National incidence of joint dislocation in China: a retrospective survey of 512,187 individuals

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Abstract

Background: Joint dislocations significantly impact public health. However, a comprehensive study on the incidence, distribution, and risk factors for joint dislocations in China is lacking. We conducted the China National Joint Dislocation Study, which is a part of the China National Fracture Study conducted to obtain the national incidence and risk factors for traumatic fractures, and to investigate the incidence and risk factors for joint dislocations.

Methods: For this national retrospective epidemiological study, 512,187 participants were recruited using stratified random sampling and probability-proportional-to-size method from January 19 to May 16, 2015. Participants who sustained joint dislocations of the trunk, arms, or legs (skull, sternum, and ribs being excluded) in 2014 were personally interviewed to obtain data on age, educational background, ethnic origin, occupation, geographic region, and urbanization degree. The joint-dislocation incidence was calculated based on age, sex, body site, and demographic factors. The risk factors for different groups were examined using multiple logistic regression.

Results: One hundred and nineteen participants sustained 121 joint dislocations in 2014. The population-weighted incidence rate of joint dislocations of the trunk, arms, or legs was 0.22 (95% confidence interval [CI]: 0.16, 0.27) per 1000 population in 2014 (men, 0.27 [0.20, 0.34]; women, 0.16 [0.10, 0.23]). For all ages, previous dislocation history (male: OR 42.33, 95% confidence interval [CI]: 12.03–148.90; female: OR 54.43, 95% CI: 17.37–170.50) and alcohol consumption (male: OR 3.50, 95% CI: 1.49–8.22; female: OR 2.65, 95% CI: 1.08–6.50) were risk factors for joint dislocation. Sleeping less than 7 h/day was a risk factor for men. Compared with children, women aged ≥15 years (female 15–64 years: OR 0.16, 95% CI: 0.04–0.61; female ≥65 years: OR 0.06, 95% CI: 0.01–0.41) were less likely to sustain joint dislocations. Women with more than three children were at higher dislocation risk than women without children (OR 6.92, 95% CI: 1.18–40.78).

Conclusions: The up-to-date data on joint dislocation incidence, distribution, and risk factors can be used as a reference for national healthcare, prevention, and management in China. Specific strategies for decreasing alcohol consumption and encouraging adequate sleeping hours should be developed to prevent or reduce dislocation incidents.

Trial Registration: Chinese Clinical Trial Registry, ChiCTR-EPR-15005878.

Keywords: Epidemiology; Incidence; Joint dislocation; National survey; Risk factor

Introduction

Joint dislocations are common clinical injuries characterized by loss of normal alignment of the articular surface of the joint bones resulting from trauma or other causes.[1] They are often accompanied by ligamentous injuries and joint-ligament and bone lesions. Dislocation leads to ligamentous tears and can also result in wear and tear of the articular cartilage. Missed injuries or late presenta-

tions could result in irreversible damage to the articular surface and loss of joint stability, potentially leading to recurrent dislocations and finally resulting in chronic degenerative arthritis, which may markedly affect the physical and mental health and quality of life.[2]

National epidemiological data on joint dislocation incidence rates and risk factors remain scarce, despite

the marked impact on patients. With a population of 1.41 billion, vast territory, and complex terrain, China lacks its own data on joint dislocation to develop targeted national prevention policies or conduct targeted research. Several studies in China have reported on the epidemiology of joint dislocations, but they were limited to specific regions, had small sample sizes, or only examined specific joint dislocation sites. Yang et al[3] performed a retrospective cohort study to estimate the annual incidence of total orthopedic dislocation in Taiwan of China from 2000 to 2005 and collected information based on hospitalization and ambulatory data. However, population-weighted incidence rates, injury causes, and risk factors for joint dislocation were not considered.

Several studies have identified fracture-related risk factors such as prior surgery, history of dislocation, old age, alcohol abuse, and engagement in unprotected sports.[4-6] However, the risk factors for joint dislocation among the Chinese population remain poorly understood. The China National Joint Dislocation Study (CNJDS) was thus designed to provide the first comprehensive and up-to-date data on the incidence rate, distribution of injured joints, injury causes, and risk factors in China.

