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Article

A Study on the Social Determinants of Falls among Elderly People in Chinese Communities from the Perspective of Urban-Rural Differences - Based on the CHARLS Data

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Abstract: Objective: To understand the current situation of falls among community-dwelling elderly in China and analyze the influencing factors. Methods: The study was conducted on respondents aged 60 and above in the 2020 China Health and Retirement Longitudinal Study (CHARLS). χ^2 test, t test, and logistic regression analysis were used to analyze the influencing factors of falls among the elderly. Results: A total of 10,837 respondents were included, with 53.51% being female. The incidence of falls among community-dwelling elderly in 2020 was 22.22%. Among the social determinants, education level, family per capita income, marital status, family structure, family support, social participation, and medical accessibility were all major risk factors for falls among the elderly. Conclusion: The incidence of falls among community-dwelling elderly in China is relatively high, with gender and age differences. The influencing factors include both individual physiology and social determinants. Targeted intervention measures should be taken, focusing on key populations, and comprehensive and precise intervention strategies should be adopted to effectively prevent falls among the elderly scientifically and effectively.

Keywords: Fall; Community-dwelling elderly; Social determinants; CHARLS; Logistic regression analysis

1. Introduction

Falls are a significant cause of injury and death among the elderly, and their impact on the elderly has multi-dimensional characteristics. From an individual perspective, falls can lead to serious consequences such as fractures and brain injuries, and even trigger chain reactions such as long-term bedriddenness and disability [1-3]; from a social perspective, fall incidents not only increase the burden on medical resources but also pose severe challenges to the construction of an elderly-friendly society [4-5]. It is worth noting that the injuries caused by falls often have irreversible nature and have become one of the main public health problems affecting the health of community-dwelling elderly populations [6-7].

Elderly falls are the result of the combined effect of multiple factors, among which social determinants cannot be ignored. In China, the social determinants of falls among community-dwelling elderly people show significant differences between urban and rural areas [8]. According to statistics from the National Health Commission of China, the incidence of falls among elderly people aged 60 and above is approximately 30%, while in rural areas, this proportion may be higher, reaching over 40% [9-10]. This is related to factors such as the scarcity of medical resources in rural areas, poor health conditions of the elderly, complex living environments, aging rural infrastructure, and insufficient home care for the elderly [11-13]. Areas with higher rates of fall incidents in cities are usually communities

with a higher degree of aging and urban centers, which are related to social factors such as high population density, busy traffic, and aging public facilities, posing challenges to the formulation of public health policies and resource allocation [14-17].

This study conceptualizes falls as a multi-dimensional health outcome influenced by multiple factors such as social economic conditions, family environment, social participation, medical accessibility, and individual health characteristics. By combining national representative databases, comprehensive theoretical frameworks, and robust statistical analysis, it aims to provide reliable evidence for the social determinants of falls among community-dwelling elderly people in China. The research results are expected to promote the development of theories and evidence-based policy-making in the fields of healthy aging and fall prevention.

2. Method

2.1. Research Design

This study adopted a quantitative, observational and secondary data analysis design to explore the association between social determinants and falls among elderly residents in Chinese communities. The theoretical framework established by the overall design of the study is shown in Figure 1, and it was implemented through a systematic research procedure, including framework construction, data collection, sample selection, variable setting, statistical analysis, and result interpretation. This structured research process ensures consistency between the research objectives, analytical methods, and empirical evidence.

