A systematic evaluation of the influencing factors of social isolation among elderly people

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Author contributions
Hong Wang and Run-Hao Jin were responsible for study design, data analysis and manuscript writing. All authors read and reviewed the final manuscript.

Competing interests
The authors declare no conflicts of interest.

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Abbreviations
OR, odds ratio; CI, confidence interval.

Citation

Abstract
Objective: To systematically evaluate the influencing factors of social isolation among elderly people. Methods: Computer search was conducted on China National Knowledge Infrastructure, Wanfang Knowledge Data Service Platform, VIP, China Biomedical Literature Database, Web of Science, PubMed, the Cochrane Library and Embase databases to comprehensively search for relevant literature on the influencing factors of social isolation among elderly people. A descriptive analysis was conducted on the influencing factors of social isolation, and meta-analysis was performed using RevMan 5.4 software. Results: A total of 10 studies were included, with a total sample size of 20,766 cases, including 5,823 issues of social isolation. The qualitative and quantitative analysis found that the relatively clear protective factor for social isolation of elderly people is high cultural level (odds ratio = 0.32, 95% confidence interval (0.16, 0.64)), and the risk factor is depression (odds ratio = 3.01, 95% confidence interval (1.83, 4.95)). The impact of gender and lifestyle on social segregation among elderly people is still uncertain. Conclusions: High cultural level is a protective factor for social isolation of elderly people aged ≥ 60 in communities, and depression is its risk factor. Due to the impact of the number and quality of included studies, the above conclusions need to be validated by more high-quality studies.

Keywords: community elderly; social isolation; system evaluation
Background
In 2015, the World Health Organization released the Global Report on Aging and Health, which interpreted healthy aging from a new perspective and pointed out that attention should be paid to the social functions of the elderly and the interaction and connection between the elderly and the social environment [1]. However, affected by various internal and external factors, the social participation of the elderly is not optimistic. With the deepening of the aging process, the social isolation of the elderly is prominent. Social isolation, also known as social segregation, is a state of active or passive deralement from society, in which activity participation, social interaction, and interpersonal communication are in a certain state of disruption or insulation, thereby inducing physiological and/or psychological negative results [2]. After aging, due to the changes in physical function, social role and family structure, the elderly have decreased social function, reduced social participation, and are prone to adverse social relationship networks, making them a high-risk group for social isolation. Studies have found that for the elderly, with the increase of age, social isolation is particularly common due to the influence of physical function and social role, with an incidence of 21.4–49.8% [2, 3-5]. Studies have confirmed that social isolation is a cause and independent risk factor for depression, suicide, cognitive impairment, high morbidity and high mortality [6], and has been proven to be associated with a variety of adverse health outcomes in the elderly (such as increased comorbidity, readmissions, disability and mortality, etc.) [9, 10]. Therefore, understanding the influencing factors of social isolation of the elderly is the first step to promoting healthy aging. Presently, domestic and foreign studies on the factors affecting the social isolation of the elderly are mostly cross-sectional studies with small samples. The research factors mostly focus on socio-demographic and psychological aspects, and the conclusions are often different and the extrapolation is small [11, 12]. Therefore, it is necessary to conduct a meta-analysis on the influencing factors of social isolation of the elderly, form a large sample study, systematically summarize the relevant influencing factors, and draw a more reliable and highly extrapolated conclusion, which will provide evidence-based evidence for the clinical staff to screen the high-risk groups of social isolation of the elderly in the later stage, and provide them with systematic and comprehensive preventive interventions.

Methods

Retrieval strategy
The combination of free words and subject words is used for retrieval. Chinese search uses 1. 老年人、老人; 2. 社会隔离、社交隔离; 3. 影响因素、相关因素、危险因素、预测因素、原因、相关性、调查 as search terms; Search in English as follows: 1. "old * people/elder/elders/aged /aging/old adult"; 2. "social isolation"/social deprivation/social segregation"/Social Exclusion"/Isolation, Social;/Exclusion, Social"; 3. influence factor */related factor *, risk factor *, predictors, factors, relevancy, investment, cross-sectional study, case-control study, cohort study and other keywords or free words are used. The search was conducted until August 2022 on China National Knowledge Infrastructure, Wanfang, VIP, China Biomedical Literature Database, Web of Science, PubMed, the Cochrane Library, etc. Embase’s eight major search libraries search for all literature related to research topics.

Inclusion criteria and exclusion criteria

Inclusion criteria. 1. Study subjects: community elderly people aged ≥ 60 years old. 2. Exposure factors: exposure to different influencing factors. 3. Research content: the influencing or predictive factors of social isolation among elderly people. 4. Study type: observational study (cross-sectional study/cohort study/case-control study). 5. Evaluation criteria: there are clear social isolation evaluation criteria; 6. Outcome indicators: the original literature provides odds ratio (OR) values and 95% confidence interval (CI), or provides relevant indicators that can be converted into OR values and 95% CI.