Methods

Sampling method and sampling size

The CNJDS investigated the incidence rate of joint dislocations with a nationally representative sample of the general population, covering 31 provinces, autonomous regions, and municipalities directly under the supervision of the central government in the mainland of China. The complex steps of the sampling design (stratified random sampling and the probability-proportional-to-size [PPS] methodology), sample size (510,000 individuals), field investigation, quality control method, data collection, and statistical analysis were previously reported.[7,8]

The first sampling level was stratified by three geographic regions, that is, East, Middle, and West, according to their socioeconomic development, terrain, and climate.[9] Eight provinces and municipalities, including Gansu, Jilin, Hebei, Shanghai, Sichuan, Hubei, Yunnan, and Guangdong, which were geographically representative, were initially selected using a stratified random sampling method. The second sampling level was stratified according to urban or rural locations. Twenty-four urban cities and 24 rural countries were selected from selected provinces and municipalities using PPS for the first stage. In the second stage, 41 streets in urban areas and 67 towns in rural areas were selected using PPS. In the third stage, 112 neighborhood communities and 223 administrative villages were also selected with PPS. Neighborhood communities are residential organizations of "communities" in urban streets and administrative towns with a relatively independent living environment in a certain urban or rural area in mainland China, similar to "neighborhoods" or "subdivisions" in the United States and Europe. In the final stage, only individuals of selected families who had been living in their current residence for ≥6 months were eligible to participate. The information of preschool and primary school students among the selected participants was provided by their guardians, while junior and senior high school children provided the information themselves. Participants who could not be reached after repeated petitions were contacted by telephone. If the selected household or village refused to participate, an alternative was randomly selected from the list.[10] We recruited 3299 individuals from two neighborhood communities and three administrative villages in Hebei Province for a preliminary experiment to calculate the incidence of dislocation in the Chinese population and combined it with the PPS method to more accurately estimate the sample size. The sample size was estimated to meet the recommended requirements for precision according to the Third National Health and Nutrition Examination Survey, with 510,000 individuals initially targeted for inclusion in the study.[11]

Participants and survey

Data were collected by trained staff who personally interviewed the eligible household members. Trained interviewers administered standard questionnaires to collect information on demographic characteristics such as age, sex, ethnic origin, education, occupation, and residence. Other collected information included cigarette consumption, alcohol consumption, calcium or vitamin D supplement intake, body mass index (BMI), average hours of sleep per day, house facing the sun, previous history of dislocation, menopause age, and children, as explained in detail in the Supplementary Appendix in Chen et al.[7] Patients who sustained joint dislocations of the trunk, arm, or leg between January 1 and December 31, 2014 responded to the questionnaire on January 19 and May 16, 2015. The participants who provided details on their joint dislocation date, site, and injury cause were asked to provide medical records such as radiographs, diagnostic reports, and medical history. The joint dislocation sites included the spine, wrists, elbows, shoulders, toes, patella, ankles, and hips. Participants with dislocation were required to provide the cause of injury including traffic accidents; slips, trips, or falls; falls from heights; crush injuries; injury caused by thrown or falling objects; sport related trauma; and trauma caused by sharp objects.

Quality control

Eight strict quality assurance teams were established to ensure the validity and reliability of the original data. They regularly checked 10% of the questionnaires to inspect the quality of the survey. Medical records and radiographs were reviewed by orthopedists and radiologists. The CNJDS research protocol was approved by the Institutional Review Board of the Third Hospital of Hebei Medical University (No. 2015-002-1). Before data collection, all participants signed an informed consent form. The CNJDS has registered in the Chinese Clinical Trial Registry (No. ChiCTR-EPR-15005878).

Statistical analysis

All data were recorded on paper by the investigator at the time of the household survey and then double-entered

using EpiData 3.1 (Odense, Denmark). A data management committee consisting of medical statisticians, epidemiologists, and ethicists independent of the researchers was established to organize, code, and check the range of data assignments to ensure reliability and data quality.