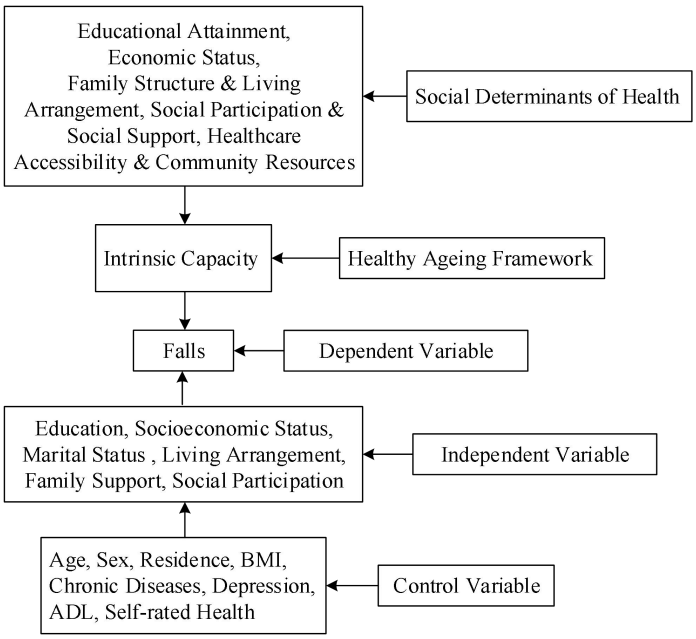

Figure 1. Research framework diagram

The research design was guided by three complementary theoretical perspectives: the Social Determinants of Health (SDH) framework, the World Health Organization's framework for healthy aging, and the ecological aging model. These theories jointly guided the selection of explanatory variables and the construction of the analytical framework. Falls were defined as the primary health outcome, while educational attainment, economic status, family structure and living arrangements, social participation and social support, medical accessibility, and community resources were identified as the primary social determinants. Demographic characteristics, lifestyle factors, and health-related variables were included as covariates to minimize potential confounding effects.

2.2. Data Sources

The data used in this article is from the 2020 Chinese Health and Retirement Longitudinal Study (CHARLS). CHARLS is a nationally representative longitudinal survey aimed at studying the health status, socioeconomic status, and aging process of middle-aged and elderly people in China. Organized by the National School of Development at Peking University, it has become one of the most authoritative

aging databases in China. The main goal of CHARLS is to provide high-quality representative data of China for analyzing issues such as population aging, chronic diseases, medical resource utilization, retirement, family support, social economic inequality, and healthy aging among Chinese adults aged 60 and above. The database contains a large amount of information on population characteristics, education level, employment history, family income, family structure, physical and mental health, health behaviors, medical utilization, social participation, community characteristics, and biomarker measurement results. CHARLS is an appropriate and reliable data source for studying the relationship between social determinants and falls among the elderly. The latest follow-up survey (in 2020) interviewed 19,395 people aged 45 and above. After exclusion screening, the sample size included in the analysis model was 10,837 people.

2.3. Variable Selection

2.3.1. Dependent Variable

The dependent variable of this study is falls, indicating whether the respondents experienced at least one fall during the specified recall period of the CHARLS survey.

Falls were measured through self-reported questionnaire items, asking the respondents if they had experienced a fall since the last interview. According to the definition of the World Health Organization, a fall refers to an unexpected event where an individual lands on the ground, floor, or a lower level unexpectedly. In the statistical analysis, the outcome variable was encoded as a binary variable: 0 = no fall; 1 = at least one fall. Since the dependent variable is binary, binary logistic regression was used to estimate the association between social determinants and the risk of falls.

2.3.2. Independent Variable

(1) Education level

Education level was included in the analysis as an indicator of social economic status, measured based on the highest level of formal education completed by the respondents as indicated in the CHARLS questionnaire. Education level is widely regarded as one of the fundamental social determinants influencing health, as it affects health literacy, employment opportunities, income, health behaviors, and accessibility to healthcare throughout one's life.

In the statistical analysis, education level was categorized into five categories according to the Chinese education system: non-formal education; primary school; junior high school; high school or vocational school; university and above. In the logistic regression model, the lowest education level (no formal education) was used as the reference category.

(2) Economic status

Economic status was evaluated by the per capita annual household income, calculated as the total household annual income divided by the number of family members. Per capita household income reflects the economic resources available to each family member and is widely used as an indicator of social economic status in epidemiological studies.

Household income shows a significant skewed distribution. The respondents were divided into four quartiles based on the distribution of per capita household income within the study population: Q1 (lowest income): below 10,000; Q2: 10,000 - 30,000; Q3: 30,000 - 50,000; Q4 (highest income): above 50,000.

(3) Marital status

Marital status was also regarded as an important social economic characteristic and was included as an additional indicator of economic and social support in the consideration. Respondents were classified as: married/cohabiting; widowed; divorced/separated; unmarried.

(4) Family Structure and Family Support

The family structure is measured based on the respondents' current living conditions. The living conditions are divided into several mutually exclusive categories to reflect the composition of family members. Family support is determined by whether the respondents receive economic support from their children, and all cases that receive support are coded as "yes", while those that do not receive support are coded as "no".

