A Meta-Analysis of the Prevalence of Chronic Disease Co-morbidity Among the Elderly in China

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Abstract. Objective: This paper aims to assess the occurrence of chronic disease co-morbidity among the elderly in China. **Methods**: The databases of PubMed, Web of Science, CNKI, VIP and Wanfang were searched by computer. Single proportion studies on the prevalence of chronic disease co-morbidity among the elderly in China from June 2011 to June 2022. All included articles were quality assessed. The heterogeneity test was performed using the Mantel-Hasenzel algorithm. Comprehensive Meta-Analysis (CMA) software was used for meta-analysis. **Results**: A total of 31 cross-sectional studies containing 226209 patients were included. Meta-analysis results showed that The prevalence of chronic disease co-morbidity in China aged ≥60 years was 42.8% [95% CI (36.6, 49.3%)]. Subgroup analysis showed that the prevalence of chronic disease co-morbidity was 37.1% (95% CI (29.6, 45.3%)) in men and 39.5% (95% CI (30.4, 49.3%)) in women; the prevalence of 2 chronic diseases was 51.6% [95% CI (43.9, 59.3%)] and 3 chronic diseases was 25.5% [95% CI (21.0, 30.4%); the prevalence was 45.3% [95% CI (33.7, 57.4%)] in < 2019 and 41.9% [95% CI (35.1, 49.0%)] in ≥ 2019; the prevalence was 74.4% [95% CI (37.6, 93.4%)] in North China and 52.5% [95% CI (33.9, 70.4%)] in East China. **Conclusion**: Current evidence suggests that the prevalence of chronic disease co-morbidity is high among the elderly in China, but there has been a downward trend in recent years, this study differed by sex, co-morbidity type, region, and time. Limited by the quality of included studies, further studies should be performed to confirm our findings.

Keywords: Chronic disease co-morbidity · Prevalence · Elderly · China · Meta-analysis

1 Introduction

As the global disease spectrum changes, chronic disease co-morbidity have become a major threat to human life health and quality of life [1], the elderly are a vulnerable population for chronic diseases and often with higher prevalence. The co-morbidity rate of chronic diseases among the elderly over 65 years of age in China is as high as 70%

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[2], the incidence rate increases sharply with age, significantly reducing the health of the elderly, increasing readmission rates and potential social and economic burdens, even increasing the risk of death [3–8], which has become an important public health problem that needs to be addressed globally. It is of great significance to explore the prevalence of chronic disease co-morbidity in the elderly for disease prevention and management. The prevalence of chronic disease co-morbidity has been studied in depth in academia, but the sample size of individual studies is small, most of them are single-center research studies, the results are not representative. In this paper, we collected studies about the prevalence of chronic disease co-morbidity in China aged ≥60 years by searching databases. Meta-analysis was used to quantitatively analyze the prevalence studies to clarify the current status of the prevalence and the influencing factors to provide a basis for strengthening the disease preventive and management.

2 Materials and Methods

2.1 Inclusion Criteria and Exclusion Criteria

Inclusion criteria: (1) Study design: Cross-sectional study; (2) Research subjects: Chronic disease co-morbidity population aged ≥60 years in China; (3) The original literature clearly provides the total sample size and the number of patients; (4) Diagnosis of diseases according to the International Classification of Diseases (ICD-10); (5) Outcome indicators: Prevalence of chronic disease co-morbidity. Exclusion Criteria: (1) Studies for which the full text was not available or incomplete data; (2) Repeated publications; (3) Complications rather than co-morbidity.

2.2 Search Strategy

The databases of PubMed, Web of Science, CNKI, VIP and Wanfang were searched by computer. Single proportion studies on the prevalence of chronic disease co-morbidity among the elderly in China from June 2011 to June 2022. Database searches and manual searches were used and references included in the literature were traced. Search terms included: chronic disease co-morbidity, chronic co-morbidity, multi-morbidity, elderly, older adults, co-morbidity, multiple chronic conditions, chronic disease, chronic illness, comorbidity, China, Chinese.

