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ORIGINAL ARTICLE

Analysis of the incidence of falls and related factors in elderly patients based on comprehensive geriatric assessment

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Abstract

Objective: To investigate the incidence of falls in elderly aged 65 years and above among outpatients and inpatients, and to analyze its related factors and identify prevention strategies.

Methods: A retrospective analysis was conducted on 451 patients aged 65 years and above who received comprehensive geriatric assessment in outpatients and inpatients from the Department of Geriatrics in the Second Xiangya Hospital from March 2021 to March 2022. According to whether there had been at least one fall in the past year, the patients were divided into a fall group and a non-fall group. Data were collected from the We-Chat applet of comprehensive geriatric assessment. A *t* test and chi-square test were performed to compare the difference between the two groups. Logistic regression analysis was then conducted to identify factors associated with falls.

Results: (1) The incidence of falls among the outpatient and inpatient was 28.8%. (2) The rate of light, moderate, and heavy dependence on daily living ability and decreased mobile balance ability were higher in the fall group than those in the non-fall group. The average calf circumference in the fall group was significantly lower than that in the non-fall group. (3) The prevalence of diabetes and eye diseases in the fall group was significantly higher than that in the non-fall group. (4) The percentage of insomnia and suspicious insomnia cases in the fall group was higher than that in the non-fall group. The mean scores for dysphagia, frailty, and incontinence were higher and the mean malnutrition score was lower in the fall group than in the non-fall group. (5) Multiple logistic regression analysis showed that frailty, insomnia, and malnutrition were independent influencing factors of fall (OR = 1.955, 1.652, 10.719, $P = 0.044$, 0.041, 0.025, respectively).

Conclusions: The incidence of falls among outpatients and inpatients aged 65 years and above is high. Frailty, insomnia, and malnutrition are the main factors influencing falls in these patients.

KEYWORDS
comorbidity, comprehensive geriatric assessment, fall, geriatric syndrome, related factors

1 | INTRODUCTION

Falls are a common mishap of geriatric patients, leading to severe disability and loss of functionality.[1] Falls are the sixth leading cause of death among people over 65 years old. Falls debilitate individuals, evoking insecurity and disabilities to perform their daily activities for fear of falling again.[2] According to the 2018 China Death Cause Monitoring Dataset, for those aged 65 and above, the primary cause of death due to injury in the elderly population is fall, and the incidence of falls increases rapidly with age.[3] Dependent and frail older individuals have a greater prevalence of risk factors for falls than the rest of community-dwelling older people.[4] Despite this, community-dwelling older adults are also at risk of suffering falls, and adequate assessment by health professionals is needed to predict such risk.[5] It is very important to explore factors that may cause accidental falls that deteriorate older people's health.[6] Early prediction and detection of falls are essential to ensure the health and safety of older persons.

Comprehensive geriatric assessment (CGA), initially introduced by Marjory Warren, extends beyond traditional medical history and incorporates an interdisciplinary diagnostic process to identify medical, functional, and psychosocial issues to develop a personalized care plan to maximize the well-being of older adults.[7,8] It can screen the health problems of the elderly from multiple dimensions and is an important method to evaluate and predict the occurrence of geriatric syndrome.[9] The evaluation indicators of CGA include basic data, health indicators, physical function, geriatric syndrome, environmental factors, and comorbidities, which can help evaluate the physical function and health status of elderly individuals in a more comprehensive way.

CGA, widely applied for clinical assessment for older adults based on the extensive practice and experience by clinical experts. Falls are not just the result of a single factor, but mostly a combination of multi-factors. There are many risk factors for falls, and fall-related factor studies often have the disadvantage of insufficient variables. This study makes full use of CGA data to analyze fall-related factors, and the selected variables include 17 geriatric syndromes, 9 comorbidities, 9 health evaluation indicators, and 7 social demographic data, with a total of 42 single-factor variables, which makes up for the limitation of collecting variables. The above assessment contents are the most direct clinical reflection of the older patient's comprehensive health, which are also mostly concerned by clinical workers. Relevant studies confirmed that CGA showed good results in fall screening and benefits in making comprehensive intervention plan according to prevent falls in the hospital.[10,11] Thus, CGA is an effective method from multiple perspectives in fall screening.[12]

The goal of the present study was to evaluate the fall status of elderly patients in outpatient and inpatient departments of geriatrics by CGA and to analyze its related factors.[12] This will provide a research basis for CGA to prevent falls in clinical practice.

2 | PATIENTS AND METHODS

2.1 | Study design and population

Retrospective analysis was performed on outpatients and inpatients aged 65 years and above of the Second Xiangya Hospital from March 2021 to March 2022 who had normal cognitive and communication skills and received a CGA. Patients with acute critical illness, advanced disease, and severe dementia were excluded. A total of 451 cases of effective data were obtained after excluding incomplete data. The patients were divided into a fall and a non-fall group based on whether they had at least one fall in the previous year.