Incidence rates for joint dislocation were estimated for the overall population and for subgroups by age and sex and by demographic factors such as education, ethnic origin, occupation, geographical region, and residency category.[12] Differences in incidence between the categories of nominal variables, such as regions, residency category, and ethnic origin, were tested using the Chi-squared test. Trends in incidence rates by age and education were tested by including these ordered categorical variables as continuous variables in a univariable logistic regression model. The incidence of joint dislocation sites among children, including boys and girls ≤14 years, young and middle-aged adults (between 15 and 64 years), and older individuals (≥65 years) was assessed by sex. Risk factors including age, ethnic origin, educational background, occupation, cigarette consumption, alcohol consumption, calcium or vitamin D supplement intake, degree of urbanization, region, BMI, average hours of sleep per day, house facing the sun, previous history of dislocation, children, menopause age, and premenopausal status were analyzed using binary logistic regression models and odds ratio (OR) and 95% confidence interval (CI) were calculated.

The sample weight was used in two ways. First, the sample weight was used to show that the probability of sample selection was not equal at each sampling stage. Second, the stratified weight was used to coordinate the sample structure of the survey with the sample structure of the Chinese standard population in the sixth census (2010). In carrying out the post-stratification process, we particularly considered age (5-year increments), sex, and geographic region. A multistage sampling design was considered in the 95% CI condition, and the Taylor series linear sampling error was estimated. All statistical analyses were performed using SAS 9.3 (SAS Institute, Cary, NC, USA) and Sudaan 11.01 (Research Triangle Institute, Cary, NC, USA).

Results

The general characteristics of the study population and joint dislocation incidence are presented in Tables 1 and 2. There were 512,187 participants recorded in the CNJDS after 23,649 (5%) questionnaires were rejected because of ambiguous, missing, or logical errors. A total of 259,649 (51%) participants were males and 252,538 (49%) were females. In 2014, 119 (0.232‰) individuals (70 men and 49 women, age 42 [12, 52] years) reported 121 joint dislocations. Among them, two reportedly sustained two dislocations within 1 year.

Of the reported 121 joint dislocations, 39 occurred in 38 (31.9%) patients younger than 14 years, 68 in 67 (56.3%) patients aged between 15 years and 64 years, and 14 in 14 (11.8%) patients older than 65 years. All data were calculated based on the first dislocation to avoid

duplication of information. The incidence rates of joint dislocations were estimated to be 0.22‰ (0.16‰, 0.27‰) in China, 0.27‰ (0.20‰, 0.34‰) in male participants, and 0.16‰ (0.10‰, 0.23‰) in female participants [Table 1].

The population-weighted incidences of joint dislocations according to individual characteristics indicated no significant differences in terms of different educational backgrounds, ethnic origins, occupations, regions, and degrees of urbanization. Based on age, 5 to 14-year-old children and 65 to 74-year-old women had the highest incidence rates at 0.51‰ (0.29‰, 0.72‰) and 0.36‰ (0.10‰, 0.62‰), respectively. Table 2 summarizes the population-weighted incidence of each category of joint dislocation site among children, young and middle-aged adults, and older adults. The most common joint dislocation site was the shoulder (0.04‰ [0.03‰, 0.06‰]). For children, spinal dislocation was most common in both boys (0.19‰ [0.05‰, 0.32‰]) and girls (0.10‰ [0, 0.21‰]). Shoulder dislocation (0.04‰ [0.03‰, 0.06‰]) was most common in both sexes among young and middle-aged adults and older people. Table 3 shows the population-weighted proportion rates of injury causes among children, young and middle-aged adults, and older individuals. The most common injury cause was injuries resulting from slips, trips, or falls (47.90% [38.92%, 56.87%]), followed by traffic accidents (15.97% [9.39%, 22.55%]). Dislocations from low-energy injuries (slips, trips, or falls) accounted for nearly half of all cases in children (44.74% [28.93%, 60.55%]), young and middle-aged men (55.00% [39.58%, 70.42%]) and women (44.44% [25.70%, 63.19%]), and older individuals (42.83% [16.93%, 68.78%]). Dislocations caused by traffic accidents accounted for more than 15% of all cases in young and middle-aged men (17.50% [5.72%, 29.28%]) and women (25.93% [9.40%, 42.46%]), and older people (21.43% [−0.07%, 42.92%]), but for only 5.26% (−1.84%, 12.36%) in children.

