman (OR=1.68, 95% CI: 1.40 to 2.02), age from 70 to 79 years (OR=1.31, 95% CI: 1.09 to 1.58), age over 80 (OR=1.63, 95% CI: 1.25 to 2.13), impaired balance ability (OR=1.45, 95% CI: 1.20 to 1.75), exercise several times per month (OR=1.69, 95% CI: 1.13 to 2.53), polypharmacy (OR=1.54, 95% CI: 1.19 to 2.00), cognition impairment (OR=1.35, 95% CI: 1.08 to 1.69), mild depression (OR=1.89, 95% CI: 1.47 to 2.45) and moderate depression (OR=3.07, 95% CI: 1.99 to 4.73).

Conclusions The hazards caused by falls to the elderly in China cannot be ignored. A multidimensional customised fall prevention programme should be considered to reduce the risk of falls among the elderly based on the results above.

INTRODUCTION

With the rapid development of the economy and medical care, human beings have made significant improvements in many aspects, and the life expectancy of residents in various countries has also been prolonged as a whole.¹ Research shows that the global population over 60 years old is expected to

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ There are few studies on falls among elderly people in Guangdong province. The results of this study can provide an important basis for future prospective studies and the implementation of fall prevention programmes for the elderly in China and other countries.
- ⇒ To our knowledge, this is one of the largest population-based cross-sectional studies to assess the prevalence and risk factors of falls in Guangdong province, including over 5000 participants.
- ⇒ Given that the data was collected from the elderly on their fall history, there was an inevitable recall bias, and the frequency of falls may be under-reported.
- ⇒ Our research methodology is cross-sectional and cannot establish causality for falls.

exceed 2 billion in 2050,² and the population in China aged over 65 is expected to rise to 400 million by 2050, 150 million of whom will be 80+.³ Moreover, ageing is associated with changes such as the decline of physical, cognitive and affective capacities, and the comorbidity associated with chronic illnesses, which makes the elderly become a high-risk group of falls.

Falls are the second cause of death due to unintentional injuries in the world only after road traffic injuries, resulting in 684 000 fatalities and 37.3 million medical treatments each year, among which the elderly over 60 years old suffer the most.⁴ Globally, approximately 30% of the community residents aged ≥65 years will fall at least once a year.⁵ Falls also bring heavy burdens to the elderly in China. In 2019, the deaths, disability-adjusted life year, years lived with disability and years of life lost caused by falls among the elderly aged 60 and above in China were 100.7 thousand, 3.18 million person-years, 1.18 million person-years and 1.37 million person-years, respectively.⁶ The injuries caused by falls can



lead to soft tissue injuries, fractures, paralysis, craniocerebral injury and even death.⁷ In addition, falls may also result in a post-fall syndrome that includes dependence, loss of autonomy, confusion, immobilisation and depression, which will lead to a further restriction in daily activities.^{8,9} It could be seen that the rate of injury, disability and death caused by falls is extremely high, so the impact of falls on patients, families, the community and the whole society cannot be ignored.

Nowadays, in developed countries, the research on falls has achieved fruitful results, including, but not limited to, the prediction of the incidence of falls, the influencing factors of falls and preventive measures. However, more than 80% of the falls occur in low-income and middle-income countries.¹⁰ China is a developing country with the largest elderly population in the world. The research on elderly falls in China started late, thus systematic achievements and intervention measures are still lacking.¹¹ Additionally, the factors influencing falls are complicated, and the reasons for falls may be varied in different countries, regions and economic backgrounds. Therefore, this study aims to further strengthen the research on the epidemiology and reasons for falls of the elderly in China.

METHODS

Study design

The survey respondents came from Prevention and Intervention Programs for Key Diseases in the Elderly carried out by China Centers for Disease Control and Prevention (CDC) in 2019. Guangdong province was one of the project sites. The survey adopted a multistage cluster random sampling method. In the first stage, 3 cities were selected by simple random sampling in 21 cities in Guangdong province. In the second stage, one county and one district were randomly selected in each city. In the third stage, one township or one street was randomly selected in each county or district. Finally, in the fourth stage, cluster sampling was adopted in each township or street, and several administrative villages or neighbourhood committees were randomly selected, and the elderly who met the inclusion and exclusion criteria were the survey objects until the sample size was reached. The inclusion criteria were residents over the age of 60 who have local household registration and have lived there for more than 1 year, with clear consciousness and strong expression skills. Exclusion criteria were older adults who did not live in the survey area during the survey period or those with severe mental illness that prevented them from cooperating to complete the questionnaire.