2.2 | Methods

2.2.1 | Data collection and assessment

All individuals had their CGA evaluated by well-trained nurses through standardized face-to-face interviews. The WeChat mini program was used. After the evaluation was completed and submitted, the system automatically saved the data and generated the evaluation report. Basic information, physical function, comorbidities, geriatric syndrome, social support, home environment, etc, were collected. The evaluation of smoking and alcohol was divided into four levels: never, occasional, frequent, and quit. Body mass index (BMI) was calculated as the patient's weight in kilograms divided by the square of the height in meters. Constipation, fecal incontinence, and pressure sore were divided into the presence or absence. Other geriatric syndromes were defined using the international General Assessment Scale and diagnostic criteria in brackets. Mini-Mental State Examination Test (MMSE) assesses cognition, with Cronbach's α 0.777 in this study.[13] The 7-item Generalized Anxiety Disorder Questionnaire (GAD-7) assessed anxiety, with Cronbach's α 0.924.[14] The Patient Health Questionnaire-9 (PHQ-9) assessed depression, with Cronbach's α 0.803.[15] The Athens Insomnia Scale (AIS) assesses insomnia with 0.891 of the Cronbach's α.[16] Pain over the past 4 weeks was assessed using digital pain drawings[17] (ranging from 0 to 10, where 0 is no pain and 10 the most severe pain imaginable). Dysphagia was measured with the Eating Assessment Tool (EAT-10), whose Cronbach's α was 0.900.[18] Risk of malnutrition was determined with the Mini Nutritional Assessment Short form (MNA-SF). The form was shown to provide early warning of poor nutrition trend with 0.543 of the Cronbach's α.[19] Frailty was measured with the FRAIL scale (FRAIL), and the Cronbach's α was 0.500.[20] Sarcopenia was tested with the Asian Working Group Diagnostic Criteria for Sarcopenia 2019.[21] Urinary incontinence was assessed with the International Consultation on Incontinence short-form questionnaire

(ICIQ-SF) with 0.716 of the Cronbach's α.[22] Polypharmacy is defined as concomitant use of five or more drugs.[23] The circumference of the calf (cm) was measured with a tape measure around the thickest position of the calf. Grip strength was measured by a CAMRY spring grip device. The dominant hand was measured twice, and the highest value was adopted. <28 kg in males and <18 kg in females were defined as decreased grip strength.[24] Vision and hearing were classified as having no problems, having problems that do not affect daily life, and having problems that affect daily life. The ability to perform basic activities of daily living was assessed with the Barthel index and the Cronbach's α was 0.898 in this study. A full score of 100, 96–100, 75–95, 46–74, and ≦45 points were defined as intact ability, mild dependence, moderate dependence, and severe dependence, respectively.[25] The short physical performance battery (SPPB) evaluated mobile balance ability, including the Romberg balance test, usual gait speed test (4 m), and five-times sit-to-stand test (FTSST). The full score was 12, and a score ≤9 indicated a decline in mobile balance ability.[26] The limb muscle volume index (SMI) was measured by InBody S10.

2.2.2 | Quality control

The nurses assigned by the geriatrics department were responsible for the evaluation. After training, researchers conducted consistency tests and simulation assessments in advance and used unified standard guidance and interpretation to evaluate the research objects. They tried to avoid assessment in the presence of other irrelevant personnel to reduce the deviation of false information provided by patients.

2.2.3 | Statistical analyses

All data were first exported in an Excel file from the evaluation software background, and valid data were selected and imported into SPSS 25.0 for data analysis. Measurement data are expressed as the mean (M) ± standard deviation (SD), and a *t* test was used to compare the two groups. Counting data were represented by the number of cases and percentage, and the chi-square test was used for comparisons between groups. Logistic regression analysis was used for multivariate analysis. $P < 0.05$ was considered statistically significant.

3 | RESULTS

3.1 | General information

Of the 451 patients included, 130 had at least one fall in the past year (fall group), and 321 had no fall (non-fall group), with a fall incidence of 28.8%. There were no significant differences between the fall and non-fall groups in terms of sex, age, education level, whether they had a spouse, whether they lived alone, and the degree of drinking and smoking (Table 1).

3.2 | Comparison of health assessment indicators

Nine health assessment indicators, including the ability of daily living activities, mobile balance ability, BMI, calf circumference, limb muscle volume index, grip strength, home environment risk, number of drugs taken (0–4; ≥5 kinds), and the number of comorbidities (0–4 kinds; ≥5 kinds), were compared. The proportion of mild, moderate, and severe dependence on daily living ability and the proportion of decreased mobility and balance ability in the fall group were significantly higher than those in the non-fall group. The calf

TABLE 1 Comparison of general data between fall and non-fall groups.