Table 4 summarizes the risk factors for male and female participants. History of dislocation was a strong risk factor for both men (OR 42.33, 95% CI: 12.03–148.90) and women (OR 54.43, 95% CI: 17.37–170.50). Alcohol consumption was a risk factor for both men (OR 3.50, 95% CI: 1.49–8.22) and women (OR 2.65, 95% CI: 1.08–6.50). Sleeping <7 h was a risk factor for men (OR 2.80, 95% CI: 1.58–4.96). When compared with children, young and middle-aged women (OR 0.16, 95% CI: 0.04–0.61) and older women (OR 0.06, 95% CI: 0.01–0.41) were less likely to sustain joint dislocations. Having more than three children (OR 6.92, 95% CI: 1.18–40.78) was a risk factor for joint dislocation compared to having no children.

Discussion

The CNJDS was the first extensive national survey of joint dislocation with clinical evidence from patients in China. Most previous studies have focused on hospital-based case studies and epidemiological surveys and few have focused

Table 1: National incidence of joint dislocations in China by demographic, socioeconomic, and geographic factors in 2014[*].

Items	Sample size	Incidence rate per 1000 population (95% CI)		
		Male	**Female**	**Total**
Individuals	512,187	0.27 (0.20, 0.34)	0.16 (0.10, 0.23)	0.22 (0.16, 0.27)
Age				
0–4 years	26,840	0.36 (0, 0.72)	0.27 (0, 0.54)	0.32 (0.07, 0.56)
5–14 years	54,326	0.66 (0.33, 0.98)	0.33 (0.12, 0.53)	0.51 (0.29, 0.72)
15–24 years	62,020	0.08 (0, 0.17)	0.04 (0, 0.13)	0.06 (0, 0.12)
25–34 years	93,194	0.11 (0, 0.20)	0.05 (0, 0.11)	0.08 (0.02, 0.14)
35–44 years	80,992	0.26 (0.12, 0.40)	0.16 (0.03, 0.29)	0.21 (0.13, 0.29)
45–54 years	79,565	0.51 (0.27, 0.75)	0.31 (0.12, 0.50)	0.41 (0.22, 0.60)
55–64 years	58,968	0.02 (0, 0.07)	0.04 (0, 0.10)	0.03 (0, 0.07)
65–74 years	38,745	0.27 (0.03, 0.50)	0.36 (0.10, 0.62)	0.31 (0.14, 0.48)
≥75 years	17,537	0.19 (0, 0.56)	0.09 (0, 0.26)	0.13 (0, 0.32)
P-value for trend test		0.191	0.455	0.287
Education (preschool children and students excluded, n = 396,163)				
Illiterate	74,937	0.33 (0.14, 0.53)	0.15 (0.02, 0.28)	0.23 (0.12, 0.34)
Primary school	158,970	0.28 (0.14, 0.43)	0.19 (0.08, 0.31)	0.24 (0.14, 0.34)
Junior high school	121,415	0.15 (0.04, 0.26)	0.10 (0.01, 0.18)	0.13 (0.05, 0.20)
Senior high school or above	40,841	0.09 (0, 0.20)	0.12 (0, 0.33)	0.10 (0, 0.22)
P-value for difference test		0.019	0.357	0.019
Ethnic origin				
Han	477,508	0.25 (0.17, 0.32)	0.16 (0.10, 0.23)	0.20 (0.15, 0.26)
Other	34,679	0.51 (0.02, 0.99)	0.19 (0, 0.40)	0.35 (0.04, 0.66)
P-value for difference test		0.155	0.815	0.245
Occupation				
Office worker	61,919	0.14 (0.03, 0.25)	0.12 (0, 0.27)	0.13 (0.04, 0.22)
Peasant	106,484	0.19 (0.06, 0.32)	0.18 (0.06, 0.30)	0.18 (0.09, 0.28)
Manual worker	148,650	0.25 (0.14, 0.37)	0.10 (0.01, 0.19)	0.19 (0.11, 0.27)
Retired	30,366	0.11 (0, 0.24)	0.20 (0, 0.40)	0.15 (0.04, 0.27)
Students	80,443	0.39 (0.21, 0.57)	0.20 (0.07, 0.32)	0.30 (0.18, 0.41)
Preschool children	35,581	0.40 (0.05, 0.74)	0.28 (0.05, 0.50)	0.34 (0.12, 0.56)
Unemployed	32,770	0.42 (0, 0.85)	0.20 (0.03, 0.38)	0.27 (0.11, 0.42)
Other	15,974	0.31 (0, 0.66)	0.10 (0, 0.29)	0.22 (0, 0.45)
P-value for difference test		0.193	0.682	0.166
Region				
East	232,998	0.27 (0.15, 0.39)	0.18 (0.07, 0.29)	0.23 (0.13, 0.32)
Central	99,109	0.26 (0.13, 0.38)	0.11 (0.01, 0.22)	0.19 (0.11, 0.26)
West	180,080	0.27 (0.15, 0.39)	0.20 (0.10, 0.30)	0.24 (0.14, 0.33)
P-value for difference test		0.977	0.528	0.693
Urbanization				
Urban area	272,099	0.29 (0.19, 0.39)	0.14 (0.07, 0.20)	0.21 (0.15, 0.28)
Rural area	240,088	0.24 (0.14, 0.34)	0.20 (0.09, 0.30)	0.22 (0.14, 0.30)
P-value for difference test		0.500	0.272	0.901

