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Prevalence and risk factors of hip fracture in a middle-aged and older Chinese population

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ABSTRACT

Summary: The prevalence of hip fracture and associated risk factors in China were evaluated in a Health and Retirement Longitudinal Study. There is an apparent geographic variation in the prevalence of hip fracture in China. Advanced age, West region, lower education, under-weight, having self-reported history of chronic lung diseases, heart diseases, stroke, and arthritis appear to be associated with risk of hip fracture.

Introduction: The aim of this study is to estimate the prevalence of hip fracture and to identify its risk factors in China.

Methods: Using the national survey data collected from the China Health and Retirement Longitudinal Study (CHARLS), we estimated the prevalence of hip fracture, considering the complex survey design and response rate. We applied the weighted logistic regression analysis to identify risk factors associated with hip fracture employing cross-sectional study designs.

Results: Among 20,110 respondents included in the analysis, there were 431 hip fractures. The overall prevalence of hip fracture among middle-aged and older Chinese adults was 2.36%. From those aged < 50 years to 60–69 years, the prevalence of hip fracture did not increase with age, but significantly increased after the age of 70; 1.62% for those aged < 50 years and 5.42% for those aged ≥70 years. East, South-Central, South-West, and North-West region had a higher prevalence of hip fracture than North and North-East region. Compared with underweight, obesity (OR 0.37 [95% CI 0.20–0.69]) was associated with a lower likelihood of hip fracture. A self-reported history of chronic lung diseases (OR 2.11 [95% CI 1.51–2.96]), heart diseases (OR 1.36 [95% CI 1.00–1.85]), stroke (OR 2.30 [95% CI 1.08–4.92]), and arthritis (OR 2.30 [95% CI 1.08–4.92]) were significantly correlated with hip fracture.

Conclusions: There is an apparent geographic variation in the prevalence of hip fracture in China. Advanced age, West region, lower education, under-weight, having self-reported history of chronic lung diseases, heart diseases, stroke, and arthritis appear to be associated with risk of hip fracture. Understanding the geographic variations in hip fracture prevalence is important for allocation of healthcare resources. Knowing the reasons for hip fracture is necessary to implement a comprehensive policy for hip fracture prevention in China.

1. Introduction

Hip fracture is a major public health problem mainly affecting older people. It often leads to premature death, considerable disability, loss of independence, and reduced quality of life [1]. Hip fracture is uncommon in younger years since the incidence of fractures is strongly associated with increasing age, particularly after the age of 70 [2,3]. The consequences of hip fractures in older people require hospitalization and health care, which impose substantial economic burden on their families, the health-care system and societies [4–6]. Considering the significant morbidity, mortality and health care costs associated with hip fractures, it is important to understand risk factors of hip fracture, so that preventive measures may be developed for patients, physicians, and public health planners.

The prevalence rate of hip fracture increased due to population aging [7,8]. It has been predicted that the number of persons suffering hip fracture will reach over 6.26 million by 2050, about 50% of them in the world will occur in Asia [9]. The demographics of world populations changed, with more elderly living in developing countries. It is estimated that in 2050 the whole world's aging population (60 years and older) will reach 2.02 billion, China will reach 0.48 billion, accounting for almost 25% of the world's aging population, as the country

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with the most aging population in the world [10].

Some studies have reported that increasing age, female sex, remote region, low socioeconomic status (SES), low body mass index (BMI), having some chronic diseases, reduced cognitive function, impaired balance, physical inactivity, and falls were risk factors of hip fractures [2,11]. Meanwhile, hip fracture rates vary markedly between populations. Studies have demonstrated geographic variation in hip fracture rates between countries, and in different regions in the same country [12–17]. One study reported that the highest hip fracture rates are seen in North Europe and the US, and lowest in Latin America and Africa. Asian countries such as Kuwait, Iran, China, and Hong Kong show intermediate hip fracture rates [13]. In China, the epidemiology and the geographic variations in hip fracture in older ages is unclear. Therefore, this study aims to provide important clues for the health commission to establish a decision-making by comprehensively overviewing the hip fracture. This study is the first investigation of the prevalence and risk factors of hip fracture using national samples in China. This review will serve as an update of the epidemiology of hip fracture in China, with special emphasis on the geographic variations and risk factors. The understanding features of this geographic variation will help policy makers develop strategies to reduce the burden of hip fractures in China.

