BMC Public Health

RESEARCH

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Prevalence of bronchiectasis in adults: a meta-analysis

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Abstract

Background Bronchiectasis, once considered an orphan disease, is receiving attention globally owing to its increasing prevalence, healthcare burden, and associated morbidity. However, the prevalence of bronchiectasis is unclear. This meta-analysis estimates the prevalence of bronchiectasis in adults, providing a valuable reference for future research.

Methods PubMed, Embase, Cochrane Library, and Web of Science databases were searched from inception to May 31, 2024 for studies reporting the prevalence of bronchiectasis. Study selection, data extraction, and overall analysis of risk of the retrieved studies were conducted independently by two authors. The tool for assessing the risk of bias in prevalence studies was used to evaluate overall risk. Stata software (version 15.1) was used to performed the meta-analysis. Subgroup and sensitivity analyses were conducted to identify the source of heterogeneity. Funnel plots combined with Egger's test were used to detect publication bias.

Results The pooled prevalence of bronchiectasis in adults from 15 studies covering 437,851,478 individuals was 680 per 100,000 (95% CI: 634–727 per 100,000). Subgroup analysis showed that the prevalence of bronchiectasis in the United States, Korea, and China was 478 per 100,000 (95% CI: 367–588 per 100,000), 886 per 100,000 (95% CI: 778–993 per 100,000), and 759 per 100,000 (95% CI: 35–2399 per 100,000), respectively; 467 per 100,000 (95% CI: 416–518 per 100,000) in males and 535 per 100,000 (95% CI: 477–592 per 100,000) in females; 3958 per 100,000 (95% CI: 117–12637 per 100,000), 4677 per 100,000 (95% CI: 427–8928 per 100,000), and 3630 per 100,000 (95% CI: 158–7103 per 100,000) among never-smokers, ever-smokers, and current smokers, respectively; 430 per 100,000 (95% CI: 411–450 per 100,000), 380 per 100,000 (95% CI: 374–386 per 100,000), and 351 per 100,000 (95% CI: 342–360 per 100,000) among individuals with body mass index<18.5, 18.5–24.9, and ≥ 25, respectively. Sixteen comorbidities were evaluated in patients with bronchiectasis, revealing a high rate.

Conclusion Bronchiectasis is not a rare disease and requires more attention from scientific researchers.

Trial registration The protocol for this review was registered with PROSPERO: CRD42023409216. Registered 26 June 2023.

Keywords Bronchiectasis, Prevalence, Adults, Meta-analysis

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Introduction

Non-cystic fibrosis bronchiectasis (hereinafter referred to as bronchiectasis) is a chronic lung disease characterized by the clinical syndromes of cough and sputum production as well as the presence of abnormal thickening and dilation of the bronchial wall visible on lung imaging [1, 2]. Bronchiectasis, caused by a variety of etiologies, affects the health of patients to varying degrees. It may cause devastating illnesses, including repeated respiratory infections requiring long-term antibiotic therapies, disabling productive cough, shortness of breath, and occasional hemoptysis [3]. The incidence of comorbidities, such as sleep disorders, anxiety, and depression, significantly increases, exerting a serious impact on patients' quality of life [4–6]. Exacerbations of bronchiectasis often lead to increased hospitalization and mortality, posing a substantial economic burden on both patients and healthcare systems [7]. There is, therefore, an urgent need for better-resourced research into bronchiectasis.

Bronchiectasis, once thought to be an orphan disease, is now being recognized globally [8, 9]. Encouragingly, the establishment of disease-specific registries in several countries, such as the Bronchiectasis Research Registry (BRR), the European Multicenter Bronchiectasis Audit and Research Collaboration (EMBARC), and the Establishment of China Bronchiectasis Registry and Research Collaboration (BE-China), can provide valuable insights into geographical and ethnic differences in bronchiectasis prevalence to help us understand the disease better [10–12]. Moreover, the growing number of clinical trials of treatments for bronchiectasis demonstrate the increasing attention to this disease among the scientific and medical communities [13, 14]. In addition, the publication of management guidelines can help clinicians make better decisions [15, 16]. Furthermore, since 2022, World Bronchiectasis Day has been celebrated on July 1 each year with the aim of raising awareness of the disease globally, providing information and support to patients, and promoting improved clinical services and more research into this neglected disease [17, 18]. All of the above reflect the surge in interest in bronchiectasis in recent years.

Although bronchiectasis is an underestimated disease, the rate of early diagnosis has improved with the application of diagnosis techniques, especially high-resolution CT. In a review by Martinez-Garcia et al. [19], bronchiectasis was reported to be the third most common chronic airway disease after chronic obstructive pulmonary disease (COPD) and asthma. Although an increasing number of studies has reported the prevalence of bronchiectasis, to our knowledge, there are no systematic reviews and meta-analyses to quantitatively synthesize data from such studies. Aiming to fill this gap, we conducted this meta-analysis to estimate the prevalence of bronchiectasis in adults.

Methods

The methodology of this study adhered to the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) reporting checklist [20], and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [21]. The detailed are provided in Supplementary file: Table S1 and Table S2.