2.3 Quality Assessment

We used the quality standards of the American Institute for Health Care Quality and Research (AHRQ) on cross-sectional studies for quality scoring [9], The AHRQ consists of 11 items, each item is evaluated by “yes”, “no” and “unclear”, “yes” is 1 point, “no” or “unclear” is 0 points, the scores of each item are added up to the total score (0–11 points), the set scores are 0–4 points for low-quality literature, 5–7 points for medium-quality literature and ≥8 points for high-quality literature.

2.4 Literature Screening and Data Extraction

Two graduate students independently screened the literature, extracted information and cross-checked. In case of disagreement, it is resolved through discussion or negotiation with the 3rd party. First, apparently irrelevant literature was eliminated by reading the title and abstract, followed by further reading of the full text to determine whether to include. Contents include: first author, year of publication, study site, age, sample size, number of patients and prevalence.

2.5 Statistical Methods

Meta-analysis was performed using Mantel-Haensel algorithm to test for Heterogeneity. $Q = \sum_{i=1}^{k} \hat{W}_i \left(\hat{J}_w - \hat{J}_{wi} \right)^2$ The statistic Q follows chi-square distribution with degrees of freedom $k - 1$. We choose k as the number of cross-sectional studies for this study, Wi as the inverse of the standard square of the effect size and Q as the total effect size. When heterogeneity test is statistically different, the heterogeneity index I^2 is further calculated and the random effects model corrected by the Der Simonian and Larird method was chosen.

$$\begin{cases} 0 & Q<K \\ \hat{\tau}^2 = \dfrac{Q-(k-1)\sum_{i=1}^{k} W_i}{\sum_{i=1}^{k} W_i^2 - \sum_{i=1}^{k} W_i^2} & Q>K \end{cases} \tag{1}$$

Weights of each study.

$$w_i^{'} = \frac{1}{SE_i^2 + \hat{\tau}^2} \tag{2}$$

Effect sizes for all studies combined and 95% *CI* (Take the *OR* value as an example).

$$OR_{MH} = \frac{\sum w_i^{'} OR_i}{\sum w_i^{'}} \tag{3}$$

$$95\%\text{CI} = OR_{MH} \pm 1.96 / \sqrt{\sum w_i^{'}}$$

CMA 3.0 software was used to evaluate the funnel plot, Begg's test and Egger's test for publication bias. Sensitivity analysis was used to evaluate the stability and reliability of the analysis results.

3 Results

3.1 Literature Search Results

A total of 2473 literatures, 582 in Chinese and 1891 in English were obtained through preliminary search, after a layer-by-layer screening. 31 literatures were finally included, including 27 Chinese literature and 4 English literatures (Fig. 1).

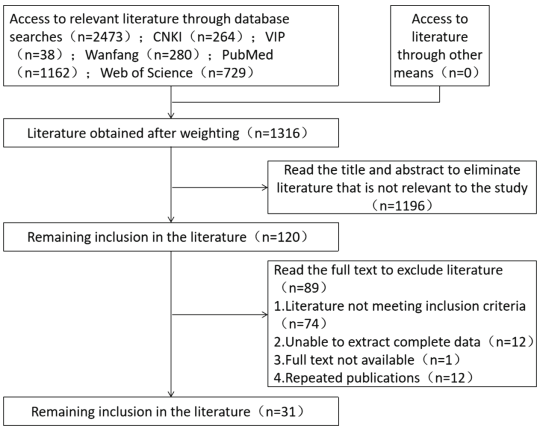

Fig. 1. Literature screening map

3.2 Basic Characteristics and Results of Risk of Bias Evaluation

The basic characteristics of the included studies and the results of the risk of bias evaluation are shown in Tables 1 and 2.

3.3 Results of Meta-Analysis

The 31 included studies were tested for heterogeneity, the results showed $I^2 = 99.87\%$ ($p < 0.01$), so the random-effects model was chosen for Meta-analysis (Fig. 2).

3.4 Subgroup Analysis

Subgroup analysis was performed using gender, type of chronic disease, publication time, and regional distribution as grouping factors, there was high heterogeneity in all subgroups, so a random-effects model was used to combine effect sizes. Subgroup analysis showed that the prevalence of chronic disease co-morbidity was 37.1% (95% CI (29.6, 45.3%)) in men and 39.5% (95% CI (30.4, 49.3%)) in women; the prevalence of 2 chronic diseases was 51.6% [95% CI (43.9, 59.3%)] and 3 chronic diseases was 25.5% [95% CI (21.0, 30.4%); the prevalence was 45.3% [95% CI (33.7%, 57.4%)] in <2019 and 41.9% [95% CI (35.1, 49.0%)] in ≥2019, In addition, the prevalence of chronic disease co-morbidity in different regions was also included (Table 3).