2. Methods

2.1. Study population and design

The China Health and Retirement Longitudinal Study (CHARLS) is a nationally representative longitudinal survey of the middle-aged and elderly population (45 years old and above) in China. The Cohort Profile reported the detailed methodology description of the CHARLS [18]. In brief, the national baseline survey for the CHARLS study was fielded between June 2011 and March 2012, and the respondents were followed every two years through a face-to-face computer-assisted personal interview (CAPI). Over the time, loss to follow occurred, and new respondents were added. Thus, 17,708 respondents were interviewed in 2011, 18,605 respondents were interviewed in 2013, and 21,095 were interviewed in 2015. CHARLS collected data on the demographic information, household roster, family, health status and function, health care and insurance, work, retirement and pension, income, expenditures, assets, housing characteristics, interviewer observation, physical measurements at every follow up, and information on blood-sample collection at every two follow-up cycles.

In the CHARLS, the four-stage (county, neighborhood, household and respondent level), stratified, random sampling design was applied to select eligible individuals. In the first stage, 150 counties from 28 provinces were randomly selected with a probability-proportional-to-size (PPS) according to region, rural/urban status and the level of economic development (gross domestic product per capita). In the second stage, three primary sampling units (PSUs) were randomly selected in the county-level unit with the PPS, administrative villages (cun) in rural areas and neighborhoods (shequ) in urban areas used as PSUs. In the third stage, a random sample of 24 households were selected on the basis of maps using the "CHARLSGIS" software package within each PSU. Finally, for the respondent-level sampling process, if a selected household had more than one member aged 45 years or older, one such member was randomly chosen, we interviewed both that member and his or her spouse.

2.2. Data collection

We used data collected in the 2015 CHARLS. Information on hip fracture was based on self-reports. The hip fracture is defined by new interviewees according to one question "Have you ever fractured your hip?" or "Have you fractured your hip since the last interview?", if the respondent answered "yes" to this question, it is concluded that they have a hip fracture. It is then categorized as "yes" or "no".

The age is grouped into < 50 years, 50–59 years, 60–69 years, and ≥ 70 years. The region type of their residence is categorized into 6 groups according to the geographical location (Fig. 1), i.e., East (Shanghai, Shandong, Jiangsu, Zhejiang, Fujian, Anhui, and Jiangxi), North (Beijing, Tianjin, Hebei, Shanxi, and Inner Mongolia), North-East (Liaoning, Jilin, and Heilongjiang), North-West (Shaanxi, Gansu, Qinghai, and Xinjiang), South-Central (Henan, Hubei, Hunan, Guangdong, and Guangxi), and South-West (Chongqing, Sichuan, Guizhou, and Yunnan). Hainan, Ningxia, Taiwan, Xianggang, Aomen, and Tibet were not included in this survey. The characteristics of the 6 geographic regions are shown in Appendix Table 1. The area type of their residence is categorized as "urban" or "rural" according to National Bureau of Statistics (NBS). An urban area is located in the city or city suburb, town or town suburb, or other non-agricultural industries, and accounted for $> 70\%$ of the special areas such as special economic zone, state-owned agricultural enterprises, etc. The other area is the rural area. Education is categorized as "no formal education", "elementary school", "middle school", and "high school or Vocational school or higher". Weight (kg) and height (cm) were measured while the respondent was dressed without shoes. BMI is calculated as the individual's weight divided by the square of the height (kg/m^2), and BMI group is categorized into 4 groups (< 18.5, 18.5–24.9, 25.0–29.9, ≥ 30).

Information on other health conditions was based on self-reports. Respondents were asked whether they had been diagnosed with any one of the following listed health status: hypertension, dyslipidemia, diabetes, cancer (excluding minor skin cancers), chronic lung diseases, liver diseases (except for fatty liver), heart diseases (heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems), stroke, kidney disease, stomach or other digestive diseases, psychiatric problems, memory-related diseases, and asthma. The chronic lung diseases, liver diseases, kidney disease, and digestive diseases are not included with tumors or cancer. Respondents who answered "yes" to these questions are defined as having these doctor-diagnosed conditions, and then are categorized as "yes" or "no".