Search strategy

PubMed, Embase, Cochrane Library, and Web of Science databases were searched from inception to May 31, 2024. In addition, potentially eligible studies were searched manually, such as reference lists of identified studies and relevant reviews. Medical Subject Headings (MeSH) terms as well as free terms, which were related to "bronchiectasis" and "prevalence", were adopted in the search strategies, which are described in detail in the Supplementary file: Table S3.

Inclusion and exclusion criteria

The inclusion criteria for eligible studies were as follows: (i) studies including patients with bronchiectasis aged over 18 years old; (ii) studies reporting the prevalence of bronchiectasis; and (iii) studies whose design was observational study.

The exclusion criteria were as follows: (i) studies in which the prevalence of bronchiectasis could not be directly obtained or indirectly calculated; (ii) studies where duplicate publication had occurred; in these cases, only one publication was retained; and (iii) studies whose full texts could not be obtained, such as conference abstracts or posters.

Study selection and data extraction

All the retrieved records were imported into the Endnote software (version X8.1). First, repeated records were removed. Second, researchers screened studies for eligibility through reading the titles and abstracts. Finally, full-text reviews were screened for eligibility. Data extraction was performed by researchers using Microsoft Excel (version 2016). The data information included title, first author, year of publication, diagnostic methods, study design, study period, demographic characteristics (e.g., sample size, age, sex, region), and prevalence of bronchiectasis. Study selection and data extraction were independently performed by the same two researchers (L Wang and GX Zhao). A third researcher (JJ Wang) was consulted if a consensus could not be reached between the first two researchers.

Risk of bias assessment

The overall risk for all the included studies was independently assessed by two researchers (L Wang and GX Zhao) using the risk of bias tool modified by Hoy et al.

[22]. The tool consists of 10 questions and assesses both internal (questions 1 to 4) and external validity (questions 5 to 10). Each question was assigned two answers: 'yes', to indicate low risk; and 'no', to indicate high risk. Studies with ≥8 questions, 6–7 questions and ≤5 questions scored as low risk were considered to be 'low risk', 'moderate risk' and 'high risk', respectively. A third researcher (JS Li) was consulted if a consensus could not be reached between the two researchers.

Statistical analysis

Stata software (version 15.1) was used for the meta-analysis to calculate the pooled prevalence and 95% confidence intervals (CIs) of bronchiectasis. A random-effects model was applied if there was significant heterogeneity; otherwise, a fixed-effects model was used. The chi-square test was performed and I^2 value determined to assess heterogeneity. Values of $P<0.1$ or $I^2>50\%$ indicated significant heterogeneity [23]. Subgroup analysis was conducted to determine whether the prevalence of bronchiectasis was influenced by country, gender, smoking status, body mass index (BMI), and presence of comorbidities. Sensitivity analysis was conducted to assess the robustness of the overall results. Funnel plots and Egger's test were used to assess publication bias.

Results

Study selection

The initial search yielded 15,857 studies. After removing 4795 duplicates, the titles and abstracts of 11,062 studies were screened. Of these, the full text of 34 studies were screened for eligibility. Eventually, 15 studies were included in this review. The selection procedure is illustrated in Fig. 1.