Table 1. Basic characteristics of the included literature

Authors	Year	Area	Age	Sample size (total/men/women)	Number of sick people (total/men/women)	Prevalence (%)
Cao [10]	2021	Henan	≥60	1336/645/691	490/233/257	36.68
Jin [11]	2019	China	60–104	5265/2923/2342	2341/–/–	44.46
Zhang [12]	2019	China	≥60	11707/5705/5993	5107/–/–	43.62
Chen [13]	2018	Chengdu	60–104	1970/839/1131	354/–/–	18
Chen [14]	2011	Beijing	72–92	160/150/10	139/–/–	86.88
Zhang [15]	2019	China	≥60	23718/10533/13185	13097/5250/7847	55.22
Fan [16]	2022	Henan	≥60	5570/2745/2825	1210/546/664	21.72
Chen [17]	2022	Jiangsu	≥90	172/125/47	156/115/41	90.7
Hua [18]	2021	Shanghai	≥60	68147/–/–	43953/17892/26061	64.5
Li [19]	2021	Guizhou	≥60	263/122/141	56/28/28	78.71
Xiao et al. [20]	2019	Yunnan	≥60	4833/2198/2635	776/334/442	16.1
Hou [21]	2020	Wuhan	≥65	622/264/358	317/120/197	50.96
Hu [22]	2020	Sichuan	≥60	1358/970/388	211/–/–	15.54
Li [23]	2021	China	≥60	10836/5288/5548	7059/3247/3812	65.14
Li [24]	2020	Henan	≥60	6094/2931/3163	770/369/401	12.64

(*continued*)

Table 1. (*continued*)

Authors	Year	Area	Age	Sample size (total/men/women)	Number of sick people (total/men/women)	Prevalence (%)
Lin [25]	2016	Shenzhen, Dongguan, Foshan	≥60	4281/2014/2267	1672/781/891	39.06
Liu [26]	2022	Guangdong	≥60	469/236/233	205/97/108	43.7
Sun [27]	2022	China	≥60	7062/3125/3937	1232/–/–	17.4
Zhang [28]	2020	Nanjing	≥60	2222/1099/1123	1021/530/491	45.9
Wang [29]	2020	Xinjiang	≥60	720/331/389	333/125/208	46.25
Wang [30]	2017	Shanghai	≥65	19185/8164/11021	4271/1747/2524	22.26
Yao [31]	2022	Zhengzhou	≥60	2506/1041/1465	566/271/295	22.6
Wang [32]	2018	Shenzhen	≥60	2705/1131/1574	1335/–/–	49.4
Wu [33]	2020	Jiangsu	≥65	523/–/–	228/–/–	43.59
Xu [34]	2021	China	≥60	9936/4896/5040	4563/2103/2460	45.92
Yan [35]	2019	China	≥60	11698/5705/5993	5106/2327/2779	43.65
Wang [36]	2016	Beijing	65–98	1187/561/626	676/–/–	56.95
Wang [37]	2018	Shenzhen	≥60	2603/1096/1507	1173/–/–	45.06
Su [38]	2016	Shanghai	≥80	2058/867/1191	1012/–/–	49.17
You [39]	2019	Zhejiang, Jiangsu	≥60	5296/2609/2687	2201/–/–	41.56
Zhang [40]	2019	China	60–107	11707/5705/6002	5107/–/–	43.62

Table 2. Results of the risk of bias evaluation of the included studies

Authors	1	2	3	4	5	6	7	8	9	10	11	Score
Cao [10]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	9
Jin [11]	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	8
Zhang [12]	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	8
Chen [13]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	9
Chen [14]	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	8
Zhang [15]	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	No	7
Fan [16]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	8
Chen [17]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	8
Hua [18]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	7
Li [19]	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	8
Lii [20]	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	No	7
Hou [21]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	9
Hu [22]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	8
Li [23]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	9
Li [24]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	7
Lin [25]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	9
Liu [26]	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	8