(5) Social Participation

Social participation is measured based on the respondents' participation in organized social activities during the reference period. According to previous CHARLS studies, any participation in social activities is coded as "yes", and no participation is coded as "no".

(6) Medical Accessibility

Medical accessibility is evaluated by indicators reflecting the respondents' access to medical services

and the availability of community health resources. 1 = Can obtain medical services promptly (high medical accessibility), 0 = Cannot obtain medical services promptly (low medical accessibility).

2.3.3. Covariates

To reduce potential confounding bias, multiple demographic and health-related variables that were consistently associated with falls in previous epidemiological studies were included as covariates in the multivariate regression analysis. These variables were selected based on previous literature, theoretical considerations, and the availability of data from the CHARLS 2020 survey. The covariates included age, gender, place of residence, number of chronic diseases, degree of limitation in activities of daily living (ADL), and depressive symptoms.

(1) Age

Age was based on the respondents' actual age at the time of the 2020 survey (unit: years). In the regression analysis, age was treated as a continuous variable. Due to the decline in muscle strength, balance ability, sensory function, and physiological reserves related to age, age has been one of the strongest predictors of falls. Age was divided into 4 groups: 60-79, 80-89, 90-100, and over 100.

(2) Gender

Gender was recorded as a binary variable based on the biological gender of the respondents. 0 = male, 1 = female. Relevant studies have shown that due to differences in body fat composition, osteoporosis, physical function, and health behaviors, the risk of falls varies significantly by gender.

(3) Place of residence

The place of residence was measured based on the respondents' current residence and classified into the following four categories: urban areas; suburban areas; rural areas; and special areas. Place of residence reflects differences in medical accessibility, socioeconomic status, built environment, and community resources, which may affect the risk of falls.

(4) Number of chronic diseases

The burden of chronic diseases was assessed based on the respondents' self-reported doctor-diagnosed chronic diseases in the CHARLS survey. A total of 14 chronic diseases were included, and the total number of diagnosed diseases was calculated by adding all positive responses. The higher the score, the greater the burden of chronic diseases.

(5) ADL Limitation

Functional status was evaluated using a six-item daily living activities scale (ADL) including dressing, bathing, eating, getting in or out of bed, using the toilet, and control of urination and defecation. If the respondents reported difficulties in one or more ADL items, they were classified as having ADL limitation and assigned a value of 1, otherwise assigned a value of 0.

(6) Depressive symptoms

Depressive symptoms were measured using the 10-item Center for Epidemiologic Studies Depression Scale (CES-D-10). According to the standard scoring method, positive statements were reverse-coded and added together. The higher the score, the more severe the depressive symptoms.

2.4. Statistical Analysis

Through statistical analysis, the association between social determinants and falls among elderly residents in Chinese communities was investigated. All analyses were conducted according to the pre-defined analytical strategy. Firstly, descriptive statistics were used to summarize the sample characteristics; then, univariate analysis was performed to compare the differences between respondents with and without falls; finally, a binary logistic regression model was established to identify the independent association between social determinants and fall risk, while adjusting for potential confounding variables. Continuous variables were summarized using the mean and standard deviation (SD) or median and interquartile range (IQR) depending on the data distribution; categorical variables were expressed as frequencies and percentages.

(1) Descriptive analysis

Descriptive statistical methods were used to summarize the demographic characteristics of the respondents, including age, socioeconomic status, family characteristics, social participation, medical accessibility, and health status. For categorical variables, frequencies and percentages were calculated; for continuous variables, mean and standard deviation or median and interquartile range were used for summarization.

(2) Univariate analysis

Univariate analysis was used to compare the differences between respondents with and without a history of falls. For categorical variables, the chi-square test was used for comparison; for continuous variables, independent sample t-test or Mann-Whitney U test was selected based on the normality of the

data. Variables with a P value less than 0.05 and statistically significant, as well as those considered epidemiologically important based on previous literature, were included in the multivariate logistic regression model.

(3) Binary logistic regression analysis

Since the outcome variable (fall) was binary, binary logistic regression analysis was used to estimate the independent association between social determinants and falls. Three regression models were constructed in this study: Model 1, the unadjusted rough model; Model 2, the adjusted for demographic variables; Model 3, the fully adjusted model, which controlled for chronic disease burden, limitations in daily living activities, and depressive symptoms. The fully adjusted model was regarded as the main model for explaining the independent association between social determinants and falls.