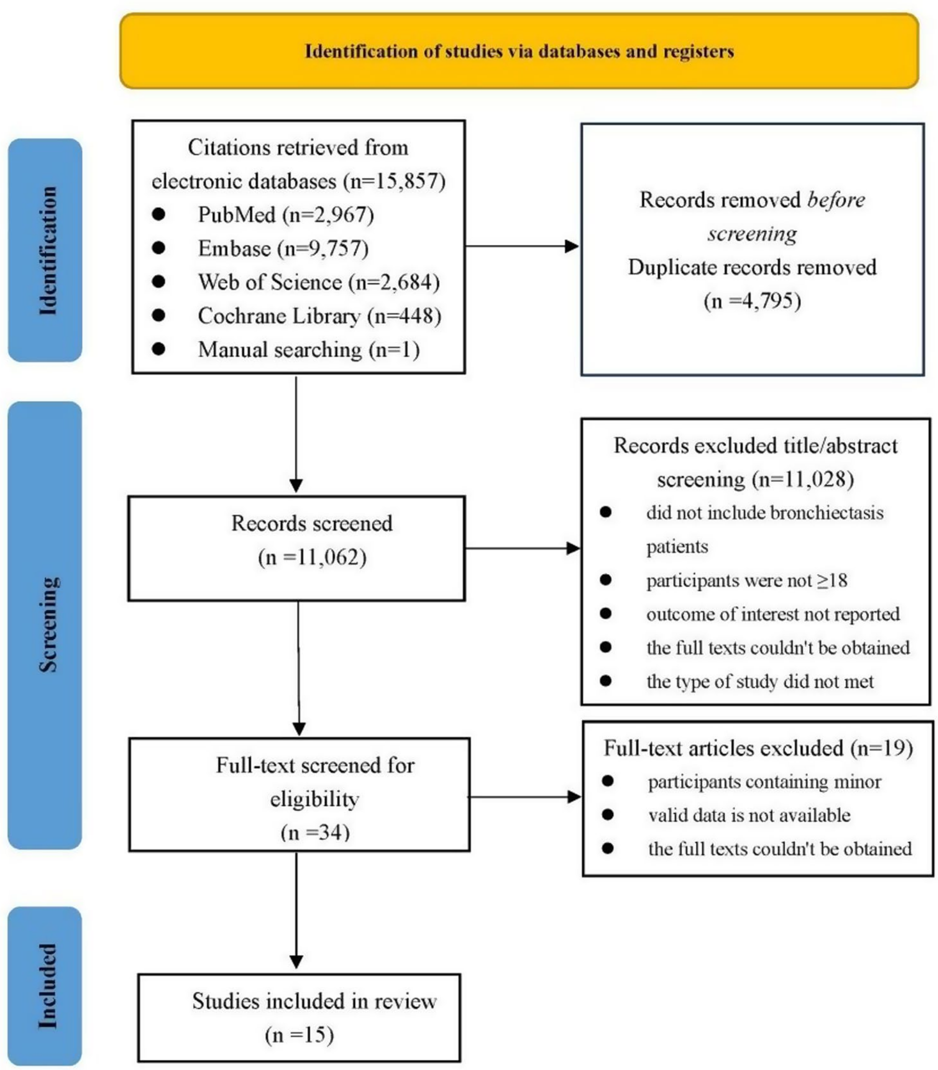

Fig. 1 Literature screening flow chart

Study characteristics

A total of 15 studies comprising 437,851,478 individuals were included, which were published from 2005 to 2024. Of the included studies, nine were observational cohort studies [24, 25, 29, 31, 33, 35–38], and six were cross-sectional studies [26–28, 30, 32, 34]. The sample sizes ranged from 1,409 to 380,000,000. Data were acquired from six countries: the United States [24, 26, 29, 35], Korea [25, 30, 32, 34, 37], China [28, 33, 36], Belgium [27], Germany [31] and Australia [38]. Table 1 presents information on the participants and characteristics of the study.

Risk of bias assessment of included studies

Eight of the included studies [24, 26, 28–31, 36, 37] were considered to be of low risk of bias and seven [25, 27, 32–35, 38] at moderate risk of bias. The grade obtained for each study is included in the Supplementary file: Table S4.

Prevalence

In total, 15 of the included studies reported the prevalence of bronchiectasis, which was estimated at 680 per 100,000 persons (95% CI: 634–727 per 100,000 persons, $I^2=100\%$) (Fig. 2). The sensitivity analyses showed that no individual study altered the pooled results, indicating that the overall prevalence of bronchiectasis remained stable (Table 2). However, there was a large heterogeneity in the prevalence of bronchiectasis.

Subgroup analysis

Subgroup analysis was conducted based on country, gender, smoking status, BMI, and comorbidities. Subgroup

Table 1 Characteristics of included studies

Study	Country	study design	Diagnosis	Sample Size	Age (years)	Male/Female	comorbidities	Dates
Weycker D. 2005 [24]	the United States	retrospective cohort	ICD9-CM	5,590,816	≥ 18	2,688,086/2,902,730	Yes	1999–2001
Kwak H.J. 2010 [25]	Korea	retrospective cohort	CT	1409	23–86	904/505	Yes	1/2008-12/2008
Seitz A.E. 2012 [26]	the United States	cross-sectional study	ICD9-CM code 494	2,021,931	≥ 65	851,082/1,170,849	Yes	2000–2007
Goeminne P.C. 2012 [27]	Belgium	cross-sectional study	CT	20,998	62(51,71)	/	/	2006–2009
Zhou Y.M. 2013 [28]	China	cross-sectional study	Questionnaires	10,811	≥ 40	4382/6429	/	2002–2004
Weycker D. 2017 [29]	the United States	retrospective cohort	ICD9-CM code 494	33,204,504	≥ 18	15,884,532/17,319,972	Yes	2009–2013
Choi H. 2019 [30]	Korea	cross-sectional study	ICD-10 code J47	6,626,435	63.8 ± 13.1	/	Yes	2012–2017
Diel R. 2019 [31]	Germany	retrospective cohort	ICD-10 code J47	3,988,648	≥ 18	/	Yes	1/2013-12/2013
Yang B. 2020 [32]	Korea	cross-sectional study	/	19,851	44.4(43.8,44.9)	/	Yes	2007–2009
Wu D. 2020 [33]	China	retrospective cohort	CT	36,984	54.9 ± 11.7	22,268/14,716	Yes	2016–2019
Kim S.H. 2021 [34]	Korea	cross-sectional study	CT	27,617	58.4 ± 8.9	/	Yes	2016–2017
Diaz A.A. 2021 [35]	the United States	prospective cohort	CT	2177	18–30	953/1224	/	(1985–1986)–(2015–2016)
Feng J. 2022 [36]	China	retrospective cohort	ICD-10 code and medical terms	380,000,000	≥ 18	184,780,000/195,220,000	/	2013–2017
Yang B. 2022 [37]	Korea	prospective cohort	ICD-10 code J47	6,275,575	30.8 ± 4.9	3,712,379/2,563,196	Yes	2009–2012
Gibbs C. 2024 [38]	Australia	retrospective cohort	CT	23,722	18–115	11,400/12,322	/	1/2011-12/2020