The on-site investigation process is as follows: first, we carried out publicity and mobilisation work in the selected areas, striving for the support of the local government and the cooperation of the survey respondents, and made an appointment by telephone for the survey time and place of the respondents. Second, according to the appointment information, the respondents gathered at the scene to take part in the survey, first filled out the

informed consent form and then conducted an inquiry survey and balance ability test face-to-face. Third, after the survey was completed, the questionnaire should be submitted to the quality controller for on-site audit, and the survey data should be uploaded to the information management system after the audit was passed. All the questionnaires were administered in the local language. Among the questionnaires collected 663 were invalid, mainly due to logical errors, damaged questionnaires and missing baseline information, and that differences between included and excluded participants could therefore not be assessed. Excluding invalid questionnaires, a total of 5374 people ≥ 60 years old were included in the analysis. Data were not collected for those who did not consent to participate and therefore it is not possible to compare their characteristics with those who were included in the study.

Data collection

Falls were defined as slips, trips and falls on the same level, such as from icy roads, and falls from one level to another, such as from a height. If the participant had fallen within the past year, a fall situation form was required to be completed, which included fall frequency, activity when an injury occurs and the injury type. The question about fall frequency expressed in the questionnaire is 'Have you ever fallen in the past year?' The answers were divided into 'none', 'once', 'twice' and 'three or more times'. When respondents choose 'none', they were considered to have not fallen while the others were considered to have fallen. The location of residence was classified into rural and urban. The occupation was divided into farmers and non-farmers. The living arrangements of the elderly were classified as living alone and not living alone. Marital status was recognised as couple and single (including unmarried, divorced, widowed or other). Behavioural factors included drinking status and frequency of exercise. Drinking included drinking liquor, red wine, beer and rice wine and other drinks with a certain degree of alcohol. Participants were classified as never drinkers (also including occasional drinkers with average alcohol intake close to zero) and drinkers (drinking more than once a week). Cognitive function was evaluated by Mini-Mental State Examination. Cognitive impairment was defined as a score of ≤ 17 for illiterates, ≤ 20 for participants with primary school education and ≤ 24 for those with junior high school degrees or above.¹² Balance ability was determined by the result of the chair rising test (CRT), the timed up and go test (TUG) and the tandem gait test (TGT). Poor balance ability was defined as CRT > 10 s or TUG > 12 s or TGT < 8 steps.¹³ The situation of disease was divided into three statuses including no disease, 1 disease and comorbidity (≥ 2 diseases, including hypertension, diabetes, dyslipidaemia, cataract, hearing loss, etc). Depressive symptoms were assessed using the Brazilian validated version of the Patient Health Questionnaire 9-item instrument. The scores were categorised into the absence of depression (0–4), mild depression

(5–9), moderate depression (10–14) and severe depression (15–27).¹⁴ Polypharmacy means the use of multiple drugs administered to the same patient. Published papers have used disparate cut-offs for polypharmacy, ranging from 2 to 9 medications.¹⁵ In this study, polypharmacy was coded as no medications, 1 medication and polypharmacy (≥ 2 medications, including hypoglycaemic agents, sleeping pills, antidepressants and anti-Parkinson's drugs, etc).

Data analysis

SPSS V.25.0 software was used for data analysis. Categorical data were described by frequency and percentage. Continuous data were described by the mean and SD ($X \pm SD$). The χ^2 test was used for univariate analysis to explore the effect of each explanatory variable on the probability of falls. Significant explanatory variables from the univariate analysis were incorporated into the multivariate logistic regression analysis to identify the relating factors of falls. OR values and 95% CI were calculated. Two-sided p values < 0.05 were considered to be statistically significant.

Patient and public involvement

No patient was involved.

RESULTS

Social-demographic characteristics and fall-related injury prevalence

A total of 5374 older adults were surveyed from Guangdong province in this study. The mean (SD) age of respondents was 69.3 (6.8) years, with 2995 participants among women (55.7%) and 4444 participants (82.7%) in rural areas. Among the 5374 older adult participants, 640 (11.9%) fell at least once in the past year, 452 (8.4%) fell once, 110 (2.1%) fell twice and 78 (1.5%) fell more than three times.