(4) Multicollinearity diagnosis

Before conducting the regression analysis, variance inflation factor (VIF) was used to assess multicollinearity among the independent variables. If the VIF value was below 10 and the tolerance value was above 0.10, severe multicollinearity was considered not to exist.

(5) Statistical significance and software

All statistical analyses were conducted using IBM SPSS Statistics 27.0 version. All statistical tests were two-tailed, and a P value less than 0.05 was considered statistically significant.

3. Result

3.1. Descriptive Statistics

Among the 10,837 elderly individuals aged 60 and above included in the analysis, 5,802 were female (53.51%); 32.62% were aged 60 to 79; and 49.23% lived in rural areas. The incidence of falls in 2017-2018 was 22.22%. The descriptive statistics of other variables are shown in Table 1.

Table 1. Descriptive Statistics of Variables

Variable	Item	N=10837	%
Falls	0	8429	77.78
	1	2408	22.22
Educational attainment	Non-formal education	1869	17.25
	Primary school	3068	28.31
	Junior high school	4056	37.43
	High school or vocational school	1348	12.44
	University degree or above	496	4.58
Household income per capita	Less than 10,000 Yuan	4265	39.36
	10000-30000 Yuan	3157	29.13
	30000-50000 Yuan	2609	24.07
	More than 50,000 Yuan	806	7.44
Marital status	Married/cohabiting	2765	25.51
	Widowed	4883	45.06
	Divorce/separation	2195	20.25
	Unmarried	994	9.17
Living arrangement	Living alone (single household)	2197	20.27
	Live only with one's spouse	4906	45.27
	Live with children (peers)	3080	28.42
	Intergenerational living	654	6.03
Family support	Yes	8528	78.69
	No	2309	21.31
Social participation	Yes	6717	61.98
	No	4120	38.02
Healthcare accessibility	0	4525	41.76
	1	6312	58.24
Age	60-79	3535	32.62
	80-89	2728	25.17
	90-100	2450	22.61
	Over 100	2124	19.60
Gender	0	5035	46.46
	1	5802	53.54
Residence	Urban area	2850	26.30
	Suburban areas	2620	24.18
	Rural areas	5335	49.23
	Special areas	32	0.30
Chronic disease burden	-	-	-
ADL limitation	0	4928	45.47
	1	5909	54.53
Depressive symptoms	-	-	-

3.2. Single Factor Analysis

The results of the single-factor analysis are shown in Table 2. The results indicate that there are

statistically significant differences in the fall rates among different educational levels, annual household income, marital status, family structure, social participation, accessibility of medical care, family support, age, gender, place of residence, and ADL limitations ($P < 0.05$).

Table 2. Univariate analysis Results of Falls among Elderly People in the Community

Variable	Item	Group		t / χ^2	P
		Fall (N1=2408)	Non-fall (N2=8429)		
Educational attainment	Non-formal education	483(20.06)	1386 (16.45)	4.224	0.035
	Primary school	655(27.20)	2413 (28.63)		
	Junior high school	835(34.68)	3221 (38.22)		
	High school or vocational school	326(13.54)	1022 (12.13)		
	University degree or above	109(4.53)	387 (4.59)		
Household income per capita	Less than 10,000 Yuan	899(37.33)	3366(39.93)	19.283	< 0.001
	10000-30000 Yuan	606(25.17)	2551(30.26)		
	30000-50000 Yuan	483(20.06)	2126(25.22)		
	More than 50,000 Yuan	420(17.44)	386(4.58)		
Marital status	Married/cohabiting	384(15.95)	2381(28.25)	18.557	< 0.001
	Widowed	783(32.52)	4100(48.64)		
	Divorce/separation	678(28.16)	1517(18)		
	Unmarried	563(23.38)	431(5.11)		
Living arrangement	Living alone (single household)	1324(54.98)	873(10.36)	63.760	< 0.001
	Live only with one's spouse	564(23.42)	4342(51.51)		
	Live with children (peers)	425(17.65)	2655(31.5)		
	Intergenerational living	95(3.95)	559(6.63)		
Family support	Yes	1811(75.21)	6717(79.69)	22.783	< 0.001
	No	597(24.79)	1712(20.31)		
Social participation	Yes	1485(61.67)	5232(62.07)	3.935	0.032
	No	925(38.41)	3195(37.9)		
Healthcare accessibility	0	1009(41.9)	3516(41.71)	3.772	0.048
	1	1399(58.1)	4913(58.29)		
Age	60-79	384(15.95)	3151(37.38)	138.25	< 0.001
	80-89	489(20.31)	2239(26.56)		
	90-100	608(25.25)	1842(21.85)		
	Over 100	927(38.5)	1197(14.2)		
Gender	0	925(38.41)	4110(48.76)	20.52	< 0.001
	1	1483(61.59)	4319(51.24)		
Residence	Urban area	518(21.51)	2332(27.67)	5.238	0.032
	Suburban areas	558(23.17)	2062(24.46)		
	Rural areas	1326(55.07)	4009(47.56)		
	Special areas	6(0.25)	26(0.31)		
ADL limitation	0	680(28.24)	4248(50.4)	49.856	< 0.001
	1	1728(71.76)	4181(49.6)		