Exclusion criteria. 1. Language: non-Chinese or English literature. 2. Literature with low-quality evaluation. 3. The types of literature reports are: news, articles, reviews, conferences, and other literature. 4. Repetitive research literature. 5. Literature that cannot obtain the full text or extract the required data.

Methodology quality evaluation
The cross-sectional study was evaluated using the Agency for Healthcare Research and Quality recommended by the US Healthcare Research and Quality Administration [13]. The scale consists of 11 items, each rated as “yes”, “no”, and “unclear”, with corresponding scores of 1, 0 and 0. Studies with final scores of 0–3, 4–7 and 8–11 were defined as low, medium and high-quality research. The cohort study selected the Newcastle Ottawa Document Quality Scale to evaluate the quality of literature. This scale is a recommended tool for literature quality evaluation, which includes 3 aspects and 8 items (research object selection (4 items), inter-group comparability (1 item), and result measurement (3 items)) to evaluate the included studies. The total score is 0–9 points. Among them, 0–4 points are low quality, 5–7 points are medium quality and 8–9 points are high-quality research [13].

Literature screening process
Two researchers will independently screen and cross-check based on the inclusion and exclusion criteria and quality evaluation criteria mentioned above. In case of disagreement, a decision will be made after consultation with a third researcher.

Data extraction and statistical analysis
The basic information of the included literature (author, year of publication, journal name, etc.) is extracted according to the designed data extraction table. The primary characteristics of the research (research area, research time, research type, statistical methods, screening tools, factors affecting social isolation, literature quality evaluation, etc.) and the essential characteristics of the research object (age of the research object, sex ratio of the research object, sample size, incidence of social isolation, etc.) are included. RevMan 5.4 was used for quantitative analysis, and the two categorical variables were expressed by OR and 95% CI. The heterogeneity test adopts the X^2 test. If the heterogeneity is small or no (P ≥ 0.05), fixed effects model is used for merging. If the heterogeneity is large (I^2 > 50%, P < 0.05), a random effects model is used for merging, and the source of heterogeneity is analyzed through sensitivity analysis. If more than 10 studies are suitable for merging using meta-analysis, funnel plot analysis should be performed on the corresponding studies to observe whether publication bias exists. The difference was statistically significant with P < 0.05.

Results

Literature screening process
A total of 3,927 articles were retrieved, with 564 duplicate articles removed and 3,363 remaining. 3,332 unrelated articles were excluded from the reading topic and abstract. After initial screening, 31 articles were obtained. After reading the full text of 31 articles, 8 were excluded that did not match the research object, 5 were repeated, 4 did not match the topic, 3 could not obtain the required data, and 1 was of low quality. Finally, 10 articles were included (Figure 1).

Quality characteristics of included research methodology
According to Newcastle Ottawa Document Quality Scale scoring criteria, one cohort study was judged to be of medium quality [14] (Table 1). Nine cross-sectional studies were included. According to the Agency for Healthcare Research and Quality scale scoring criteria, 8 were medium quality [18–22] and 1 was high quality [11] (Table 2).

Qualitative analysis
This study included 10 articles, including 9 cross-sectional studies and
Figure 1 Screening process and results of included studies

Table 1 Literature quality evaluation table of cohort study

<table>
<thead>
<tr>
<th>Inclusion study</th>
<th>Study population selection</th>
<th>Comparability between groups</th>
<th>Result measurement</th>
<th>Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Takahashi T [14]</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: ① is the representative of the exposed group; ② is the selection method of non-exposed group; ③ is the method of determining exposure factors; ④ there are no indicators to be observed in order to determine the starting fashion of the study; ⑤ considering the comparability of exposed and unexposed groups in design and statistical analysis; ⑥ whether the evaluation of the results is sufficient; ⑦ whether the follow-up is long enough after the outcome occurs; ⑧ whether the follow-up between exposed and non-exposed groups is sufficient.

Table 2 Quality evaluation table of cross-sectional research literature

<table>
<thead>
<tr>
<th>Inclusion study</th>
<th>Entry 1</th>
<th>Entry 2</th>
<th>Entry 3</th>
<th>Entry 4</th>
<th>Entry 5</th>
<th>Entry 6</th>
<th>Entry 7</th>
<th>Entry 8</th>
<th>Entry 9</th>
<th>Entry 10</th>
<th>Entry 11</th>
<th>score</th>
</tr>
</thead>
</table>