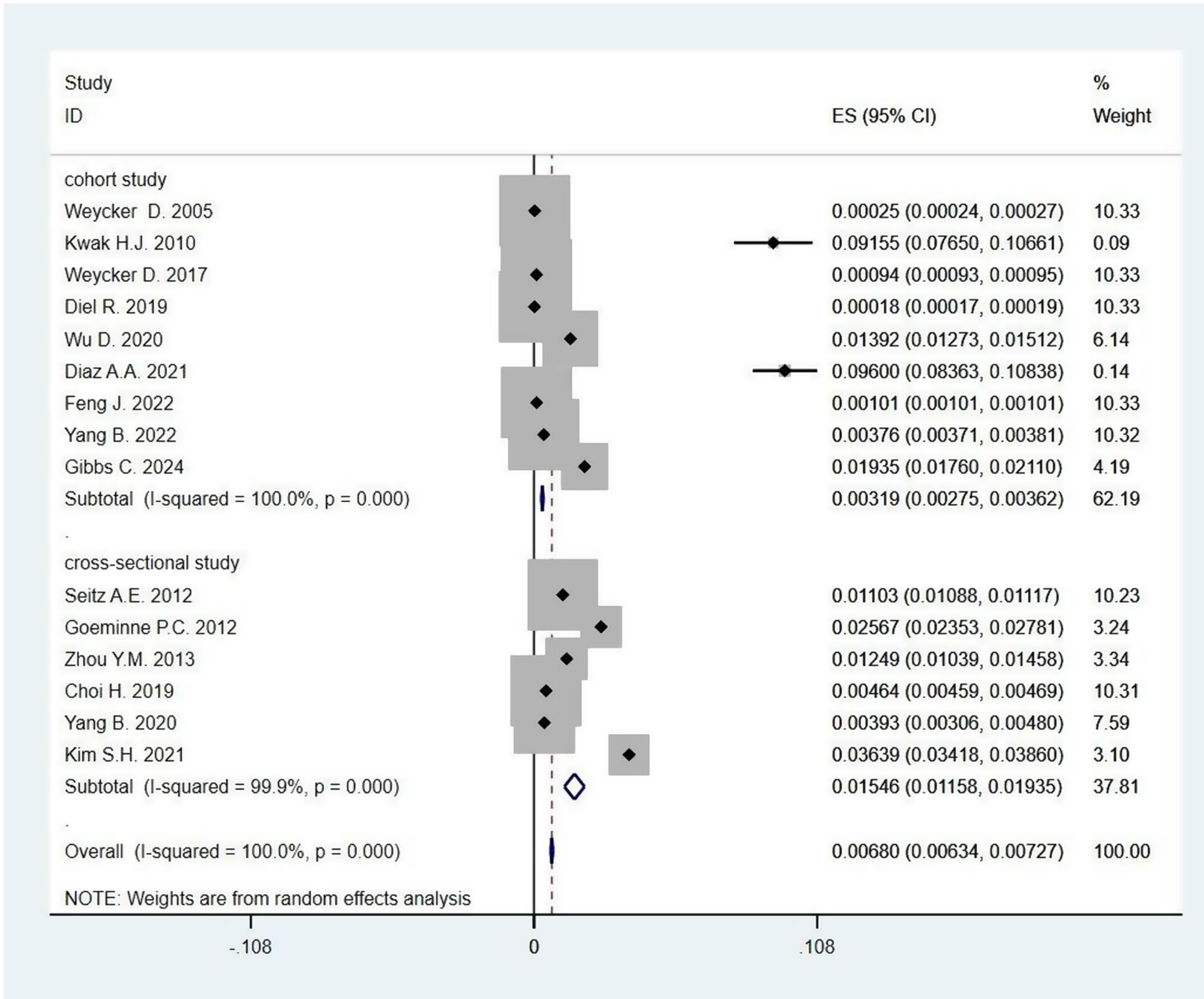

Fig. 2 prevalence of bronchiectasis in adults

Table 2 Sensitivity analysis showing prevalence of bronchiectasis in adults

Deletion	Result
Weycker D. 2005 [24]	ES = 0.78%, 95% CI [0.73%, 0.84%]
Kwak H.J. 2010 [25]	ES = 0.67%, 95% CI [0.63%, 0.72%]
Seitz A.E. 2012 [26]	ES = 0.58%, 95% CI [0.53%, 0.62%]
Goeminne P.C. 2012 [27]	ES = 0.62%, 95% CI [0.57%, 0.66%]
Zhou Y.M. 2013 [28]	ES = 0.66%, 95% CI [0.61%, 0.71%]
Weycker D. 2017 [29]	ES = 0.85%, 95% CI [0.79%, 0.91%]
Choi H. 2019 [30]	ES = 0.65%, 95% CI [0.61%, 0.70%]
Diel R. 2019 [31]	ES = 0.78%, 95% CI [0.72%, 0.83%]
Yang B. 2020 [32]	ES = 0.70%, 95% CI [0.66%, 0.75%]
Wu D. 2020 [33]	ES = 0.63%, 95% CI [0.58%, 0.68%]
Kim S.H. 2021 [34]	ES = 0.58%, 95% CI [0.54%, 0.63%]
Diaz A.A. 2021 [35]	ES = 0.67%, 95% CI [0.62%, 0.71%]
Feng J. 2022 [36]	ES = 0.92%, 95% CI [0.85%, 0.99%]
Yang B. 2022 [37]	ES = 0.68%, 95% CI [0.64%, 0.73%]
Gibbs C.2024 [38]	ES = 0.62%, 95% CI [0.58%, 0.67%]