[*] All incidence rates were weighted to obtain nationally representative estimates.

on estimating the national incidence of dislocation.[1,13,14] Our study estimated that the national incidence of joint dislocation was 0.22 per 1000 people in 2014, indicating that more than 0.3 million patients had sustained joint dislocations in China at that time. The CNJDS suggested that joint dislocation may have reached an alarming level and has become a major public health issue among the general Chinese population, which could potentially lead to large-scale dislocation-related complications, including joint instability, ankylosis, arthritis, and even osteonecrosis in the near future in the absence of adequate attention and effective national intervention.

Although population-based studies on the incidence of dislocation have been conducted in some countries, the reported results have been inconsistent for different regions. Zacchilli and Owens[15] investigated a probability sample of all injuries presenting to emergency departments in the United States using the National Electronic Injury Surveillance System. They reported a shoulder dislocation rate of 23.9 per 100,000 individuals. Using the same method, Stoneback et al[16] reported an elbow dislocation incidence rate of 6.87 per 100,000 individuals in the United States. These values were all higher than those in the current study (shoulder, 0.04‰ [0.03‰, 0.06‰];

Table 2: National incidence of joint dislocations of the trunk, arms, or legs (not including the skull, sternum, and ribs) in China by body site in 2014.

| Body site | Children (0–14 years) | | Young and middle adults (15–64 years) | | Older people (≥65 years) | | Total |
	Boys	Girls	Men	Women	Men	Women	
Spine	0.19 (0.05, 0.32)	0.10 (0, 0.21)	0.01 (0, 0.03)	0.01 (0, 0.02)	0.03 (0, 0.08)	0.03 (0, 0.08)	0.04 (0.02, 0.05)
Wrist	0.14 (0.01, 0.27)	0.09 (0, 0.18)	0.02 (0, 0.03)	0.01 (0, 0.01)	-	0.02 (0, 0.07)	0.03 (0.01, 0.04)
Elbow	0.10 (0, 0.21)	0.05 (0, 0.12)	0.04 (0.01, 0.07)	0.02 (0, 0.04)	-	0.02 (0, 0.07)	0.03 (0.02, 0.05)
Shoulder	0.02 (0, 0.07)	-	0.06 (0.03, 0.09)	0.03 (0, 0.07)	0.09 (0, 0.22)	0.08 (0, 0.18)	0.04 (0.03, 0.06)
Toe	0.03 (0, 0.08)	-	0.01 (0, 0.03)	0.01 (0, 0.01)	0.03 (0, 0.08)	-	0.01 (0, 0.02)
Knee	0.04 (0, 0.08)	0.06 (0, 0.14)	0.03 (0, 0.05)	0.03 (0.01, 0.05)	0.07 (0, 0.20)	0.03 (0, 0.10)	0.03 (0.02, 0.05)
