Prevalence of cognitive frailty among older adults in China: a systematic review and meta-analysis

Jian Liu,1 Shengjia Xu,2 Jiurui Wang,1 Zeping Yan,1 Zhiwei Wang,1 Qian Liang,1 Xiaorong Luan1,3

ABSTRACT

Objective This study aimed to investigate the prevalence of cognitive frailty among older adults in China.

Design Systematic review and meta-analysis.

Methods We searched the Cochrane Library, PubMed, Web of Science, Embase, China National Knowledge Infrastructure(CNKI), Wanfang, Chinese Biomedical Literature and Weipu (VIP) databases to collect information on the epidemiology of cognitive frailty among older adults in China. The study period was from the establishment of the database to March 2022. Two researchers independently screened the literature, extracted the data and assessed the risk of bias in the included studies. All statistical analyses were performed using Stata V15.0.

Results We screened 522 records, of which 28 met the inclusion criteria. The results of the meta-analysis showed that the prevalence of cognitive frailty among older adults in China was 15% (95% CI (0.13%, 0.17%)). The prevalence of cognitive frailty was higher in hospitals and nursing homes than in communities. Moreover, the prevalence of cognitive frailty was higher in women than in men. Furthermore, the prevalence rates of cognitive frailty in North China Hospital, older adults aged≥80 years, and illiterate individuals were 25%, 29%, and 55%, respectively.

Conclusions In conclusion, in China, the prevalence of cognitive frailty is higher among older adults, is higher in women than in men, is higher in hospitals and nursing homes than in communities, and is higher in North China than other regions. Moreover, the higher the educational level, the lower the prevalence of cognitive frailty. Multimodal interventions for cognitive frailty, including increased exercise, nutritional support, increased socialisation opportunities and multifactorial strategies, may be effective in preventing cognitive frailty. These findings have important implications for adjusting healthcare and social care systems.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The studies included in this systematic review and meta-analysis are cross-sectional studies.
⇒ Cognitive frailty is highly prevalent among older adults in China, and early prediction and intervention can prevent the onset or development of cognitive frailty.
⇒ Although we explained the higher level of heterogeneity in this study to some extent by subgroup analysis and sensitivity analysis, some factors associated with heterogeneity remain uncertain.

INTRODUCTION

Population ageing has become an important public health issue worldwide.1 China has the largest number of older adults worldwide. The proportion of older adults in China will increase by approximately 11 percentage points from 2020 to 2035.2 An ageing population will lead to healthcare systems worldwide facing challenges to maintain older adults’ functional independence, which will have a significant effect on individuals and societies.3

Physical frailty and cognitive impairment are the two most common geriatric syndromes that greatly impair physical and mental independence in older adults.4 Physical frailty refers to the cumulative decline of multiple physiological systems over time, leading to decreased physiological reserves and resistance to stressors in older adults.5 It is associated with a significant increase in various adverse outcomes, such as falls,6 dementia7 and death.8 Cognitive impairment is a pre-dementia stage in which age-related cognitive decline is insufficiently severe to cause significant impairment in daily functioning.9 In addition, when frailty and cognitive impairment coexist, the risk of adverse outcomes such as mortality increases significantly.10

In 2013, the International Academy on Nutrition and Aging and International Association of Gerontology and Geriatrics international consensus group5 first proposed a new identification of “cognitive frailty”; that is, in the absence of neurodegenerative diseases, such as Alzheimer’s disease or other types of dementia, physical frailty coexists with cognitive impairment. The concept of cognitive frailty was proposed to combine the two, emphasising the coexistence of physical frailty and cognitive impairment. The
most used assessment method in the literature includes two parts to identify cognitive frailty. Part of the physical assessment tool, such as the Fried Frailty Phenotype Scale, includes five atypical criteria (unintentional weight loss, self-reported exhaustion, weakness, slowness of movement and low physical activity). The other part is a cognitive test, such as the Montreal Cognitive Assessment Scale.12

Cognitive frailty, a new concept involving both physical and cognitive dimensions, has attracted increasing attention from experts and scholars, providing a new target for exploring the mechanisms and processes of ageing in older adults. Numerous studies have investigated the epidemiology of cognitive frailty, making healthy ageing and dementia secondary prevention new targets.13–15