Group	Non-fall group ($n = 321$)	Fall group ($n = 130$)	*P*
Gender			
Male	168 (52.3)	62 (47.7)	0.372
Female	153 (47.7)	68 (52.3)	
Age			
65–74	58 (18.1)	28 (21.5)	0.647
75–84	191 (59.5)	72 (55.4)	
≥85	72 (22.4)	30 (23.1)	
Education level			
Never went to school	15 (4.7)	10 (7.7)	0.147
Primary school	68 (21.2)	35(26.9)	
Junior high school	78 (24.3)	25 (19.2)	
Senior high school	66 (20.6)	30 (23.1)	
Junior college and above	93 (29.0)	28 (21.5)	
There was a spouse			
Have a spouse	240 (74.8)	97 (74.6)	0.973
Have no spouse	81 (25.2)	33 (25.4)	
Live alone or not			
Yes	298 (92.3)	116 (90.6)	0.568
No	25 (7.7)	12 (9.4)	
The degree of drinking			
Never	225 (70.1)	94 (72.3)	0.245
Occasional	42 (13.1)	10 (7.7)	
Frequent	9 (2.8)	7 (5.4)	
Quit drinking	45 (14.0)	19 (14.6)	
The degree of smoking			
Never	221 (68.8)	94 (72.3)	0.741
Occasional	12 (3.7)	6 (4.6)	
Frequent	14 (4.4)	6 (4.6)	
Quit smoking	74 (23.1)	24 (18.5)	

TABLE 2 Comparison of health assessment indicators between fall and non-fall groups.

Group	Non-fall group ($n=321$)	Fall group ($n=130$)	P
The ability of daily living activities			
Ability intact	218 (67.9)	65 (50.0)	0.002**
Mild dependence	84 (26,2)	47 (36.2)	
Moderate dependence	13 (4.0)	12 (9.2)	
Severe dependence	6 (1.9)	6 (4.6)	
Mobile balance ability			
Normal	81 (25.2)	20 (15.4)	0.023*
Decline	240 (74.8)	110 (84.6)	
BMI	23.513 ± 3.306	23.146 ± 3.590	0.306
Calf circumference	32.52 ± 3.999	31.63 ± 4.048	0.044*
Limb muscle volume index	6.642 ± 2.390	6.384 ± 1.079	0.318
Grip strength	21.88 ± 7.70	21.66 ± 8.33	0.789
Home environment risk	1.54 ± 1.39	1.82 ± 1.55	0.061
The number of drugs taken			
0–4	154 (52.2)	62 (52.5)	0.950
≥5	141 (4708)	56 (47.5)	
The number of comorbidity			
0–4	142 (44.2)	52 (40.0)	0.410
≥5	179 (55.8)	78 (60.0)	

*$P<0.05$, **$P<0.01$.

circumference of the fall group was significantly lower than that of the non-fall group. There were significant differences in the comparison results of these three indicators between the two groups ($P<0.05$) (Table 2).

3.3 | Comparison of comorbidity prevalence between groups

The prevalence of hypertension, coronary heart disease, diabetes, stroke, chronic obstructive pulmonary disease, osteoporosis, osteoarticular disease, prostatic hyperplasia, and eye disease were compared between the fall group and non-fall group. The prevalence of diabetes mellitus and eye disease in the fall group was significantly higher than that in the non-fall group ($P<0.05$) (Table 3).

3.4 | Comparison of the prevalence of geriatric syndromes

The incidence of 17 geriatric syndromes, such as constipation and fecal incontinence, was compared between the fall and non-fall groups. The percentage of patients with insomnia and suspected insomnia in the fall group was higher than that in the non-fall group. The mean scores of dysphagia, frailty, and urinary incontinence in the fall group were higher than those in the non-fall group. The average malnutrition score of the fall group was lower than that of the non-fall group. The differences were statistically significant for these five geriatric syndromes between the two groups ($p<0.05$) (Table 4).

3.5 | Logistic regression analysis of influencing factors for falls

Meaningful indicators in the above univariate analysis, including 10 factors (daily living ability, mobility and balance ability, calf circumference, diabetes, eye disease, insomnia, dysphagia, malnutrition, frailty, and incontinence), as independent variables, and whether fall occurred within 1 year as the dependent variable, multivariate logistic regression analysis showed that frailty, insomnia, and malnutrition were statistically significant independent factors (Table 5).

4 | DISCUSSION

Our study confirmed that falls is a common problem among outpatients and inpatients in geriatric departments. In this study, among 451 elderly patients aged 65 years and above who were treated in the geriatric medicine department of a general hospital, the incidence of falls was 28.8%. Lu et al. selected 4736 eligible elderly people as research subjects using data from the China Health and Pension Tracking Survey (CHARLS) in 2015, and found that the incidence of falls among Chinese elderly people was 20.8%.[27] The results of a meta-analysis by Wang et al. showed that the incidence of falls among elderly individuals in Chinese communities was 14.3%.[28]

TABLE 3 Comparison of comorbidity prevalence between the fall and non-fall groups.

