Prevalence and risk factors of senile pruritus: a systematic review and meta-analysis

Shi Chen 1, Faquan Zhou 2,3, Yiquan Xiong 4

ABSTRACT
Objectives To systematically assess the prevalence and risk factors for senile pruritus (SP) in the elderly (≥60 years of age).
Design A meta-analysis was used to pool the prevalence and risk factors for SP estimated from individual studies. Four subgroup analyses were conducted to explore the prevalence for SP in different age, sex, research sites and region.
Setting, participants and measures SP reduces quality of life in the elderly, yet the worldwide prevalence is unclear. Moreover, the risk factors for SP are controversial. Data from cross-sectional studies, case–control studies, longitudinal studies and cohort studies that reported the prevalence or the risk factors for SP were collected by searching nine electronic databases up to October 2020, including Web of Science, PubMed, Embase, Cochrane Library, CINAHL, CBM, CNKI, Wanfang and VIP. Two reviewers independently screened studies according to the inclusion and exclusion criteria, extracted data and assessed methodological quality. Data analysis was performed using Stata V.15.1 software.
Results Seventeen studies involving 28 666 participants were included. The overall pooled prevalence of SP was 21.04% (95% CI 11.37% to 32.72%). In addition, the results showed that smoking, excessive drinking and monophagism were possible risk factors for SP, with pooled ORs of 1.26 (95% CI 1.14 to 1.40), 25.03 (95% CI 18.28 to 34.25) and 1.22 (95% CI 1.12 to 1.33), respectively.
Conclusions The overall prevalence of SP was high. Smoking, excessive drinking and monophagism were possible risk factors for SP.

INTRODUCTION
The geriatric population (≥60 years of age) has been growing steadily worldwide in recent decades. It is estimated that the geriatric population will account for 20% of the world’s population by the middle of this century. Ageing results in numerous adverse changes in the structure and function of multiple human organs, including the skin.

Senile pruritus (SP) is defined as generalised pruritus in patients without primary skin lesions. Pruritus is the most common skin disorder in the geriatric population. It can lead to an unpleasant cutaneous sensation, which provokes the desire to scratch (itchiness) and is accompanied by skin lesions, pain and infection.

Furthermore, it can lead to adverse consequences for patients’ psychological health and quality of life, including anxiety, depression, disruption of normal sleep patterns and poor daytime concentration.

Therefore, investigating the prevalence of SP is essential for informing policymakers, clinicians, and the general population.

The prevalence of SP has been reported around the world, ranging from 41% in Thailand, 40.6% in America, 18.9% in Italy and 14.2% in China. However, these studies were limited by sample size and regional differences, and therefore do not represent the prevalence of SP worldwide. Furthermore, several studies conducted surveys on inpatients or outpatients to report the prevalence of SP. Inpatients or outpatients do not represent the whole elderly population, making the results less representative of the actual prevalence of SP in the community. For these reasons, the precise prevalence and characteristics of the population are unknown worldwide. Furthermore, the risk factors for SP have been reported extensively, but with controversial conclusions. For example, Yang et al indicated that smoking was associated with SP (OR 2.23, 95% CI 1.35 to
However, Chen et al reported that smoking was not associated with SP (OR 1.25, 95% CI 0.99 to 1.35). In this study, we conducted a systematic review and meta-analysis to synthesise the prevalence of SP in different ages, sexes and regions based on the general population and to evaluate the risk factors for SP.

**MATERIALS AND METHODS**

**Protocol registration**

This study was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.

**Search strategy**

Nine databases were searched in this study, including Web of Science, PubMed, Embase, Cochrane Library, CINAHL, CBM, CNKI, Wanfang and VIP. The following strategy was used in the searches: (Pruritus OR Itching) AND (Senile OR Aging OR Aged OR Geriatrics) AND (Incidence OR Epidemiology OR Prevalence OR Risk factors). Complete details of the search strategy are available in online supplemental table S1. All of the databases were searched from their inception dates to the 24 October 2020. Additional relevant literature was included following a manual search of the included studies reference lists.