Understanding the current epidemiology of cognitive frailty in older adults is necessary for policymakers, public health authorities, clinicians and the general population. To date, there is no consensus on the prevalence of cognitive frailty among older adults in China, owing to different assessment measures and diagnostic criteria. Although Vatanabe et al. were the first to conduct a systematic review of risk factors for cognitive frailty in older adults, this study only focused on older adults in the communities of Western countries, and the prevalence was not reported in this study. Considering the different populations and controversial results, exploring the current status of cognitive frailty among older adults in China is necessary, and these findings will lead to new progress in this field. Therefore, this study aimed to systematically evaluate the current status of cognitive frailty among older adults in China, and analyse the prevalence of cognitive frailty in different sexes, ages, regions, and educational levels to provide evidence-based findings for the formulation of medical care interventions and aid the government in formulating relevant public health strategic decisions.

METHODS
This systematic review and meta-analysis followed the Preferred Reporting Item for Systematic Review and Meta-analysis17 and Meta-analysis of Observational Studies in Epidemiology18 reporting guidelines.

Search strategy
We searched the Cochrane Library, PubMed, Web of Science, Embase, China National Knowledge Infrastructure (CNKI), Wanfang, Chinese Biomedical Literature and Weipu (VIP) to collect research; the retrieval time is from the establishment of the database to March 2022. The search terms were retrieved using a combination of free words and subject words, and the included literature was tracked for a secondary expansion search. The search strategy is shown in online supplemental appendix A. No language restrictions were imposed.

Inclusion and exclusion criteria
Inclusion criteria were based on the PICO process: (1) Population: a cross-sectional study investigating cognitive frailty among ≥60-year-old adults in China; (2) Intervention: a survey related to the prevalence of cognitive frailty; (3) Comparison: cognitive frailty versus non-cognitive frailty; (4) Outcomes: estimates of the prevalence of cognitive frailty in China.

Exclusion criteria: (1) non-random sample size; (2) older non-Chinese adults; (3) review articles, case reports and letters to the editor; (4) duplicate publications; (5) data on outcome indicators could not be extracted.

Our protocol has been registered on PROSPERO. The protocol registration number is CRD42023390486.

Qualitative evaluation
The quality of the literature was evaluated by two researchers according to the criteria, and any disagreements were resolved through discussion or consultation with the third researcher. Cross-sectional studies used the cross-sectional quality assessment criteria recommended by the Agency for Healthcare Research and Quality (AHRQ) to evaluate the risk of bias in included studies. The AHRQ criteria contained 11 items, and the evaluation results were ‘yes’, ‘no’ or ‘unclear’.

Literature screening and data extraction
Two researchers independently screened literature, extracted and cross-checked data according to criteria, and in case of disagreements, resolved by discussion or consultation with a third researcher. If there is a lack of data, we try to contact the original study authors for supplementary information. In case of lacking information, the original study authors were contacted to add information as much as possible. After waiting for duplication, literature screening was performed by first reading the title and abstract, and after excluding apparently irrelevant literature, further reading the full text to determine inclusion. Data extraction included: author, year of publication, region, population source, number of men/women, mean age and screening tools for cognitive frailty.

Statistical analysis
EndNote V.X9 software was used for document management, and Excel tables were used to extract data. Stata V.15.0 software was used to calculate the prevalence of cognitive frailty among older adults in China. The heterogeneity of the included studies was analysed by the χ² test (the test level was α = 0.1), and the size of the heterogeneity was quantitatively judged by I². If p > 0.10 and I² ≤ 50%, it indicates that there is homogeneity among the studies, and a fixed-effects model is used for meta-analysis; if p ≤ 0.10 and I² > 50%, it indicates that there is heterogeneity among studies, and a random-effects model is used for meta-analysis. Subgroup analyses were performed based on the underlying characteristics of the included studies to identify sources of heterogeneity wherever possible. Sensitivity analysis was performed to determine the stability of the results by eliminating literature one by one, and Egger’s test combined with funnel plots was used to...
evaluate the publication bias of each study. The significance level of the tests was considered less than 0.05.