Note: √ indicates Yes; × indicates no; ? represent is unclear. Entry 1 is whether the source of the data is identified; entry 2 is whether to list the inclusion and exclusion criteria for exposed and non-exposed groups or refer to previous publications; entry 3 is whether the time stage of patient identification is given; entry 4 is whether the research objects are continuous if they are not population sources; entry 5 is whether the evaluator’s subjective factors cover up other aspects of the research object; entry 6 is intended to describe any assessment undertaken to ensure quality; entry 7 explains the reason for excluding any patient from analysis; entry 8 describes how to evaluate and/or control confounding factors; entry 9 explains how lost data is handled in the analysis; entry 10 summarizes the response rate of patients and the integrity of data collection; entry 11 is to identify the percentage of expected patients with incomplete data or follow-up results if follow-up is available.
1 cohort study. The publication time range of the included literature is from 2013 to 2022. The survey period is from 2007 to 2021. Survey locations: 7 in China and 3 abroad (China;India;Japan;Malaysia = 7:1:1:1). The gender ratio in each study is relatively balanced, with the age range being ≥ 60 years old, except for Takahashi T’s study subjects ≥ 65 years old and Cheng-Cheng Liu’s survey subjects ≥ 80 years old [14, 15]. The total sample size is 20,766, but there are significant differences between studies, with a minimum of 210 cases and a maximum of 9,836 cases [16, 17]. The screening criteria for social isolation in the included studies are not entirely consistent. Most studies [11, 15, 18–22] used the simplified version of the social network scale LSNS-6, item [16] used the original version of the social network scale LSNS-10, and Takahashi T [14] referred to the social isolation criteria of previous literature: face-to-face or non-face-to-face contact with individuals outside the family less than once a week. The social isolation standard of Kotian DB [17] is that a person has never responded to all four activities within the past year: 1. participating in public gatherings; 2. participating in any group/club/organization meeting; 3. participating in any religious activity; 4. visiting relatives and friends (Table 3).

The single-factor analysis involved 44 influencing factors, and the composition of social demography characteristics, health status, lifestyle, medical factors, social factors and psychological factors were 14, 9, 7, 5, 4 and 4 in turn. Among the 17 factors involved in ≥ 2 studies, high education level, high monthly income, employment, high social participation, and high social support level are protective factors, while age, poor economic status, poor self-rated health status, a large number of chronic diseases, depression, impairment of daily living ability, and a history of falls in the past year are risk factors. The impact of gender, marital status, place of residence, occupation, and lifestyle is inconsistent.

The multi-factor analysis involves 52 influencing factors. The social demography characteristics, health status, lifestyle, medical, social, and psychological factors are 17, 9, 11, 3, 7 and 5 in turn. Among the 11 factors involved in ≥ 2 studies, high cultural level, high social participation, high social support level, and high family care were protective factors, while age increase, female gender, living in rural communities, poor self-rated health status, depression, and daily living ability disorders were risk factors. The impact of the number of children in different studies was not consistent.

The protective factors that are consistent with the results of univariate and multivariate analysis include high cultural level, high social participation and high social support level, while risk factors include age increase, poor self-rated health status, depression, and daily living ability disorders; Factors that are inconsistent across studies include gender, marriage, place of residence, and way of residence.

**Quantitative meta-analysis**

**Single factor analysis.** 8 studies [11, 14, 15, 17–21] reported the influencing factors of gender on the occurrence of social isolation among elderly people, and the results of 7 studies [11, 14, 15, 18–21] can be combined. After heterogeneity testing, it was found that there was significant heterogeneity among the studies (P < 0.0001, I² = 95%). By excluding each study, it was found that heterogeneity was still significant. Therefore, a random effects model was used, and the results showed that the impact of gender on social isolation in the elderly was not yet clear. (OR = 0.92, 95% CI (0.62, 1.36), P = 0.67) (Figure 2, Table 4).