2.3. Statistical analysis

The prevalence of hip fracture is calculated considering the complex survey design and non-response rate. The Proc Surveyfreq procedure (SAS 9.4; SAS Institute) is used to calculate the overall and gender-specific prevalence of hip fracture using the inverse probability weighting method. Categorical variables are shown as percentage. The χ^2 test is used to analyze the difference for categorical variables. In order to explore factors associated with the prevalence of hip fracture, we build two models using the Proc Surveylogistic procedure in SAS version 9.4, consider the complex survey design and non-response rate. Variables in model 1 include the variables: gender, age, area, region, education, and BMI group. Variables in model 2 include the model 1 variables and self-reported history of some disease. Odds ratios (ORs) and 95% CIs were presented for variables in the models. For all analyses, the α level was set at ≤ 0.05 (two-tailed).

3. Results

Although 21,095 individuals were surveyed in the 2015 CHARLS study, 20,110 respondents had complete data, answered the hip fracture question and had the weight value (Table 1). Among these 20,110 respondents, 431 had hip fracture (229 were women, 202 were men), 19,679 did not have hip fracture, the mean age was 62.0 years (SD = 10.4) and 50.6% lived in urban areas.

3.1. Prevalence of hip fracture

The overall and sex-specific prevalence of hip fracture was shown in

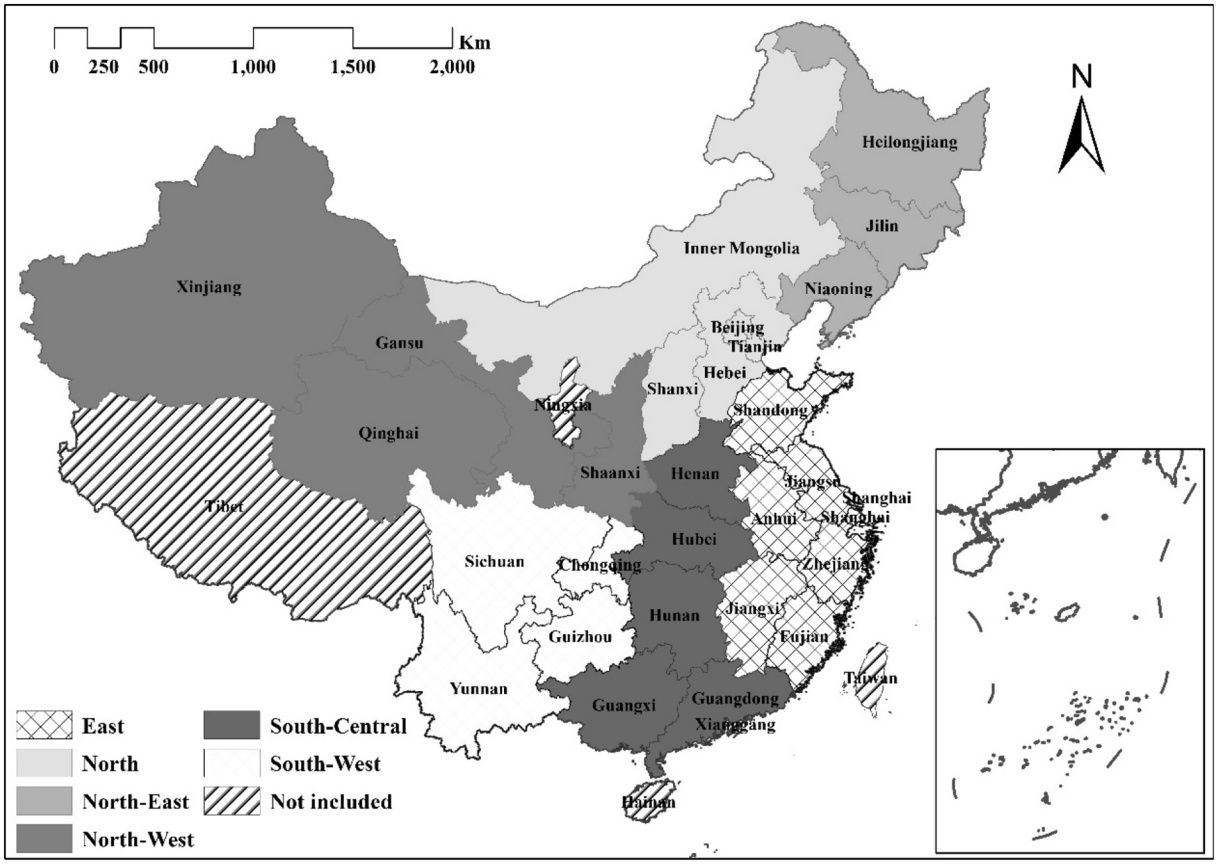

Fig. 1. The boundaries of the six different regions in China.