**Patient and public involvement**

Patients and the public were not involved in this study.

**RESULTS**

**Literature screening process and results**

A total of 522 studies were obtained from the preliminary search, and after layer-by-layer screening, 28 cross-sectional studies were finally included.19–46 The specific process and results of literature screening are shown in figure 1.

**Characteristics and quality evaluation results of the included literature**

The characteristics of the included studies are shown in table 1. A total of 28 studies19–46 were included, of which 2719–22 24–46 mentioned the specific study location, and 123 only mentioned the word ‘China’. According to the geographical area of the National Bureau of Statistics, Northeast China (Liaoning) accounted for 3.6%, North China (Beijing, Shanxi, Hebei) accounted for 10.7%, East China (Shandong, Jiangsu, Jiangxi, Shanghai) accounted for 28.6%, South China (Hainan, Henan, Guangxi, Hunan) accounted for 21.4%, Northwest China (Shanxi, Xinjiang) accounted for 10.7%, Southwest China (Chongqing, Sichuan, Guizhou) accounted for 10.7%, and China Taiwan and China Hong Kong accounted for 5.3%. The quality evaluation results of the included studies are shown in online supplemental table 1.

**Meta-analysis of prevalence**

Due to the high heterogeneity of the 28 included articles (I²=98.7%, p<0.001), a random-effects model was used in the meta-analysis, and the source of heterogeneity was explored by subgroup analysis (see figure 2). Of the 28 included studies,19–46 16 studies included communities,19–28 30 31 33 34 43 44 9 studies included hospitals,29 32 35 37–42 and 3 studies included aged care institutions,36 45 46 The most commonly used tools for cognitive frailty screening are the Fried Frailty Phenotype Scale and the Mini-Mental State Examination.25 27 30 31 40 42

**Prevalence of cognitive frailty in different populations**

Community: a total of 16 studies were included, and the prevalence of cognitive frailty is 9% (95% CI (0.07%,
### Table 1  Characteristics of included studies