### Table 3 Basic information table of included literatures

<table>
<thead>
<tr>
<th>First author</th>
<th>Country</th>
<th>Research type</th>
<th>Evaluation criteria</th>
<th>Age (years)</th>
<th>Sample size (n)</th>
<th>Male/female (%)</th>
<th>Incidence (%)</th>
<th>Influencing factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liu Chengcheng</td>
<td>Shanghai, China</td>
<td>Cross-sectional</td>
<td>LSNS-6</td>
<td>≥ 80</td>
<td>411/218</td>
<td>54.0</td>
<td>1–17</td>
<td></td>
</tr>
<tr>
<td>Xie Ying</td>
<td>Chongqing, China</td>
<td>Cross-sectional</td>
<td>LSNS-6</td>
<td>≥ 60</td>
<td>506/242</td>
<td>27.0</td>
<td>1–5, 7, 14, 18, 20, 21, 24, 26, 35, 41</td>
<td></td>
</tr>
<tr>
<td>Zhao Di</td>
<td>Qingdao, China</td>
<td>Cross-sectional</td>
<td>LSNS-6</td>
<td>≥ 60</td>
<td>592/301</td>
<td>30.0</td>
<td>1–4, 6, 14, 15, 17, 18, 23, 24, 27, 28</td>
<td></td>
</tr>
<tr>
<td>Li Shaojie</td>
<td>Jinan, China</td>
<td>Cross-sectional</td>
<td>LSNS-6</td>
<td>≥ 60</td>
<td>881/472</td>
<td>31.0</td>
<td>1–4, 6, 29, 32-36</td>
<td></td>
</tr>
<tr>
<td>Meng Dijuan</td>
<td>Nanjing, China</td>
<td>Cross-sectional</td>
<td>LSNS-10</td>
<td>≥ 60</td>
<td>210/109</td>
<td>7.0</td>
<td>4, 6, 8, 15, 29, 37</td>
<td></td>
</tr>
<tr>
<td>Han Ying</td>
<td>China</td>
<td>Cross-sectional</td>
<td>LSNS-6</td>
<td>≥ 60</td>
<td>1,526/769</td>
<td>24.0</td>
<td>7, 22, 24, 25</td>
<td></td>
</tr>
<tr>
<td>Ibrahim R</td>
<td>Malaysia</td>
<td>Cross-sectional</td>
<td>LSNS-6</td>
<td>≥ 60</td>
<td>1,880/989</td>
<td>49.8</td>
<td>1–4, 6, 18, 30, 31, 34, 35, 38, 40, 49</td>
<td></td>
</tr>
<tr>
<td>Li W</td>
<td>China</td>
<td>Cross-sectional</td>
<td>LSNS-6</td>
<td>≥ 60</td>
<td>2,267/1143</td>
<td>39.6</td>
<td>1–4, 18, 20, 21, 42, 43, 50-60</td>
<td></td>
</tr>
<tr>
<td>Kotian DB</td>
<td>India</td>
<td>Cross-sectional</td>
<td>*</td>
<td>≥ 60</td>
<td>9,836/5167</td>
<td>20.0</td>
<td>1–3, 6, 14, 18, 20, 38, 39, 43, 46-48, 62-64</td>
<td></td>
</tr>
<tr>
<td>Takahashi T</td>
<td>Japan</td>
<td>Cohort</td>
<td>**</td>
<td>≥ 65</td>
<td>2,657/11545</td>
<td>32.0</td>
<td>2, 6, 20, 29, 31, 44, 45</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** * means never responded to all 4 activities within 12 months: (1) attending a public meeting; (2) attending a meeting of any group/club/organization; (3) attending any religious activity; (4) visiting friends and family. ** means face-to-face or non-face-to-face contact with individuals outside the family less than once a week. 1. Age; 2. gender; 3. marriage; 4. cultural level; 5. monthly income; 6. health self-assessment; 7. slow disease amount; 8. history of falls in the past one year; 9. polypharmacy; 10. urinary incontinence; 11. visual acuity; 12. listening; 13. chronic pain; 14. ADL; 15. depression; 16. impaired cognitive function; 17. social participation; 18. place of residence; 19. with a view to occupation; 20. way of living; 21. smoking; 22. residential floors; 23. burden of medical expenses; 24. social support; 25. degree of family care; 26. degree of loneliness; 27. exercise; 28. personality type; 29. economic status; 30. races; 31. employment situation; 32. subjective well-being; 33. ways of supporting the elderly; 34. number of children; 35. types of medical insurance; 36. satisfaction of medical service; 37. method of payment for medical treatment; 38 whether they own a house; 39. number of children; 40. number of siblings; 41. drink alcohol; 42. economic sources; 43. length of residence in the country; 44. get involved in community groups; 45. frequency of participants running away from home; 46. Alzheimer’s disease; 47. whether there is a pension; 48. religion; 49. family size; 50. social relations; 51. social skills; 52. participate in public welfare activities; 53. take part in economic activities; 54. use smart electronic products; 55. monthly expenditures; 56. whether you care about yourself; 57. participate in cultural activities; 58. psychological resilience; 59. availability of recreational facilities; 60. identity of cultural activities; 61. household income; 62. have cerebrovascular disease; 63. cancer; 64. injuries from falls. ADL, activities of daily living.

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Six studies [11, 15, 18–21] reported that marriage is a contributing factor to the occurrence of social isolation among elderly people. After heterogeneity testing, there was significant heterogeneity among the studies \((P < 0.0001, I^2 = 93\%)\). By excluding each study, it was found that heterogeneity was still significant. Therefore, a random effects model was used, and the results showed that not being in a marital state was a risk factor for social isolation among elderly people, with statistically significant differences \((OR = 1.85, 95\% CI (1.19,2.87), P = 0.006)\) (Figure 3, Table 4).