The injury characteristics of falls

Among 640 older adults who had fallen, 456 (71.3%) had suffered injury from a fall. The common injuries caused by falls were bruise/scrape (40.0%) and fractures (15.5%), respectively. Housework (35.0%) and recreation or walking outside (25.0%) were the top two activities in which falls occurred (table 1).

Univariate analysis of associated factors of falls

Univariate analysis showed that 14 factors were associated with falls among older adults in Guangdong province, including gender, age, residence, occupation, education level, balance ability, the situation of cognition, disease, depression, living arrangement, marital status, the behaviour of exercise, drinking and drug use ($p < 0.05$) (table 2).

Multivariate analysis of associated factors of falls

Significant explanatory variables ($p < 0.05$) from the univariate analysis were included in the multivariate

Table 1 The characteristics of falls among older adults aged over 60 in Guangdong province

Variable	Falls	
	n	%
Activity when falls occur		
Doing housework	224	35.0
Recreation or walking outside	160	25.0
Going up and down stairs or over the threshold	48	7.5
When getting on and off using transportation	59	9.2
Doing sports activities	5	0.8
Working	45	7.0
Other activities	99	15.5
Injury types		
No injuries	184	28.8
Bruise/scrape	256	40.0
Fracture	99	15.5
Sprain/strain	79	12.3
Concussion/contusion and laceration	5	0.8
Other types	17	2.7

logistic regression analysis. The dependent variable was whether a fall occurred or not. Multivariate logistic regression analysis showed that women, advanced age, exercise several times per month, poor balance ability, polypharmacy and depression were associated with the risk of falls among the older adults in Guangdong province (table 3).

DISCUSSION

A systematic review in China showed that the incidence of falls in the elderly aged 60 and over in China was 0.6%–19.5%.¹⁶ In this study, the fall rate of elderly people in Guangdong province was 11.9%, which was close to Shanghai (10.7%)¹⁷ and Beijing community (13.1%),¹⁸ probably because the economic development of the above three regions is relatively similar. Overall, it was lower than the USA (27.5%)¹⁹ and South Africa (20.8%).²⁰ The prevalence of falls in different reports may be related to ethnic, behavioural and cultural factors, as well as reporting bias. Although the prevalence of falls was lower than in other countries, studies have shown that between 1990 and 2019, the incidence of falls among elderly people in mainland China increased significantly, regardless of gender, age and province.²¹ This highlights the importance of falls as a growing healthcare problem and underscores the urgent need for the exploration of risk factors and implementation of evidence-based interventions to prevent falls in older adults in mainland China.

The results of the multivariate analysis showed that six risk factors (women, advanced age, exercise several times per month, poor balance ability, polypharmacy, depression) had a relationship with the occurrence of falls. Age was a common risk factor for falls in the previous studies.²² This may be because some age-related conditions (osteoporosis, diabetes, impaired vision, cerebrovascular disease, etc) may increase the risk of falls.