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Investigation time</th>
<th>Region/sample source</th>
<th>Sample size</th>
<th>Male and female</th>
<th>Average age</th>
<th>Cognitive frailty assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zhou et al., 2020&lt;sup&gt;46&lt;/sup&gt;</td>
<td>May 2019–Sep 2019</td>
<td>Chongqing Nursing Home</td>
<td>303</td>
<td>137/166</td>
<td>81.87±7.36</td>
<td>FP, MoCA, CDR</td>
</tr>
<tr>
<td>Zheng et al., 2019&lt;sup&gt;45&lt;/sup&gt;</td>
<td>Jun 2017–Dec 2017</td>
<td>Jiangsu Nursing Home</td>
<td>340</td>
<td>154/186</td>
<td>81.54±8.12</td>
<td>Tilburg, MoCA</td>
</tr>
<tr>
<td>Zhang et al., 2020&lt;sup&gt;44&lt;/sup&gt;</td>
<td>Jan 2019–Jun 2019</td>
<td>Henan Community</td>
<td>255</td>
<td>91/164</td>
<td>69±6.62</td>
<td>FP, MoCA, CDR</td>
</tr>
<tr>
<td>Yang and Zhang, 2021&lt;sup&gt;43&lt;/sup&gt;</td>
<td>Aug 2020–Oct 2020</td>
<td>Liaoning Community</td>
<td>674</td>
<td>287/387</td>
<td>72.65±8.95</td>
<td>FP, MoCA, CDR</td>
</tr>
<tr>
<td>Yan et al., 2021&lt;sup&gt;42&lt;/sup&gt;</td>
<td>Jan 2019–Oct 2019</td>
<td>Guangxi Hospital</td>
<td>106</td>
<td>44/62</td>
<td>75.76±8.36</td>
<td>FP, MMSE</td>
</tr>
<tr>
<td>Wen et al., 2021&lt;sup&gt;41&lt;/sup&gt;</td>
<td>Apr 2020–Nov 2020</td>
<td>Shanghai Hospital</td>
<td>848</td>
<td>541/307</td>
<td>75.36±8.00</td>
<td>FP, MoCA, CDR, SCD</td>
</tr>
<tr>
<td>Wei et al., 2021&lt;sup&gt;40&lt;/sup&gt;</td>
<td>Feb 2018–Nov 2019</td>
<td>Beijing Hospital</td>
<td>98</td>
<td>62/36</td>
<td>64.78±9.14</td>
<td>FP, MMSE</td>
</tr>
<tr>
<td>Wang et al., 2019&lt;sup&gt;39&lt;/sup&gt;</td>
<td>Nov 2015–Jan 2018</td>
<td>Sichuan Hospital</td>
<td>692</td>
<td>408/284</td>
<td>≥60</td>
<td>CGA-FI, MMSE</td>
</tr>
<tr>
<td>Wang et al., 2021&lt;sup&gt;38&lt;/sup&gt;</td>
<td>May 2020–Jul 2020</td>
<td>Hunan Hospital</td>
<td>204</td>
<td>129/75</td>
<td>≥65</td>
<td>FP, MoCA, CDR, SCD</td>
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<td>Wang et al., 2021&lt;sup&gt;37&lt;/sup&gt;</td>
<td>Nov 2019–Oct 2020</td>
<td>Hebei Hospital</td>
<td>198</td>
<td>127/71</td>
<td>≥65</td>
<td>FRAIL, CDR</td>
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<tr>
<td>Wang et al., 2021&lt;sup&gt;36&lt;/sup&gt;</td>
<td>Jun 2018–Dec 2018</td>
<td>Jiangxi Community</td>
<td>268</td>
<td>129/139</td>
<td>80.59±8.50</td>
<td>FP, MMSE, CDR</td>
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<tr>
<td>Wang et al., 2019&lt;sup&gt;35&lt;/sup&gt;</td>
<td>Oct 2018–Dec 2018</td>
<td>Shanghai Hospital</td>
<td>139</td>
<td>99/40</td>
<td>88.0±7.30</td>
<td>FRAIL, MMSE, RCS</td>
</tr>
<tr>
<td>Song et al., 2021&lt;sup&gt;34&lt;/sup&gt;</td>
<td>Jul 2019–Aug 2019</td>
<td>Guizhou Community</td>
<td>1652</td>
<td>693/959</td>
<td>71.40±6.50</td>
<td>FRAIL, MMSE</td>
</tr>
<tr>
<td>Pan et al., 2019&lt;sup&gt;33&lt;/sup&gt;</td>
<td>Mar 2018–Sep 2018</td>
<td>Zhengzhou Community</td>
<td>1190</td>
<td>443/747</td>
<td>72.52±7.45</td>
<td>FP, MoCA, CDR</td>
</tr>
<tr>
<td>Liu et al., 2021&lt;sup&gt;32&lt;/sup&gt;</td>
<td>Apr 2019–Dec 2019</td>
<td>Xinjiang Hospital</td>
<td>395</td>
<td>166/229</td>
<td>75.30±6.80</td>
<td>FP, MoCA, CDR</td>
</tr>
<tr>
<td>Li and Qiao, 2021&lt;sup&gt;31&lt;/sup&gt;</td>
<td>Jan 2020–Dec 2020</td>
<td>Hainan Community</td>
<td>1458</td>
<td>717/741</td>
<td>76.42±5.57</td>
<td>FP, MMSE</td>
</tr>
<tr>
<td>Kong et al., 2020&lt;sup&gt;30&lt;/sup&gt;</td>
<td>Jun 2019–Oct 2019</td>
<td>Hubei Community</td>
<td>291</td>
<td>137/154</td>
<td>69 (67–72 )</td>
<td>FP, MMSE</td>
</tr>
<tr>
<td>Jiang et al., 2020&lt;sup&gt;29&lt;/sup&gt;</td>
<td>Dec 2018–Jun 2019</td>
<td>Zhengzhou Hospital</td>
<td>255</td>
<td>137/118</td>
<td>72.27±5.70</td>
<td>Tilburg, MoCA, CDR</td>
</tr>
<tr>
<td>Cui et al., 2021&lt;sup&gt;28&lt;/sup&gt;</td>
<td>Dec 2019</td>
<td>Shandong Community</td>
<td>1091</td>
<td>635/456</td>
<td>≥60</td>
<td>Tilburg, MMSE</td>
</tr>
<tr>
<td>Huang et al., 2021&lt;sup&gt;27&lt;/sup&gt;</td>
<td>2014–2016</td>
<td>China Taiwan Community</td>
<td>1115</td>
<td>—</td>
<td>≥65</td>
<td>FRAIL, MMSE</td>
</tr>
<tr>
<td>Kwan et al., 2019&lt;sup&gt;26&lt;/sup&gt;</td>
<td>Jan 2017–Jun 2018</td>
<td>China Hong Kong Community</td>
<td>185</td>
<td>53/132</td>
<td>86.20±4.50</td>
<td>FRAIL, CDR</td>
</tr>
<tr>
<td>Ruan et al., 2019&lt;sup&gt;24&lt;/sup&gt;</td>
<td>2018–2019</td>
<td>Shanghai Community</td>
<td>5328</td>
<td>2359/2717</td>
<td>73.16</td>
<td>FRAIL, RCS, SCD</td>
</tr>
<tr>
<td>Ge et al., 2020&lt;sup&gt;23&lt;/sup&gt;</td>
<td>Jul 2018–Nov 2018</td>
<td>West China Community</td>
<td>4302</td>
<td>1711/2392</td>
<td>67.80±5.90</td>
<td>FP, SPMRS</td>
</tr>
<tr>
<td>Ma et al., 2019&lt;sup&gt;22&lt;/sup&gt;</td>
<td>2011–2012</td>
<td>China Community</td>
<td>3202</td>
<td>1397/1805</td>
<td>70.14±7.08</td>
<td>FP, MMSE</td>
</tr>
</tbody>
</table>