Six studies [11, 15, 16, 18, 19, 21] reported the impact of cultural level on the occurrence of social isolation among elderly people, and the results of 5 studies [11, 15, 18, 19, 21] can be combined. After heterogeneity testing, there was significant heterogeneity among the studies \((P = 0.0009, I^2 = 79\%)\). After excluding Li Shaojie’s study [19], it was found that heterogeneity decreased \((P = 0.27, I^2 = 24\%)\). Therefore, after excluding Shao-Jie Li’s research, a fixed effects model was used for meta-analysis and the results showed that the higher the cultural level of community elderly people, the less likely they were to experience social isolation, and the difference was statistically significant \((OR = 0.35 (0.31, 0.41), P < 0.0001)\) (Figure 4, Table 4).

A total of 4 studies [14, 17, 18, 21] reported the impact of residential style on social isolation among elderly people in communities, and the results of 3 studies [14, 18, 21] can be combined. After heterogeneity testing, there was significant heterogeneity among the studies \((P < 0.0001, I^2 = 97\%)\), and no sources of heterogeneity were included in the included studies. Therefore, a random effects model was adopted, and the results showed that the impact of residential style on social isolation of elderly people is not yet clear \((OR = 0.51, 95\% CI (0.19, 1.39), P = 0.19)\) (Figure 5, Table 4).

Two studies [14, 20] reported the impact of employment on social segregation among elderly people. After heterogeneity testing, there was no significant heterogeneity among the studies \((P = 0.49, I^2 = 0\%)\). Therefore, a fixed effects model was used for analysis, and the results showed that not being in employment was a risk factor for social isolation among elderly people, with statistically significant differences \((OR = 1.24, 95\% CI (1.08,1.42), P = 0.002)\) (Figure 6, Table 4).

Three studies [18, 20, 21] reported the impact of place of residence on the occurrence of social isolation among elderly people, and the results of two studies [18, 21] can be combined. After heterogeneity testing, there was no heterogeneity among the studies \((P = 0.85, I^2 = 0\%)\). Therefore, a fixed effects model was used for analysis, and the results showed that living in rural communities was a risk factor for social isolation among elderly people, with statistically significant differences \((OR = 1.89, 95\% CI (1.62, 2.22), P < 0.0001)\) (Figure 7, Table 4).

Three studies [11, 15, 16] reported that depression contributes to social isolation among elderly people, and the results of two studies [11,15] can be combined. After heterogeneity testing, there was significant heterogeneity among the studies \((P < 0.0001, I^2 = 94\%)\), so a random effects model was used. The results showed that depression was a risk factor for social isolation among elderly people, and the difference was statistically significant \((OR = 15.26, 95\% CI (3.59,64.92), P = 0.0002)\) (Figure 8, Table 4).

Two studies reported the impact of the number of chronic diseases...
<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>log(Odds Ratio)</th>
<th>SE</th>
<th>Weight</th>
<th>Odds Ratio IV, Random, 95% CI</th>
<th>Odds Ratio IV, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xie Ying 2021</td>
<td>-1.77078</td>
<td>0.323229</td>
<td>30.8%</td>
<td>0.17 (0.09, 0.32)</td>
<td></td>
</tr>
<tr>
<td>Weitong Li 2022</td>
<td>-0.71847</td>
<td>0.1164</td>
<td>34.5%</td>
<td>0.49 (0.39, 0.61)</td>
<td></td>
</tr>
<tr>
<td>Tomoya Takahashi 2019</td>
<td>0.363531</td>
<td>0.108532</td>
<td>34.6%</td>
<td>1.44 [1.16, 1.78]</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>100.0.0%</td>
<td>0.51</td>
<td>1.39</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.74; Chi² = 70.24, df = 2 (P < 0.00001); I² = 97%
Test for overall effect: Z = 1.31 (P = 0.19)

Figure 3 Forest plot of the relationship between marriage and social isolation

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>log(Odds Ratio)</th>
<th>SE</th>
<th>Weight</th>
<th>Odds Ratio IV, Fixed, 95% CI</th>
<th>Odds Ratio IV, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zhao Di 2020</td>
<td>-0.7323</td>
<td>0.206125</td>
<td>12.6%</td>
<td>0.48 (0.32, 0.72)</td>
<td></td>
</tr>
<tr>
<td>Xie Ying 2021</td>
<td>-0.93318</td>
<td>0.237173</td>
<td>9.7%</td>
<td>0.39 [0.25, 0.63]</td>
<td></td>
</tr>
<tr>
<td>Li Shaojie 2021</td>
<td>-0.34871</td>
<td>0.164016</td>
<td>0.0%</td>
<td>0.71 [0.51, 0.97]</td>
<td></td>
</tr>
<tr>
<td>Liu Chengchong 2022</td>
<td>-0.90634</td>
<td>0.224043</td>
<td>10.9%</td>
<td>0.40 [0.26, 0.63]</td>
<td></td>
</tr>
<tr>
<td>Weitong Li 2022</td>
<td>-1.1365</td>
<td>0.090332</td>
<td>66.8%</td>
<td>0.32 [0.27, 0.38]</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>100.0.0%</td>
<td>0.35</td>
<td>1.41</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Chi² = 3.03, df = 3 (P = 0.27); I² = 24%
Test for overall effect: Z = 14.11 (P < 0.000001)