**Inclusion and exclusion criteria**

The inclusion criteria were as follows: (1) the study design was either cross-sectional study, case–control study, cohort study or longitudinal study; (2) participants were greater than or equal to 60 years of age; (3) exact diagnostic criteria for SP were provided and (4) prevalence or risk factors for SP were reported. The exclusion criteria were as follows: (1) the study populations were inpatients and outpatients; (2) the prevalence or risk factor effect value (mainly referred to as OR in this study) of SP was not clearly reported in the original study, and the data provided by the original study couldn’t calculate the prevalence or risk factor effect value of SP; (3) republished literature and (4) or studies published in a language other than Chinese or English.

**Quality of the studies**

Two independent reviewers assessed the quality of the included studies according to 11 criteria recommended by the American Agency for Healthcare Research and Quality. The criteria included assessment of selection bias, performance bias, attrition bias, detection bias and publication bias. An item would be scored ‘1’ if it was answered ‘YES’, and if it was answered ‘NO’ or ‘UNCLEAR’, then the item scored ‘0’, providing a maximum score of 11.

**Data analysis**

Double arcsine transformation was used to convert the prevalence of SP so that the data can follow an approximately normal distribution. The ORs with their corresponding 95% CIs were selected to assess the effect size of risk factors for SP. Heterogeneity among studies was tested by Cochrane’s Q and I² statistics. Heterogeneity was recognised as significant when I² > 50%. A fixed-effect model (Mantel and Haenszel method) was used if I² ≤ 50%, otherwise a random-effects model (DerSimonian and Laird method) was used.

Forest plots were constructed for a visual display of the pooled results if necessary. Four subgroup analyses were conducted to explore the prevalence for SP in different age, sex, research sites and region. Sensitivity analysis were assessed by excluding single studies. Publication bias was assessed by using Begg’s and Egger’s tests. Tests of publication bias and sensitivity analysis were not conducted in the risk factor analysis section due to the limited number of studies included. Statistical analyses were conducted using STATA V.15.1 (Stata).

**RESULTS**

**Study description**

A total of 8518 records were identified from the 9 databases, of which 647 were duplicates. After screening
titles and abstracts, 7740 records were excluded with reasons of age, outcome, study design. Full-text documents of 131 records were screened, and 114 studies were excluded with reasons listed as follows: participants were not ≥60 years of age (n=49), outcome was not SP (n=44), not cross-sectional, case–control, cohort or longitudinal study (n=9), non-Chinese and English study (n=5), duplicate publication (n=7). In summary, 17 studies were eligible and included in the meta-analysis finally (figure 1).