Group	Non-fall group ($n=321$)	Fall group ($n=130$)	*P*
Hypertension			
Yes	231 (72.0)	93 (71.5)	0.928
No	90 (28.0)	37 (28.5)	
Coronary heart disease			
Yes	189 (58.9)	68 (52.3)	0.202
No	132 (41.1)	62 (47.7)	
Diabetes			
Yes	97 (30.2)	59 (45.4)	0.002**
No	224 (69.8)	71 (54.6)	
Stroke			
Yes	77 (24.0)	31 (23.8)	0.975
No	244 (76.0)	99 (76.2)	
Chronic obstructive pulmonary disease			
Yes	33 (10.3)	15 (11.5)	0.695
No	288 (89.7)	115 (88.5)	
Osteoporosis			
Yes	46 (14.3)	20 (15.4)	0.774
No	275 (85.7)	110 (84.6)	
Osteoarticular disease			
Yes	30 (9.3)	16 (12.3)	0.346
No	291 (90.7)	114 (87.7)	
Prostatic hyperplasia			
Yes	60 (18.7)	27 (20.8)	0.613
No	261 (81.3)	103 (79.2)	
Eye disease			
Yes	21 (6.5)	16 (12.3)	0.043*
No	300 (93.5)	114 (87.7)	

*$P<0.05$, **$P<0.01$.

According to the results of a meta-analysis by Kang et al., the incidence of falls among elderly individuals in China is 19.3%.[29] Based on the Brazilian Ministry of Health, approximately 30% of people aged over 65 fell at least once a year.[30] Prevalence discrepancy between studies has not been analyzed in depth and may be due to the varied study designs and methodologies.

Gender has an inconsistent effect on the incidence of falls among elderly individuals in different environments. Studies have confirmed that women have a higher incidence of falls in communities, while men have a higher incidence in hospitals.[31] In this study, there was no significant difference in the incidence of falls between the male and female groups, which was consistent with the results of Duarte et al.[32]

Multiple studies have shown that age is a significant influencing factor in univariate analysis but not in multivariate analysis.[3,31,32] The results are the same as in this study. Meanwhile, the average age of patients is as high as 79.68 years old in fall group, and 80.04 years old in non-fall group, there is almost no difference in the average age between the two groups. The result is different from some studies which showing the age is significant influencing factor[3,33,34] may be related to the high average age and the limitation that the samples selected.

The factors related to falls are substantial and interrelated, including previous history of falls, gait changes, osteoporosis, descending physical function, fear of falling, vision changes, impaired cognitive ability, urinary incontinence, cardiovascular problems, drug intake, fatigue, and environment.[35,36] The results in this study showed that falls were mainly related to function, comorbidities, and geriatric syndrome, including activities of daily living, moving balance ability, calf circumference, diabetes, eye disease, insomnia, dysphagia, malnutrition, frailty, and incontinence in univariate analysis. After multivariate logistic regression screening, only frailty, insomnia, and malnutrition were independent factors of fall, indicating that fall was highly correlated with these three senile syndromes. More attentions should be paid to these senile syndromes.

Frailty is a common elderly syndrome and a nonspecific state in which the anti-stress ability of elderly individuals decreases due to insufficient physiological reserve.[37] Its prevalence increases with age and is considered to be a predictor of adverse events associated with falls, disability, hospitalization, and death.[10,11] According to the study of Zhou et al.,[38] the higher the frailty index (FI value) of elderly individuals, the higher the risk of falling and the number of falls. Compared with other factors that cause falls, such as age and sex, the FI value has the greatest influence on the occurrence and increase in falls. Mai et al.[39] evaluated middle-aged and elderly hemodialysis patients to analyze the influencing factors of frailty and its impact on falls. The results showed that the risk of falls was significantly increased for frail elderly patients during dialysis. According to ROC analysis of frailty score and fall events, the area under the ROC curve was 0.79, suggesting that frailty score has a good predictive effect on fall occurrence. The above studies show that the higher degree of frailty is associated with the higher risk of falling, which may be related to the increased proportion of sarcopenia in patients with frailty and the resulting myasthenia.[40] This means that the risk of falling in the elderly should be predicted by evaluating the degree of frailty to develop targeted preventive measures, including resistance exercise, nutritional supplementation, drug therapy, etc., to reduce the occurrence of falls in elderly individuals.