Ankle	-	-	0.02 (0, 0.05)	0.01 (0, 0.03)	-	0.02 (0, 0.07)	0.01 (0, 0.03)
Hip	-	-	0.01 (0, 0.02)	0.01 (0, 0.01)	0.03 (0, 0.10)	0.05 (0, 0.14)	0.01 (0, 0.01)

Data are incidence rates per 1000 persons (95% CI). All incidence rates were weighted to obtain nationally representative estimates. "-" indicates no dislocation cases recorded in this subgroup. CI: Confidence interval.

Table 3: Proportion of joint dislocation by injury causes in China in 2014 (% [95% CI]).

| Injury mechanism | Children (0–14 years) | Young and middle age (15–64 years) | | Older people (≥65 years) | Total |
		Men	Women		
Traffic accident	5.26 (−1.84, 12.36)	17.50 (5.72, 29.28)	25.93 (9.40, 42.46)	21.43 (−0.07, 42.92)	15.97 (9.39, 22.55)
Slip, trip or fall	44.74 (28.93, 60.55)	55.00 (39.58, 70.42)	44.44 (25.70, 63.19)	42.83 (16.93, 68.78)	47.90 (38.92, 56.87)
Fall from heights	5.26 (−1.84, 12.36)	2.50 (−2.34, 7.34)	3.70 (−3.42, 10.83)	7.14 (−6.35, 20.63)	4.20 (0.60, 7.81)
Crush injury	2.63 (−2.46, 7.72)	2.50 (−2.34, 7.34)	3.70 (−3.42, 10.83)		2.52 (−0.30, 5.34)
Struck by thrown, thrown, or falling objects	-	5.00 (−1.75, 11.75)	-	-	1.68 (−0.63, 3.99)
Sports trauma	18.42 (6.10, 30.75)	10.00 (0.70, 19.30)	18.52 (3.87, 33.17)	7.14 (−6.35, 20.63)	14.29 (8.00, 20.57)
Sharp trauma	-	2.50 (−2.34, 7.34)	-	-	0.84 (−0.80, 2.48)
Others	23.68 (10.17, 37.20)	5.00 (−1.75, 11.75)	3.70 (−3.42, 10.83)	21.43 (−0.07, 42.92)	12.61 (6.64, 18.57)

CI: Confidence interval; -: Not available.

elbow, 0.03‰ [0.02‰, 0.05‰]). However, a 6-year cohort study in Taiwan of China reported a knee dislocation rate of 1.4 per 100,000 individuals,[3] which is lower than that in our study (0.03‰ [0.02‰, 0.05‰]).

Because the joint capsules and ligaments of children are more elastic, and their sockets are shallow, joint dislocation is more likely to occur among the pediatric population. In the current study, children had the highest dislocation incidence rate among all age groups. Similarly, in our study, we found that postmenopausal older women had the highest dislocation rate among the female age groups because of decreased estrogen levels, increased risk of osteoporosis, decreased muscle strength, and joint ligament laxity.[17-19] Older patients are more likely to sustain injuries to the rotator cuff, axillary nerve, or brachial plexus.[20]