Continued
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Prevalence of cognitive frailty in men and women was 25% (95% CI (0.20%, 0.30%)) and 30% (95% CI (0.22%, 0.37%)).

**Prevalence in different regions**

Northeast China: one study showed 33.5% prevalence of cognitive frailty in community-dwelling older adults. North China: two studies showed that the prevalence of cognitive frailty in the hospital population was 25% (95% CI (0.16%, 0.35%)), and one study showed that the prevalence of cognitive frailty in the community was 4.0%. East China: five studies in the community reported the prevalence of cognitive frailty is 7.0% (95% CI (0.06%, 0.08%)), whereas one study in the hospital showed that the prevalence of cognitive frailty was 43.2%. South China: three studies in the community showed that the prevalence of cognitive frailty was 10% (95% CI (0.09%, 0.11%)), whereas three studies in the hospital showed that the prevalence of cognitive frailty was 24% (95% CI (0.20%, 0.27%)). Northwest China: two studies in the hospital showed that the prevalence of cognitive frailty was 16% (95% CI (0.08%, 0.25%)), while one study in the community showed that the prevalence of cognitive frailty was 8.6%. South West China: Wang et al. found that the prevalence of cognitive frailty among older adults with comorbidities in Chengdu was 25.4%; Song et al. used the Frailty Scale and the Mini-Mental State Examination to screen the elderly aged 60 years and over in a community in Guizhou Province, and found that the prevalence of cognitive frailty was 3.3%. Taiwan and Hong Kong: Kwan et al. found that the prevalence of cognitive frailty was 35.7%, which is the community with the highest prevalence of cognitive frailty in the included literature; one study in a Taiwan community showed that the prevalence of cognitive frailty was 4.2%. A total of three studies in nursing homes were included, and the prevalence of cognitive frailty was 24% (95% CI (0.17%, 0.30%)).