Insomnia is one of the manifestations of sleep disorders. Research has showed that 49.4% of elderly people with sleep disorders in nursing homes have a high risk of falling. Sleep disorders can cause sarcopenia, which will gradually reduce the balance ability of elderly individuals, resulting in walking difficulties and other conditions.[41,42] The study of Liu et al.[43] found that elderly men with insomnia have a greater risk of falling. A meta-analysis on sleep disorders and fall risk in the elderly showed that sleep disorders increase the risk of fall in the elderly.[44] Takada et al.[45]

TABLE 4 Comparison of the prevalence of geriatric syndromes in the fall and non-fall groups.

Group	Non-fall group	Fall group	*P*
Constipation			
No	231 (72.0)	82 (63.1)	0.064
Yes	90 (28.0)	48 (36.9)	
Fecal incontinence			
No	313 (97.5)	124 (95.4)	0.239
Yes	8 (2.5)	6 (4.6)	
Pressure sore			
No	319 (99.4)	128 (98.5)	0.344
Yes	2 (0.6)	2 (1.5)	
Decreased vision			
Have no problem	120 (37.4)	40 (30.8)	0.328
Having problems that do not affect daily life	179 (55.8)	82 (63.1)	
Having problems that affect daily life	22 (6.9)	8 (6.1)	
Decreased hearing			
Have no problem	215 (67.0)	85 (65.4)	0.459
Having problems that do not affect daily life	80 (24.8)	30 (23.1)	
Having problems that affect daily life	26 (8.1)	15 (11.5)	
Polypharmacy (>5 kinds)			
No	190 (63.8)	68 (57.6)	0.245
Yes	108 (36.2)	50 (42.4)	
Sarcopenia			
Normal	163 (66.0)	65 (65.0)	0.860
Sarcopenia	84 (34.0)	35 (35.0)	
Insomnia			
Normal	165 (51.4)	54 (41.5)	0.045*
Suspicious insomnia	40 (12.5)	27 (20.8)	
Insomnia	116 (36.1)	49 (37.7)	
Senile dementia	25.28 ± 6.313	25.29 ± 4.947	0.989
Anxiety	3.08 ± 4.380	3.43 ± 4.446	0.445
Depression	2.50 ± 4.564	2.25 ± 4.586	0.598
Risk of dysphagia	1.50 ± 2.914	2.62 ± 4.856	0.003**
Pain	2.79 ± 1.569	2.83 ± 1.505	0.843
Malnutrition	11.34 ± 2.098	10.67 ± 2.277	0.003**
Frailty	1.60 ± 1.291	2.42 ± 1.256	0.000**
Urinary incontinence	2.00 ± 3.326	3.27 ± 4.470	0.001**

*$P < 0.05$, **$P < 0.01$.

noted that the frequency of insomnia can predict the fall risk of elderly individuals, which may be related to the unstable gait, poor balance, the use of sleep drugs, and the easy generation of anxiety. The study by Bian et al.[46] also showed that insomnia is an independent risk factor for falls. Attention should be given to sleep management of elderly individuals, and timely scientific intervention should be provided to prevent falls effectively.

Malnutrition has a high incidence in elderly patients and is an important factor affecting the therapeutic effect and health status of patients.[47] Trevisan et al.[48] noticed that malnutrition or the presence of malnutrition risk would aggravate aging, cause muscle atrophy and calcium loss, and increase the risk of falling. A study on elderly people in communities showed that nutritional status was an independent predictor of falls.[49] Li et al.[50] showed that malnutrition defined by a low MNA-SF score constituted the risk of falling in elderly hypertension patients combined with cerebral infarction. Malnutrition in the elderly is an independent risk factor for falls, which requires comprehensive intervention. The improvement of nutrition and fall prevention for the elderly is a comprehensive work that requires the attention and intervention of society, medical care, family nursing, and other parties.[51]

TABLE 5 Logistic regression analysis of influencing factors for fall.

Variable	*b*	S_b	Wald χ^2	*P*	OR	OR 95%CI	
						Lower limit	Upper limit
The ability of daily living activities							
Ability intact					1.000		
Mild dependence	−0.257	0.332	0.601	0.438	0.773	0.404	1.481
Moderate dependence	−0.141	0.603	0.054	0.816	0.869	0.267	2.831
Severe dependence	0.782	1.044	0.561	0.454	2.185	0.282	16.898
Mobile balance ability	−0.096	0.342	0.078	0.780	0.909	0.465	1.776
Calf circumference	−0.027	0.036	0.582	0.445	0.973	0.907	1.044
Diabetes	0.346	0.272	1.621	0.203	1.414	0.830	2.408
Eye disease	0.131	0.452	0.083	0.773	1.139	0.470	2.763
Insomnia	0.502	0.246	4.164	0.041*	1.652	1.020	2.676
Risk of dysphagia	0.322	0.329	0.959	0.327	1.380	0.724	2.630
Malnutrition							
Normal					1.000		
Malnutrition risk	0.097	0.280	0.119	0.730	1.101	0.636	1.909
Malnutrition	2.372	1.060	5.007	0.025*	10.719	1.342	85.593
Frailty	0.671	0.332	4.074	0.044*	1.955	1.020	3.750
Urinary incontinence	0.205	0.268	0.587	0.444	1.227	0.727	2.074

*$P < 0.05$.