Figure 4 Forest plot of the relationship between cultural level and social isolation

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>log(Odds Ratio)</th>
<th>SE</th>
<th>Weight</th>
<th>Odds Ratio IV, Fixed, 95% CI</th>
<th>Odds Ratio IV, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zhao Di 2020</td>
<td>0.813593</td>
<td>0.203949</td>
<td>15.9%</td>
<td>2.26 [1.51, 3.36]</td>
<td></td>
</tr>
<tr>
<td>Xie Ying 2021</td>
<td>1.495418</td>
<td>0.220451</td>
<td>15.6%</td>
<td>4.46 [2.90, 6.87]</td>
<td></td>
</tr>
<tr>
<td>Li Shaojie 2021</td>
<td>0.363184</td>
<td>0.159891</td>
<td>16.8%</td>
<td>1.44 [1.05, 1.97]</td>
<td></td>
</tr>
<tr>
<td>Liu Chengchong 2022</td>
<td>-0.366155</td>
<td>0.185876</td>
<td>16.3%</td>
<td>0.69 [0.48, 1.00]</td>
<td></td>
</tr>
<tr>
<td>Weitong Li 2022</td>
<td>1.045001</td>
<td>0.091496</td>
<td>17.8%</td>
<td>2.84 [2.38, 3.40]</td>
<td></td>
</tr>
<tr>
<td>Ibrimah, R 2013</td>
<td>0.371839</td>
<td>0.09283</td>
<td>17.8%</td>
<td>1.45 [1.21, 1.74]</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>100.0.0%</td>
<td>1.85</td>
<td>2.87</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.27; Chi² = 76.02, df = 5 (P < 0.000001); I² = 93%
Test for overall effect: Z = 2.74 (P = 0.006)

Figure 5 Forest plot of the relationship between residential style and social isolation

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>log(Odds Ratio)</th>
<th>SE</th>
<th>Weight</th>
<th>Odds Ratio IV, Fixed, 95% CI</th>
<th>Odds Ratio IV, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liu Chengchong 2022</td>
<td>1.992221</td>
<td>0.237428</td>
<td>50.4%</td>
<td>7.33 [4.60, 11.68]</td>
<td></td>
</tr>
<tr>
<td>Zhao Di 2020</td>
<td>3.469563</td>
<td>0.269653</td>
<td>49.6%</td>
<td>32.12 [18.94, 54.49]</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>100.0.0%</td>
<td>15.26</td>
<td>64.92</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 1.03; Chi² = 16.91, df = 1 (P < 0.00001); I² = 94%
Test for overall effect: Z = 3.68 (P = 0.0002)

Figure 6 Forest plot of the relationship between employment and social isolation

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>log(Odds Ratio)</th>
<th>SE</th>
<th>Weight</th>
<th>Odds Ratio IV, Fixed, 95% CI</th>
<th>Odds Ratio IV, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xie Ying 2021</td>
<td>0.675698</td>
<td>0.212685</td>
<td>14.3%</td>
<td>1.97 [1.30, 2.98]</td>
<td></td>
</tr>
<tr>
<td>Weitong Li 2022</td>
<td>0.631644</td>
<td>0.087002</td>
<td>85.7%</td>
<td>1.88 [1.59, 2.23]</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>100.0.0%</td>
<td>1.89</td>
<td>2.22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Chi² = 0.04, df = 1 (P = 0.85); I² = 0%
Test for overall effect: Z = 7.92 (P < 0.000001)

Figure 7 Forest plot of the relationship between residence and social isolation

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>log(Odds Ratio)</th>
<th>SE</th>
<th>Weight</th>
<th>Odds Ratio IV, Fixed, 95% CI</th>
<th>Odds Ratio IV, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ibrimah, R 2013</td>
<td>0.268943</td>
<td>0.145792</td>
<td>41.5%</td>
<td>1.31 [1.06, 1.62]</td>
<td></td>
</tr>
<tr>
<td>Tomoya Takahashi 2019</td>
<td>0.172103</td>
<td>0.090863</td>
<td>59.5%</td>
<td>1.19 [0.99, 1.42]</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>100.0.0%</td>
<td>1.24</td>
<td>1.42</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Chi² = 0.48, df = 1 (P = 0.49); I² = 0%
Test for overall effect: Z = 3.06 (P = 0.002)

Figure 8 Forest plot of the relationship between depression and social isolation

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on the occurrence of social isolation among elderly people [15, 18]. After heterogeneity testing, there was significant heterogeneity among the studies ($P = 0.08, I^2 = 68\%$), so a random effects model was adopted. The results showed that elderly people with more chronic diseases were more likely to develop social isolation (OR = 1.97, 95% CI (1.13, 3.42), $P = 0.02$) (Figure 9, Table 4).