**Table 1 Continued**

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Investigation time</th>
<th>Region/sample source</th>
<th>Sample size</th>
<th>Male and female</th>
<th>Average age</th>
<th>Frailty assessment</th>
<th>Cognitive frailty assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lu et al., 2021</td>
<td>Sep 2019-Dec 2019</td>
<td>Shanxi Community</td>
<td>3558</td>
<td>1817/1741</td>
<td>69.90±8.80</td>
<td>FP</td>
<td>CMMSE</td>
</tr>
<tr>
<td>Zhao et al., 2020</td>
<td>May 2019–Jun 2019</td>
<td>Shandong Community</td>
<td>3242</td>
<td>1181/2061</td>
<td>70.14±6.17</td>
<td>FP</td>
<td>MMSE</td>
</tr>
<tr>
<td>Wang et al., 2021</td>
<td>Dec 2020–Mar 2021</td>
<td>Shanghai Community</td>
<td>305</td>
<td>108/197</td>
<td>60-89</td>
<td>FP</td>
<td>MMSE</td>
</tr>
<tr>
<td>Xie et al., 2020</td>
<td>Jun 2018–Aug 2018</td>
<td>Shanghai Community</td>
<td>1585</td>
<td>663/922</td>
<td>81.38±4.72</td>
<td>FP</td>
<td>CMMSE</td>
</tr>
</tbody>
</table>

CDR, Clinical Dementia Rating; CGA-FI, Comprehensive Geriatric Assessment-Frailty Index; CMMSE, Chinese version of the Mini-Mental State Examination Scale; FP, Fried Frailty Phenotype Scale; FRAIL, Frailty Scale; MMSE, Mini-Mental State Examination Scale; MoCA, Montreal Cognitive Assessment Scale; RCS, rapid cognitive screening; SCD, subjective perceptions or family members’ complaints of cognitive decline in older adults; SPMSQ, Short Portable Mental State Questionnaire; Tilburg, Tilburg Frailty Scale.

**Figure 2** Forest plot of prevalence of cognitive frailty. ES, effect size.
Prevalence by age
A total of 16 studies are age-stratified, of which 5 studies included the elderly aged 65 years old according to the International Geriatric Criteria, 10 studies included people 60 years and older, and 1 study included people 75 years and older. The prevalence of cognitive frailty is 4% (95% CI: 0.02%, 0.05%) in those 60–69 years old, 7% (95% CI: 0.05%, 0.10%) in those 70–79 years old and 29% (95% CI: −0.03%, 0.62%) in those ≥80 years old.

Prevalence by different educational levels
Twelve studies conducted stratification of educational level, of which two studies were conducted according to illiteracy, primary school, junior high school, high school and above. The prevalence of cognitive frailty in the illiterate group was 55% (95% CI: 0.45%, 0.64%), the prevalence of cognitive frailty in the primary school group was 17% (95% CI: 0.05%, 0.29%), the prevalence of cognitive frailty in the junior high school group was 15% (95% CI: 0.07%, 0.22%), and the prevalence of cognitive frailty in the high school and above group was 11% (95% CI: 0.03%, 0.20%).

Three studies were stratified according to primary school and below, junior high school, high school, college and above. The prevalence of cognitive frailty in primary school and below group was 11% (95% CI: 0.07%, 0.16%), the prevalence of cognitive frailty in junior high school group was 9% (95% CI: 0.06%, 0.12%), the prevalence of cognitive frailty in high school group was 8% (95% CI: 0.06%, 0.11%), and the prevalence of cognitive frailty in college and above was 13% (95% CI: 0.01%, 0.24%).

PUBLICATION BIAS
The publication bias of the included studies was tested by Egger’s test. The results showed that the difference was not statistically significant (p=0.104), and the funnel plot was basically symmetrical, so it could be considered that there was no publication bias. The results of sensitivity analysis showed that after excluding one study, the combined prevalence rate did not change significantly, indicating that the results of the meta-analysis were stable (see figures 3 and 4).
Cognitive frailty is a public health problem for older adults and has attracted worldwide attention in recent years. Since the concept of cognitive frailty was first proposed in 2013, the number of studies on cognitive frailty among older adults has increased worldwide. Multiple risk factors for cognitive impairment are also associated with the development and worsening of frailty among older adults, both causal and biopathological mechanisms have demonstrated an association between frailty and cognitive function, and the physical and nervous system functions of the elderly decline with age. Nonetheless, cognitive frailty is not a necessary part of the ageing process, and many older adults do not develop cognitive frailty when they enter advanced age. Implementing targeted interventions can prevent, slow or reverse this decline.