At present, there are many reports on fall risk assessment and related risk factor analysis of the elderly population. The characteristic of this study is that the data of CGA are used for fall risk factor analysis. CGA is a welcome trend and a hot topic in geriatric medicine all over the world. It has clear advantages in preventing falls in older people.[10,11] Through long-term follow-up CGA, collaboration and ongoing follow-up management by a multidisciplinary team ensure comprehensive continuous assessment and regular flexible adjustment of interventions. Early risk comprehensive identification and personalized intervention by CGA will reduce the risk of falls and improve their quality of life and safety.[12]

5 | SUMMARY

This study showed that the incidence of falls is higher in outpatient and inpatient aged 65 years and over; frailty, insomnia, and malnutrition are independent risk factors for falls. Nutritional support, exercise rehabilitation, drug adjustment, and lifestyle change may be helpful in improving physical function and preventing falls.

The limitations of this study include a small sample size, the lack of grouping by number of falls, and that selected subjects are inpatient and outpatient elderly population. In future studies, the sample size and coverage should be expanded and the results should be analyzed in subgroups according to the number of falls to obtain more accurate results and provide a basis for the prevention of falls and early identification of fall risks in elderly.

AUTHOR CONTRIBUTIONS

Xiao Xun: The first draft of the paper, revised; Li Ling, Tai Hongyan, Yang Huijuan, Guo Chunbo, Cui Wei, Peng Lei: Data Collection; Liu Shunying: Research Guidance; Yu Renhe, Statistical Analysis of Data; Zhang Xiangyu: Research guidance, paper revision; Zhang Mengxi: Research guidance, financial support, paper writing and modification.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest related to this study.

ETHICS STATEMENT

This study is based on anonymous data obtained from the Comprehensive geriatric assessment (CGA) of Department of Geriatrics, the Second Xiangya Hospital, Central South University. The study were approved by Clinical Research Ethics Committee of the Second Xiangya Hospital of Central South University (Ethical Review [Clinical Research] No- 074/2022).