3.3. Logistic Regression Analysis

The results of the Logistic regression analysis, using the 9 significant influencing factors from the single-factor analysis, as well as the number of chronic diseases (continuous variable) and depressive symptoms (continuous variable) as independent variables, are shown in Table 3. Model 1 is the unadjusted rough model, and gender, age, and place of residence have a significant impact on the falls of the elderly ($p < 0.001$). Among them, women are 1.256 times that of men; as the age increases, the risk of falls for the elderly also gradually rises. The elderly living in rural areas have a significantly higher risk of falls than those living in cities and suburbs ($p < 0.001$). Model 2 adds social determinants on the basis of Model 1, and multiple aspects reflect that social determinants have a significant impact on the risk of falls for the elderly. Among them, family per capita income, marital status, family structure, and medical accessibility are significant at 0.001; education level and social participation are significant at 0.01; family support is significant at 0.05. Model 3 is the fully adjusted model, and at the same time controls for the burden of chronic diseases, limitations in daily life activities, and depressive symptoms. It can be seen that the direction and significance of the influence of social determinants variables have not changed significantly, and the model has the highest explanatory power and the best fit index,

indicating that the falls of community-dwelling elderly are the result of the combined effect of multiple risk factors.

Table 3. Logistic Regression Analysis (OR) of Falls among Elderly People in the Community

Variable		Model 1	Model 2	Model 3
Basic situation	Age	1.342***	1.320***	1.284***
	Gender	1.256***	1.189***	1.256***
	Residence	1.320***	1.332***	1.181***
Social determinants	Educational attainment		1.001**	1.016***
	Household income per capita		0.926***	0.996***
	Marital status		1.124***	1.118***
	Living arrangement		0.809***	0.816***
	Family support		0.725*	0.731*
	Social participation		0.918**	0.932**
Health condition	Healthcare accessibility		1.114***	1.201***
	Chronic disease burden			1.205***
	ADL limitation			1.272***
	Depressive symptoms			1.234***
Log-likelihood ratio		14733.251	14354.243	24286.997
Cox & Snell R^2		0.025	0.041	0.053
Nagelkerke R^2		0.034	0.073	0.085

Note: * p <0.05, ** p <0.01, *** p <0.001.

4. Discussion

This study investigated the influencing factors of falls among 10,837 elderly people in Chinese communities. The results showed that the incidence of falls in the past year was 22.22%. Women had a higher risk of falling than men, and age was a risk factor for falls among the elderly, which was consistent with the research results of Huang et al. [18]. Relevant studies suggest that elderly women have a higher rate of bone loss than men, which may be the reason for their higher risk of falling. With the increase in age, the body of the elderly shows varying degrees of degenerative changes in physiological structure and function, typically manifested as certain degrees of decline in the central and peripheral nervous systems and the musculoskeletal system. Elderly women and elderly people with advanced age should receive more attention to the occurrence of falls.