Table 2. The overall prevalence of hip fracture was 2.36%, which was 2.64% among females and 2.06% among males. For those aged < 50 years to 60–69 years, the prevalence of hip fracture did not increase with age, but significantly increased after the age of 70, 1.62% for those aged < 50 years and 5.42% for those aged ≥70 years. The urban area of the prevalence (2.37%) was as much as the rural area (2.34%). The East, South-Central, North-West, and South-West region had a greater prevalence of hip fracture than the North and North-East region. Prevalence was much higher among respondents who had received less years of education, also much higher among respondents who had lower BMI. The prevalence of hip fracture was higher among respondents affected with physician-diagnosis diseases (i.e. hypertension, dyslipidemia, diabetes, chronic lung diseases, liver diseases, heart diseases, stroke, kidney disease, digestive diseases, psychiatric diseases and asthma) compared with that among respondents not being affected with physician-diagnosis diseases.

We calculated the prevalence of hip fracture of provinces, and marked it on the map in Fig. 2, and we can easily visualize three provinces with the lowest prevalence (< 1%), which are Beijing, Liaoning, and Tianjin. There is one province with the greatest prevalence (> 5%), which is Qinghai (5.08%).

3.2. Cross-sectional analysis

On univariate weighted analyses, age, education, self-reported history of hypertension, chronic lung diseases, heart diseases, stroke, kidney disease, digestive diseases, psychiatric diseases, arthritis, and asthma were significantly associated with hip fracture (Table 1). As shown in Table 3, age, region, education, BMI group, self-reported history of chronic lung diseases, heart diseases, stroke, and arthritis significantly differed between people with and without hip fracture on multivariate weighted analyses. Compared with subjects aged < 50 years, the adjusted OR was 2.18 (95% CI 1.48–3.21) for those aged ≥70 years. In addition, East, South-Central, and North-West region had a greater prevalence of hip fracture than North region. Higher education level was associated with less likelihood of hip fracture. Compared with underweight, obesity (OR 0.37 [95% CI 0.20–0.69]) was associated with a lower likelihood of hip fracture. Having self-reported history of chronic lung diseases (OR 2.11 [95% CI 1.51–2.96]), heart diseases (OR 1.36 [95% CI 1.00–1.85]), stroke (OR 2.30 [95% CI 1.08–4.92]) and arthritis (OR 2.30 [95% CI 1.08–4.92]) were associated with a higher likelihood of hip fracture.

4. Discussion

Using data collected from the CHARLS, a national population survey, we aimed to describe the prevalence of self-reported hip fracture history among Chinese adults aged ≥45 years and to examine factors associated with self-reported hip fracture history. We calculated the prevalence of self-reported hip fracture history of provinces, and knew which provinces had the lowest prevalence, and which provinces had the greatest prevalence. To our knowledge, this is the first study to estimate the self-reported hip fracture history prevalence among this population. Further, the cross-sectional study analyses demonstrated that age, region, education, BMI group, having self-reported history of chronic lung diseases, heart diseases, stroke, and arthritis were associated with self-reported hip fracture history. Understanding geographic variation in the prevalence of hip fracture and the reasons for hip fracture would contribute to better healthcare planning and developing strategies for prevention of hip fracture in China.

In our study, the prevalence of self-reported hip fracture history was found to be 2.36% overall, 2.64% in females and 2.06% in males. One study using data from the Health and Retirement Study reported lower hip fracture prevalence, which was 1.3% in the previous two years at

Table 1
Characteristics of the respondents by hip fracture in cross-sectional study (Values are the weighted percentage of hip fracture).