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REFERENCES

1. Swift CG. The role of medical assessment and intervention in the prevention of falls. *Age Ageing*. 2006;35:ii65-ii68. doi:10.1093/ageing/afl083
2. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Análise de Situação em Saúde. *Saúde Brasil 2011: uma análise da situação de saúde e de evidências selecionadas de impacto de ações de vigilância em saúde*. Ministério da Saúde; 2012. https://repositorio.unb.br/handle/10482/12834
3. Yan G, Jiping T, Ting M, Zhuoying P, Luning W. Investigation of the incidence and risk factors of falls in 792 elderly people stationed in Beijing. *Chin J Health Med*. 2023;25(1):51-54.
4. Herrero A, Cadore EL, Zambom-Ferraresi F, et al. Functional capacity, muscle fat infifiltration, power output, and cognitive impairment in institutionalized frail oldest old. *Rejuvenation Res*. 2013;16(5):396-403. doi:10.1089/rej.2013.1438
5. Cattelani L, Palumbo P, Palmerini L, et al. FRAT-up, a webbased fall-risk assessment tool for elderly people living in the community. *J Med Internet Res*. 2015;17(2):e41. doi:10.2196/jmir.4064
6. Zhang L, Ding Z, Qiu L, Li A. Falls and risk factors of falls for urban and rural community-dwelling older adults in China. *BMC Geriatr*. 2019;19:379. doi:10.1186/s12877-019-1391-9
7. Ellis G, Whitehead MA, Robinson D, O'Neill D, Langhorne P. Comprehensive geriatric assessment for older adults admitted to hospital: meta-analysis of randomised controlled trials. *BMJ*. 2011;343:d6553. doi:10.1136/bmj.d6553
8. St John PD, Hogan DB. The relevance of Marjory Warren's writings today. *Gerontologist*. 2014;54:21-29. doi:10.1093/geront/gnt053
9. Chen X, Yan J, Wang J, Yu P, Geriatric, Gerontology Branch of Chinese Medicine Association. Chinese expert consensus on the application of comprehensive geriatric assessment for the elderly. *Age Medicine*. 2018;1(2):100-105. doi:10.1002/agm2.12019
10. Efendioglu EM, Cigiloglu A, Ozturk ZA. The role of comprehensive geriatric assessment in predicting fall risk. *Ir J Med Sci*. 2023;192(1):303-310. doi:10.1007/s11845-022-02978-z
11. Magnuszewski L, Wojszel A, Kasiukiewicz A, Wojszel ZB. Falls at the geriatric hospital Ward in the context of risk factors of falling detected in a comprehensive geriatric assessment. *Int J Environ Res Public Health*. 2022;19(17):10789. doi:10.3390/ijerph191710789
12. Tricco AC, Thomas SM, Veroniki AA, et al. Comparisons of interventions for preventing falls in older adults: a systematic review and meta-analysis. *JAMA*. 2017;318(17):1687-1699. doi:10.1001/jama.2017.15006
13. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12(3):189-198. doi:10.1016/0022-3956(75)90026-6
14. Dhira TA, Rahman MA, Sarker AR. Validity and reliability of the Generalized Anxiety Disorder-7 (GAD-7) among university students of Bangladesh. *PLoS One*. 2021;16(12):e0261590. doi:10.1371/journal.pone.0261590
15. Thombs BD, Ziegelstein RC. Does depression screening improve depression outcomes in primary care? *BMJ*. 2014;348:g1253. doi:10.1136/bmj.g1253
16. Soldatos CR, Dikeos DG, Paparrigopoulos TJ. Athens insomnia scale: validation of an instrument based on ICD-10 criteria. *J Psychosom Res*. 2000;48(6):555-560. doi:10.1016/s0022-3999(00)00095-7
17. Boudreau SA, Badsberg S, Christensen SW, Egsgaard LL. Digital pain drawings: assessing touch-screen technology and 3D body schemas. *Clin J Pain*. 2016;32(2):139-145. doi:10.1097/AJP.0000000000000230
18. Belafsky PC, Mouadeb DA, Rees CJ, et al. Validity and reliability of the eating assessment tool (EAT-10). *Ann Otol Rhinol Laryngol*. 2008;117(12):919-924. doi:10.1177/000348940811701210
19. Kaiser MJ, Bauer JM, Ramsch C, et al. Validation of the mini nutritional assessment short-form (MNA-SF): a practical tool for identification of nutritional status. *J Nutr Health Aging*. 2009;13(9):782-788. doi:10.1007/s12603-009-0214-7
20. Thompson MQ, Theou O, Tucker GR, Adams RJ, Visvanathan R. FRAIL scale: predictive validity and diagnostic test accuracy. *Australas J Ageing*. 2020;39(4):e529-e536. doi:10.1111/ajag.12829
21. Chen LK, Woo J, Assantachai P, et al. Asian Working Group for Sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. *J Am Med Dir Assoc*. 2020;21(3):300-307. doi:10.1016/j.jamda.2019.12.012
22. Krhut J, Gärtner M, Mokris J, et al. Effect of severity of urinary incontinence on quality of life in women. *NeurourolUrodyn*. 2018;37(6):1925-1930. doi:10.1002/nau.23568
23. Unutmaz GD, Soysal P, Tuven B, Isik AT. Costs of medication in older patients: before and after comprehensive geriatric assessment. *Clin Interv Aging*. 2018;13:607-613. doi:10.2147/cia.s159966
24. Roberts HC, Denison HJ, Martin HJ, et al. A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardised approach. *Age Ageing*. 2011;40:423-429. doi:10.1093/aging/afr051
25. Mahoney FI, Barthel DW. Functional evaluation: the Barthel index. *Md State Med J*. 1965;14:61-65.
26. Lauretani F, Ticinesi A, Gionti L, et al. Short-physical performance battery (SPPB) score is associated with falls in older outpatients. *Aging Clin Exp Res*. 2019;31(10):1435-1442. doi:10.1007/s40520-018-1082-y
27. Junying L, Dongxia G, Fangwei L, et al. Current situation and influencing factors of falls among the elderly in China. *Med J Zhengzhou Univ*. 2020;5:662-667. doi:10.13705/j.issn.1671-6825.2020.07.052
28. Wang X, Yang X, Yuanyuan Z, Yanxia G. A meta-analysis of the incidence of falls among the elderly in Chinese communities. *Evid Based Nurs*. 2020;11:1149-1154.
29. Ning K, Haijun Y, Xiaomin L, et al. A meta-analysis of the incidence of falls in the elderly in China. *Chin J Evid Based Med*. 2022;22(10):1142-1148.
30. Brasil. *Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Envelhecimento e saúde da pessoa idosa/Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica*. Ministério da Saúde; 2006. http://bvsms. saude.gov.br/bvs/publicacoes/abcad19.pdf
31. Peel NM. Epidemiology of falls in older age. *Can J Aging*. 2011;30(1):7-19. doi:10.1017/S071498081000070X
32. Duarte GP, Santos JLF, Lebrão ML, Duarte YADO. Relationship of falls among the elderly and frailty components. *Rev Bras Epidemiol*. 2019;21(Suppl.2):e180017. doi:10.1590/1980-549720180017.supl.2
33. Dizhi L, Xiaolin N, Chunyuan J, et al. Analysis on the occurrence and risk factors of fall injury in elderly people. *Chin J Geriatr Health Med*. 2022;20(6):23-28.
34. Haifeng Y, Dani H. Hangzhou Fuyang district community elderly fall in the status quo and influencing factors of [J]. *J Prevent Med Jiangsu Province*. 2022;6:680-682 + 701. doi:10.13668/j.iSSN.1006-9070.2022.06.016
35. Granbom M, Clemson L, Roberts L, et al. Preventing falls among older fallers: study protocol for a two-phase pilot study of the multicomponent live life program. *Trials*. 2019;20:2. doi:10.1186/s13063-018-3114-5
36. Pellicer-García B, Antón-Solanas I, Ramón-Arbués E, García-Moyano L, Gea-Caballero V, Juárez-Vela R. Risk of falling and associated factors in older adults with a previous history of falls. *Int J Environ Res Public Health*. 2020;17:4085. doi:10.3390/ijerph17114085
37. Yuedi W, Lamei L, Zhenzhu W, et al. Research progress on the correlation between frailty and fall in the elderly. *Gen Pract Nurs*. 2021;19(24):3377-3380.doi:10.12104/j.issn.1674-4748.2021.24.015