Three studies [11, 15, 18] reported the impact of activities of daily living on the occurrence of social isolation among elderly people. After heterogeneity testing, there was significant heterogeneity among the studies ($P = 0.0006, I^2 = 87\%$), and no sources of heterogeneity were found in the included studies. Therefore, a random effects model was adopted, and the results showed that daily activity disorders were a risk factor for social isolation among elderly people (OR = 9.81, 95% CI (4.83, 19.92), $P < 0.0001$) (Figure 10, Table 4).

**Multi-factor analysis results.** Four studies [11, 17, 18, 20] reported age's impact on social isolation among elderly people. After heterogeneity testing, it was found that there was significant heterogeneity among the studies ($P < 0.0001, I^2 = 93\%$). By excluding each study, it was found that heterogeneity was still significant. Therefore, a random effects model was used. The results showed that age growth was a risk factor for the occurrence of social isolation, and the older the elderly, the more likely they were to develop social isolation. The difference was statistically significant (OR = 1.43, 95% CI (1.03, 1.99), $P = 0.03$) (Figure 11, Table 4).

Four studies [15, 16, 20, 21] reported the impact of cultural level on the occurrence of social isolation among elderly people, and the results of 3 studies [15, 16, 20] can be combined. After heterogeneity testing, it was found that there was significant heterogeneity among the studies ($P = 0.007, I^2 = 80\%$). By excluding the studies that included Ibrahim R one by one [20], it was found that heterogeneity decreased ($P = 0.56, I^2 = 0\%$). Therefore, after excluding Ibrahim's research, a fixed effects model was used for meta-analysis and the results showed that elderly people in communities with higher cultural levels were less likely to experience social isolation, with a statistically significant difference (OR = 0.32, 95% CI (0.16, 0.64), $P = 0.001$) (Figure 12, Table 4).

Four studies [11, 15, 16, 21] have reported the impact of depression on the occurrence of social isolation among elderly people, and the results of 3 studies [11, 15, 16] can be combined. After heterogeneity testing, there was significant heterogeneity among the studies ($P = 0.94, I^2 = 0\%$). By excluding each study, it was found that heterogeneity was still significant. Therefore, a random effects model was used. The results showed that depression was a risk factor for social isolation among elderly people, and elderly people with

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**Figure 9 Forest plot of the relationship between number of chronic diseases and social isolation**

**Figure 10 Forest plot of the relationship between ADL and social isolation. ADL, activities of daily living.**

**Figure 11 Forest plot of the relationship between age and social isolation**

**Figure 12 Forest plot of the relationship between cultural level and social isolation**

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depression were more likely to experience social isolation, with a statistically significant difference (OR = 3.01, 95% CI (1.83, 4.95), P < 0.0001) (Figure 13, Table 4).

Three studies [11, 18, 22] reported the impact of social support on the occurrence of social isolation among elderly people, and the results of two studies [18, 22] can be combined. After heterogeneity testing, there was significant heterogeneity among the studies (P = 0.0003, I² = 92%), so a random effects model was used. The results showed that the impact of social support level on the occurrence of social isolation among elderly people is not yet clear (OR = 0.37, 95% CI (0.07, 1.94), P = 0.24) (Figure 14, Table 4).

Analysis of publication bias
Due to the inclusion of less than 10 studies on various influencing factors, the efficacy of using funnel plots to test publication bias is relatively low, so publication bias analysis is not conducted.

Discussion
Among the 10 studies included in this study, 9 were cross-sectional studies, and 1 was a cohort study, which excluded low-quality literature, so the meta-analysis results were relatively reliable.

Multiple studies have shown that educational level has a significant impact on the occurrence of social isolation in elderly people: elderly people with high educational levels have a lower risk of social isolation [23–25]. The conclusion is consistent with this study. Elderly people with higher education have richer social resources, and can establish a good outlook on life during the education process. They have higher subjective initiative and social adaptability, and can better maintain and utilize social networks, thereby reducing the risk of social isolation.