analysis by country revealed that the prevalence of bronchiectasis in the United States, Korea, and China was 478 per 100,000 persons (95% CI: 367–588 per 100,000 persons, I^2 = 100%), 886 per 100,000 persons (95% CI: 778–993 per 100,000 persons, I^2 = 99.7%), and 759 per 100,000 persons (95% CI: 35–2399 per 100,000 persons, I^2 = 99.86%), respectively.

In terms of gender, the estimated pooled prevalence was 467 per 100,000 persons (95% CI: 416–518 per 100,000 persons, I^2 = 100%) in males and 535 per 100,000 persons (95% CI: 477–592 per 100,000 persons, I^2 = 100%) in females.

In regard to smoking status, the prevalence of bronchiectasis among never-smokers, ever-smokers, and current smokers was 3958 per 100,000 persons (95% CI: 117–12637 per 100,000 persons, I^2 = 99.86%), 4677 per 100,000 persons (95% CI: 427–8928 per 100,000 persons,

I^2=99.3%), and 3630 per 100,000 persons (95% CI: 158–7103 per 100,000 persons, I^2=98.7%, respectively.

The prevalence among individuals with BMI<18.5, 18.5–24.9, and ≥25 was 430 per 100,000 persons (95% CI: 411–450 per 100,000 persons, I^2=96.3%), 380 per 100,000 persons (95% CI: 374–386 per 100,000 persons, I^2=99.8%), and 351 per 100,000 persons (95% CI: 342–360 per 100,000 persons, I^2=99.6%), respectively (Fig. 3).

Based on comorbidities condition, sixteen comorbidities were analyzed in our study, and Fig. 4 shows the prevalence of bronchiectasis with comorbidities.

Publication Bias

The funnel plot exhibited visual asymmetry (Fig. 5), while the regression values from Egger's test (P=0.196) indicated that there was no publication bias in regard the prevalence of bronchiectasis.

Discussion

Our review synthesizes the current evidence on the prevalence of bronchiectasis as reported in 15 population-based studies covering 437,851,478 individuals. The pooled prevalence was 680 per 100,000 persons, indicating that bronchiectasis is not a rare disease, but in fact surprisingly common. The estimated prevalence according to our study is higher than that reported for some European countries. Monteagudo et al. analyzed primary care data in Catalonia and reported that the prevalence of bronchiectasis was 362 per 100,000 persons in 2012 [39]. In contrast, a population-based review in Italy reported that the prevalence of bronchiectasis in 2015 was 163 per 100,000 persons [40]. Interestingly, both studies include individuals with bronchiectasis who were under 18 years old. The discrepancy between the results might be related to several factors such as the study type, study populations, sample size, definition, and diagnostic criteria for bronchiectasis. Geographical heterogeneity may also be a significant factor [41].

The estimated prevalence in the United States, Korea, and China was 478 per 100,000 persons, 886 per 100,000 persons, and 759 per 100,000 persons, respectively. Our study revealed a higher prevalence in Asia. A variety of reasons may be proposed to explain this higher prevalence. For example, tuberculosis (TB) is the most common underlying cause of bronchiectasis, and it is highly prevalent in Asian countries such as China, South Korea, and India [42–44]. The pooled prevalence of bronchiectasis combined with TB was 10,989 per 100,000 persons in this study. The three evaluated countries were all from Korea, which also indicates a higher incidence of TB in the Asian region. Furthermore, a potential genetic predisposition to bronchiectasis may contribute to the higher prevalence in Asia. Additionally, the influence of the environment and its accompanying climate may influence the impact of microorganisms and/or pathogens on the airways of individuals with bronchiectasis [41, 45]. As we mentioned in the Introduction, several countries have established disease-specific registries [10–12]. Indian