**Characteristics of the included studies**

The characteristics of the 17 studies are summarised in table 1. Eleven articles were written in Chinese, and six were written in English. Thirteen studies were conducted in Asia and four in Europe. Sample sizes ranged from 45 to 8252. Four of the 17 studies reported the risk factors for SP.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Publication years</th>
<th>Study area</th>
<th>Diagnostic criteria</th>
<th>Sample size</th>
<th>Prevalence (%)</th>
<th>Risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dalgard et al</td>
<td>2004</td>
<td>Norway</td>
<td>①</td>
<td>3876</td>
<td>6.91</td>
<td>NA</td>
</tr>
<tr>
<td>Li et al</td>
<td>2000</td>
<td>China</td>
<td>NA</td>
<td>534</td>
<td>12.36</td>
<td>NA</td>
</tr>
<tr>
<td>Xue</td>
<td>2008</td>
<td>China</td>
<td>NA</td>
<td>311</td>
<td>19.29</td>
<td>NA</td>
</tr>
<tr>
<td>Ni et al</td>
<td>2012</td>
<td>China</td>
<td>④</td>
<td>426</td>
<td>5.63</td>
<td>NA</td>
</tr>
<tr>
<td>Zhang</td>
<td>2012</td>
<td>China</td>
<td>NA</td>
<td>1283</td>
<td>9.90</td>
<td>NA</td>
</tr>
<tr>
<td>Li et al</td>
<td>2014</td>
<td>China</td>
<td>③</td>
<td>500</td>
<td>33.40</td>
<td>NA</td>
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<tr>
<td>Wu and Zhang</td>
<td>2014</td>
<td>China</td>
<td>⑥</td>
<td>1286</td>
<td>42.38</td>
<td>NA</td>
</tr>
<tr>
<td>Yang et al</td>
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<td>China</td>
<td>NA</td>
<td>5000</td>
<td>33.84</td>
<td>NA</td>
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<tr>
<td>Tseng et al</td>
<td>2014</td>
<td>China</td>
<td>NA</td>
<td>313</td>
<td>7.35</td>
<td>NA</td>
</tr>
<tr>
<td>Miller et al</td>
<td>2016</td>
<td>Denmark</td>
<td>①</td>
<td>8252</td>
<td>6.31</td>
<td>NA</td>
</tr>
<tr>
<td>Kara et al</td>
<td>2017</td>
<td>Turkey</td>
<td>NA</td>
<td>105</td>
<td>19.05</td>
<td>NA</td>
</tr>
<tr>
<td>Cowdell et al</td>
<td>2017</td>
<td>Britain</td>
<td>④</td>
<td>1116</td>
<td>9.32</td>
<td>NA</td>
</tr>
<tr>
<td>Dyhre-Petersen and Gazerani</td>
<td>2019</td>
<td>Denmark</td>
<td>⑤</td>
<td>45</td>
<td>28.89</td>
<td>NA</td>
</tr>
<tr>
<td>Ge et al</td>
<td>2006</td>
<td>China</td>
<td>②</td>
<td>1236</td>
<td>66.91</td>
<td>Age, xerosis, astiction</td>
</tr>
<tr>
<td>Yang et al</td>
<td>2009</td>
<td>China</td>
<td>⑥</td>
<td>3785</td>
<td>61.98</td>
<td>Less water intake; bathing with soap; baths too much; smoking; malignant tumour.</td>
</tr>
<tr>
<td>Chen et al</td>
<td>2015</td>
<td>China</td>
<td>④</td>
<td>200</td>
<td>10.50</td>
<td>Bathing with soap; smoking; chronic illness; excessive drinking; monophasia; Insomnia; contact with animal</td>
</tr>
<tr>
<td>Hou and Zhang</td>
<td>2016</td>
<td>China</td>
<td>④</td>
<td>398</td>
<td>18.09</td>
<td>Smoking; chronic illness; excessive drinking; monophasia; insomnia; contact with animal</td>
</tr>
</tbody>
</table>

Diagnostic criteria: ① self-reported skin complaints scale; ② participants ≥60 years, an itch lasting more than 2 weeks, pruritus of whole body or multiple parts, no primary rash, no other pruritic skin disease, no obvious liver and kidney damage, diabetes and mental disease; ③ dermatology and venereology; ④ clinical dermatology; ⑤ dermatovenerolog; ⑥ self-report skin diseases scale; ⑦ self-report skin diseases scale.

NA, not available.

**Risk of bias assessment**

Results of the risk of bias assessment are listed in online supplemental table S2. Higher scores indicative of less bias and more quality. Article quality was assessed as follows: 0–3 indicates a low quality, 4–7 indicates a moderate quality and 8–11 indicates a high quality. Study quality was found to be moderate in 11 studies and high in the other six studies.

**Prevalence of SP**

Seventeen studies, involving 2866 participants reported the prevalence of SP, ranging from 5.63% to 66.91%. A random-effects model-based meta-analysis showed that the pooled prevalence of SP was 21.04% (95% CI 11.37% to 32.72%). Subgroup analyses indicated that the pooled prevalence of SP for people aged 60–69, 70–79, 80–89 and ≥90 years old were 11.98% (95% CI 3.91% to 23.62%), 26.79% (95% CI 8.71% to 50.36%),...
51.31% (95% CI 47.20% to 96.33%) and 57.53% (95% CI 8.18% to 98.09%), respectively. The pooled prevalence of SP was 8.26% (95% CI 5.88% to 11.00%) in females and 18.65% (95% CI 0.83% to 51.61%) in males. The pooled prevalence of SP in health examination centres, nursing homes and communities was 43.83% (95% CI 19.39% to 69.94%), 16.26% (95% CI 4.55% to 33.29%) and 12.21% (95% CI 3.46% to 25.34%), respectively. The pooled prevalence of SP in Turkey and China was 24.34% (95% CI 14.03% to 36.38%). The pooled prevalence of SP in Norway, Denmark and Britain was 8.23% (95% CI 6.36% to 10.35%). The results of subgroup analyses of age, sex, research site and region are shown in table 2.