(*continued*)

Table 2. (*continued*)

Authors	1	2	3	4	5	6	7	8	9	10	11	Score
Sun [27]	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	8
Zhang [28]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	8
Wang [29]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	9
Wang [30]	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	No	7
Yao [31]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	8
Wang [32]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	9
Wu [33]	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	8
Xu [34]	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	8
Yan [35]	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	8
Wang [36]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	9
Wang [37]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	9
Su [38]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	8
You [39]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	8
Zhang [40]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	8

Notes 1 is a clear source of information; 2 is a list of inclusion and exclusion criteria for the exposed and unexposed groups or reference to previous publications; 3 is given to identify the time stage of the patient; 4 is whether the study population is continuous if it is not a population source; 5 is that the subjective element of the evaluator overshadows other aspects of the subject of the study; 6 is a description of any assessment undertaken for quality assurance; 7 is an explanation of the rationale for excluding any patient from the analysis; 8 is a description of how measures to evaluate and/or control confounding factors; 9 is an explanation of how missing data is handled in the analysis, if possible; 10 is a summary of patient response rates and the completeness of data collection; 11 is to identify the percentage of patients with incomplete data expected or the outcome of the follow-up, if any

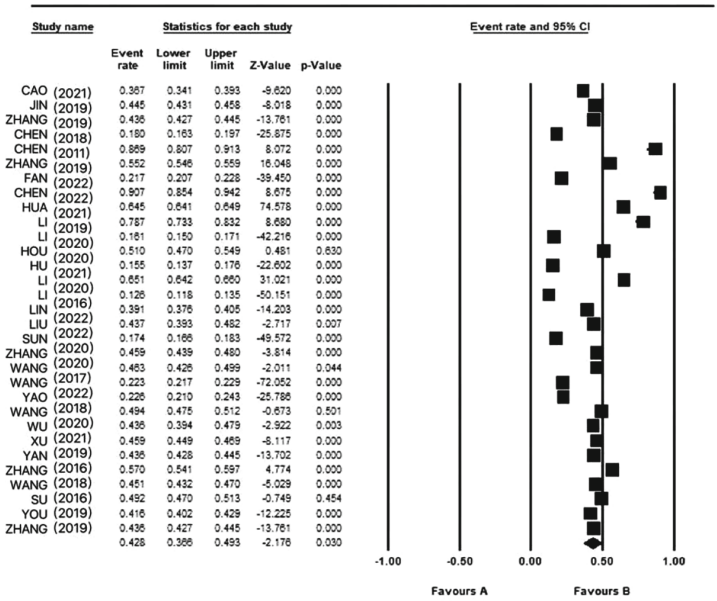

Fig. 2. Forest plot of the total prevalence

3.5 Sensitivity Analysis

Sensitivity analysis was performed using a literature-by-literature exclusion method. The study results did not change significantly before and after excluding literature, the findings of this study were more stable.

3.6 Publication Bias Analysis

The results of the funnel plot show that the symmetry of the distribution of the left and right points of each study is poor, however, the p-values of Egger's and Begg's tests were 0.063 and 0.126, suggesting a low likelihood of publication bias (Fig. 3).

Table 3. Subgroup analysis

Subgroup	Number of studies	Heterogeneity test		Model	Prevalence (95%CI) (%)
		I^2 (%)	P		
Gender					
Male	17	99.6	<0.001	Random	37.1 (29.6,45.3)
Female	17	99.8	<0.001	Random	39.5 (30.4,49.3)
Types of chronic diseases					
2	22	99.7	<0.001	Random	51.6 (43.9,59.3)
3	13	99.4	<0.001	Random	25.5 (21.0,30.4)
≥3	11	99.5	<0.001	Random	41.9 (30.9,53.9)
≥4	11	98.8	<0.001	Random	24.6 (20.5,29.2)
Area distribution					
North China	2	97.8	<0.001	Random	74.4 (37.6,93.4)
East China	7	99.9	<0.001	Random	52.5 (33.9,70.4)
South China	4	96.0	<0.001	Random	44.3 (39.2,49.5)
Central China	5	99.4	<0.001	Random	27.0 (17.6,39.0)
South West	4	99.2	<0.001	Random	28.7 (16.5,45.2)
China	8	99.8	<0.001	Random	44.2 (36.2,52.5)
Publish time					
<2019	8	99.7	<0.001	Random	45.3 (33.7,57.4)
≥2019	23	99.9	<0.001	Random	41.9 (35.1,49.0)