Variables	Hip fracture		*P*-value
	Yes(n = 431)	No(n = 19,679)	
Gender			0.1557
Male	41.33	47.63	
Female	58.67	52.37	
Age,years			< 0.0001
< 50	14.15	15.40	
50–59	22.74	31.34	
60–69	26.45	31.73	
≥70	36.66	21.53	
Area			0.8940
Urban	51.21	50.59	
Rural	48.79	49.41	
Region			0.1394
North	9.98	12.77	
East	31.32	31.50	
North-East	2.78	7.31	
South-Central	22.51	23.61	
North-West	11.60	7.61	
South-West	21.81	17.20	
Education			< 0.0001
No formal education	30.34	21.79	
Elementary school	42.96	40.19	
Middle school	18.69	24.58	
High school or vocational school or higher	8.01	13.44	
BMI group			0.0911
< 18.5	32.00	27.12	
18.5–24.9	44.24	45.00	
25.0–29.9	20.71	23.39	
≥30	3.06	4.49	
Hypertension			0.0026
Yes	42.96	29.04	
No	57.04	70.96	
Dyslipidemia			0.1452
Yes	19.02	13.79	
No	80.98	86.21	
Diabetes			0.0507
Yes	12.32	8.39	
No	87.68	91.61	
Chronic lung disease			0.0003
Yes	24.61	9.81	
No	75.39	90.19	
Liver disease			0.2222
Yes	26.66	13.70	
No	73.34	86.30	
Heart disease			0.0040
Yes	8.92	2.84	
No	91.08	97.16	
Stroke			0.0021
Yes	11.24	6.42	
No	88.76	93.58	
Kidney disease			0.0019
Yes	29.96	21.66	
No	70.04	78.34	
Digestive disease			0.0296
Yes	26.66	13.70	
No	73.34	86.30	
Psychiatric disease			0.0013
Yes	3.75	1.51	
No	96.25	98.49	
Arthritis			< 0.0001
Yes	50.85	30.43	
No	49.15	69.57	
Asthma			< 0.0001
Yes	8.25	3.97	
No	91.75	96.03	

Table 2
Prevalence of self-reported history of hip fracture by age, area, region, education, BMI group, activities and chronic disease (Values are the weighted prevalence of hip fracture).

Variables	Prevalence		
	Women	Men	Total
Total	2.64	2.06	2.36
Age, years			
< 50	1.52	1.80	1.62
50–59	1.19	1.39	1.29
60–69	1.59	1.58	1.58
≥70	6.92	3.81	5.42
Area			
Urban	2.82	1.88	2.37
Rural	2.44	2.24	2.34
Region			
North	1.66	1.64	1.65
East	3.12	1.78	2.48
North-East	1.32	0.66	1.01
South-Central	2.66	2.28	2.47
North-West	3.24	2.63	2.96
South-West	2.76	2.92	2.83
Education			
No formal education	4.61	2.32	4.14
Elementary school	2.66	3.01	2.83
Middle school	0.99	1.73	1.41
High school or vocational school or higher	0.80	1.16	1.02
BMI group			
< 18.5	3.56	2.19	2.87
18.5–24.9	2.07	1.82	1.94
25.0–29.9	2.67	2.51	2.60
≥30	1.30	1.08	1.23
Hypertension			
Yes	4.03	2.86	3.49
No	2.07	1.72	1.90
Dyslipidemia			
Yes	4.01	2.44	3.26
No	2.42	1.99	2.21
Diabetes			
Yes	4.00	2.78	3.44
No	2.48	2.00	2.25
Chronic lung disease			
Yes	7.96	3.85	5.77
No	2.12	1.83	1.98
Liver disease			
Yes	8.44	1.45	4.35
No	2.44	2.10	2.27
Heart disease			
Yes	5.93	2.26	4.52
No	1.99	2.03	2.01
Stroke			
Yes	5.57	8.02	7.10
No	2.58	1.82	2.22
Kidney disease			
Yes	5.01	3.36	4.10
No	2.50	1.95	2.24
Digestive disease			
Yes	3.68	2.68	3.26
No	2.31	1.91	2.11
Psychiatric disease			
Yes	6.49	4.77	5.74
No	2.58	2.03	2.32
Arthritis			
Yes	3.79	4.12	3.92
No	2.02	1.34	1.67
Asthma			
Yes	3.95	5.51	4.83
No	2.59	1.88	2.26