Risk factors
Four studies, including 5619 participants, reported the risk factors for SP.\textsuperscript{18, 19, 26, 33} There were three studies,\textsuperscript{18, 19, 33} including 4383 participants, that reported the association of smoking and SP. Meta-analyses showed smoking was associated with SP (pooled OR of 1.26 (95% CI 1.14 to 1.40), I\textsuperscript{2}=0%). The results of two studies,\textsuperscript{19, 33} involving 598 participants, suggested that excessive drinking increased the occurrence of SP (pooled OR of 25.03 (95% CI 18.28 to 34.25), I\textsuperscript{2}=0%). Two studies\textsuperscript{19, 33} involving 589 participants reported the association of monophagism and SP (pooled OR of 1.22 (95% CI 1.12 to 1.33), I\textsuperscript{2}=0%) (table 3).

### Sensitivity analysis
Sensitivity analysis was performed by excluding a single study and showed that the results of the meta-analysis were stable (18.61%–22.23%). Sensitivity analysis was not conducted for the risk factor analysis due to the limited number of studies.

### Publication bias
Publication bias was assessed by using Begg’s and Egger’s tests. Begg’s (Z=0.70, p=0.484) and Egger’s test (t=0.26, p=0.796) results showed that the possibility of publication bias was less in the overall prevalence pooled analysis. Publication bias was not assessed in the risk factor analysis due to the limited number of studies.

### DISCUSSION
In this study, 17 studies involving 28 666 participants were included encompassing Norway, China, Denmark, Turkey and Britain. Subgroup analyses found that the difference in the prevalence of SP based on epidemiological factors. Subgroup analyses indicated that a steadily increasing