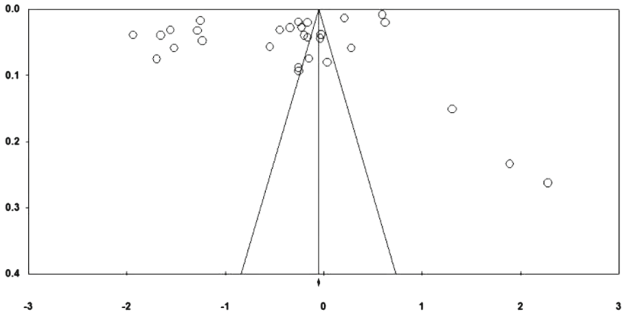

Fig. 3. Publication bias funnel plot

4 Conclusion

With the accelerated aging of the global population, the increase in life expectancy and the widespread prevalence of risk factors, the base of patients with chronic disease co-morbidity in China is gradually increasing [41–43], many problems caused by co-morbidity are posing a great challenge to the development of the economy and society. Previous studies were mainly limited to small sample surveys with poorly representative outcomes. A total of 31 cross-sectional studies involving 226209 patients were included in this paper, with literature quality scores ranging from 7 to 9, indicating that the quality of the included studies was moderate and above. Individual studies were excluded one by one for sensitivity analysis. Egger's and Begg's tests were performed to verify publication bias. Meta-analysis showed that the prevalence of chronic disease co-morbidity among the elderly in China was 42.8% [95% CI (36.6, 49.3%)],the prevalence was lower than in Switzerland [44] and the United States [45] and higher than in Italy [46] and Indonesia [47], which may be related to differences in geography, economic conditions, study setting and sample size. In order to study the true variability of co-morbidity, more in-depth studies are needed in China in the future. The prevalence is still at a high level, which may be related to the Chinese people's health level, while the elderly have poorer physical resistance compared to younger people and poor lifestyle habits such as excessive smoking and alcohol consumption and lack of exercise can lead to the occurrence of chronic disease co-morbidity [48].

The prevalence of co-morbidity was higher in women (39.5%) than in men (37.1%), which is consistent with the results of previous studies and may be related to the higher life expectancy and longer exposure to risk factors in women than in men [49], so women should pay more attention to their chronic disease co-morbidity status [48] and enhance their self-management awareness. Subgroup analysis of different chronic disease categories showed that the prevalence of 2 chronic diseases (51.6%) was higher than the prevalence of 3 chronic diseases (25.5%), the prevalence $\geq$3 chronic diseases was 41.9%, and the prevalence $\geq$4 chronic diseases was 24.6%.The results of subgroup analysis in different regions showed that the prevalence was highest in northern China (74.4%), followed by eastern China (52.5%), which may be related to the different dietary habits and lifestyles in each region. Subgroup analysis of different publication times showed a higher prevalence of chronic disease co-morbidity in $<$2019 (45.3%) than

in ≥2019 (42.7%). In recent years, the problem of co-morbidity has attracted national attention and people's awareness of co-morbidity has gradually increased, changing bad habits and lifestyles can reduce the occurrence of disease.

This study also has some limitations: (1) There may be publication bias due to under-inclusion of literature. (2) Limited by the characteristics of individual rate Meta-analysis, there was high heterogeneity among the included literature, although subgroup analysis was conducted by gender, type of chronic disease, region, and time, it still could not reduce the heterogeneity, which may have affected the accuracy of the results. (3) The included studies were cross-sectional studies, selection and measurement biases were inevitable due to the limitations of the study design.

In summary, the prevalence of chronic disease co-morbidity among the elderly in China was 42.8%, with a higher prevalence among women than men. The above findings need to be confirmed by additional high-quality studies, influenced by the quality and number of included studies.

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