the 2004 baseline interview [19]. While other two studies reported slightly higher hip fracture prevalence. The results of Hispanic EPESE study observed that the prevalence of hip fracture was 4% among Mexican American adults at baseline [20], another study, using data from the Survey on Assets and Health Dynamics Among the Oldest Old (AHEAD), reported the prevalence of hip fracture was 8.98% [21]. Maybe there are two possible reasons for the inconsistent hip fracture prevalence 1) difference in hip fracture definition and 2) selection bias such as population demographics. The review study using data from 73

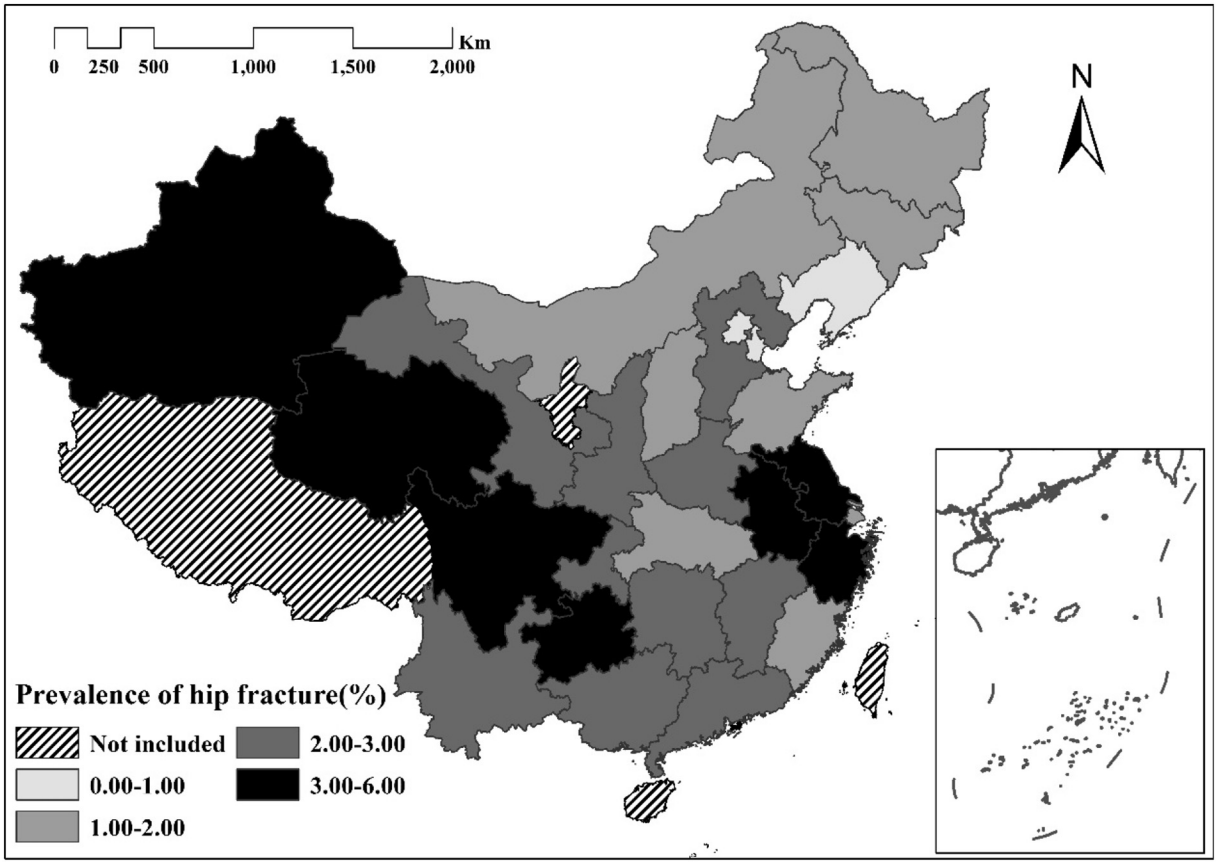

Fig. 2. Prevalence of hip fracture in different provinces of China.

studies (63 countries) showed a wide geographic variation across the world, there was approximately a 10-fold range in hip fracture incidence [17].