38. Baiyu Z, Dongni Y, Yongkang T, et al. The relationship between fall occurrence and frailty among the elderly in Beijing. *Chin J Epidemiol*. 2018;39(3):308-312. doi:10.3760/cma.j.issn.0254-6450.2018.03.011
39. Cuifang M, Biyan Y, Cuiyun L. Analysis on the occurrence of frailty and prediction of fall in middle-aged and elderly hemodialysis patients. *J Clin Pathol Pathol*. 2019;39(7):1486-1492.
40. Ning Z, Wenling Z, Xiaohong L, et al. Cross-sectional analysis of frailty and muscle function evaluation in hospitalized elderly patients with coronary heart disease. *Chin J Integr Med*. 2019;58(4):265-269. doi:10.3760/cma.j.issn.0578-1426.2019.04.006
41. Cauley JA, Hovey KM, Stone KL, et al. Characteristics of self-reported sleep and the risk of falls and fractures: the Women's Health Initiative (WHI). *J Bone Miner Res*. 2019;34(3):464-474. doi:10.1002/jbmr.3619
42. Xueqi G, Yifan G, Jiao Y, et al. Study on risk factors of fall risk in elderly people with sleep disorder in nursing home. *J Nurs*. 2022;22:11-14. doi:10.16460/j.issn1008-9969.2022.22.011
43. Liu G, Xu S, Zhang T, et al. Analysis on the current situation and related factors of falls among the elderly in Nanshan District, Shenzhen. *Prevent Control Chronic*. 2022;30(11):855-859. doi:10.16386/j.cjpccd.issn.1004-6194.2022.11.012
44. Li X, Gao J, Zhao X, et al. Meta-analysis of sleep disorders and fall risk in elderly people. *Modern Prevent Med*. 2019;46(6):1040-1044. doi:10.3969/j.issn.1000-6729.2019.04.010
45. Takada S, Yamamoto Y, Shimizu S, et al. Association between subjective sleep quality and future risk of falls in older people: results from LOHAS. *J Gerontol A Biol Sci Med Sci*. 2018;73(9):1205-1211. doi:10.1093/gerona/glx123
46. Meng B, Qingqing F, Yufeng D. Relationship between fall risk and geriatric syndrome in community elderly people. *Pract Geriatr Med*. 2021;35(12):1249-1253. doi:10.3969/j.issn.1003-9198.2021.12.010
47. Xiyun G, Liming Z, Mengmeng Y, et al. Analysis of the correlation between nutritional status and fall risk in elderly patients. *Chin J Clin Health Care*. 2017;20(4):411-443. doi:10.3969/J.issn.1672-6790.2017.04.032
48. Trevisan C, Crippa A, Ek S, et al. Nutritional status, body mass index, and the risk of falls in community-dwelling older adults: a systematic review and meta-analysis. *J Am Med Dir Assoc*. 2019;20(5):569-582. doi:10.1016/j.jamda.2018.10.027
49. Chien MH, Guo HR. Nutritional status and falls in community-dwelling older people: a longitudinal study of a population-based random sample. *PLoS One*. 2014;9(3):e91044. doi:10.1371/journal.pone.0091044
50. Li Y, Libo S, Yuxiang L. Application of comprehensive assessment technique in fall risk analysis of elderly patients with hypertension complicated with cerebral infarction. *Chin J Mod Med*. 2021;23(5):47-50. doi:10.3969/j.issn.1672-9463.2021.05.012
51. Baiyu Z, Pulin Y. Fall of elderly people. *Chin J Epidemiol*. 2011;32(11):6. doi:10.3760/cma.j.issn.0254-6450.2011.11.003

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