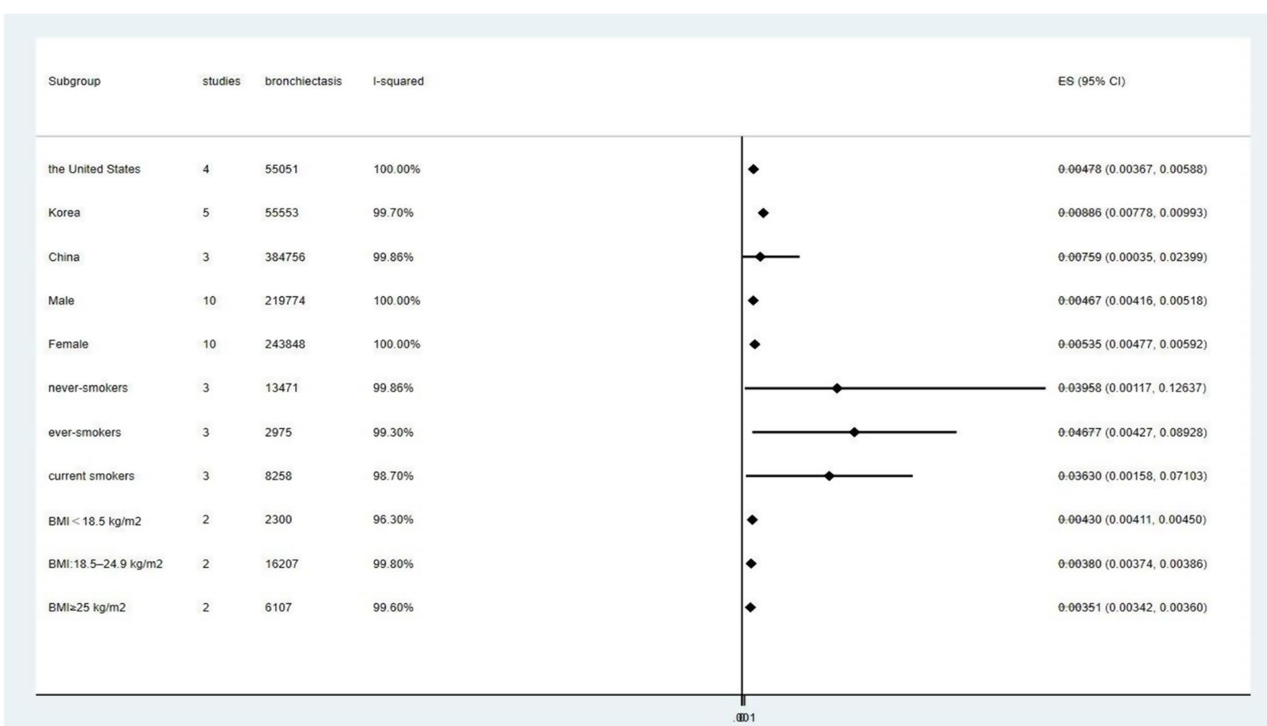

Fig. 3 The prevalence of bronchiectasis based on country, gender, smoking status and BMI