Women had higher hip fracture prevalence than men, especially aged ≥70 years, however, it was not statistically significant in the multivariate model (OR 1.03; 95% CI 0.78–1.36). As previously stated, the vast majority of the hip-fracture literature supported that women tend to experience more hip fracture events than men [22,23]. One study found that the overall female/male ratio of hip fracture incidence significantly decreased with years [23]. We found that hip fracture prevalence among adults aged ≥70 years is significantly higher than in those aged < 50 years. Some previous studies also found the risk of hip fracture rose with increasing age [2,11,24]. One study found that the peak number of hip fractures occurred between the ages of 75–79 years [25].

In previous studies, socioeconomic status such as education level was associated with hip fracture [26,27]. Our study also found that higher lever education decreased the risk of hip fracture. Maybe the person who received less education is more likely to have heavy physical labor, which may result in falls and hip fractures.

We found an apparent geographic variation in the prevalence of hip fracture in China. Beijing, Liaoning, and Tianjin had the lowest prevalence, Qinghai had the greatest prevalence. Residents in the East, South-Central, South-West and North-West region had a much higher prevalence of hip fracture than those living in the North and North-East region. There are several possible explanations for this geographic variation. First, falling is the main reason for hip fracture, the terrain of the regions consists mainly of plateau and mountains areas which are more likely to increase the risk of falling, residents living in rural areas often engaged in heavy physical labor and this also increased the risk of falling. Second, better socioeconomic development may contribute to better public health, which may further contribute to the lower prevalence of hip fracture. At last, differences in genetic background, culture, climate, and lifestyle patterns might contribute to disparities across regions [28]. Further investigation is needed to investigate and find the causes.

In our study, we found that normal weight and obesity were associated with a lower likelihood of hip fracture (normal weight OR: 0.58, 95% CI 0.45–0.76; obesity OR: 0.37, 95% CI 0.20–0.69) than underweight. A meta-analysis of prospective cohort studies also found that obesity was a protective factor that significantly decreased the risk of hip fracture in adults (unadjusted RR: 0.66, 95% CI 0.56–0.78) [29]. Obesity is widely proposed to be protective against hip fracture, because of the effect of increased soft-tissue padding and higher bone mineral density (BMD) [30].

Having self-reported history of chronic lung diseases, heart diseases, stroke, and arthritis were associated with self-reported hip fracture history. One study found that there was no significant difference in the odds of reporting lung diseases between with and without hip fracture [31]. But some studies found that certain chronic health conditions substantially increase the risk of falling, and lead to the risk of hip fracture [32]. Heart diseases included heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems. Cardiovascular disease (CVD) also included the heart attack, coronary heart disease, angina, and heart failure. Studies examining the relationship between Cardiovascular disease (CVD) and risk of hip fracture have found that CVD was significantly associated with risk of hip fracture [33,34]. Stroke is a well-documented risk factor for hip fracture [31,34,35]. One reason is an increased risk of fall following a stroke, especially because of hemiplegia. Another reason is that stroke-related immobility induces sarcopenia and bone loss [33]. Furthermore, some studies found that patients with rheumatoid arthritis had an increased risk of hip fracture [36–38]. One study confirmed that high Japanese version of the Health Assessment Questionnaire (J-HAQ)

Table 3
Cross-sectional analysis of hip fracture with different variables in the different models (Bold text represents significant odds ratios).