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Prevalence (%)</th>
<th>95% CI (%)</th>
<th>Heterogeneity</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>I\textsuperscript{2} (%)</td>
</tr>
<tr>
<td>Age</td>
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<td></td>
<td></td>
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<tr>
<td>60–69</td>
<td>11.98</td>
<td>3.91 to 23.62</td>
<td>98.1</td>
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<tr>
<td>70–79</td>
<td>26.79</td>
<td>8.71 to 50.36</td>
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<tr>
<td>80–89</td>
<td>51.31</td>
<td>47.20 to 96.33</td>
<td>99.6</td>
</tr>
<tr>
<td>≥90</td>
<td>57.53</td>
<td>8.18 to 98.09</td>
<td>99.0</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>8.26</td>
<td>5.88 to 11.00</td>
<td>87.4</td>
</tr>
<tr>
<td>Males</td>
<td>18.65</td>
<td>0.83 to 51.61</td>
<td>99.9</td>
</tr>
<tr>
<td>Research sites</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Health examination centre</td>
<td>43.83</td>
<td>19.39 to 69.94</td>
<td>99.8</td>
</tr>
<tr>
<td>Nursing homes</td>
<td>16.26</td>
<td>4.55 to 33.29</td>
<td>93.2</td>
</tr>
<tr>
<td>Community</td>
<td>12.21</td>
<td>3.46 to 25.34</td>
<td>99.8</td>
</tr>
<tr>
<td>Region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turkey, China</td>
<td>24.34</td>
<td>14.03 to 36.38</td>
<td>99.6</td>
</tr>
<tr>
<td>Norway, Denmark, Britain</td>
<td>8.23</td>
<td>6.36 to 10.35</td>
<td>90.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3 Pooled risk factors of senile pruritus</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>
prevalence of SP was associated with increasing age. Xerosis is related to ageing and is reported as the most common cause of SP.41–45 One of the skin’s most important functions is to retain water. Skin surface lipids and sebum on the skin helps retain water.44 As skin ages, there is a decrease in lipids and sebum on the skin, leading to suboptimal moisture retention.45 It was reported that pruritus can also be secondary to diabetes, kidney disease, liver disease, etc.44 45 Furthermore, pruritus is commonly listed as a medication complication,46 including ACE inhibitors, salicylates, chloroquine and calcium channel blockers.44 However, elderly people have more basic diseases and complex medication, which also contributed to the higher incidence of pruritus. Another view is that SP is probably a subclinical neuropathy, degenerative change in peripheral nerve endings may be attributable to age. This age alteration can cause pruritus without specific stimuli.43 In addition, immunosenescence occurs with ageing and also produces a higher incidence of pruritus.42 Moreover, decreases in androgen, oestrogen with ageing and also produces a higher incidence of logical, social, environmental and cultural factors.49 These changes reduce skin lipids, sebum and elastin fibres in the dermis, and increases keratinocyte dysplasia.50 These changes reduce skin lipids, sebum and moisture retention, leading to dryness and pruritus of skin.51 52 Therefore, smoking is a potential risk factor for SP. This study also identified drinking alcohol as a potential risk factor for SP. Studies have demonstrated that alcohol consumption could reduce the concentration of carotenoids in the skin.35 Carotenoids can neutralise free radicals, delay premature skin ageing and skin diseases caused by free radicals.53–55 It could be proposed that alcohol consumption may lead to skin diseases by affecting the concentration of carotenoids. The human body cannot synthesise carotenoids in sufficient amounts without relying on a nutrient rich diet including fruit and vegetables. Therefore, monophagism could contribute to reducing the concentration of carotenoids and it could be considered a risk factors for skin diseases. Regrettably, the specific types of monophagism wasn’t pointed out in the included study, which prevented further analysis and discussion. We expect that follow-up studies will explore and investigate this. In addition, point out the participants’ dietary structure and specific types of monophagism.

Although this study indicated smoking, excessive drinking and monophagism were associated with an increased risk of SP, all the studies included in the meta-analysis were cross-sectional. Consequently, it is not possible to infer on the causality between exposure and outcomes. Further studies are needed to confirm these findings. In addition to the three risk factors identified through the meta-analyses, the included studies also showed that the risk factors for SP also include age, xerosis, astriction, less water intake, bathing with soap, bathing too frequently, malignant tumour, chronic illness, excessive drinking, insomnia and contact with animals.

To the best of our knowledge, this study is the first to provide a systematic review of SP prevalence and risk factors. However, several limitations of this study should be noted. First, The epidemiological data on SP was only from Norway, China, Turkey, Britain and Denmark, which cannot be generalised to the worldwide population. Second, the methods of identifying SP varied among the included studies, the definitions of SP may not be uniform among investigators and researchers in different countries, the study of different countries may not be unified in assessing the prevalence of SP, making it difficult to analyse the prevalence of SP using a gold standard method. These limitations make we less confident that the final estimate is close to a ‘true’ estimate. Considering these limitations, further studies will be needed to better understand the prevalence and risk factors of SP worldwide.

CONCLUSION
In conclusion, this study found the prevalence of SP was 21.04%. Individuals who were older, male or living in Turkey and China were associated with a higher prevalence of SP. Additionally, among health examination centres, nursing homes and communities, the highest detection rate of SP was found in the health examination centres. Smoking, excessive drinking and monophagism were possible individual risk factors for SP.

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Contributors SC and FZ contributed equally to this study. SC conceived and participated in the design of this review. SC and FZ performed the literature searches, study selection, data extraction and assessed the risk of bias. SC and FZ drafted the manuscript. YX helped in performing the analysis with constructive discussions. SC revised the final version. All authors read and approved the final manuscript. SC is responsible for the overall content as the guarantor.

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Patient consent for publication Not applicable.

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