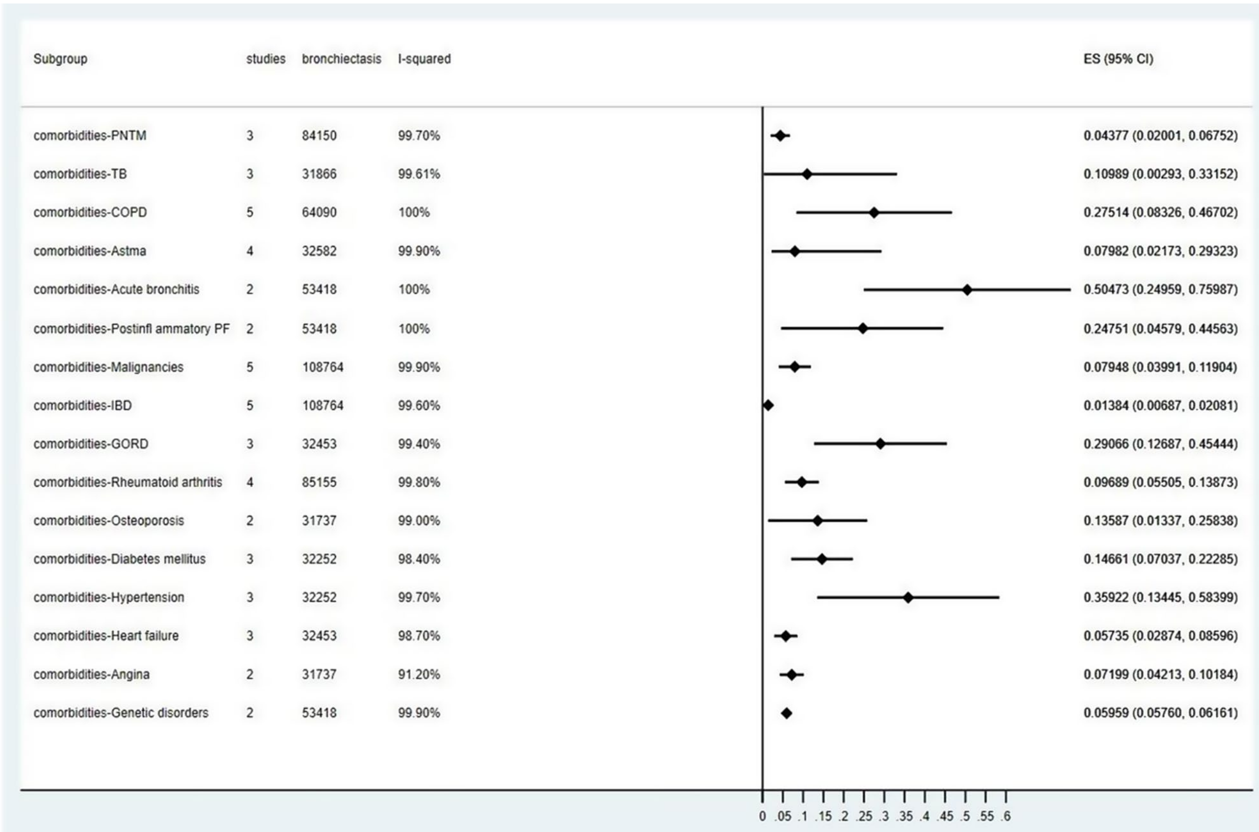

Fig. 4 The prevalence of bronchiectasis with comorbidities

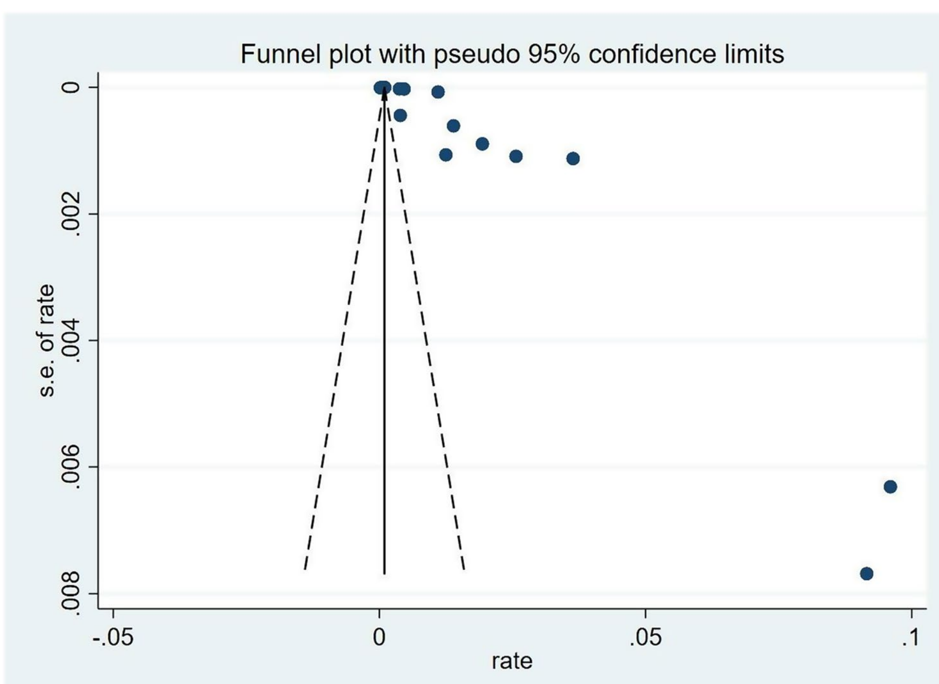

Fig. 5 Funnel plot showing the prevalence of bronchiectasis in adults

researchers have presented unique epidemiological data for bronchiectasis in the Indian registry, comparing it with published data from European and US registries [44]. Research collaborations should be established to describe the clinical characteristics of bronchiectasis and perform comparisons between different regions. Full utilization of these resources could make it possible to elucidate factors associated with the onset of bronchiectasis in different countries, which would involve determining the precise prevalence of the condition and developing personalized diagnosis and treatment plans that are more suited to the specific population.

We found that the prevalence of bronchiectasis is higher in females than in males. The higher rates in females were consistent with those reported in prior studies conducted in various geographic areas, including China [28], the United Kingdom [46], the United States [47], Germany [48], and Singapore [49]. The higher prevalence of bronchiectasis in females might result from certain etiologies such as increased non-tuberculous mycobacterial infection and connective tissue disease, which are generally more common in females [50, 51]. Regrettably, owing to constraints due to the dataset available from the included studies, a subgroup analysis delineating the statistical impact of etiology on bronchiectasis prevalence was not feasible. Hence, clinical trials stratified by specific etiologies and geographic variations of bronchiectasis should be conducted in the future to help clinicians formulate improved management strategies.

Another finding of this study is that the prevalence of bronchiectasis among never-smokers, ever-smokers, and current smokers was 3958 per 100,000 persons, 4677 per 100,000 persons, and 3630 per 100,000 persons, respectively. Unfortunately, there is a paucity of useful literature to compare with our results. As is well known, bronchiectasis is a chronic inflammatory airway disease characterized by remodeling and dilation, which is caused by multiple factors [9]. Nicotine and other harmful components in cigarettes, when smoked, can damage lung cells, which may be a contributing factor to bronchiectasis. Furthermore, smoking is one of the most important factors influencing the development of chronic lung diseases [52, 53]. However, few studies have evaluated the association between smoking and bronchiectasis. Only three of our included studies reported the number of bronchiectasis according to smoking status, and their sample sizes vary widely. Therefore, our results should be interpreted with caution. It is crucial to conduct further research to confirm the association between smoking and incident bronchiectasis.