The study results show that economic conditions are one of the important social determinants for elderly people to fall. Elderly people with lower economic levels are more likely to fall. This may be because the social economic status causes health inequality, which leads to the emergence of fall differences. In the current context of "Healthy China" and "Targeted Poverty Alleviation" strategies, efforts should be strengthened to prevent falls among elderly people with lower social economic status to avoid "falling back into poverty" or "falling into poverty" due to illness, and to enhance the health resilience of such groups [19]. Additionally, the study results show that chronic diseases are one of the most important biological risk factors for elderly people to fall. As people age, the prevalence of coexisting diseases significantly increases, and the coexistence of multiple chronic diseases may affect activity ability, balance, muscle strength, sensory function, and cognitive performance, thereby increasing the risk of falls. Unlike age and gender, chronic diseases affect the risk of falls through multiple physiological pathways, including neuromuscular dysfunction, cardiovascular instability, visual impairment, pain, fatigue, and functional decline.

For elderly people living in communities, the home is not only a place of residence but also the main venue for daily activities, such as walking, bathing, cooking, and going up and down stairs. Therefore, inadequate housing conditions or environmental hazards may significantly increase the risk of falls, especially for those with declining physical function, impaired vision, or limited mobility. This study found that the fall rate of elderly people in rural communities was significantly higher than that of those in urban or suburban communities. Based on the analysis of the Chinese Health and Retirement Longitudinal Study (CHARLS), it further indicates that living characteristics, including bathroom facilities, housing quality, and living arrangements, may indirectly affect the risk of falls through their impact on physical activity, functional independence, and psychological well-being [20]. Elderly people living in low-quality housing in rural areas may face more environmental barriers, while those living in urban or suburban areas suitable for the elderly are more likely to maintain independence, mobility, and confidence in daily activities.

Education is widely regarded as one of the most important social determinants of health (SDOH) and

is considered a fundamental upstream factor of lifelong health inequality. Unlike biological or behavioral risk factors, education shapes an individual's social economic status through its influence on employment opportunities, income, health literacy, social capital, and access to health-promoting resources, thereby having a long-term impact on health and well-being. According to the conceptual framework of health social determinants of the World Health Organization, education is classified as a structural determinant because it determines social economic status and thereby affects intermediate determinants including material living conditions, psychosocial environment, health-related behaviors, and access to healthcare. Therefore, education level exacerbates health inequality through multiple interrelated pathways, rather than functioning solely as a single risk factor. Compared to other indicators of social economic status, education level has several methodological advantages in epidemiological studies. Education is usually completed in early adulthood and remains relatively stable throughout one's life, making it less susceptible to the reverse causality caused by deteriorating health conditions in later years. This study found that educational attainment is also one of the social determinants influencing the risk of falls among community-dwelling elderly individuals. Elderly individuals with higher educational attainment typically have better health literacy, healthier behavioral patterns, more active utilization of preventive medical services, and better maintenance of physical and cognitive functions in later life, resulting in a lower fall rate. In contrast, individuals with lower educational attainment may accumulate unfavorable factors in terms of health knowledge, disease management, and accessibility to medical care, thereby increasing the risk of falls.

Access to healthcare is one of the main mechanisms through which economic status affects the risk of falls among the elderly. This study found that the accessibility of healthcare has a significant impact on the risk of falls among the elderly. Access to healthcare not only includes the accessibility of medical services but also whether individuals can promptly obtain preventive, diagnostic, therapeutic, and rehabilitative care. Elderly individuals with higher income or greater family wealth typically face fewer financial barriers in utilizing healthcare, enabling them to manage chronic diseases continuously and participate in preventive intervention measures to reduce the risk of falls. The accessibility of healthcare plays a crucial mediating role between economic status and fall risk. Financial resources affect the availability and utilization of preventive, therapeutic, and rehabilitative medical services, thereby shaping long-term health trajectories and functional capabilities. Therefore, improving the fairness of access to healthcare for economically disadvantaged elderly individuals may become an important strategy to reduce the social and economic inequality in fall risk.

5. Conclusion

The results of this study show that the risk of falls among community-dwelling elderly people aged 60 and above in China is 22.22%. The influencing factors are numerous and complex. Besides basic factors such as gender and age, physiological factors such as chronic diseases and limitations in activities of daily living, social determinants are also factors influencing the risk of falls among community-dwelling elderly people. These include education level, family per capita income, marital status, family structure, family support, social participation, and medical accessibility, all of which have a significant impact on the risk of falls among community-dwelling elderly people. Therefore, it is necessary to effectively enhance social support for the elderly population and contribute to the "Healthy China" development strategy.

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