The CNJDS showed that traffic accidents accounted for the largest proportion of injury causes, followed by low-energy injuries such as slipping, tripping, or falling. Findings from the CNJDS showed that low-energy injuries were most common in children, young and middle-aged female participants, and older individuals, while high-energy injuries (injuries excluding slips, trips, or falls) were most common in young and middle-aged male partic-

ipants. This may be because joint dislocation is closely related to age, physical quality, and joint characteristics. For frail and infirm individuals who often lack muscle strength, the odds of sustaining joint dislocations are much higher than for those who are strong and healthy. This is especially true for the elderly population. In addition, based on clinical anatomy, children's shoulder glenoids are small and shallow, their humeral heads are large, and the anterior and lower parts of their joint capsules are loose, while the muscles around the joints are less dense, making them more prone to joint dislocations.

Statistical analysis of our data showed that having previous history of dislocation was a strong risk factor for both male and female participants. Some studies have also shown that having previous history of dislocation increases the risk of dislocation because of residual ligament injury, hyperlaxity, and poor reduction quality after the initial dislocation.[7,21,22] Huntington et al[6] conducted a systematic review and meta-analysis with 1324 participants. They noted that the overall rate of recurrent dislocations after a first-time lateral patellar dislocation was 33.6%. Huntington et al[6] noted that recurrent dislocations after a first-time lateral patellar dislocation could occur in >50% of patients and cause long-term disability.

Table 4: Risk factors for joint dislocation by multivariate analysis among males and females (OR [95% CI]).

Items	Male	Female
Age group		
Children (0–14 years)	Reference	Reference
Young and middle adults (aged 15–64 years)	0.15 (0.02, 1.04)	0.16 (0.04, 0.61)
Older people (≥65 years)	0.15 (0.02, 1.27)	0.06 (0.01, 0.41)
Ethnic origin		
Han	Reference	Reference
Other	2.31 (0.87, 6.17)	1.14 (0.42, 3.08)
Education		
Illiterate	Reference	Reference
Primary school	0.84 (0.40, 1.77)	2.19 (0.83, 5.81)
Junior high school	0.43 (0.16, 1.16)	1.23 (0.34, 4.38)
Senior high school or above	0.32 (0.07, 1.43)	3.11 (0.70, 13.79)
Occupation		
Unemployed	Reference	Reference
Office worker	0.42 (0.12, 1.55)	0.79 (0.16, 3.97)
Peasant	0.41 (0.12, 1.42)	0.78 (0.33, 1.84)
Manual worker	0.71 (0.26, 1.98)	0.71 (0.18, 2.85)
Retired	0.23 (0.04, 1.40)	0.77 (0.17, 3.52)
Students	0.90 (0.16, 5.04)	1.66 (0.18, 15.41)
Preschool children	0.47 (0.06, 3.77)	3.58 (0.32, 39.55)
Other	0.77 (0.16, 3.69)	0.41 (0.05, 3.51)
Cigarette smoking		
No	Reference	Reference
Yes	1.36 (0.71, 2.58)	-
Alcohol consumption		
No	Reference	Reference
Yes	3.50 (1.49, 8.22)	2.65 (1.08, 6.50)
Calcium or vitamin D supplement		
No	Reference	Reference
Yes	1.17 (0.44, 3.09)	0.58 (0.15, 2.22)
Urbanization		
Rural area	Reference	Reference
Urban area	1.36 (0.77, 2.39)	0.67 (0.29, 1.57)
Region		
West	Reference	Reference
Central	1.11 (0.59, 2.12)	0.63 (0.21, 1.94)
East	1.16 (0.61, 2.21)	1.08 (0.44, 2.66)
BMI		
≤23.9 kg/m^2	Reference	Reference
24.0–27.9 kg/m^2	1.46 (0.70, 3.06)	0.73 (0.33, 1.63)
≥28.0 kg/m^2	0.81 (0.10, 6.73)	2.36 (0.94, 5.90)
Average sleep time per day		
≥7 h	Reference	Reference
<7 h	2.80 (1.58, 4.96)	1.97 (0.80, 4.86)
House facing the sun		
No	Reference	Reference
Yes	0.58 (0.06, 5.78)	-
Previous history of dislocation		
No	Reference	Reference
Yes	42.33 (12.03, 148.90)	54.43 (17.37, 170.50)
Children		
No	-	Reference
1	-	2.50 (0.56, 11.11)
2	-	3.25 (0.64, 16.64)
3	-	1.54 (0.12, 19.91)
≥4	-	6.92 (1.18, 40.78)
Menopause age		
>50 years	-	Reference
46–50 years	-	1.01 (0.32, 3.13)
<46 years	-	1.52 (0.39, 5.98)
Premenopausal	-	0.48 (0.22, 1.05)