Based on our finding, the estimated prevalence of bronchiectasis among individuals with BMI<18.5, 18.5–24.9, and ≥25 was 430 per 100,000 persons, 380 per 100,000 persons, and 351 per 100,000 persons, respectively. This shows that the prevalence of bronchiectasis is higher in individuals with a low BMI, which is consistent with previous studies [54, 55]. It is well known that bronchiectasis with some comorbidities, such as TB and inflammatory bowel disease (IBD), is closely related to a low BMI [56–58]. In our study, the prevalence of bronchiectasis combined with TB and IBD was 10,989 per 100,000 persons and 1,384 per 100,000 persons, respectively. BMI is a commonly used indicator for screening for malnutrition in patients with TB and IBD. A cross-sectional study found that 14% of patients with bronchiectasis presented with malnutrition as defined by BMI<18.5 kg/m^2 [59]. Another study found that nutritional depletion (as assessed by BMI<20 kg/m^2) accounted for 30% of patients with bronchiectasis [60]. It is not clear whether malnutrition is a concomitant symptom of bronchiectasis or an important extrapulmonary manifestation of bronchiectasis. As is mentioned in the British Thoracic Society Guidelines for bronchiectasis in adults, patients' weight and BMI at each clinic appointment should be recorded [16]. Further studies are warranted to clarify the precise mechanisms that underlie the association between BMI and the development of bronchiectasis. Studies of the nutritional status of patients with bronchiectasis are necessary to explore the role of nutrition in disease management, in the future.

The last important finding in our study is that comorbidities are common in patients with bronchiectasis, and the relationship between them should be investigated. In this study, sixteen comorbidities were evaluated in patients with bronchiectasis, which indicated a high rate of comorbidities, similar to previous studies [16, 61, 62]. There are many possible reasons for this. First, bronchiectasis is a chronic disease that occurs more frequently in elderly people who usually have other diseases. In addition, the role of underlying etiologies of bronchiectasis can also be relevant in determining specific comorbidities. Patients with bronchiectasis accompanied by comorbidities exhibit more pronounced clinical symptoms, more severe lung function impairment, higher rates of acute exacerbations, and higher mortality rates [61]. However, owing to the limitations of the available data, we were unable to explore the impact of comorbidities on bronchiectasis. The specific treatment of comorbidities could have an impact on the management of bronchiectasis. For example, drug interactions and side effects can potentially contribute to increased overall morbidity and/or mortality [63]. In fact, in about 30% of bronchiectasis patients, the primary cause of death is not attributable to a respiratory event [64, 65]. Therefore, it is necessary to understand the pathogenesis and causality of bronchiectasis and comorbid diseases in future to better inform patient management strategies.

Strengths and limitations

To the best of our knowledge, our meta-analysis is the first study to quantitatively synthesize the prevalence of bronchiectasis worldwide. Subgroup and sensitivity analyses were conducted to validate the stability of the results. The estimated prevalence of bronchiectasis may provide a useful reference for strategic planning and health policymaking. However, despite its strengths, our meta-analysis also has several limitations. First, we only included observational studies comprising patients with bronchiectasis aged over 18 years old. As a consequence, the prevalence of bronchiectasis may have been underestimated. Furthermore, our meta-analysis was only based on studies from six countries; further research is needed to confirm our findings and provide deeper insights into the epidemiological characteristics of bronchiectasis. Besides, owing to differences in investigation periods, locations, and demographic characteristics, the heterogeneity of the pooled data was high, and could not be resolved even through subgroup analysis. Additionally, the incomplete and missing reports on age, etiology and other variables in the included studies resulted in imperfect comparisons of all influencing factors. Therefore, positive results should be interpreted with caution.

Conclusion

The high prevalence of bronchiectasis observed in this study confirms that it should no longer be considered an orphan disease, but rather a common chronic respiratory disease. It requires more attention from scientific researchers, and further epidemiological studies are warranted in the imminent future.

Abbreviations

BMI	Body mass index
COPD	Chronic Obstructive Pulmonary Disease
MOOSE	Meta-analysis Of Observational Studies in Epidemiology reporting checklist
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement
CI	Confidence intervals
PNTM	Pulmonary nontuberculous mycobacterial disease
TB	Tuberculosis
PF	Pulmonary fibrosis
IBD	Inflammatory bowel disease
GORD	Gastroesophageal reflux disease

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-024-19956-y.

Supplementary Material 1

Acknowledgements

Not applicable.

Author contributions

JS Li and JJ Wang conceived and designed this study; L Wang searched the literature, L Wang and GX Zhao screened the studies, extracted the data, and evaluated the risk of bias. L Wang drafted the manuscript, while JS Li and JJ Wang read and revised it. All authors reviewed and approved the final version of the manuscript.

Funding

This research was supported by Qi-Huang Chief Scientist Project of the National Administration of Traditional Chinese Medicine ([2020] No.219); the Henan Province Scientific Research Project – Double First-Class Traditional Chinese Medicine (HSRP-DFCTCM-2023-4-09); Henan Province Special Research Project for Traditional Chinese Medicine (NO.2023ZY2039, 2024ZY2022).

Data availability

All data generated or analyzed during the present study are included in this article and supplementary materials.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 1 February 2024 / Accepted: 2 September 2024
Published online: 30 September 2024

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