Psychological health is closely related to social isolation, and depression further increases the risk of social isolation in elderly people [26, 27]. Elderly people with a depressive state or tendency towards depression often have more withdrawn and introverted personalities, are unwilling to communicate with others, have lower confidence in life, give up many previous hobbies and activities, and even develop a sense of pessimism. This can lead to gradual self-isolation, shrinking social networks, and the emergence of social fear among elderly people, greatly increasing the risk of social isolation [8]. Meanwhile, studies have found that social isolation is an antecedent variable of depression symptoms in elderly people, and social isolation can significantly predict depression symptoms [28].

Research has shown that marital status is a key predictive indicator of social isolation, which may be related to marital relationships being a fundamental manifestation of social relationships [29]. Xin-Feng Cheng et al. found that the proportion of elderly people with abnormal marital status experiencing family isolation has increased [30]. The single-factor quantitative analysis results of this study are consistent with them. Due to limitations in the number of studies, this study’s multi-factor quantitative analysis did not calculate the differences between marriages. In terms of family structure, the proportion of the elderly who have no spouse and do not live with their children falling into friend isolation is higher than the corresponding population with other characteristics [24]. Another study [31] found that more than 40% of elderly people whose spouses have passed away take care of their own lives. Their proportion of family and social resources is relatively low, which is not conducive to paying attention to the mental state of the elderly, leading to a certain reduction in the frequency of social participation of widowed elderly people. And compared to the elderly who have not lost their spouse, the probability of elderly people with abnormal marital status being sent to mental hospitals has increased by 5–6 times [32]. The situation of residence, employment, and marriage are similar. Single-factor quantitative analysis shows that residence is a risk factor for social isolation of elderly people, but specific data has not been obtained in multivariate quantitative analysis. The place of residence has a significant impact on the occurrence of social isolation among elderly people, with rural elderly people at greater risk of encountering social isolation than urban elderly people [33]. Research has shown that the detection rate of social isolation among rural elderly is higher than that of urban elderly (P < 0.0001) [26]. Some scholars believe that in the contemporary era, where the phenomenon of rural empty villages is severe, the psychological endurance of elderly people in rural areas after widowhood is relatively low, leading to an increase in their sense of loneliness, social network disruption, and an increase in the risk of social isolation [34].

In contrast, elderly people who have lost their spouses in urban areas have strong enthusiasm for social participation and high social integration [35]. In addition, elderly people in employment have more opportunities to participate in social activities, have more communication with the outside world, and can maintain an excellent social network. Therefore, the risk of social isolation is lower than that of unemployed elderly people. The relationship between marriage, place of residence, and employment, as common features of social demographics, and social isolation of elderly people need further exploration.

![Figure 13 Forest plot of the relationship between depression and social isolation](https://doi.org)

![Figure 14 Forest plot of the relationship between social support and social isolation](https://www.tmrjournals.com)
The existence of multiple diseases and impairment of daily living ability, as common physical health problems for elderly people, have significant implications for preventing and intervening in social isolation among elderly people. The risk of chronic diseases among elderly people gradually increases with age [36]. Single-factor analysis in this study shows that the greater the number of chronic diseases, the greater the risk of social isolation among elderly people. The detection rate of social isolation among elderly people with comorbidities in China is 39.1% [26]. In addition, research shows that the rate of multiple medication use in elderly people with coexisting chronic diseases is as high as 38.1% to 91.2% [37]. Multiple medication use can increase the incidence of various adverse health outcomes in elderly people, such as falls and adverse drug reactions. Dysfunction in daily living activities means decreased self-care ability and behavioral autonomy. As previous studies have pointed out, behavioral limitations caused by a lack of physical health can reduce the opportunities for elderly people to meet and communicate with family and friends [38, 39]. The results of qualitative analysis and univariate analysis in this study are consistent; that is, elderly people with impairments in their daily living abilities are more likely to fall into social isolation, their subjective perception of social isolation is stronger, and they are more likely to feel lonely and helpless.

Limitations of this study: 1. Most of the findings are cross-sectional surveys, and the credibility of the research results needs further improvement; 2. Some influencing factors cannot extract more data for analysis due to insufficient literature. There is high heterogeneity among the included studies, which leads to a decrease in testing efficiency and, to some extent, affects the combined analysis results.

Conclusions

The protective factors obtained from both single-factor and multi-factor quantitative analysis have a high level of education; risk factors include depression. The protective factors obtained after the merger of single factor analysis include marital status and employment; risk factors include living in rural areas, a large number of chronic diseases, and impairment of daily living abilities. In addition, the impact of gender and lifestyle on social segregation among elderly people is not yet clear. Therefore, community nursing staff should focus on the social relationship network of elderly people with low cultural levels, depressive symptoms, abnormal marital status, unemployment, and coexistence of multiple diseases, and rural community medical staff should pay more attention to timely identify and screening elderly people from social isolation, take targeted measures to help them maintain a positive attitude, improve their quality of life, and promote the achievement of successful aging goals.

References


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