A previous study comparing commonly used tools to screen for frailty and cognitive impairment found that these assessments were equally effective in predicting adverse health outcomes, such as death. Therefore, this study pooled cross-sectional studies reporting the prevalence of cognitive frailty regardless of the frailty and cognitive impairment screening tools used. Eight studies in this review used the Fried Frailty Phenotype Scale and Mini-Mental State Examination Scale to screen for cognitive frailty, the combination of which is currently the most widely used assessment tool. In 2015, Ruan et al proposed a new definition of cognitive frailty, including ‘reversible cognitive frailty’ and ‘potentially reversible cognitive frailty prophase’, due to the lack of epidemiological evidence to support this definition, and only two studies were reported in the included literature. The prevalence before cognitive frailty was 20.8% and 20.0%, respectively. To avoid misleading results, we did not perform a meta-analysis.

In the current study, the prevalence of cognitive frailty was higher in women than in men. In China, the prevalence of cognitive frailty in elderly women in the communities and hospitals is higher than that in elderly men, which is consistent with the findings of Pan et al. found that elderly women usually have more comorbidities, such as obesity and depression, than men, which may lead to a higher prevalence of cognitive frailty. In addition, the decline in oestrogen levels in postmenopausal women promotes vitamin D deficiency and decreases protection of the nervous system, which affects neuromuscular balance and brain–nerve activity. Moreover, older Chinese women tend to take care of their offspring at home after retirement. Hence, their social support and activity participation reduce significantly, all of which have increased the risk of cognitive frailty in older women. The prevalence of cognitive frailty among the elderly in hospitals and nursing homes is higher than that in communities. This study included older adults from the communities, hospitals and nursing homes, and aimed to analyse the necessity of cognitive frailty screening in hospitalised patients and those in nursing homes. The prevalence of cognitive frailty is higher in hospitals and elderly care institutions than in communities. A possible reason is that the elderly live in a relatively closed environment, which further reduces activity participation and

DISCUSSION
To the best of our knowledge, this study is the first comprehensive and systematic review and meta-analysis of the current status of cognitive frailty among older adults in China, which is of great significance for disease prevention. Twenty-eight studies were included in this review, including 33,279 patients aged 60 years and older, and the heterogeneity of all meta-analyses in this study was greater than 90%. Heterogeneity was divided into three categories: less than 25% (low heterogeneity), 25%–75% (moderate heterogeneity) and ≥75% (high heterogeneity). Therefore, this study belongs to the category of high heterogeneity, and the meta-analysis used a random-effects model. The results showed that the prevalence of cognitive frailty was between 2.3% and 43.2%, and that the combined prevalence of cognitive frailty among older adults in China was 15%. The prevalence of cognitive frailty reported in this study is higher than those reported by He et al among older adults in China. This suggests that the problem of cognitive frailty among older adults in China is significantly common, and that medical staff need to pay attention to the occurrence of this problem and conduct screening and intervention as soon as possible.
social support. In addition, they are mostly demented and widowed, lack interpersonal communication and emotional support, and are at risk of loneliness, depression, and other negative emotions. These factors increase the risk of cognitive frailty. Therefore, the risk factors of cognitive frailty should be paid significant attention to and be identified as early as possible. Moreover, active interventions should be provided to patients with cognitive frailty. The prevalence of cognitive frailty is higher in older adults than in younger adults. When grouped by age, the prevalence of cognitive frailty was 4% and 29% for patients aged 60–69 and ≥80 years, respectively. This suggests that the prevalence of cognitive frailty increases with age. This finding is consistent with the results of previous studies. A possible reason for this is that with an increase in age, the level of hormones in the body decreases. In addition, the elderly are at risk of hearing loss, muscle strength loss, osteoporosis and other problems, leading to the occurrence of cognitive frailty. Older people should actively prevent cognitive frailty through cognitive function training.