Variables	Cross-sectional analysis results			
	Model 1		Model 2	
	OR	95%CI	OR	95%CI
Gender				
Male				
Female	1.05	0.76–1.44	1.03	0.78–1.36
Age, years				
< 50				
50–59	0.98	0.68–1.41	0.92	0.63–1.34
60–69	1.00	0.69–1.44	0.80	0.55–1.17
≥70	**3.12**	**2.06–4.73**	**2.18**	**1.48–3.21**
Area				
Urban				
Rural	0.80	0.61–1.06	0.77	0.58–1.03
Region				
North				
East	**1.58**	**1.03–2.41**	**1.81**	**1.14–2.86**
North-East	0.52	0.24–1.12	0.54	0.25–1.19
South-Central	1.71	0.97–3.01	**1.88**	**1.11–3.18**
North-West	**1.89**	**1.15–3.10**	**1.88**	**1.12–3.18**
South-West	**1.63**	**1.02–2.59**	1.56	0.95–2.57
Education				
No formal education				
Elementary school	0.80	0.58–1.12	0.80	0.59–1.07
Middle school	**0.48**	**0.34–0.69**	**0.46**	**0.32–0.67**
High school or vocational school or higher	**0.30**	**0.18–0.50**	**0.29**	**0.17–0.50**
BMI group				
< 18.5				
18.5–24.9	**0.60**	**0.46–0.76**	**0.58**	**0.45–0.76**
25.0–29.9	0.95	0.57–1.58	0.81	0.51–1.28
≥30	**0.47**	**0.26–0.86**	**0.37**	**0.20–0.69**
Chronic disease				
Hypertension (Yes vs. No)			1.15	0.82–1.60
Dyslipidemia (Yes vs. No)			1.09	0.69–1.72
Diabetes (Yes vs. No)			1.25	0.74–2.10
Chronic lung disease (Yes vs. No)			**2.11**	**1.51–2.96**
Liver disease (Yes vs. No)			1.40	0.60–3.25
Heart disease (Yes vs. No)			**1.36**	**1.00–1.85**
Stroke (Yes vs. No)			**2.30**	**1.08–4.92**
Kidney disease (Yes vs. No)			1.25	0.76–2.06
Digestive disease (Yes vs. No)			1.10	0.83–1.45
Psychiatric disease (Yes vs. No)			1.83	0.94–3.54
Arthritis (Yes vs. No)			**1.79**	**1.33–2.40**
Asthma (Yes vs. No)			0.74	0.44–1.24

disability score was associated with the risk of hip fracture among Japanese rheumatoid arthritis patients, so the increased risk of hip fracture appears to be attributable to the functional impairment in rheumatoid arthritis patients [38].

This study involved several strengths. First, the CHARLS represented a nationwide representative sample of middle-aged and older adults, which allowed for the assessment of the rare hip fracture outcome. Second, data is reliable as the survey was conducted using a strict quality control program. Finally, the study participants were chosen according to strict multistage probability sampling procedure, the results are more likely than the results of hospital-based studies to be generalizable to the overall middle-aged and older adult population of China.

However, there are some limitations as well. First, the diagnosis of hip fracture was based on self-reported, it is possible that a number of individuals who sustained a hip fracture are not included in this study, since mortality from hip fractures is substantial, the prevalence may be potential bias. Thus, the result was different from other studies. Second, hip fracture was self-reported in this large study of Chinese men and women, but there was not a follow-up question to differentiate low and high trauma fractures, thus there did not appear to be any distinction between these types of fracture. Third, the data for other chronic diseases were based on self-reports, so estimates regarding these conditions may be potential bias. However, we only use these data to analyze the factors with hip fracture, some findings are consistent with previous studies. In addition, although the CHARLS is a nationally representative longitudinal survey of the middle-aged and elderly population in China, this study only report the cross-sectional results.

5. Conclusion

In conclusion, using data from the CHARLS, we have observed overall and sex-specific prevalence of hip fracture for China. We also observed marked geographic variation in hip fracture prevalence by different provinces and regions within China. The related factors of hip fracture including advanced age, West region, lower education, underweight, having self-reported history of chronic lung diseases, heart diseases, stroke, and arthritis were confirmed in our study. This information will be useful in the formulation of hip fracture prevention and health planning in China and will provide clues for future studies. Understanding geographic variations in hip fracture prevalence will be important for allocation of healthcare resources, particularly in province with the highest hip fracture prevalence in China. Knowing the causes of hip fracture will help health planners design prevention strategies for reducing hip fracture rate.

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The authors thank all workers who collected the data. The current study is a secondary analysis of the identified CHARLS public data. All data collected in CHARLS are maintained at the National School of Development of Peking University, Beijing, China. The datasets are available from http://charls.ccer.edu.cn/charls/.

Competing interests

The authors declare no competing interests.

Ethical approval

The CHARLS has been approved by the Ethical Review Committee of Peking University, and all participants signed informed consent at the time of participation. Therefore, no separate ethical approval was required for our study.

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