BMI: Body mass index; CI: Confidence interval; OR: Odds ratio; -: Not available.

The potential association between alcohol consumption and increased dislocation risk has been explored, possibly because of its association with metabolic effects and alcohol consumption potentially increasing the chances of falls and being associated with a more hazardous lifestyle in general.[23] Scholes *et al*[24] conducted nationally representative health surveys in the UK (2002–2007) with 24,725 adults aged ≥55 years. They concluded that consuming >8 units of alcohol on the heaviest drinking day in the past week had a significant independent association with fracture. Clark *et al*[23] showed that alcohol abuse and dependence were associated with lower femoral neck and lumbar spine bone mineral density. Women with a history of alcohol dependence had a higher lifetime prevalence of fractures.

Findings from the CNJDS showed that sleeping <7 h/day was a risk factor for male participants, which is consistent with previous findings. Studies have linked frequent insufficient or excessive sleep at night to an increased risk of cognitive impairment, while sleeping for 7 h/night was associated with a lower risk.[25,26] Stone *et al*[27] estimated sleep and daytime inactivity using wrist actigraphy data collected for a minimum of three consecutive 24-h periods in 2978 primarily community dwelling women aged ≥70 years. They found that women with poor sleep efficiency (<70% of the time in bed spent sleeping) had a 1.36-fold increased chance of falls compared with the other participants. Holmberg *et al*[28] prospectively investigated the risk factors for low-energy fractures in 22,444 men and 10,902 women, with a mean follow up of 19 years and 15 years, respectively. They noted that sleep disturbances increased the fracture risk in men.

Another issue elucidated in the CNJDS was that young and middle-aged women had a reduced dislocation risk compared to children. This finding is related to the physical structure of children. Women who had more than three children had a higher risk of dislocation than women who had no children. After pregnancy, the mother supplies nutrients to the infant, and because of hormonal changes, there can be bone-mass reduction during lactation. Giving birth to more than three children, coupled with non-timely calcium and other nutritional supplementation, could lead to maternal osteoporosis, fractures, ligament relaxation, and other complications.

This study had several limitations. First, it was impossible to select individuals in each administrative village or community for research in China, and therefore households were selected as the final sampling unit in PPS. Second, medical evidence was not available for patients with dislocation who did not visit a hospital, although only 2% of such patients were identified. Third, recall bias is inevitable in a retrospective study, especially for patients with low-energy injuries, and the incidence rate may have been underestimated. Fourth, the sample size of dislocation cases in some specific populations was limited, leading to significant sampling errors for some indicators or even missing data. For example, the absence of children with ankle and hip dislocations rendered this incidence incalculable.

The CNJDS was the first detailed epidemiological investigation of joint dislocations performed across the entire Chinese population. The estimated prevalence of joint dislocation in a representative sample of Chinese adults was 0.22‰. Given its large population, China may bear a higher dislocation burden than other countries. This study provided detailed information on the population-weighted incidence, distribution, and risk factors of joint dislocation, which can be used as an up-to-date clinical evidence base for national healthcare planning and prevention efforts. To reduce the risk of joint dislocation, public health policies focusing on reducing alcohol consumption and encouraging individuals to sleep for an adequate amount of time should be implemented. Education and interventions to prevent falls and other forms of trauma need to be strengthened, especially for children, the elderly, and individuals with history of dislocation.

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Conflicts of interest

None.

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