Table 2 Univariate analysis of associated factors of falls among older adults

Factor	n	No (%)	Yes (%)	χ^2	P value
Total	5374	4734 (88.1)	640 (11.9)		
Gender				49.91	<0.001
Male	2379	2179 (91.6)	200 (8.4)		
Female	2995	2555 (85.3)	440 (14.7)		
Age				42.14	<0.001
60–69	3086	2784 (90.2)	302 (9.8)		
70–79	1764	1525 (86.5)	239 (13.5)		
≥80	524	425 (81.1)	99 (18.9)		
Residence				4.84	0.028
Urban	930	839 (90.2)	91 (9.8)		
Rural	4444	3895 (87.6)	549 (12.4)		
Occupation				9.77	0.002
Farmers	3577	3116 (87.1)	461 (12.9)		
Non-farmers	1797	1618 (90.0)	179 (10.0)		
Educational level				17.79	<0.001
Illiterate	1613	1375 (85.2)	238 (14.8)		
Primary school	2461	2198 (89.3)	263 (10.7)		
Junior high school and above	1300	1161 (89.3)	139 (10.7)		
Balance ability				42.01	<0.001
Normal	2241	2050 (91.5)	191 (8.5)		
Abnormal	3133	2684 (85.7)	449 (14.3)		
Cognition				34.23	<0.001
Normal	4634	4130 (89.1)	504 (10.9)		
Impairment	740	604 (81.6)	136 (18.4)		
Disease situation				16.03	<0.001
None	1787	1600 (89.5)	187 (10.5)		
One	1636	1461 (89.3)	175 (10.7)		
Comorbidity	1951	1673 (85.8)	278 (14.3)		
Depression				90.57	<0.001
Normal	4805	4298 (89.4)	507 (10.6)		
Mild depression	432	436 (78.9)	91 (21.1)		
Moderate depression	104	70 (67.3)	34 (32.7)		
Severe depression	33	25 (75.8)	8 (24.2)		
Living alone				17.83	<0.001
No	4940	4379 (88.6)	561 (11.4)		
Yes	434	355 (81.8)	79 (18.2)		
Marital status				26.04	<0.001
Single	1123	940 (83.7)	183 (16.3)		
Couple	4251	3794 (89.2)	457 (10.8)		
Drinking				14.22	<0.001
No	4462	3897 (87.3)	565 (12.7)		
Yes	912	837 (91.8)	75 (8.2)		
Exercise frequency				13.17	0.004
None	1024	886 (86.5)	138 (13.5)		
Several times per month	211	172 (81.5)	39 (18.5)		
3–4 days per week	454	404 (89.0)	50 (11.0)		
Almost every day	3685	3272 (88.8)	413 (11.2)		

Continued

Table 2 Continued

Factor	n	No (%)	Yes (%)	χ^2	P value
Drug use				22.92	<0.001
None	3077	2733 (88.8)	344 (11.2)		
One	1794	1591 (88.7)	203 (11.3)		
Polypharmacy	503	410 (81.5)	93 (18.5)		

One study showed that age was strongly linked with an increased incidence of the cervical spine, rib and pelvic fracture.²³ The fracture was also a common injury caused by falls among the elderly in this study. This may be related to the fact that the elderly are prone to osteoporosis, which increases the risk of fracture, suggesting that we should pay attention to strengthening the prevention and treatment of osteoporosis, especially in the elderly. Research demonstrated that gender was significantly associated with an increased risk of accidental falls,²⁴ which was consistent with the findings in our study. This may prompt that the difference in falls in older age may stem from gender-related factors. Biological difference contributes to greater risk, for instance, women's muscle mass declines faster than that of men in the immediate few years after menopause.²⁵ It may explain why women are more likely to fall than men to some extent.

In our study, balance ability was a risk factor for falls. Our finding is consistent with the results of the previous research.^{26–27} Compared with young people, aged people have less coordinated, and more dangerous gaits, and functional declines such as posture control, body-orienting reflexes and muscle strength may impair their ability to avoid falling.²⁸ Therefore, measures to enhance the gait and balance ability of the elderly are needed. Physical exercise has been shown to improve balance ability and reduce fear of falling in older adults.^{29–31} However, our study showed exercising several times per month had a higher risk of falls than no exercise. The type, intensity and duration of exercise, as well as the physical condition of the individual, the design and implementation of the intervention and many other factors determine whether exercise can effectively prevent falls in the elderly. Some older adults exercise only a few times a month, rather than forming a regular and frequent routine, which may make them lose their physical flexibility. This may be one of the reasons that the risk of falls with exercise several times a month is greater than that of no exercise.

Polypharmacy refers to the use of multiple drugs administered to the same patient, most commonly seen in elderly patients. In our study, multiple drug use was also a risk factor for falls. Similar results have been found in some of the literature.^{32–34} However, the exact mechanism through which multiple drug use increases fall risk is unknown, and it may depend on the single and combined effects of the medications on multiple complex systems that affect balance and gait. A cross-sectional study showed that fall risk was associated with the use of multiple drugs, but only when at least one established fall risk-increasing drug was part of the daily