This study has several advantages. First, we employed a comprehensive search strategy to maximise the identification of all relevant studies. Second, all study phases were assessed independently by two researchers, and differences were resolved through discussion. We contacted lead authors or study leaders to ensure that duplicate publications were removed and, in some cases, to obtain additional data. Third, we integrated the data using a random-effects model to provide a conservative estimate of the prevalence of cognitive impairment among older Chinese adults. We also performed sensitivity and subgroup analyses to investigate the possible causes of heterogeneity, and publication bias was assessed, which made our findings more rigorous. Finally, this study has limitations in that high levels of heterogeneity were observed among the included studies. Despite the subgroup analyses of the study subjects, sources of heterogeneity have been identified, and high levels of heterogeneity may be related to differences in study design, sample size and study screening tools. In addition, this study included cross-sectional studies, and the results of the meta-analysis still need to be verified.

CONCLUSIONS
In conclusion, this systematic review found that the prevalence of cognitive frailty among older adults in China was 15%. Subgroup analysis showed that the prevalence of cognitive frailty was higher in hospitals and nursing homes than in the communities, and in women than in men. The prevalence of cognitive frailty increased with age, and the prevalence of cognitive frailty was higher in different regions. Multimodal interventions for cognitive frailty, including increased exercise, nutritional support, depression prevention, sleep disturbance adjustment, increased social opportunities and multicomponent strategies, may be effective in preventing cognitive frailty. Prospective studies with larger sample sizes should be conducted to establish a consensus to evaluate the various diagnostic criteria reported for cognitive frailty.

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Contributors JL and SX—conceptualisation, writing (original draft), formal analysis, data curation and writing (review and editing). SX, JW, ZW, GL and ZY—conceptualisation, formal analysis and writing (review and editing). XL—conceptualisation, writing (original draft) and funding acquisition. XL is the senior responsible author and accepts full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish. All authors read and approved the final manuscript.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data that support the findings of this study are available from the corresponding author on reasonable request.

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ORCID iD Xiaorong Luan http://orcid.org/0000-0002-8181-4852

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Appendix A: Search strategies
Take PubMed and CNKI as examples

PubMed
#1 "cognitive dysfunction" [Mesh]
#2 cognitive frailty OR cognitive dysfunction OR cognitive impairment OR cognitive decline OR cognit*
#3 (#1 OR #2)
#4 "Frailty"[Mesh]
#5 frail* OR frailty syndrome* OR frail elderly OR frailty index OR asthenia
#6 (#4 OR #5)
#7 "Prevalence"[Mesh]
#8 "Epidemiology"[Mesh]
#9 "Cross-Sectional Studies"[Mesh]
#10 prevalence* OR epidemiology OR incidence*
#11 (#7 OR #8 OR #9 OR #10)
#12 "Aged"[Mesh]
#13 "Geriatrics"[Mesh]
#14 aged OR elderly OR geriatrics OR gerontology
#15 (#12 OR #13 OR #14)
#16 "China"[Mesh]
#17 China OR Mainland China OR Chinese
#18 (#16 OR #17)
#19 (#3 AND #6 AND #11 AND #15 AND #18)

CNKI
SU=('认知衰弱' + '认知障碍' + '认知下降' + '衰弱指数') * ('衰弱' + '虚弱' + '衰弱综合症' + '衰弱指数') * ('发病率' + '患病率' + '现患率' + '流行病学') * ('老年人' + '老人' + '老年' + '老年医学') * ('中国' + '中国大陆')
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1: Whether the data source is clear; 2: Whether the inclusion and exclusion criteria of the exposed group and the non-exposed group (cases and controls) are listed or refer to previous publications; 3: Whether the collection time of the research subjects is clear; 4: Whether the research subjects are clear representative; 5: it is clear whether the measured variable is masked by other characteristics; 6: any assessments made to ensure quality are described; 7: the description of exclusions from the analysis of the results; 8: how to describe the assessment and/or assessment of confounders Controls; 9: Describes handling of missing data; 10: Summarizes patient response rates and completeness of data collection; 11: If follow-up is available, identifies expected percentage of incomplete patient data or follow-up results.