Table 3 Multivariate analysis of associated factors of falls among older adults

Factor	β	SE	Wald	P value	OR	95% CI
Gender (reference: male)	0.52	0.09	31.47	<0.001	1.68	1.40 to 2.02
Age (reference: 60–69)			15.72	<0.001		
70–79	0.27	0.10	8.03	0.005	1.31	1.09 to 1.58
≥ 80	0.49	0.14	12.74	<0.001	1.63	1.25 to 2.13
Balance ability (reference: normal)	0.37	0.10	14.50	<0.001	1.45	1.20 to 1.75
Exercise (reference: none)			8.70	0.034		
Several times per month	0.52	0.21	6.48	0.011	1.69	1.13 to 2.53
3–4 days per week	–0.10	0.18	0.33	0.563	0.90	0.63 to 1.28
Almost every day	–0.02	0.11	0.02	0.893	0.99	0.79 to 1.22
Drug use (reference: none)			14.61	0.001		
One	–0.10	0.10	1.07	0.302	0.91	0.75 to 1.09
Polypharmacy	0.43	0.13	10.59	0.001	1.54	1.19 to 2.00
Cognition (reference: normal)	0.30	0.11	7.01	0.008	1.35	1.08 to 1.69
Depression (reference: normal)			47.70	<0.001		
Mild depression	0.64	0.13	23.75	<0.001	1.89	1.47 to 2.45
Moderate depression	1.12	0.22	25.86	<0.001	3.07	1.99 to 4.73
Severe depression	0.81	0.42	3.76	0.052	2.25	0.99 to 5.09

regimen.³⁵ As a result, more research about the fall assessment should focus on identifying risk-increasing drugs rather than polypharmacy per se. Many other lifestyles of the elderly can affect their health, such as excessive drinking. It is proposed that older adults' alcohol consumption should be considered alongside their assessment of patient medications, particularly among those receiving central nervous system agents.³⁶ Nonetheless, the univariate analysis results in our study showed that the proportion of falls of the elderly who did not drink was higher than that of the elderly who drank. This may be because the habit of drinking is considered to be not in conformity with social norms, and the respondents may tend to understate these behaviours.

Depression is a factor growing in the emotional sphere, which increases the risk of falling. Relevance to the incidence of falls has been confirmed in depressed patients.³⁷ Our study also found a higher risk of fall injuries among the population who has depression and the risk of falling increased with the deepening of depression. This could be because depression can not only reduce the concentration of the elderly but also lead to a state of potential psychological disorder,³⁸ which can cause a decrease in the elderly's perception and response to environmental risk factors. Moreover, these individuals are more likely to live alone and lack confidence and social support.³⁹ The elderly are more likely to feel lonely without a spouse, and prone to have physical, cognitive and sensory limitations, which in turn increases the likelihood of depression. Just as our study showed, the elderly were mainly engaged in housework when falling occurred, which reminds us that we should improve the activities of daily living of the elderly.⁴⁰ Meanwhile, we should encourage them to actively participate in social activities. Besides, more attention should be paid to the elderly's psychological status, and more care and companionship should be given to them.

The limitations of this study could be concluded as follows: first, it is difficult to exhaust all potential risk factors for falls. For example, we did not make a detailed assessment of vision, hearing, fear of falling, environmental factors. The effect of these confounding factors on the association was unknown. More comprehensive research on factors affecting falls in older adults is needed. Second, given that the data was collected from the elderly on their fall history, there was an inevitable recall bias, and the frequency of falls may be under-reported. Moreover, self-report of cataracts and other health conditions are subject to reporting bias typically in rural areas. However, we have also made some efforts to reduce the problem of information bias, such as training researchers to conduct multiple interviews in the local dialect. Finally, our research methodology is cross-sectional and cannot establish causality for falls. Therefore, a prospective study is warranted to identify the incidence and risk factors of falls. Although this study has certain limitations, we tried to minimise bias, and here are few studies on falls among elderly people in Guangdong province. The results of this study can provide an important basis for future prospective studies and the implementation of fall prevention programmes for the elderly in China and other countries.

In conclusion, people who are woman, with advanced age, impaired balance ability, polypharmacy, cognition impairment, depression or exercise at an inappropriate frequency, are more susceptible to suffering falls. Identifying modifiable risk factors for falls of ageing is of significant public health importance. The risk factor identified in this study can contribute to an effective, comprehensive geriatric assessment to facilitate the adoption of a multidimensional customised fall prevention programme.

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Patient consent for publication Not applicable.

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Data availability statement Data are available upon reasonable request.

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